PRODUCTIVE USE

CATALOG 2023

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AFSIA
Africa Solar Industry Association

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EXECUTIVE SUMMARY

Productive Use of Energy or PUE is a term that has been popping up growingly in discussions and literature around solar energy for the African continent over the past 2 years.

Next to the other traditional solar segments such as “large scale”, “mini-grids” or “SHS – Solar Home Systems” to cite a few, PUE indeed presents very specific attributes in the African context in that it offers revenue-increasing solutions in areas where they were previously not economically viable or simply not possible because of technical considerations.

As a result, PUE has the potential to unlock or drastically improve economic activity in many places across the continent. PUE can create a virtuous circle where the end-user of the solution is empowered to make its activity more efficient, leading to

increased income, more stable employment, as well as less vulnerable to weather conditions. In some cases, PUE can also be the ideal companion of other solar initiatives such as mini-grids. A growing number of examples demonstrate that the introduction of PUE solutions, in combination with mini-grids, help increase the electricity consumption of the mini-grid, thereby improving the financial viability of the mini-grid infrastructure as a whole.

Therefore, PUE truly deserves the attention of all stakeholders of the African solar industry. PUE will undeniably be a major driver of the industry in the years to come and as a result, represents an amazing opportunity for development aid and/or commercial investment.

PUE solutions evolve very quickly and new applications are brought to market on a regular basis. This PUE Catalog humbly intends to identify, categorize and describe the main solutions currently available and implemented across Africa. Whenever available, unit economics and the business case of the specific PUE solution are also provided to help the reader get a better grasp of the possibilities unlocked by it.

PUE comes in many shapes and forms. In this Catalog, PUE solutions are categorized by their field of application (agriculture, commercial, services and private). As a nascent solar specialty, the frontiers of PUE are not yet fully cast in stone and some solutions are home to several categories. We trust the reader will identify these few cases and understand this PUE Catalog is not yet a final scientific document but rather a humble attempt to shed more light on a new discipline which will shape the life of many Africans in the years to come.

Definition

Productive Use of Energy, often abbreviated by PUE, is the utilization of **electricity-powered solutions which support any economic activity and which will leave the user with more income** than the previously used solution (if any).

Most often, the source of energy is renewable, because it is now cheaper to run that fossil fuels or because this source of energy is the only one available in a particular area. But PUE also applies to electric equipment which can be connected to the grid, and the grid itself may not necessarily be powered from renewable energy sources.

PUE is composed of solutions which replace and improve previously used solutions (eg: solar maize grinder replacing a diesel maize grinder), but also of new solutions because no economically viable solution was previously available (irrigation by diesel pump not affordable in many areas).

What this catalog covers and what it does not

As described in the previous page, PUE comprises of pretty much any machine or solution which can be powered by electricity (on-grid and off-grid). In line with the Lighting Global 2019 PULSE report, this catalog however focuses **exclusively on PUE solutions which are solar-powered**. This means that this report does not cover solutions provided by the growing group of companies which finance traditional electrical machinery which will be connected to and powered by grid electricity. The activity of this new type of PUE companies is commendable and plays a growing role in the economic development across the continent, but is not covered in this report because not directly connected to solar.

There is a **thin line between PUE and C&I** (commercial and industrial) solar. Indeed, C&I is not defined by the size of the

solar installation, but rather by the nature of what the solar electricity is used for. Hence any economic activity powered by solar energy may be considered as C&I. In this report, in order to define the limit between C&I and pure PUE solutions, we opted to consider **PUE as all solutions that require an equipment or machinery change**. Therefore, a company which already runs electrical equipment connected to a diesel generator or the grid, but which installs solar to get cheaper and more stable electricity is considered “C&I” and not PUE in this report. On the other hand, a person currently running a diesel maize grinder and who wishes to switch to solar, needs to obtain a completely new device (because based on an electric engine) and is therefore considered as PUE.

Depending on its final use, a specific solution can be considered as PUE or not. A typical example is a solar kit with a TV. If installed at home, it does not generate an additional income and should not be considered PUE. But if installed at a bar to attract more customers, it then falls under the category PUE.

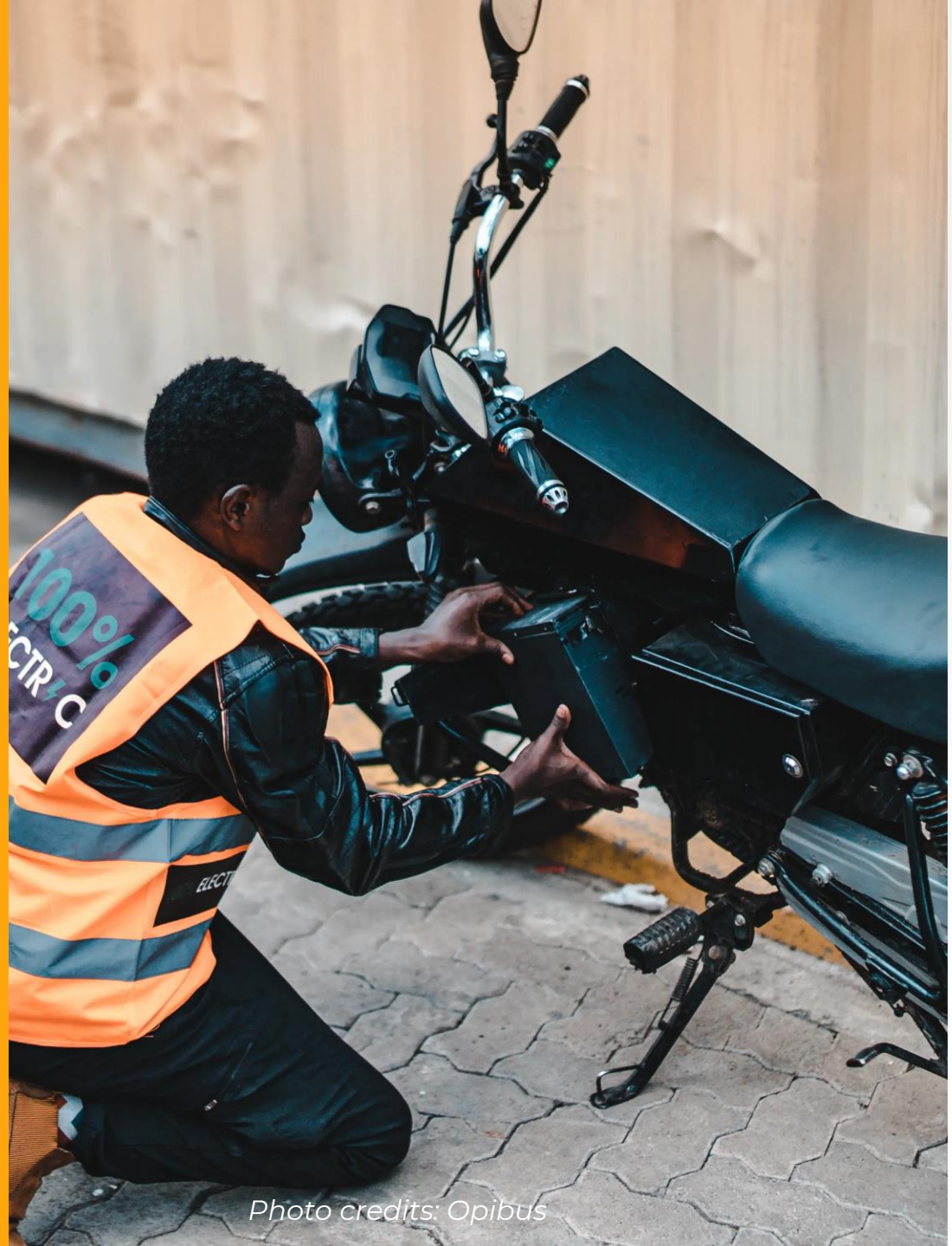

Photo credits: Opibus

This report also makes **one exception** to the definition in the section related to "**PUE for services**". This includes solutions related to education and healthcare. Here, the improvement is not economic but rather societal, by making education or fundamental health care services more widely available and accessible. The positive impact on society is in this case considered as equally important to any other economic gain.

Each section in this Catalog contains slides about the business case from the end-user perspective as well as a list of companies active in this specific PUE solution. The figures shared in the business case are based on the input of the various experts contacted by AFSIA. They should be regarded **only as indicative of potential savings thanks to PUE and not as absolute numbers valid across all situations**. Similarly, the companies listed are the companies which AFSIA managed to identify during this research and may not be an exhaustive list of all companies providing the PUE solutions at the time of reading this report. We invite all **companies which would like to be featured to get in touch with the AFSIA team** for future editions of this PUE Catalog.

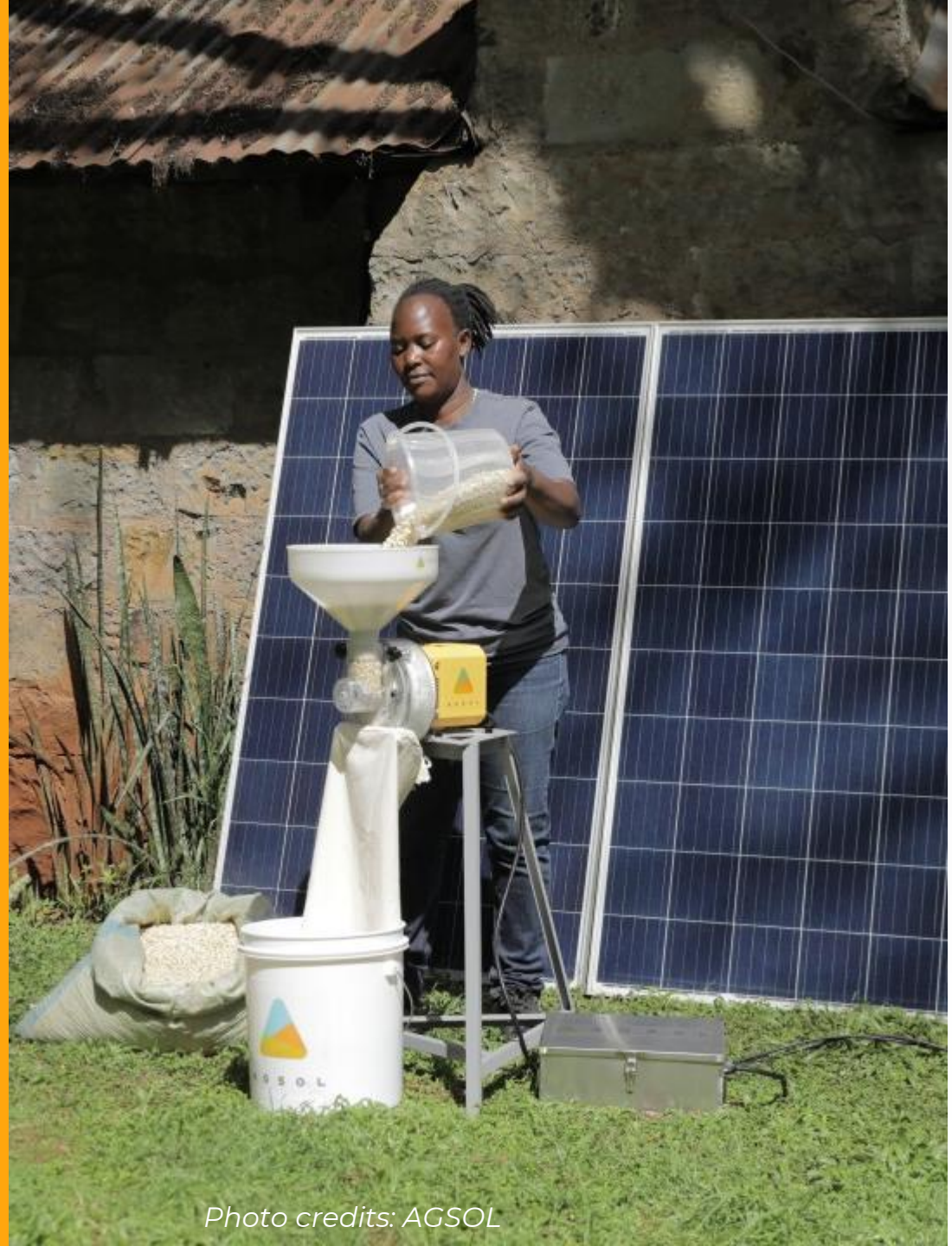

Photo credits: AGSOL

Thank you note

This first PUE Catalog compiled by AFSIA is the fruit of many months of research, analysis and discussions with key industry stakeholders.

First thanks go to Kersy Nsengiyumva, Research Associate at AFSIA. Over the past few months, Kersy has relentlessly researched the PUE market to build a comprehensive overview of the PUE reality and potential in Africa. In doing so, Kersy has developed solid knowledge about this nascent but key segment of the solar industry.

A big thank you as well to Ines Rachel Dushime for overseeing and reviewing this report, and sharing precious guidance and advice to the team as it was discovering this emerging solar specialty.

We would also like to thank the PUE companies and experts who have accepted our invitation to share information about their solutions and activities. AFSIA is very focused on the commercial reality of solar in Africa and how this impacts individuals and companies tangibly. Without this candid contribution, we would not have been able to present to you today this catalog alongside some key performance indicators and unit economics information, which we hope will help the reader to build a better understanding of the reality of PUE in Africa.

We would also like to thank other organizations who have previously documented research on this future key segment of the African solar industry. Several reports have stood out while the AFSIA team was building a better understanding and overview of the existing solutions within PUE. We would like to particularly highlight the following reports and their authors for their efforts in compiling knowledge about PUE:

- The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa by Lighting Global
- Off-Grid Solar Market Trends Report 2022: State of the Sector by Lighting Global
- Selling productive use of energy products to last mile consumers by the Global Distributors Collective
- Nefco PUE Market Assessment March 2023 by TetraTech

Photo credits: ColdHubs

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Meet the team

INÈS	ALINE	JOHN	VESTINE	JOSÉE	VINCENT	KERSY	ÉUGENIE
TEAM MANAGER	MARKET INTELLIGENCE MANAGER	CEO	DIGITAL COMMUNICATION MANAGER	COMMUNITY MANAGER	PARTNERSHIPS MANAGER	RESEARCH ASSOCIATE	EVENTS COORDINATOR

Photo credits: ENGIE Energy Access

INTRODUCTION TO AREA OF APPLICATION IN PUE

01 **Agriculture**

02 **Commercial**

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04 **Private**

INTRODUCTION TO AREA OF APPLICATION IN PUE

Agriculture

- **Cold storage - positive**
- Cold storage - negative
- Solar freezer
- Solar irrigation
- Milling
- Drying
- Oil press
- Egg incubator
- Night fishing
- Milk chilling
- Electric fences
- Pulping

Cold storage – positive

This term refers to storage at temperatures below room temperature but above freezing (usually between 0°C and 15°C).

It is often used for products that do not need to be kept at very low temperatures but need to be kept cool, such as fruits, vegetables, and dairy products. In brief, cold storage keeps products that will be consumed in a short period of time.

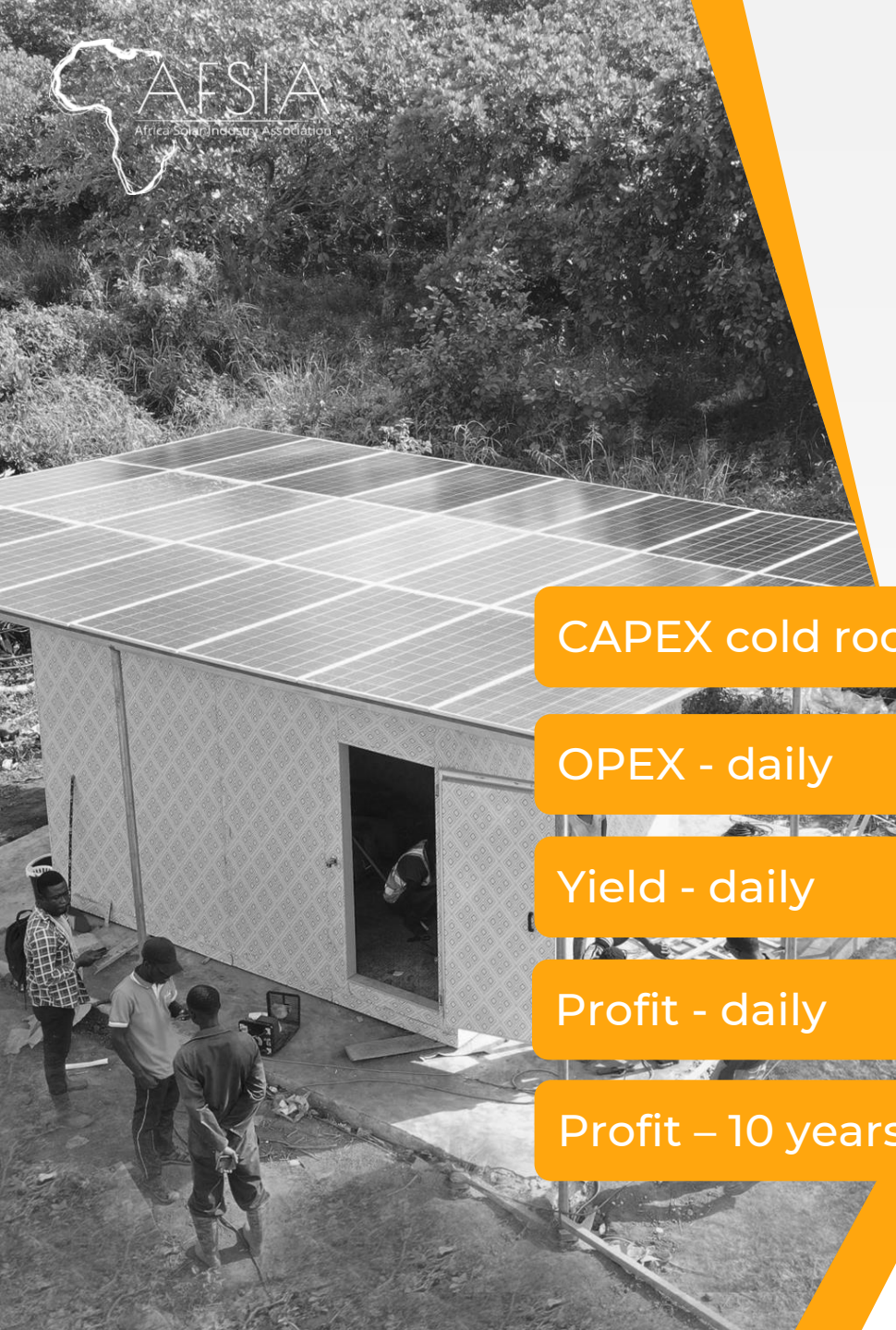
PUE in this context refers to cold storage systems that use solar electricity as their source of energy.

Photo credits: ColdHubs

Photo credits: TERMODIZAYN

Advantages of productive use of energy for cold storage - positive

- Extends shelf life of perishable items, like fruits, and vegetables
- Preserves the quality of perishable items by maintaining the flavor and texture
- Generates positive financial returns by reducing food losses



POSITIVE COLD STORAGE
BUSINESS CASE
Farmers cooperative

	No cold room	Cold room
CAPEX cold room	USD 0	USD 40,000
OPEX - daily	USD 0	USD 0
Yield - daily	160 kg (200 kg/day * 20% waste)	200 kg (200 kg/day * 0% waste)
Profit - daily	USD 80 (160 kg/day * USD 0.5 /kg)	USD 120 (200 kg/day * USD 0.6 / kg)
Profit – 10 years	USD 292,000	USD 398,000

Assumptions: year-round production thanks to irrigation, 20% of production wasted when not enough quantity to be collected by aggregators, 10 years life of cold room, higher selling price thanks to increased negotiation power and better quality

Cold storage - positive Companies

Manufacturers & Distributors

Photo credits: SokoFresh

Photo Credits: ColdHubs

TESTIMONIAL

Cold storage - Positive

Farmers in Nigeria are using ColdHubs cold storage rooms by transferring their perishable foods into 20kg (44lbs) returnable plastic crates on a flexible pay-as-you-store subscription model. They pay a daily flat fee of about $0.50 per each crate of food they store.

By extending the shelf life of their perishable food from 2 days to 21, ColdHubs reduces post-harvest loss by 80%. The 54 installed ColdHubs stations saved 42,042 tons of food from spoilage in 2020. Consequently, with more of their harvest to sell, smallholder farmers increased their monthly income from previous $60 per month to a minimum of $120 per month.

Source

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Cold storage – negative

This type of cold storage is designed to maintain a temperature below zero, generally between -15°C and 0°C.
Generating and maintaining these lower temperatures requires slightly different equipment from positive cold rooms.

Negative cold rooms are used particularly for meat and fish, and allow for extended preservation of the product as opposed to positive cold rooms.

Negative cold rooms have a different business case from solar freezers as they are generally used for semi-industrial or communal use, where the solar freezers (described in the next section) are more suited for individual use.

Advantages of productive use of energy for cold storage-negative

- Suitable for produces such as fish, meat, vaccines etc
- Lower energy consumption and reduced operating costs compared to other types of negative temperature controlled storage

Photo credits: Adili Solar Hubs

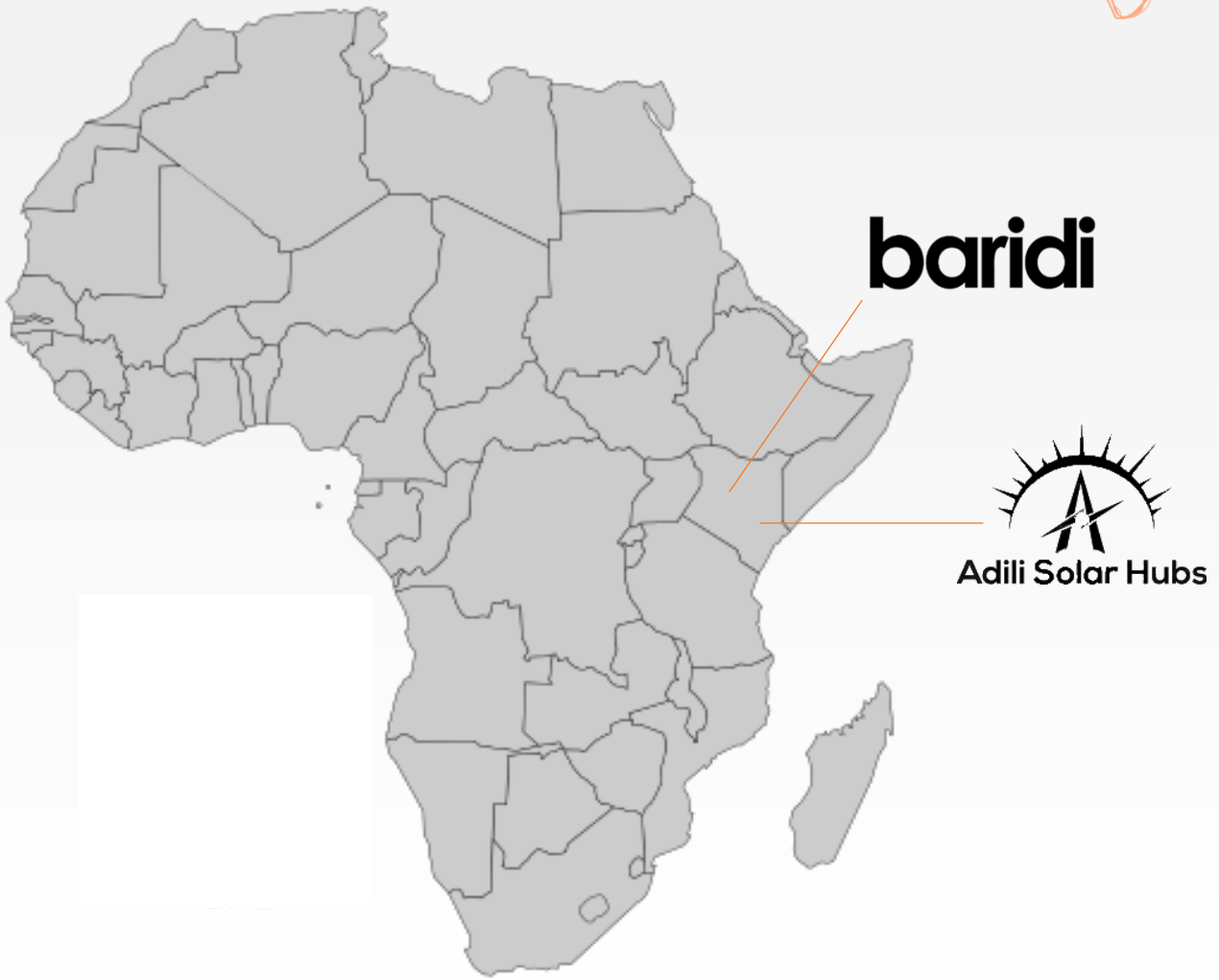
COLD STORAGE – NEGATIVE
BUSINESS CASE
Slaughter house in Kenya

	No cold storage	Solar cold room rental
CAPEX	USD 0	USD 0
OPEX - daily	USD 20 (waste management fee)	USD 25 ($0.04 * 650 kg/day)
Loss - daily	USD 975 (650 kg/day bought and wasted)	
Gain - daily		USD 1,235 (650 kg/day not wasted and sold)
Loss & Gain – 10 years	(USD 2,985,000)	USD 3,561,000

Assumptions: seasonal variations in volumes lead to waste of 650kg/day on average, average purchase price KSh 200/kg, avg sale price KSh 250/kg, 10 years life of cold room
Illustrative data provided by Baridi

Cold storage - negative Companies

Manufacturers & Distributors



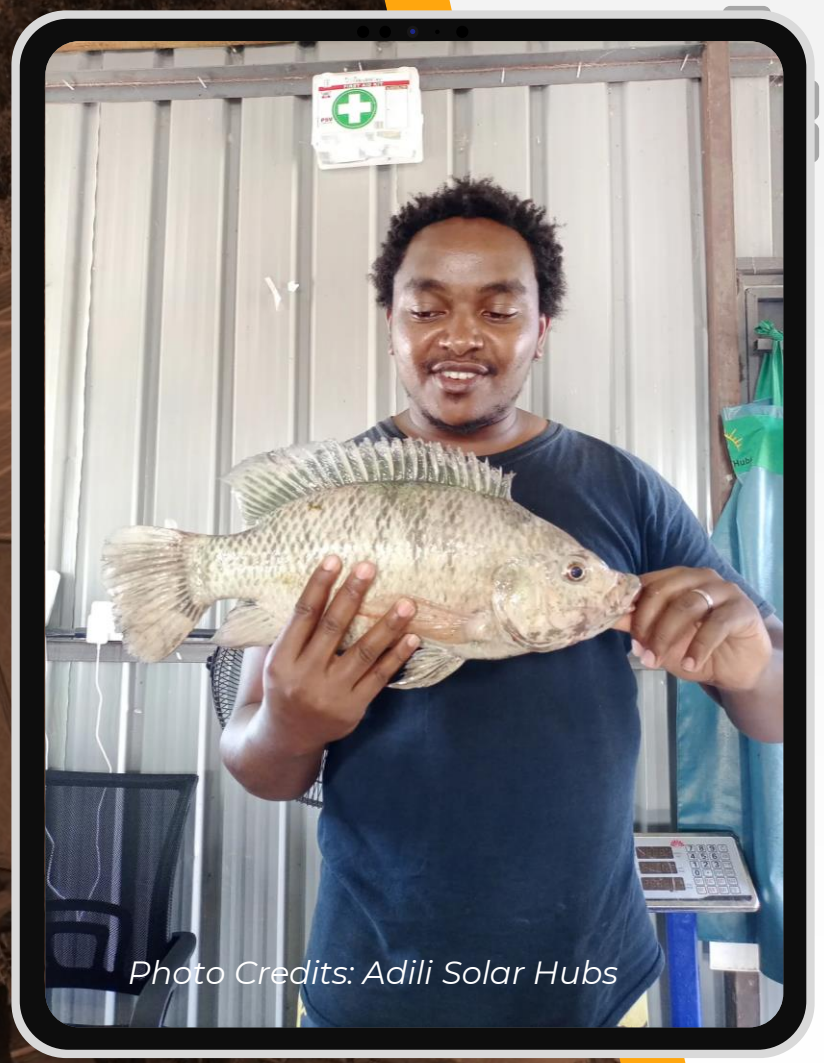


Photo Credits: Adili Solar Hubs

TESTIMONIAL

Cold storage - Negative

Fisherfolk in the Turkana County, which is the poorest county in Kenya were struggling to get their fishes to urban centers fresh or frozen due to lack of cooling infrastructure and the poor state of the road network.

Adili Solar Hubs has worked on a solution for the fisherfolk after assessing what was the issue, the absence of cold storage. They installed cold hubs in the Turkana county where they have ever since reduced fish spoilage.

The hubs installed in the county have increased the earnings of the fisherfolk three-fold.

Source

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Solar freezers

Solar freezers are particularly helpful for keeping produce at temperatures below 0°C to maintain a very long shelf life of the product.

Solar freezers are different from negative cold rooms in that they are significantly smaller and are meant for individual use (for example at a shop).

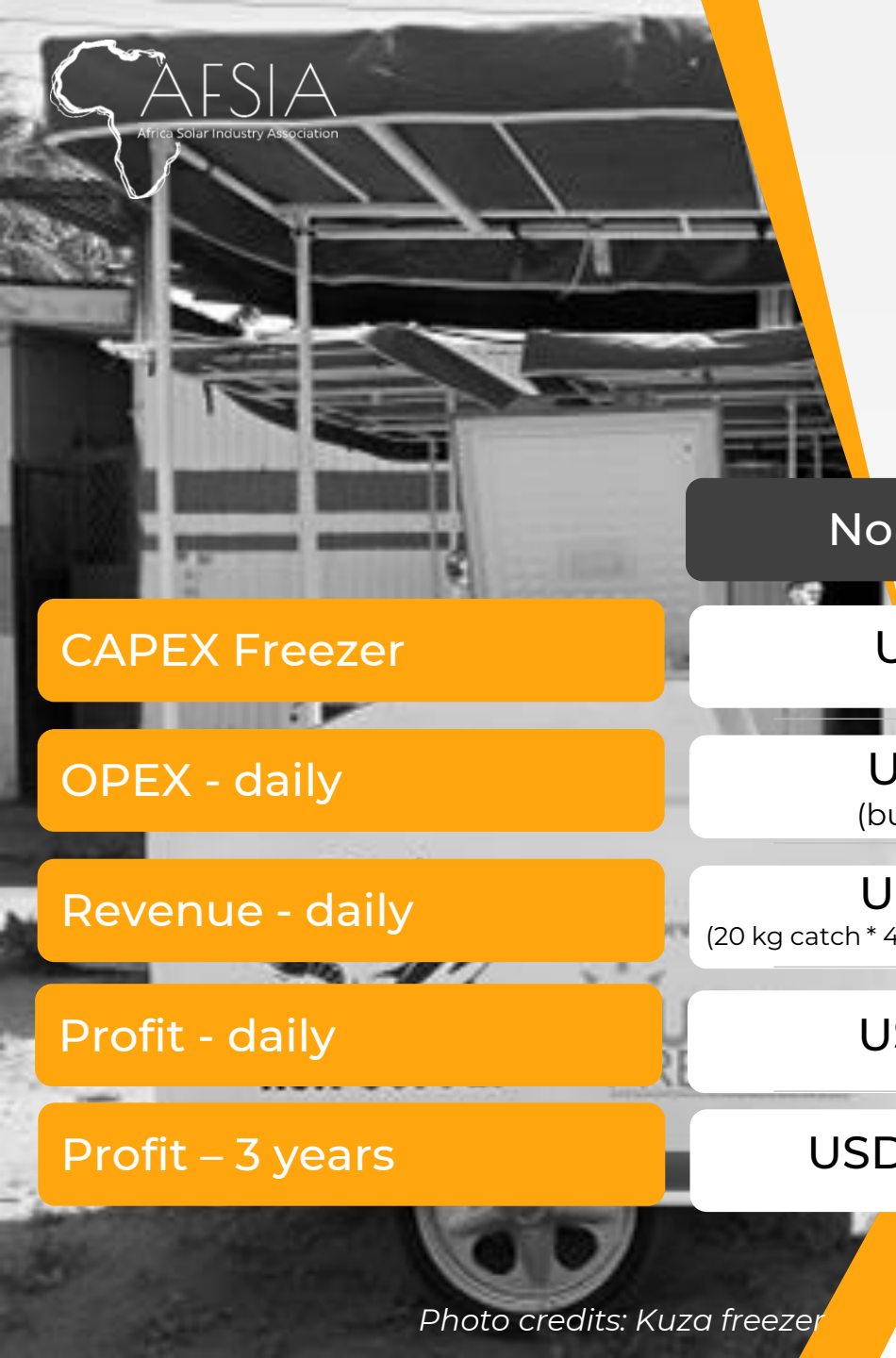
Solar freezers are ideal to keep a wide range of perishable products, including meat, fish and poultry.

Photo credits: Koolboks

Photo credits: Kuza Freezer

Advantages of productive use of energy for solar freezers

- Farmers and traders can store their produce for longer periods of time
- Reduce the need for expensive and energy-intensive transportation and storage methods



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SOLAR FREEZERS
BUSINESS CASE
Kenyan fishermen

	No freezer	Solar freezer CAPEX	Solar freezer PAYG
CAPEX Freezer	USD 0	USD 1,000	USD 150
OPEX - daily	USD 12 (buying ice)	USD 0	USD 3
Revenue - daily	USD 33 (20 kg catch * 45% waste * USD 3 / kg)	USD 70 (20 kg catch * 0% waste * USD 3.5 / kg)	USD 70 (20 kg catch * 0% waste * USD 3.5 / kg)
Profit - daily	USD 21	USD 70	USD 67
Profit – 3 years	USD 18,900	USD 62,000	USD 59,565

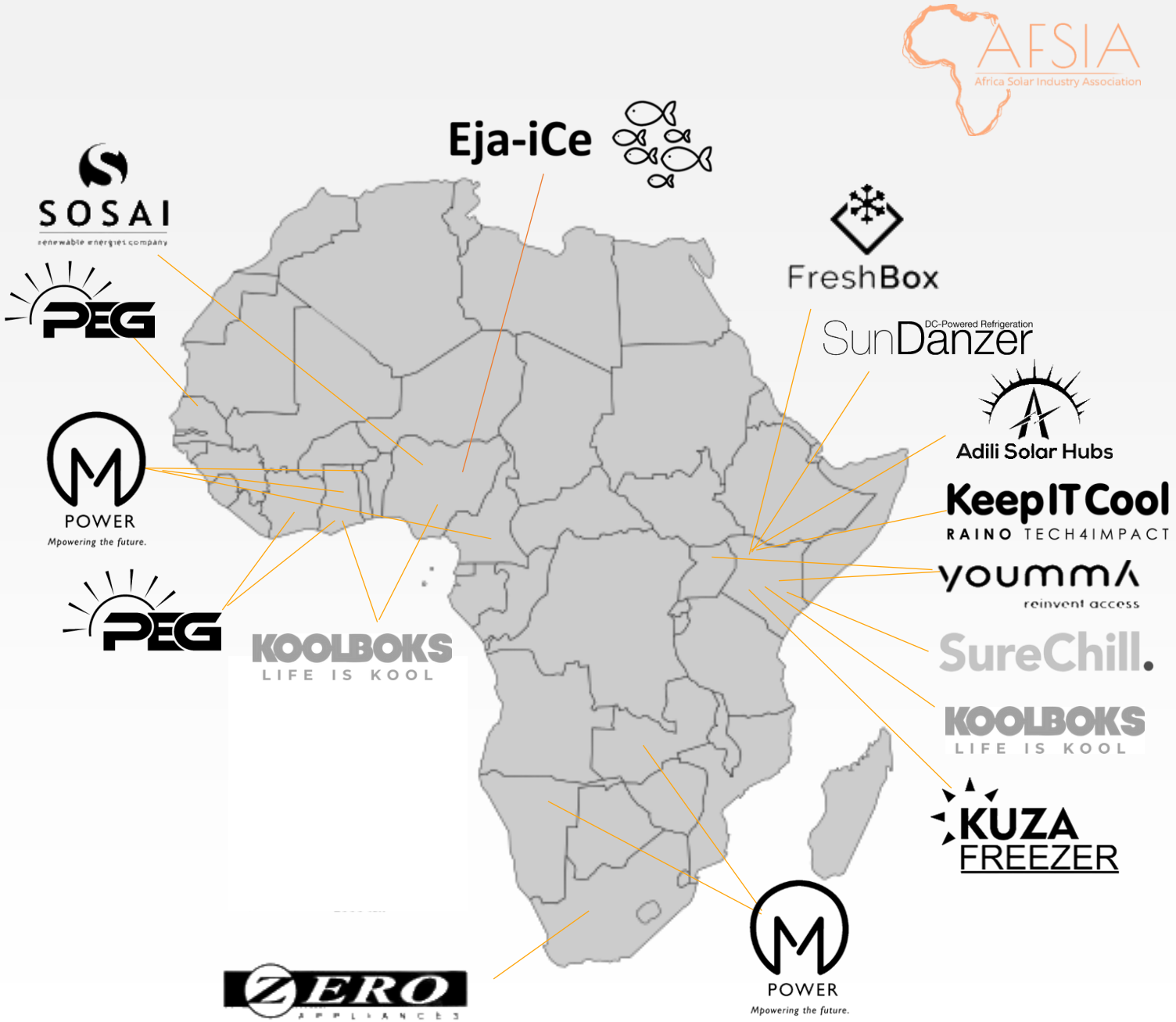
Photo credits: Kuza freezer

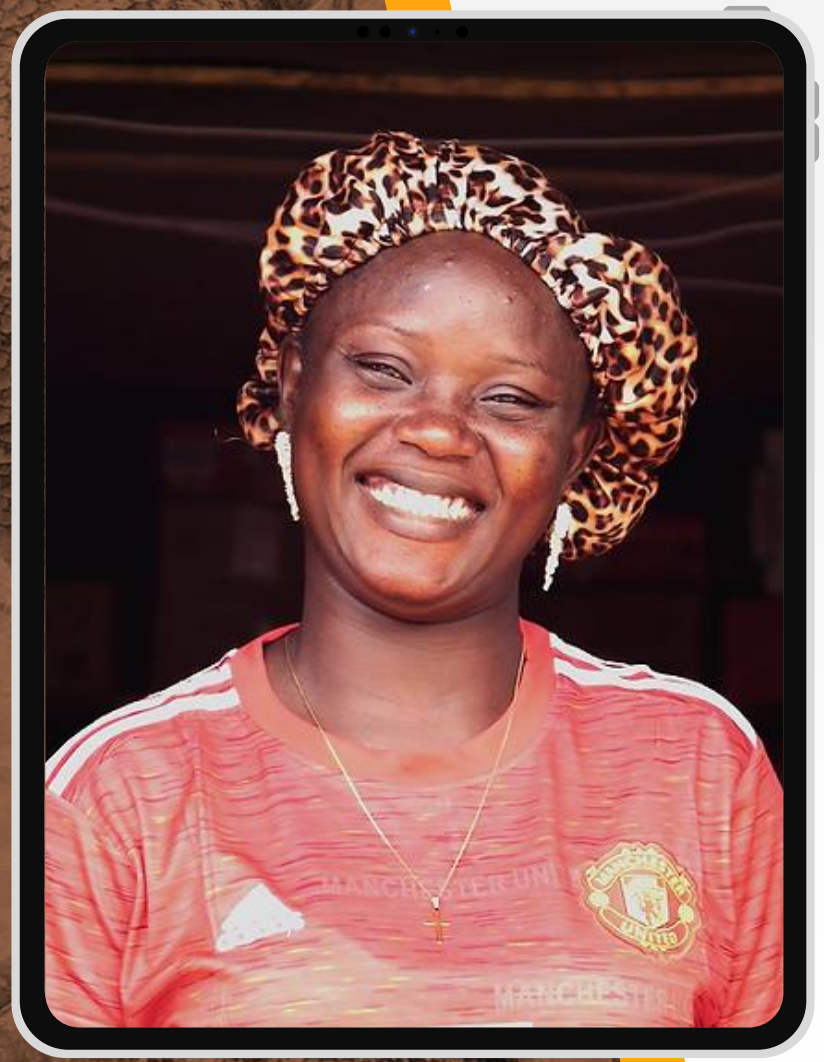
Assumptions: fishing 25 days/month, fish kept in freezer can be sold at higher price, all costs related to fishing excluded
Illustrative data provided by Kuza Freezer

Solar freezer Companies

Manufacturers & Distributors

Photo credits: SureChill





TESTIMONIAL

Solar freezer

Located in the heart of Badagry, Mrs. Oshuntolu's frozen food store faces the challenge of frequent power outages in the area, making it difficult to keep her 4 freezers running.

She used to run diesel generators as back-up during power outages. And as a result, she ended up spending more than N90,000 every month just to maintain the freshness of her food products.

But since acquiring 3 Koolboks Freezers, she now benefits from the sun's free energy and has completely abandoned the use of her generator and power grid. She now exclusively relies on the Koolboks Freezers for her business.

Source

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Solar irrigation

This is a type of pump that is powered by solar energy.

It uses photovoltaic panels to convert sunlight into electricity, which then powers the motor of the pump.

The pump is typically used to pump water from a well, borehole, or other water sources for irrigation, livestock, and domestic use.

Photo credits: Future Pump

Photo credits: SNV by SunCulture

Advantages of productive use of energy irrigation

- 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

Types of water pumps

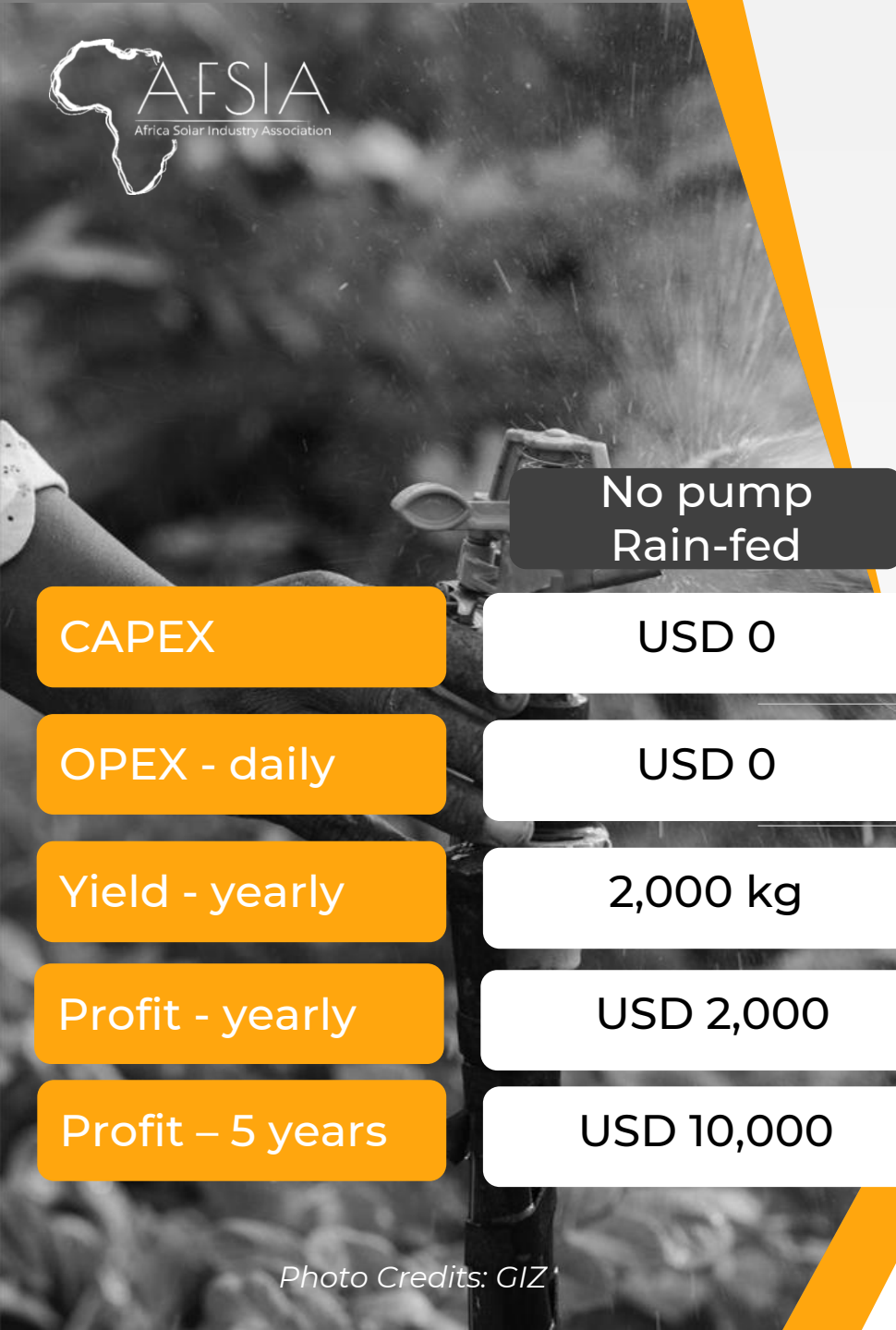
Submersible solar pumps: These pumps are installed directly in the water source, such as a well or borehole at depth varying from a few meters to a few dozens meters. They require a strong system to pump up the water above ground level.

Surface solar pumps: These pumps are installed in the water body at ground level and are used for pumping water from lakes, rivers, or other shallow water sources. They are suitable for both domestic and agricultural use.

AC pumps: These pumps require an inverter to convert the DC power from solar panels to AC power to operate. They can also be connected to the grid.

DC pumps: These pumps are directly powered by solar panels without the need for an inverter. They are extremely efficient but their pumping capacity is directly proportionate to the sunlight intensity.

Photo credits: Desalegne Tadesse



SOLAR IRRIGATION
BUSINESS CASE
1 acre grain farm

	No pump Rain-fed	Diesel pump	Solar pump CAPEX	Solar pump PAYG
CAPEX	USD 0	USD 250	USD 375	USD 30
OPEX - daily	USD 0	USD 3	USD 0	USD 0.67
Yield - yearly	2,000 kg	4,500 kg	4,500 kg	4,500 kg
Profit - yearly	USD 2,000	USD 3,450	USD 4,500	USD 4,257
Profit – 5 years	USD 10,000	USD 16,775	USD 22,125	USD 21,983

Assumptions: 2,000 kg/yr/acre with rain-fed, yield x2.25 with irrigation, USD 1/kg, 5 years life time of pump

Photo Credits: GIZ

Solar irrigation Companies

Manufacturers & Distributors

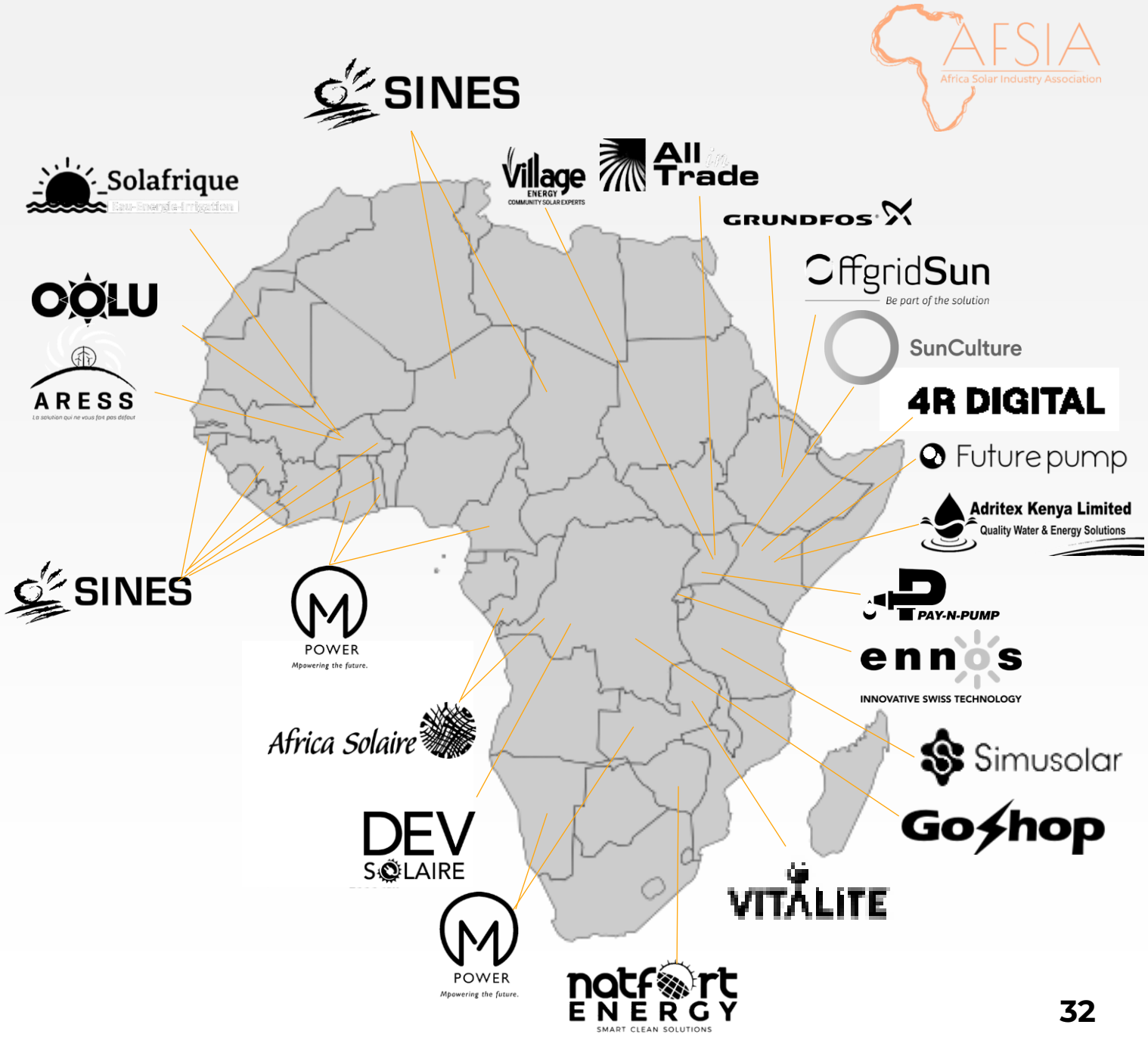


Photo Credits: Mulugeta Ayene/WLE

TESTIMONIAL

Solar Water Pump

Over the past year, 20 women's cooperatives supported by the JP RWEE in Ngoma have seen an increase in fruit and vegetable production. The yield from their lands have more than quadrupled within a year, from an average of 3 to 13 tons of tomatoes and 1 to 15 tons of green peppers per hectare.

"Before the introduction of a solar-powered irrigation system, my cooperative was suffering losses due to the use of a fuel-powered irrigation system, spending over Rwf 200,000 ($184) per month. The harvested vegetables couldn't cover operational costs," says Goretti.

"Now I'm very happy our cooperative earnings have increased from less than Rwf 200,000 to over 2M ($1,848) per season through the sale of fruits and vegetables from the solar irrigated land."

Source

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Milling

Milling is an essential component of eating in the majority of communities in sub-Saharan Africa which rely on grains and cassava for their main food intake.

Diesel mills have relatively low capital costs but high operational costs and also leave a fuel fumes after taste in the milled product.

Electric mills offer an alternative to diesel mills, avoiding the bad after taste and producing finer milled product which is more appreciated. But they require access to electricity, which often means long travel times to the city.

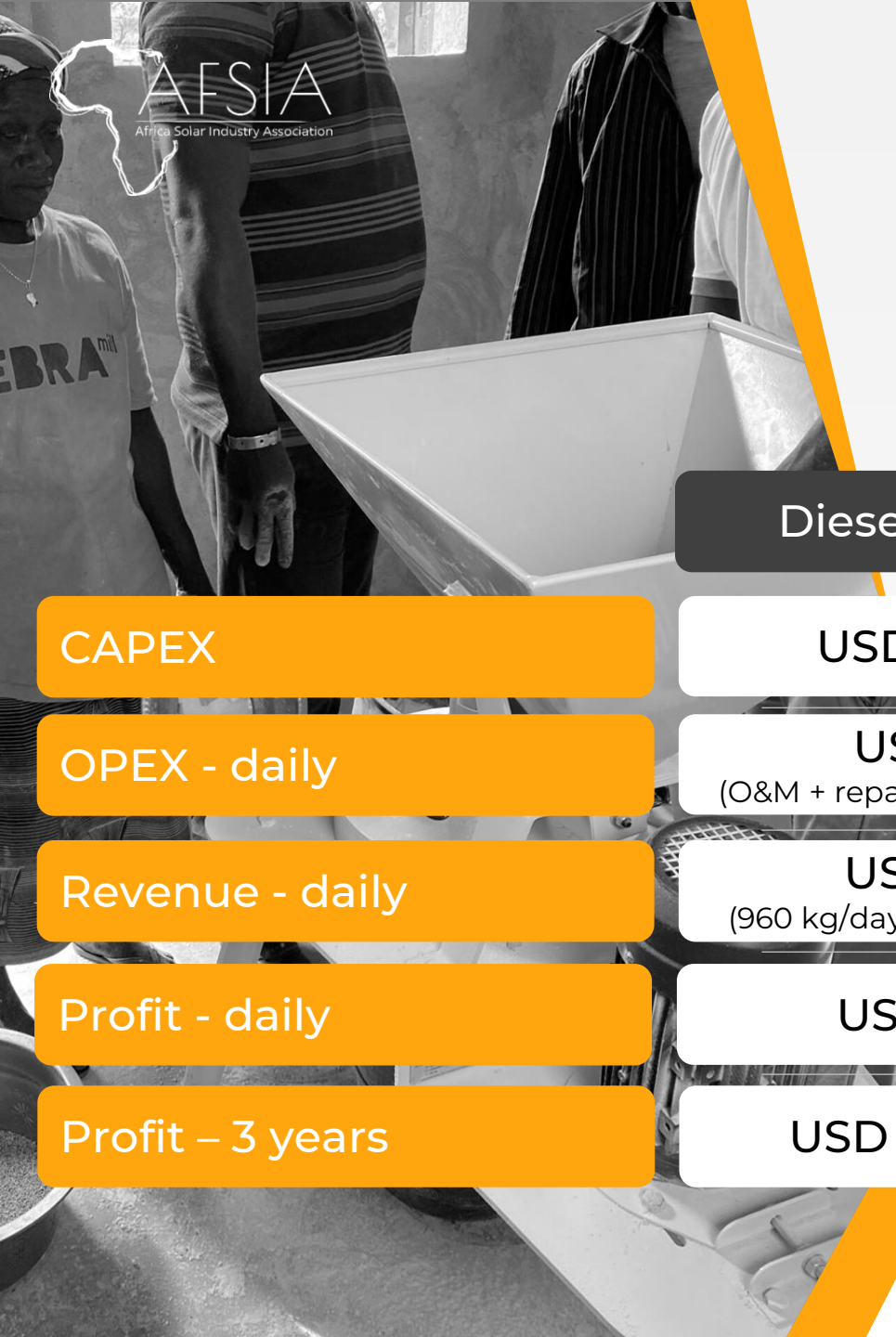
This is where solar mills have the best value proposition: they are cheap to operate and can be installed in any rural location, thereby significantly reducing the time and labor burden associated with accessing milling services.

Photo credits: AGSOL

Photo credits: AGSOL

Advantages of productive use of energy in milling

- Farmers process their own grain instead of relying on expensive and often distant milling services
- Reduces the labor required for grain processing and increase the efficiency of the milling process



SOLAR MILLING
BUSINESS CASE
960 kg/day maize milling

	Diesel milling	Electric milling	Solar milling
CAPEX	USD 1,000	USD 2,000	USD 10,000 (4 * USD 2,500 for 120kg/h)
OPEX - daily	USD 12 (O&M + repairs not included)	USD 15	USD 0
Revenue - daily	USD 96 (960 kg/day * USD 0.10 /kg)	USD 154 (960 kg/day * USD 0.16 /kg)	USD 154 (960 kg/day * USD 0.16 /kg)
Profit - daily	USD 84	USD 139	USD 154
Profit – 3 years	USD 74,600	USD 122,740	USD 128,240

Assumptions: 120 kg/hr throughput, 8 h/day, diesel consumption 1.5 l/hr, lower price for diesel milling because lower quality, 3 years life of mill, 60 kWh/day @ $0.25/kWh elec conso

Illustrative data from Efficiency for Access

Milling Companies

Manufacturers & Distributors

TESTIMONIAL

Milling

Sarafina Betty Namusobya and Annette Kubonaku Bazibu are utilizing solar-powered milling technology in Uganda.

Namusobya reports that her solar mill can process 250 kilograms of cereals daily. After operating the business for two months, she is earning an average of Shs30,000 to Shs40,000 per day from milling for other individuals. This income has allowed her to purchase her own mill for her poultry farm, enabling her to be self-sustaining.

She no longer needs to buy feed from other producers and neighboring poultry farmers now purchase feed from her. This has turned her home into a source of income, where people buy or mill their produce. Namusobya has also provided training to other farmers in the area.

Source

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Drying

Post-harvest loss (PHL) is a major issue in the agri value chain in Africa. One solution to limit PHL is to dry the produce. This process consists of removing moisture from food in order to preserve it and extend its shelf life.

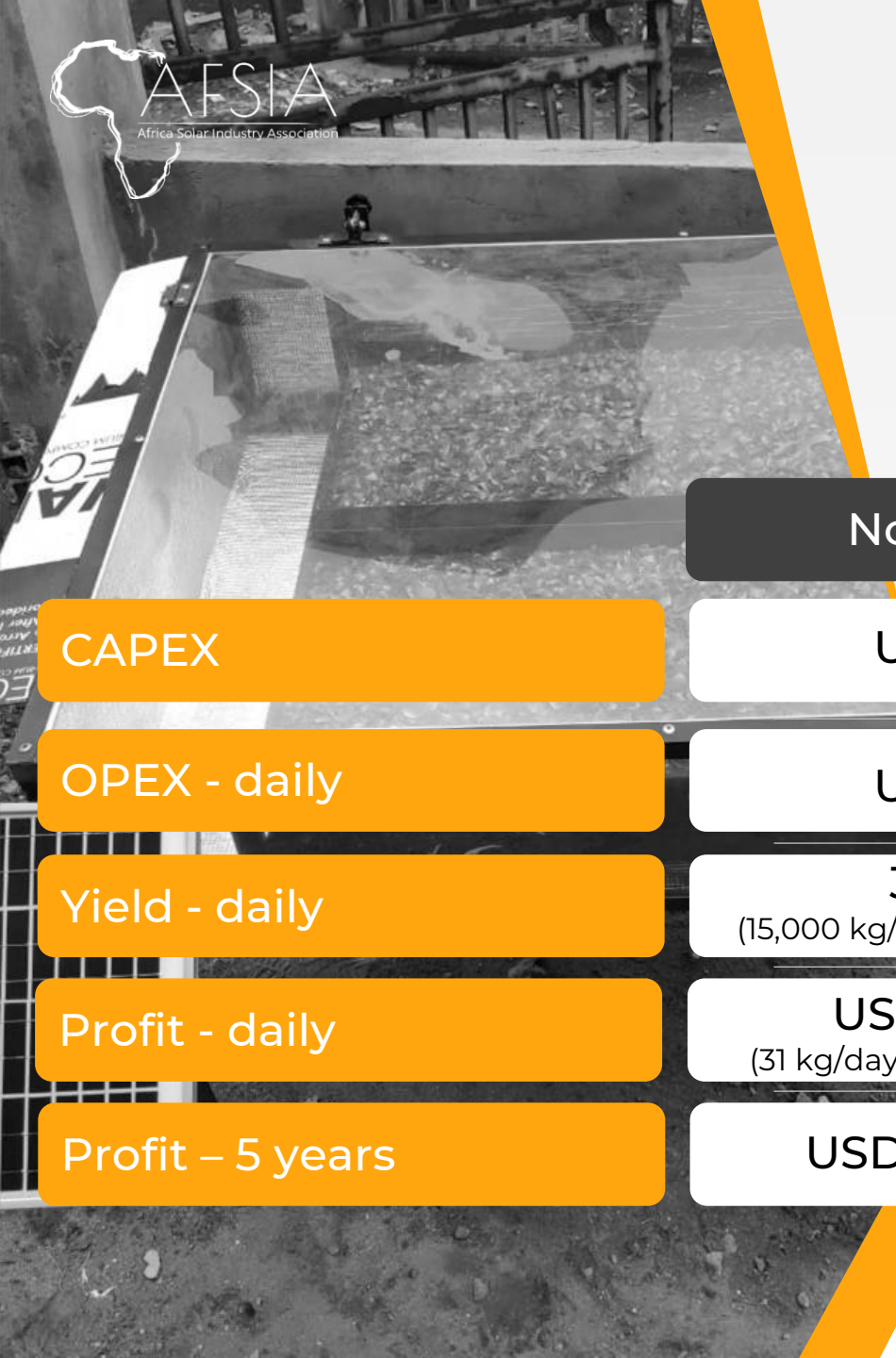
This can be done through various methods such as air-drying, sun-drying, oven-drying, or using a food dehydrator. It involves exposing the food to low heat and airflow, which removes the water content that microorganisms need to grow, which inhibits their ability to spoil the food.

Solar dryers offer a great drying option as they rely on clean energy and can be installed in literally any sunny location. They are relatively cheap and very easy to maintain. They offer a much better drying result than open air drying.

Photo credits: JUA Technologies

Advantages of productive use of energy in drying

- No grid-electricity or fuel required, which makes it an affordable option for small-scale farmers and individuals
- Provide even and consistent drying preventing the growth of mold and bacteria



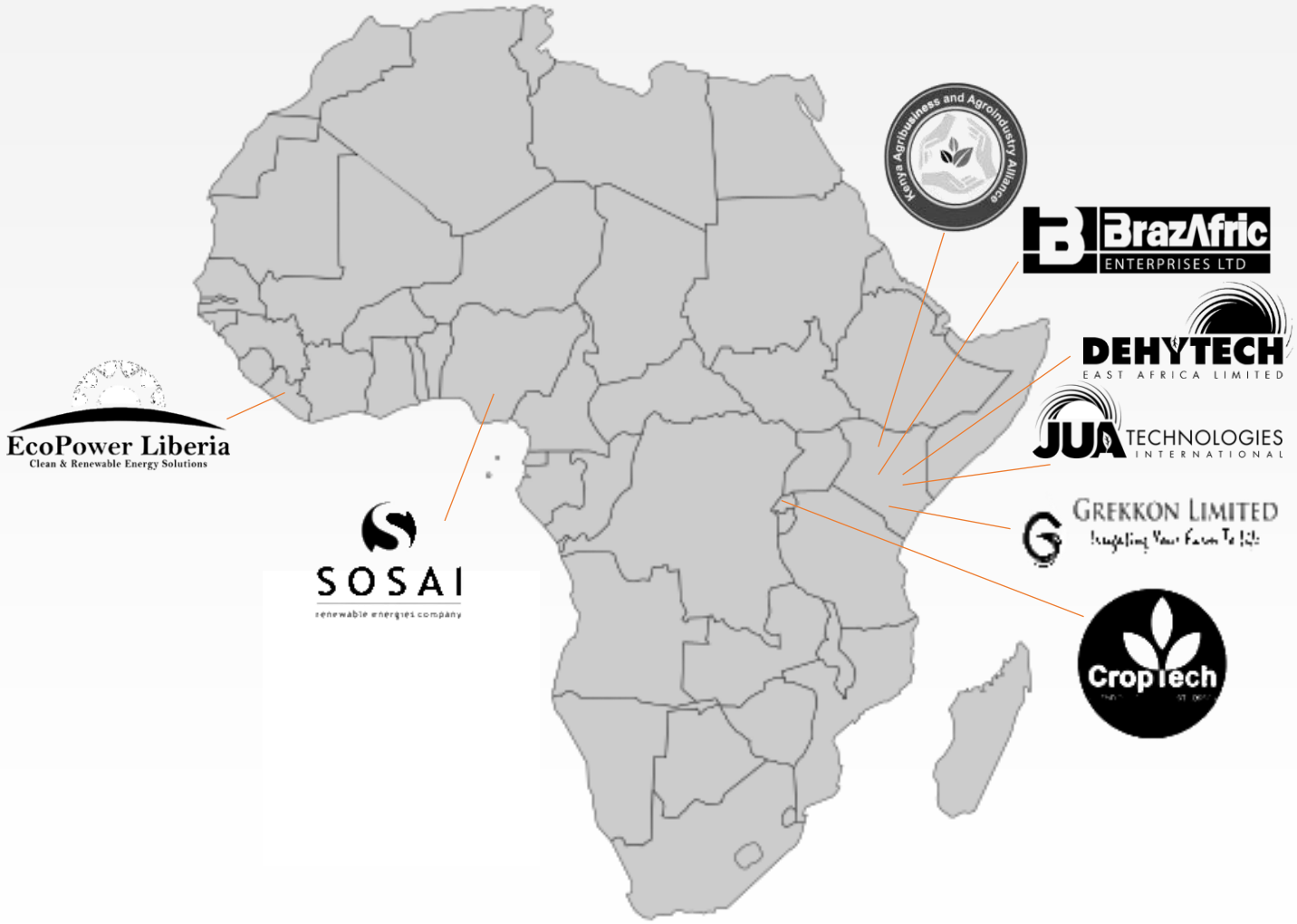
SOLAR FOR DRYING
UNIT ECONOMICS
Chilly farming

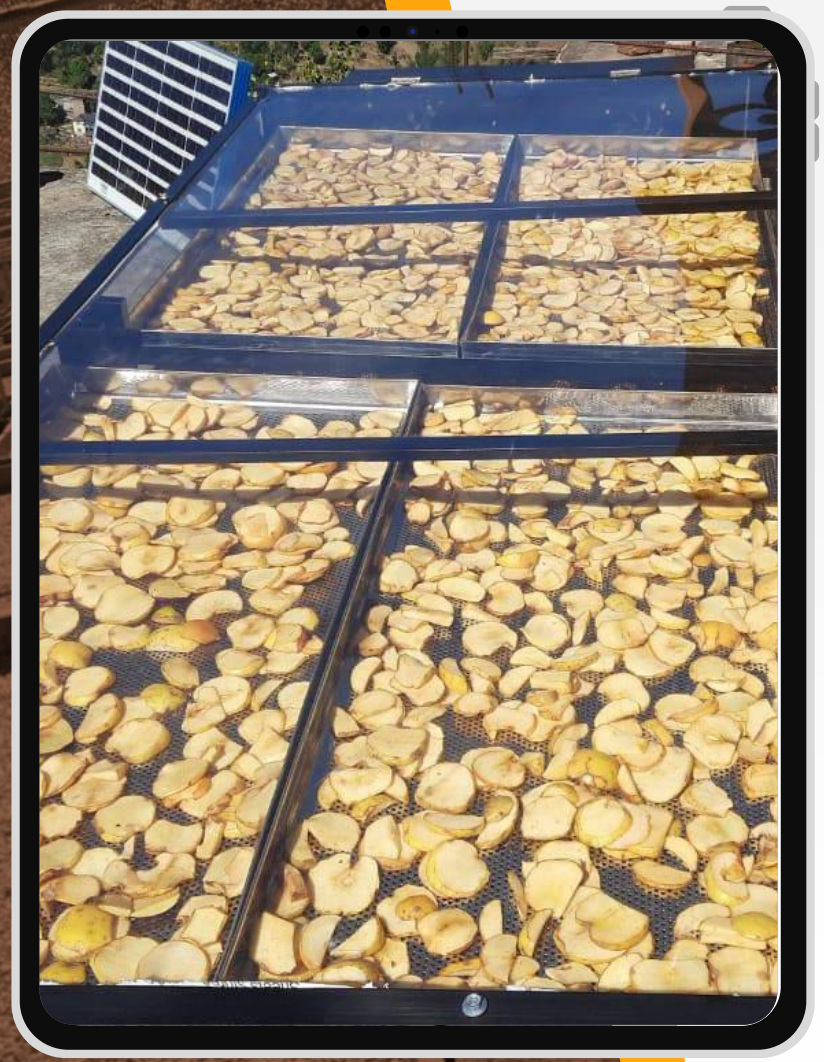
	No dryer	Electric dryer	Solar dryer
CAPEX	USD 0	USD 2,000	USD 3,000
OPEX - daily	USD 0	USD 4	USD 0
Yield - daily	31 kg (15,000 kg/year * 25% waste)	41 kg (15,000 kg/year * 0% waste)	41 kg (15,000 kg/year * 0% waste)
Profit - daily	USD 46.5 (31 kg/day * USD 1.50 /kg)	USD 61.5 (41 kg/day * USD 1.50 /kg)	USD 61.5 (41 kg/day * USD 1.50 / kg)
Profit – 5 years	USD 84,375	USD 103,200	USD 109,500

Assumptions: 25% of production wasted if open air drying, UV sheets need replacement after 5 years life of dryer, electric consumption of dryer at 16 kWh/day @ $0.25/kWh
Illustrative data provided by Grekkon, JUA Technology

Solar drying Companies

Manufacturers & Distributors





TESTIMONIAL

Drying

Fortunee Musanabera, a female entrepreneur and farmer in Rwanda is using solar dryers in her community.

Musanabera was drying Orange Fleshed Sweet Potatoes (OFSP) under the sun which was lot of work and had many challenges. She had to remove drying produce quickly if it started raining and it was challenging to even dry produce during rainy months. Musanabera shared that it takes less time for the commodities to dry with chimney solar dryer than drying under the sun. Plus, improved color and quality of the dried produce and its improved safety.

Currently, she is selling OFSP flour at 1,000 Rwf per kg, beetroot flour at 4,000 Rwf per kg, igisura at 10,000 Rwf per kg and amaranth flour at 2,000 Rwf per kg.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Agriculture

- Cold storage - positive
- Cold storage - negative
- Solar freezer
- Solar irrigation
- Milling
- Drying
- **Oil press**
- Egg incubator
- Night fishing
- Milk chilling
- Electric fences
- Pulping

Oil press

Oil pressing refers to the process of extracting oil from seeds, nuts, or other oil-bearing materials by applying pressure to them.

Different types of presses are used for oil pressing, including hydraulic presses, screw presses and expeller presses.

PUE in this context refers to the use of solar energy to power the presses.

Photo: University of Hohenheim

Advantages of productive use of energy in oil press

- Reduce the manpower efforts and increase efficiency
- Creates job opportunities
- Environmentally friendly

OIL PRESS
BUSINESS CASE

	No oil press	Electric oil press	Solar oil press
CAPEX		Insufficient information found	
OPEX - daily			
Yield - daily			
Profit - daily			
Profit – 10 years			

Suggested reading from A2EI

Oil press Companies

Manufacturers & Distributors

Note:
Barkelou is not a manufacturer nor a distributor, but rather and end-user of solar oil presses.

Photo Credits: University of Hohenheim

TESTIMONIAL

Oil press

The University of Hohenheim, Stuttgart in Germany developed a solar-powered oil press for sesame seeds to test its efficiency compared to the currently used technologies. The project to evaluate the feasibility of solar-powered sesame oil production, took into consideration real conditions of medium and small-scale enterprises in rural areas of Burkina Faso.

Results obtained from the use of photovoltaic energy to run the oil press for sesame seeds in Burkina Faso has been seen not only as a sustainable and profitable way to produce electricity but also a cost effective one. The unit did show potential to create job opportunities in rural areas and providing economic viability and sustainability from the oil quality with regard to exportation.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Agriculture

- Cold storage - positive
- Cold storage - negative
- Solar freezer
- Solar irrigation
- Milling
- Drying
- Oil press
- **Egg incubator**
- Night fishing
- Milk chilling
- Electric fences
- Pulping

Egg Incubator

Egg incubators are devices designed to simulate the conditions necessary for eggs to hatch. They typically consist of a temperature and humidity-controlled environment that provides the ideal conditions for eggs to develop and hatch.

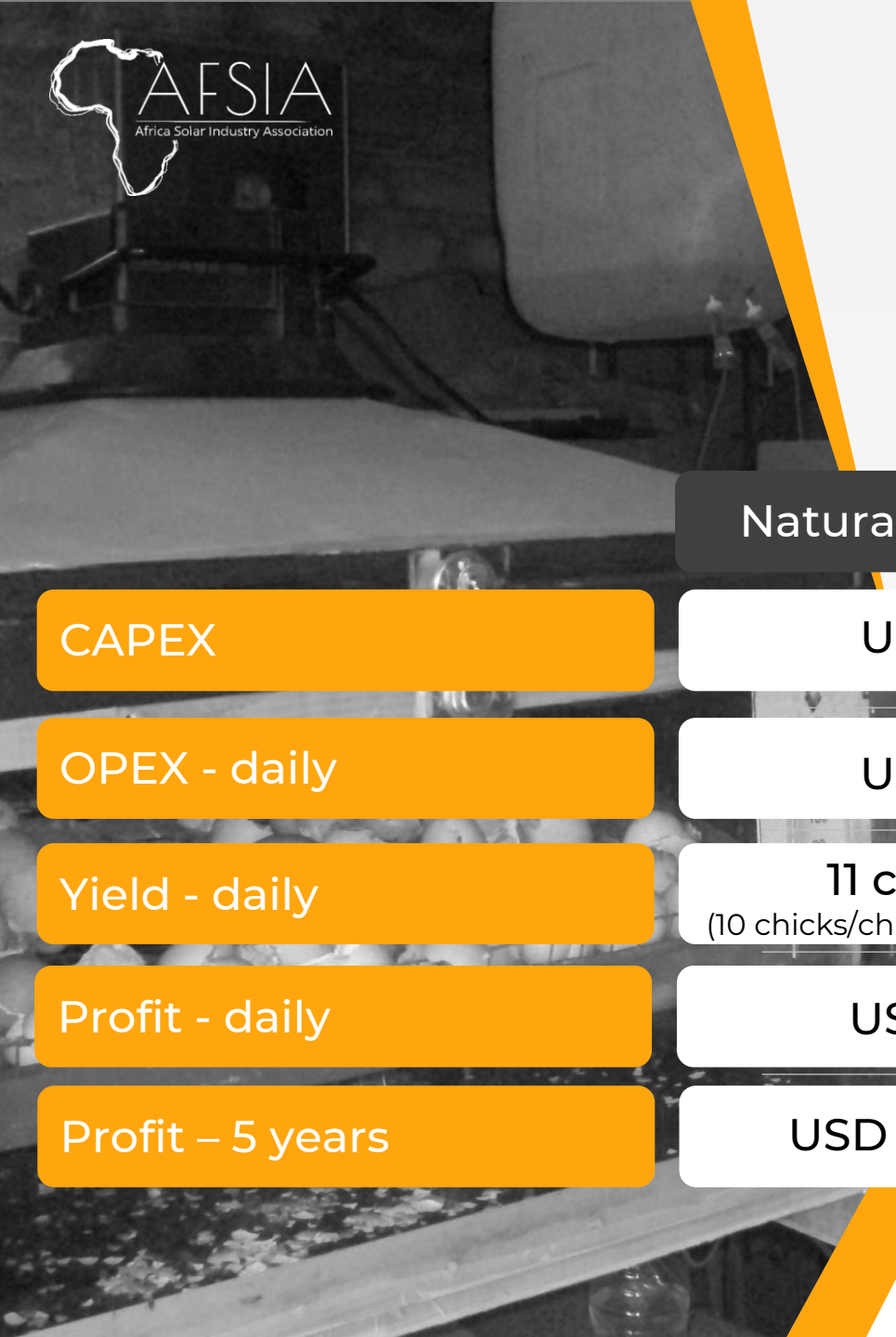
Natural incubation has a higher success rate (close to 100% vs. 85% with machine) but incubators function 365 days per year while hens are only broody on some seasons.

Solar egg incubators offer not only cheaper electricity than the grid in many countries, but they also offer constant and reliable power. Incubators connected to a faulty grid cannot maintain ideal hatching conditions and this often leads to loss of entire batches of eggs.

Photo credits: FarmbizAfrica

Advantages of productive use of energy in egg incubator

- Year-round hatching possible
- No losses induced by power shortages or grid failures



EGG INCUBATOR
BUSINESS CASE
100 chickens farm

	Natural hatching	Electric incubator	Solar incubator
CAPEX	USD 0	USD 1,500	USD 4,500
OPEX - daily	USD 0	USD 3	USD 0
Yield - daily	11 chicks (10 chicks/chicken/3 months)	49 chicks (250 eggs/chicken/yr * fertility * grid up)	55 chicks (250 eggs/chicken/yr * fertility)
Profit - daily	USD 11	USD 49	USD 55
Profit – 5 years	USD 20,000	USD 82,965	USD 95,500

Assumptions: 5 years life of incubator, electric consumption of electric incubator at KSh 3,000 / 21 day cycle, 3 * 500 eggs incubator required for 100 chickens, 80% fertility with incubator, grid failure leads to 10% production loss
Illustrative data provided by Engoho Kuku Farms

Egg incubator Companies

Manufacturers & Distributors

Photo Credits: Efficiency for Access

TESTIMONIAL

Egg incubator

Godfrey Ng’ang’a is a Kiambu county farmer in Kenya using a solar powered egg incubator.

Godfrey Ng'ang'a has developed and implemented a solar-powered egg incubator due to the high cost of traditional incubators and electricity bills. Although his previous incubator was effective, its power consumption was prohibitively expensive, using 45 kW per day and costing him approximately Sh11,000 for 21 days.

By switching to a solar-powered incubator, Ng'ang'a can achieve more than a 70% success rate over the 21-day incubation period. He has also provided this solution to other farmers in the area.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Agriculture

- Cold storage - positive
- Cold storage - negative
- Solar freezer
- Solar irrigation
- Milling
- Drying
- Oil press
- Egg incubator
- **Night fishing**
- Milk chilling
- Electric fences
- Pulping

Night fishing

It is a type of fishing that is done after the sun has set and darkness has fallen. During this process, special tools including night lights, headlamps, and glow-in-the-dark lures must be used.

In this case, solar energy may be applied to lighting systems to brighten fishing grounds and entice fish to bait or lures. These can be more successful in drawing fish because they frequently mirror the natural light patterns that fish are used to, such the moonlight or stars.

Photo credits: MillenniumEngineers

Photo credits: MillenniumEngineers

Advantages of productive use of energy in night fishing

- Cost-effective in the long run, as it eliminates the need for kerosene lights
- The light attracts a wide range of fish species by mimicking the natural light patterns that they are accustomed to

Photo credits: MillenniumEngineers

NIGHT FISHING
BUSINESS CASE
Sardine fishing at Lake Victoria

	Kerosene fishing light	Solar fishing light
CAPEX	USD 40	USD 0
OPEX - daily	USD 18	USD 8
Yield - daily	20 kg	20 kg
Gain - daily		USD 10
Gain – 3 years		USD 6,336

Assumptions: 8 lights / boat, USD 5 for 1 kerosene light, 18 days of fishing per month, $40/month/light in kerosene, catch similar with kerosene and solar light, 3 years life of solar light
Illustrative data sourced from Millenium Engineers

Night fishing Companies

Manufacturers & Distributors

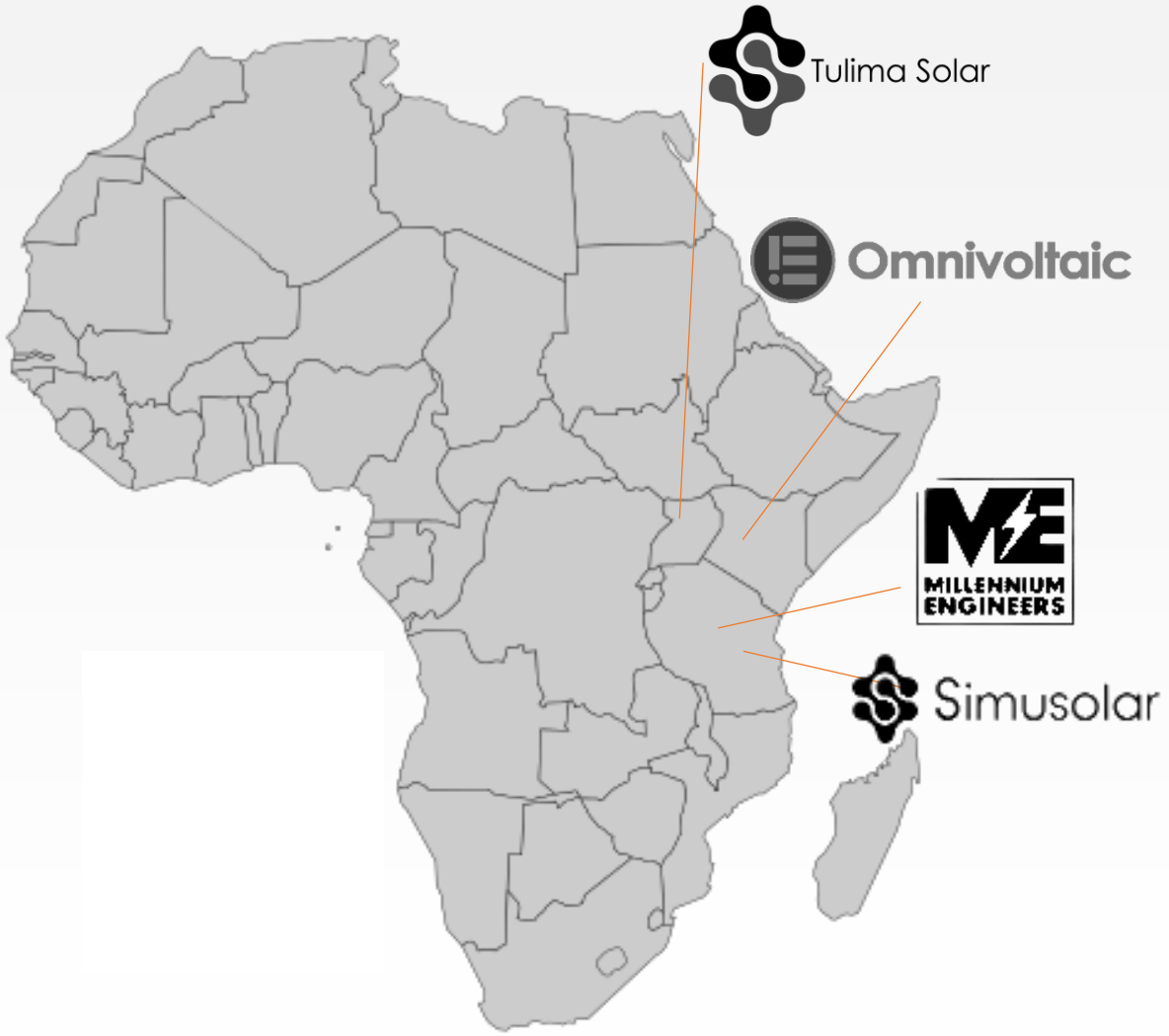


Photo Credits: The New York Times

TESTIMONIAL

Night fishing

You can turn the kerosene lanterns on waiting for fish to come, then when the fish are gathering, the lights go off!
Then, when you start servicing the lanterns, you lose all the fish.

Kerosene lanterns affected me because their expenses were very high.
Their operational costs were very high.
Sometimes people were even burnt by the kerosene lanterns.

John Masanja and Renatus Juvenali are fishermen from Lake Victoria in Tanzania.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Agriculture

- Cold storage - positive
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- Milling
- Drying
- Oil press
- Egg incubator
- Night fishing
- **Milk chilling**
- Electric fences
- Pulping

Milk chilling

Milk chilling refers to the process of lowering the temperature of milk to a particular range for the purpose of impeding bacterial growth and maintaining the milk's quality.

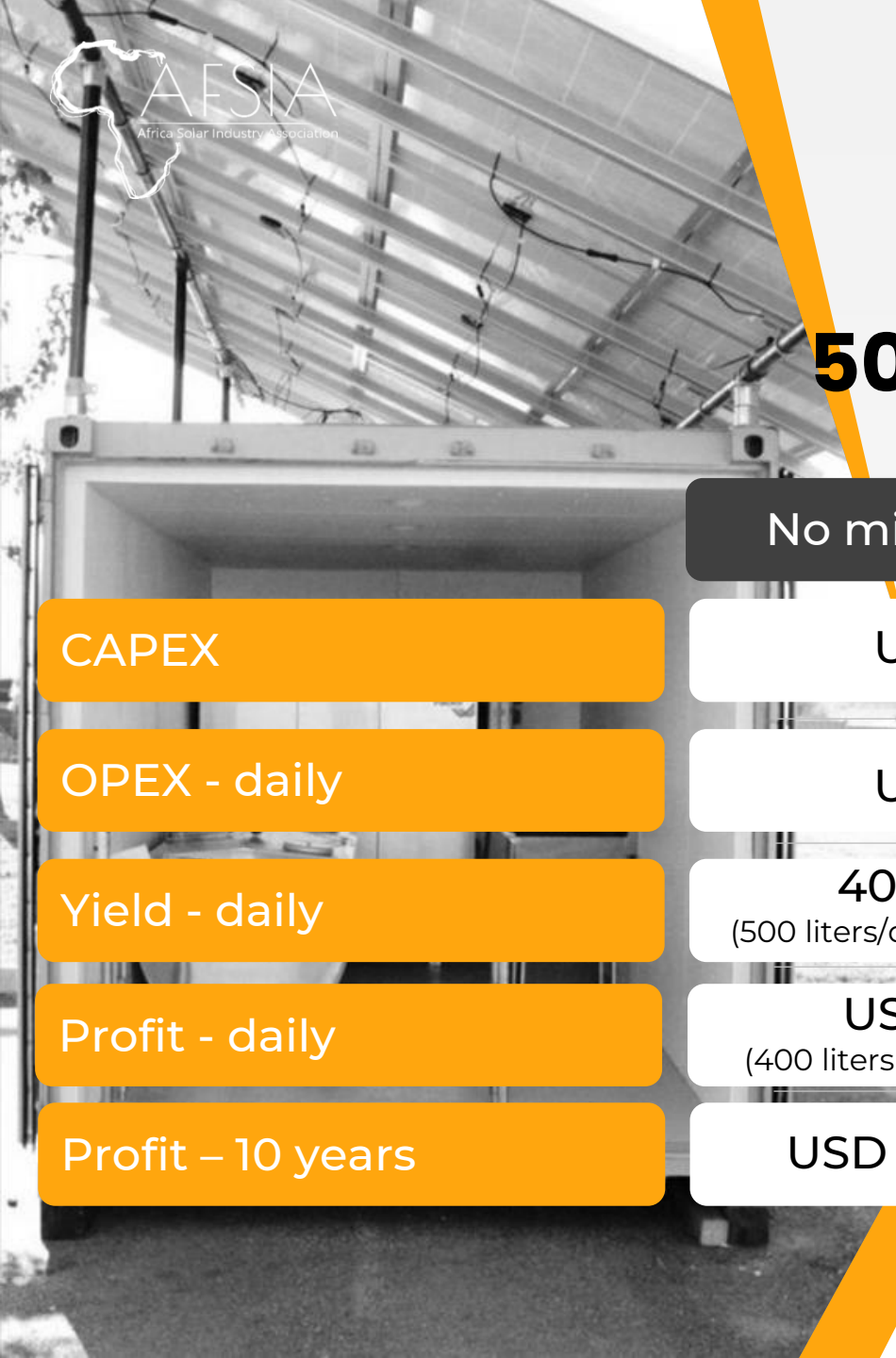
Once milk is collected from animals such as cows or goats, it is rapidly cooled to a temperature between 32°F (0°C) and 45°F (7°C).

Solar energy in this case is used to power the refrigeration system to cool the milk.

Photo credits: Savanna Circuit

Advantages of productive use of energy in milk chilling

- Beneficial for small-scale dairy farmers who may not have access to grid electricity
- Reduced carbon footprints



MILK CHILLING
BUSINESS CASE
500 liters milk chiller at cooperative

	No milk cooling	Electric milk cooling	Solar milk cooling
CAPEX	USD 0	USD 9,000	USD 20,000
OPEX - daily	USD 0	USD 4.1	USD 0
Yield - daily	400 liters (500 liters/day * 20% spoiled)	450 liters (500 liters/day * 10% spoiled)	500 liters (500 liters/day * 0% spoiled)
Profit - daily	USD 120 (400 liters * USD 0.3 /liter)	USD 135 (450 liters/day * USD 0.3 /liter)	USD 150 (500 liters/day * USD 0.3 /liter)
Profit – 10 years	USD 438,000	USD 468,694	USD 527,500

Assumptions: 20% wasted if not cooled, 10% wasted when unreliable grid, 10 years life of solar cooler, electric consumption of cooler at 16.5 kWh/day @ $0.25/kWh
Illustrative data provided by SelfChill

Milk Chilling Companies

Manufacturers & Distributors

Photo Credits: Progessive Dairy

TESTIMONIAL

Milk chilling

In Kenya, up to approximately 7% of milk produced is lost during post-harvest. Prolonged droughts have reduced livestock productivity resulting in low food production leaving about 3.5 million people facing food insecurity, according to the recent analysis carried out in 2022 by ReliefWeb.

With reduced milk losses, in rural areas, thanks to Savanna Circuit's milk chilling solutions, farmers have moved from casual laborers to business people. The high cost of initial dairy farming can be mitigated resulting in profits. And, through the digitization of the milk management system, it is easy for dairy farmers and businesses to manage their operations more effectively and efficiently.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Agriculture

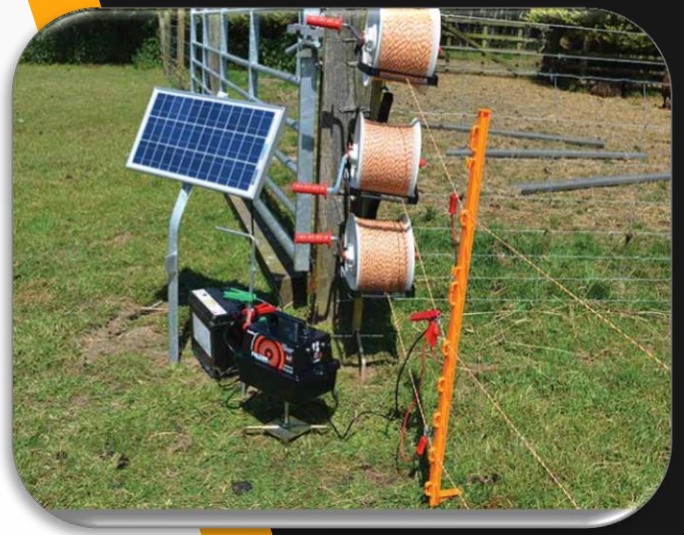
- Cold storage - positive
- Cold storage - negative
- Solar freezer
- Solar irrigation
- Milling
- Drying
- Oil press
- Egg incubator
- Night fishing
- Milk chilling
- **Electric fences**
- Pulping

Electric fences

This is a type of barrier used to protect properties from animals and intruders.

An electric shock is delivered to anything that comes into contact with the fence, typically through a series of wires or conductive materials.

In the PUE, electric fences' source of power is from solar energy. They can be used for a variety of applications, including agricultural, industrial, and residential purposes.



Advantages of productive use of energy in electric fences

- Operational even during power outages, ensuring continuous protection of property or animals
- Easy to install and can be set up in remote areas which do not have access to grid electricity

Electric fences Companies

Manufacturers & Distributors

TESTIMONIAL

Electric fences

Mr. Muli, a farmer residing in Ngiluni Village, Uganda, is currently overjoyed that the conflict between humans and elephants in his area is finally abating.
This positive development is attributable to the efforts of Tsavo Trust, a non-governmental organization responsible for the management of Kamungi Conservancy. The organization is actively working to mitigate human-wildlife conflict in the impoverished region that borders Tsavo East National Park by installing electric fences around homesteads.

Mr. Muli is one of the many beneficiaries of this conservation measure, which aims to safeguard wildlife and ensure food security. He expresses gratitude that the fence has enabled him and his fellow farmers to expect a bountiful harvest of cowpeas, thereby filling their granaries.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

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- Milk chilling
- Electric fences
- **Pulping**

Pulping

African countries are renowned for being top global producers of various raw materials. For instance, Uganda and Ethiopia are among the leading coffee producers worldwide, while Benin is known for its cotton production. The process to obtain a final product involves pulping which is the breaking down of raw materials into pulp. In many African countries, this is carried out manually using hand-pulpers.

However, using pulping machines can be much more efficient and can result in substantial time savings. Plus, adopting solar energy to power these machines would have several benefits, including increased income and a reduction in carbon emissions compared to traditional machines.

Advantages of productive use of energy in pulping

- Ability to work efficiently and consistently
- Reduced energy costs

Photo credits: Village Square

SOLAR FOR PULPING
BUSINESS CASE
Coffee pulping in Uganda

	Hand-pulping	Electric pulping machine	Solar pulping machine
CAPEX			
OPEX - daily			
Yield - daily			
Profit - daily			
Profit – 5 years			

Insufficient information found

Suggested reading from Lighting Global Uganda PULSE report

Pulping Companies

Manufacturers & Distributors

No companies identified specializing in the solar pulping machines.

Photo credits: AWF/Paul Thomson

TESTIMONIAL

Pulping

The unit economics of a small-scale solar powered coffee pulping machine suggest it is viable. However, transportation and portability add costs and pain points for end-users and this presents a challenge to the desirability of the solution.

Despite coffee's high market value, the pulping process is not valued particularly high. Faced with the cost and inconvenience of transporting large amounts of coffee cherries for a benefit of little value, we find it likely that the services of our modeled business are less desirable than alternatives, such as paying day laborers to pulp coffee directly on the farm.

Source

Other PUE applications in agriculture

The productive use of energy in agriculture encompasses a wide range of applications beyond just powering irrigation systems, chilling or milling. It involves various technologies, including those for grain drying, and agro-processing equipment, which have the potential to enhance crop yields, maintain food quality, and lengthen growing seasons and reducing greenhouse emissions at the same time.

By incorporating solar energy as a source of power, farmers can adopt a sustainable and economical energy solution. The use of energy-efficient technologies does not only boost farmers' productivity and revenue, it also promotes a more sustainable future.

Below we have listed all other areas of agriculture that could potentially benefit from the productive usage of energy:

- Milk processing
- Ice making machine
- Borehole drilling
- Maize shelling
- Wheat milling machines
- Hullers
- Threshers
- Paste-maker

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- **Hairdressing**
- Entertainment
- Transport
- Retail cooking
- Phone charging
- Water desalination
- Sewing machine

Hairdressing

Hairdressing generally refers to the profession or skill of cutting, styling, and coloring hair. Those activities involve using various tools and techniques to create hairstyles and maintain the health and appearance of hair.

Solar energy may be used to power equipment used in the hairdressing such as hair dryers, flat irons, curling irons, to name a few.

The solar powered tools used are efficient especially in rural areas with limited access to electricity.

Photo credits: Africa GreenTec

Advantages of productive use of energy in hair dressing

- In many countries, there are some existing tax incentives for these types of equipment
- Hair salons can become more independent and self-sufficient

Photo credits: ENGIE Energy Access

HAIRDRESSING
BUSINESS CASE
Starting a salon

	Solar hair clipper
CAPEX	USD 60
OPEX - daily	USD 0
Profit - daily	USD 1.25 (5 haircuts * $0.25)
Profit – 3 years	USD 1,125

Assumptions: salon open 6 days/week, 3 years life time of system, if salon in new facility rent cost must be factored in
Illustrative data provided by MPower Ventures

Hairdressing Companies

Manufacturers & Distributors

Photo credits: MySol

TESTIMONIAL

Hairdressing

Drissa is a hairdresser in Djoliba, Mali and has been running his own hair salon since late 2014.

"Before Africa GreenTec came to Djoliba, like most people here, I kept switching between diesel power and batteries. But the batteries kept breaking, I kept having to buy new ones, and the diesel power is extremely expensive and also kept breaking down. It's also noisy and disturbs the neighbors. But now I've switched to clean energy and everything is good, my clients are happy and there is an income."

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- Hairdressing
- **Entertainment**
- Transport
- Retail cooking
- Phone charging
- Water desalination
- Sewing machine

Entertainment

Solar powered cinema kits are becoming increasingly popular in many parts of the world as a sustainable and eco-friendly alternative to traditional movie theaters or as an alternative in remote areas. A kit for a solar powered cinema is a collection of equipment and parts that can be utilized to construct a movie theater that operates on solar energy. These kits usually consist of solar panels, a battery bank to accumulate the energy produced by the panels and other additional components such as cables, connectors, and mounting materials.

They can be utilized in a variety of contexts, from outdoor film festivals and screenings to community centers and schools.

Photo credits: D.Light

Photo credits: ENGIE Energy Access

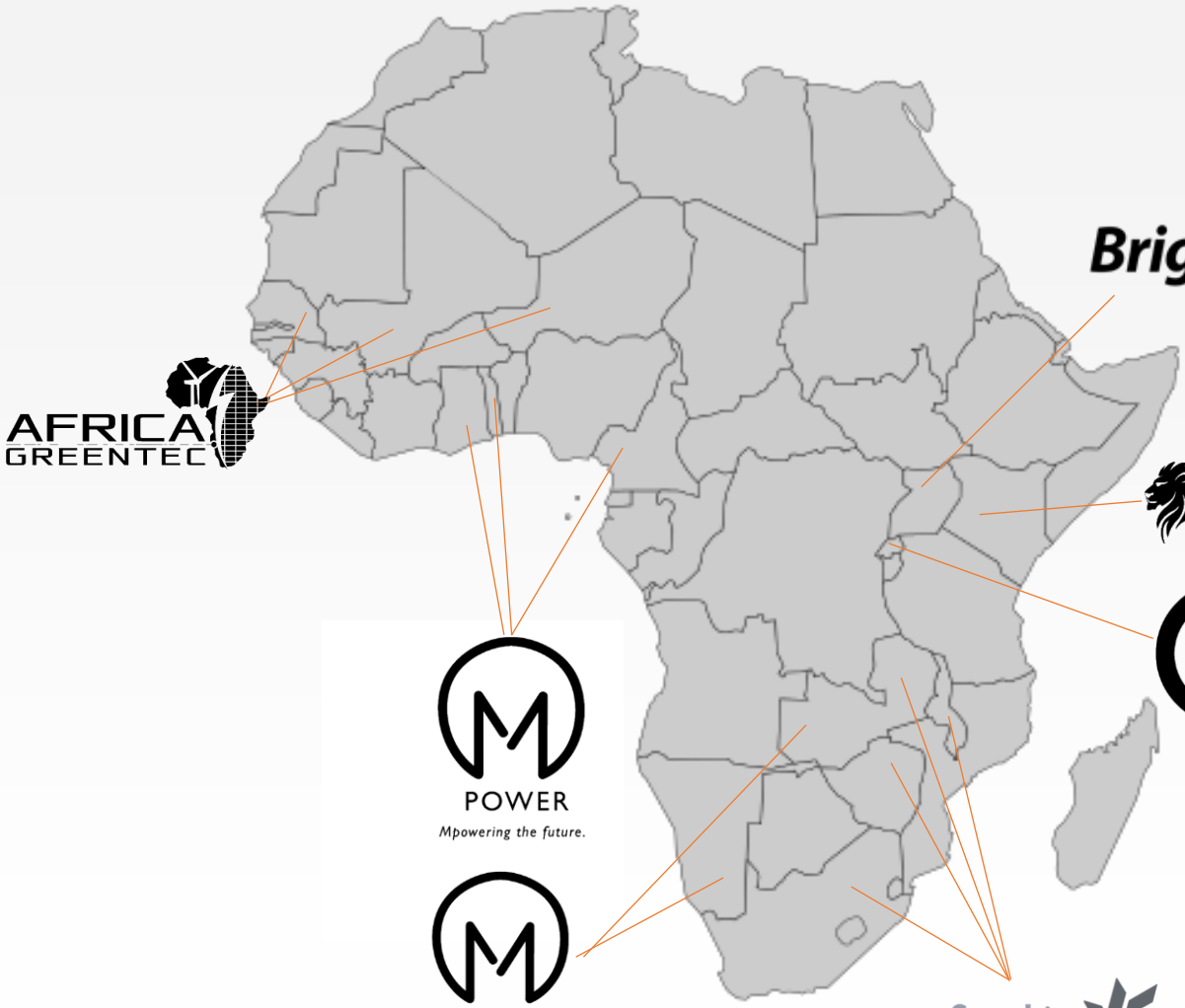
Advantages of productive use of energy in entertainment

- Improved social interactions
- Source of income for the owner

Entertainment Companies

Manufacturers & Distributors

AFSIA
Africa Solar Industry Association



AFRICA GREENTEC

Bright Life
By FINCA International

sun king
from Greenlight Planet

MySol
Best Solar, Best Life

POWER
Mpowering the future.

POWER
Mpowering the future.

Sunshine Cinema
#SPARKconversation

Photo Africa GreenTec

TESTIMONIAL

Entertainment

Abdoulaye Sidibe a photo shop owner and a cinema place owner in Sirakoro, a village in Mali.

Abdoulaye runs a small photo shop in Sirakoro. Besides his actual work he earns some extra money from time to time. For example, when football matches take place, he lets people watch TV at his place and demands a small amount of money for it; in a big city, this business model would probably be called “cinema”.

Since there are many enthusiastic football fans in the village who do not always have the opportunity or resources to afford a television or electricity, Abdoulaye helps them out with his solar home system kits.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- Hairdressing
- Entertainment
- **Transport**
- Retail cooking
- Phone charging
- Water desalination
- Sewing machine

Transport

Electric mobility refers to the use of electric vehicles as means of transportation. For example, electric cars, electric bicycles, and electric scooters.

With the continuous effort in carbon emission reduction, electric mobility is becoming increasingly popular and the development of new battery technology that makes electric vehicles more practical and affordable.

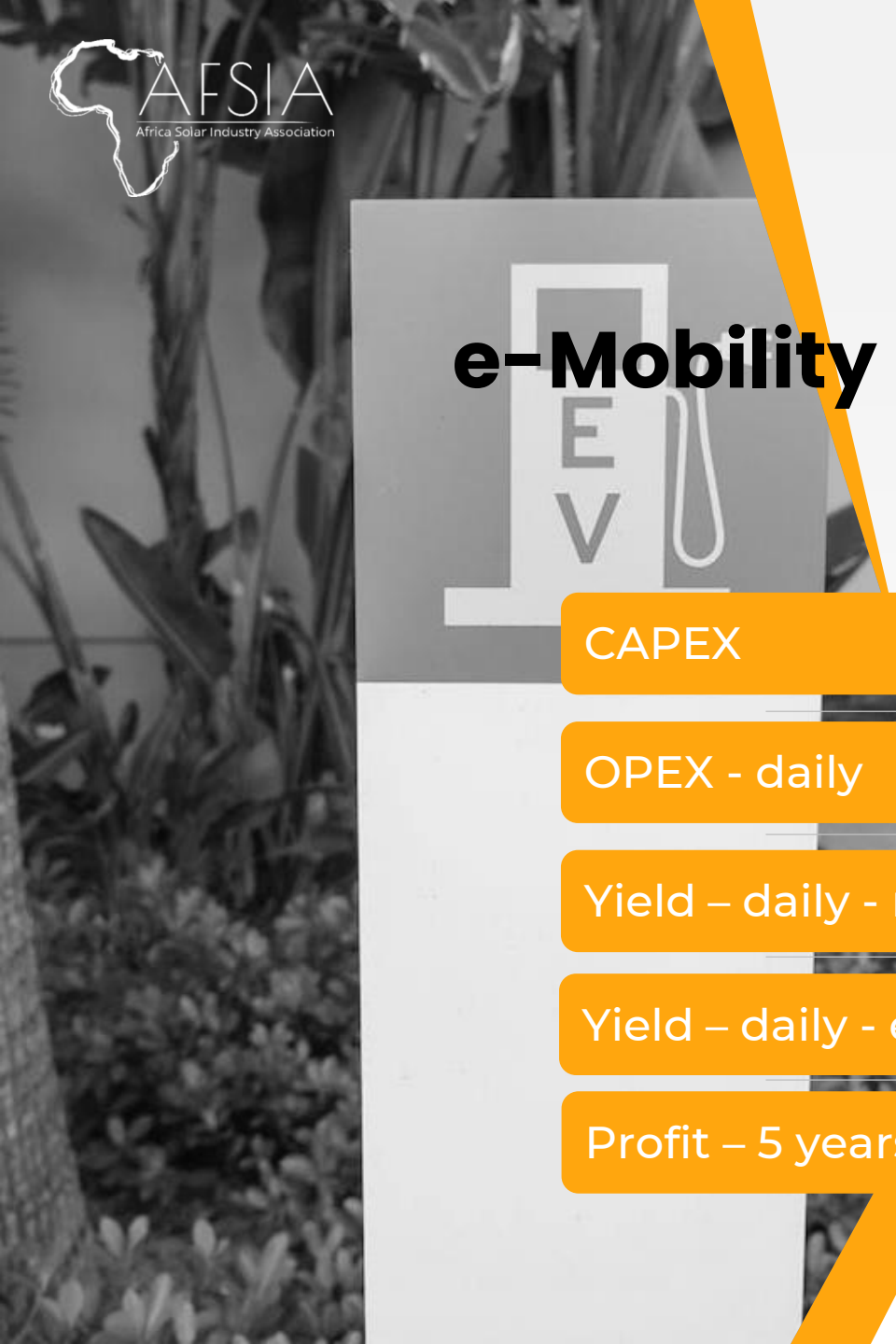
Some e-mobility companies are charging their batteries and powering their vehicles exclusively with solar energy, others don't and charge directly from the grid, which may or may not have renewables as part of the generation mix.

Advantages of productive use of energy in transport

- Reduces air pollution and greenhouse gas emissions making them better for public health
- Lowers operating costs than traditional gasoline-powered vehicles
- Offers a smoother and quieter ride than conventional vehicles

Photo credits: Ampersand

Photo credits: Ampersand



TRANSPORT
BUSINESS CASE
e-Mobility for milk cooperative in Zimbabwe

	No vehicle	electric 3-wheeler
CAPEX	USD 0	USD 2,200 (includes driving lessons)
OPEX - daily	USD 0	USD 3 (14 months vehicle rent + battery swap)
Yield – daily - milk	USD 105 (210 liters/day)	USD 175 (350 liters/day)
Yield – daily - extra	USD 0 (no time for other production)	USD 27 (time for veg production)
Profit – 5 years	USD 191,625	USD 362,915

Assumptions: 10 farmers in cooperative, farmer can only carry 21 liter/day but produces 35 liter/day, extra time allows to cultivate for sale, 2 t/farmer/year @ USD 0.5/kg
Illustrative data provided by Mobility For Africa

Transport Companies

Manufacturers & Distributors

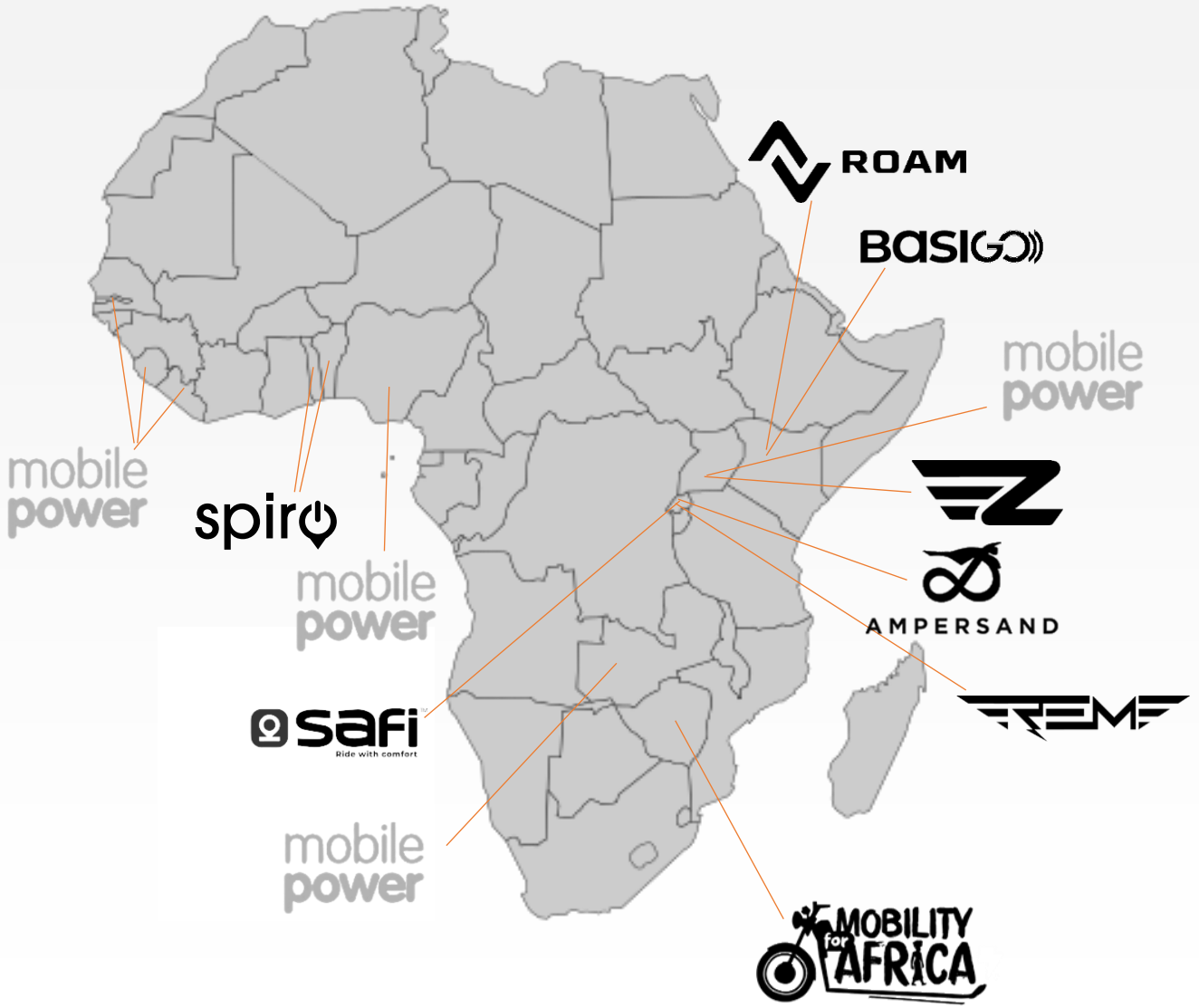


Photo credits: Mobility For Africa

TESTIMONIAL

Transport

Meet Selena, a dairy farmer from Chipinge, Zimbabwe.

Before using the Hamba “it took 45 minutes [each way] but that’s if I was really running” she laughed, “now it takes about 20 minutes but would be even less if the road was better”.

Selena brings 18 - 19 litres to collection every morning and about 10 litres in the evening. Before Hamba she said she would have left at least 8 litres at home every morning as it would be too much to carry.

As well as dairy farming with her 10 cattle and 4 calves, Selena is kept more than busy with her horticulture and poultry. In-between milk collections she needed to prepare her lands for the planting of her maize seed as well as managing sales of her boiler.

Selena has also taken to supporting two other female dairy farmers who live near her. She transports them and their milk canisters to collection when needed.

Source Mobility For Africa

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- Hairdressing
- Entertainment
- Transport
- **Retail cooking**
- Phone charging
- Water desalination
- Sewing machine

Retail cooking

Street food vending from portable stalls, carts or trucks is particularly popular in some African countries and provides food to be eaten on-the-go.

Historically, the street food carts and stalls have been using charcoal to cook or keep food warm throughout the day. This charcoal has a negative effect on the environment but also on the health of the street food vendors.

Solar power now allows to cook and keep food warm without the use of any charcoal, but instead through traditional induction systems powered by solar of through hybrid solar-bioethanol systems.

Advantages of productive use of energy in retail cooking

- Removes the need for charcoal
- Higher efficiency leading to less food loss
- Creates additional working time to sell more products and increase revenue

Photo credits: Zuhura Solutions

Photo credits: Zuhura Solutions

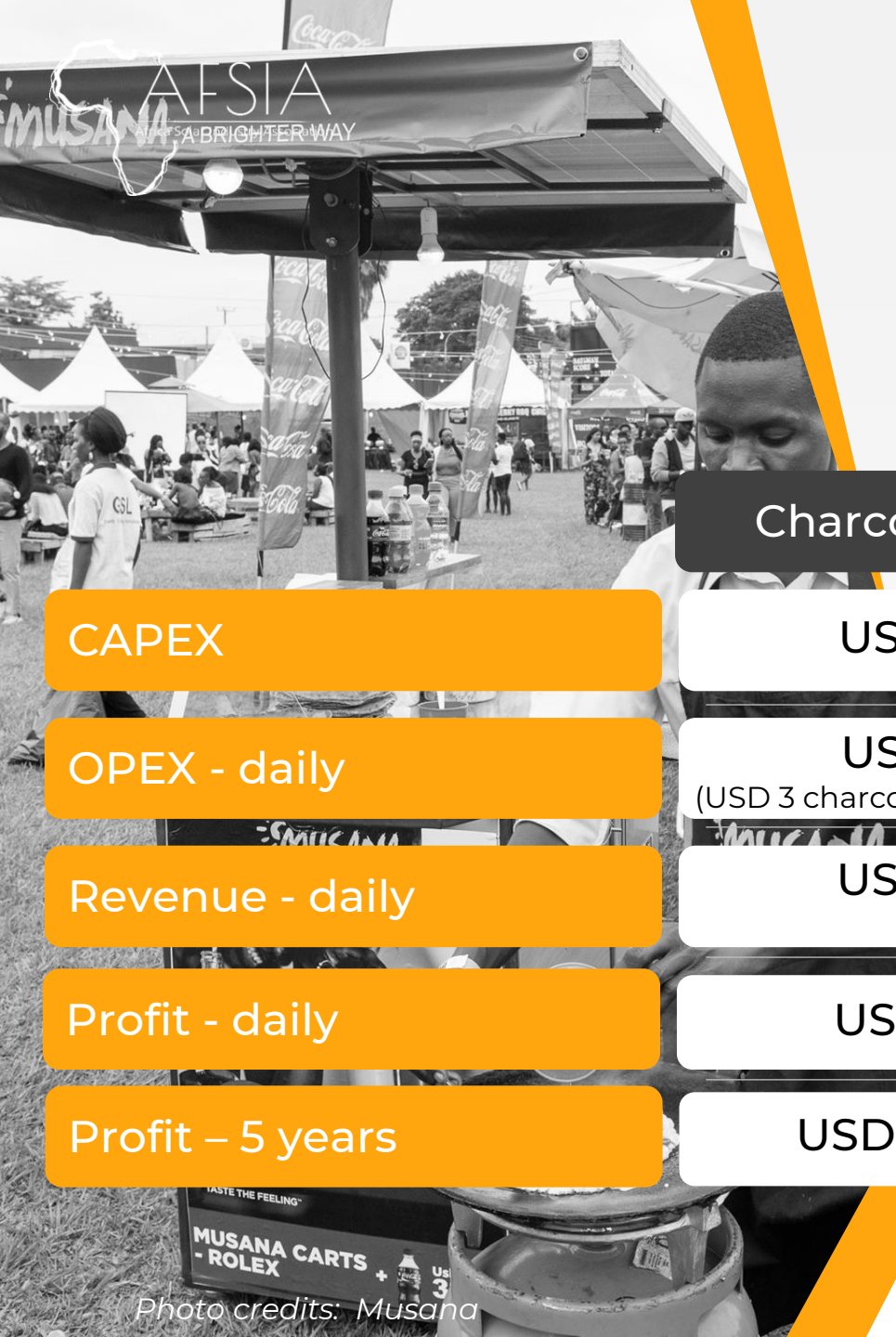


Photo credits: Musana

RETAIL COOKING
BUSINESS CASE
Solar food trolleys in Nairobi

	Charcoal trolley	Solar trolley CAPEX	Solar trolley PAYG
CAPEX	USD 150	USD 800	USD 160
OPEX - daily	USD 9.5 (USD 3 charcoal + USD 6.5 food)	USD 6.5 (USD 6.5 food)	USD 9.5 (USD 3 rental + USD 6.5 food)
Revenue - daily	USD 18	USD 23 (lower food waste)	USD 23 (lower food waste)
Profit - daily	USD 8.5	USD 16.5	USD 13.5
Profit – 5 years	USD 12,600	USD 23,950	USD 23,330

Assumptions: 300 working days/year, higher sales volume with solar trolley not taken into account but could represent 25%-40% increased sales
Illustrative data provided by Zuhura Solutions

Retail cooking Companies

Manufacturers & Distributors

Photo credits: Musana

Photo credits: Musana

TESTIMONIAL

Retail cooking

Street vendors in Kampala, Uganda using Musana carts.

Musana carts allows Kampala vendors to reduce energy costs and increase additional working time to sell more products and increase revenues.

Street vendors in Kampala are now able to invest in the livelihoods of their families (e.g. pay school fees more consistently), treat common illnesses more often and save money for any emergencies that may come.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- Hairdressing
- Entertainment
- Transport
- Retail cooking
- **Phone charging**
- Water desalination
- Sewing machine

Phone charging

Phone charging kits are likely to be included in SHS kits to power phones batteries.

But in rural regions there are phone charging stations on the streets where some people either plug their phones to charge or the energy provider gives a battery swap possibility.

Those stations are generally solar powered and act as a source of energy itself for others in the area that come to charge their phones or to sway power banks.

Photo credits: SunKing

Photo credits: ARED

Advantages of productive use of energy in phone charging

- Generates revenue for the station's operators
- Suitable for off-grid areas
- No grid-connection needed

Photo credits: African Renewable Energy Distributor (ARED)

PHONE CHARGING
BUSINESS CASE
Starting phone charging business

	Phone charging station PAYG
CAPEX	USD 100
OPEX - daily	USD 0.55
Revenue - daily	USD 4 (80 phone charges * $0.05)
Profit - daily	USD 3.45 (160 kg/day * USD 0.5 /kg)
Profit – 3 years	USD 3,300

Assumptions: installments for 12 months for total of $200, simultaneous charge of 30 phones, average 80 phone charges per day, 6 days/week, 3 years life time of system
Illustrative data from African Renewable Energy Distributor (ARED)

Phone charging Companies

Manufacturers & Distributors

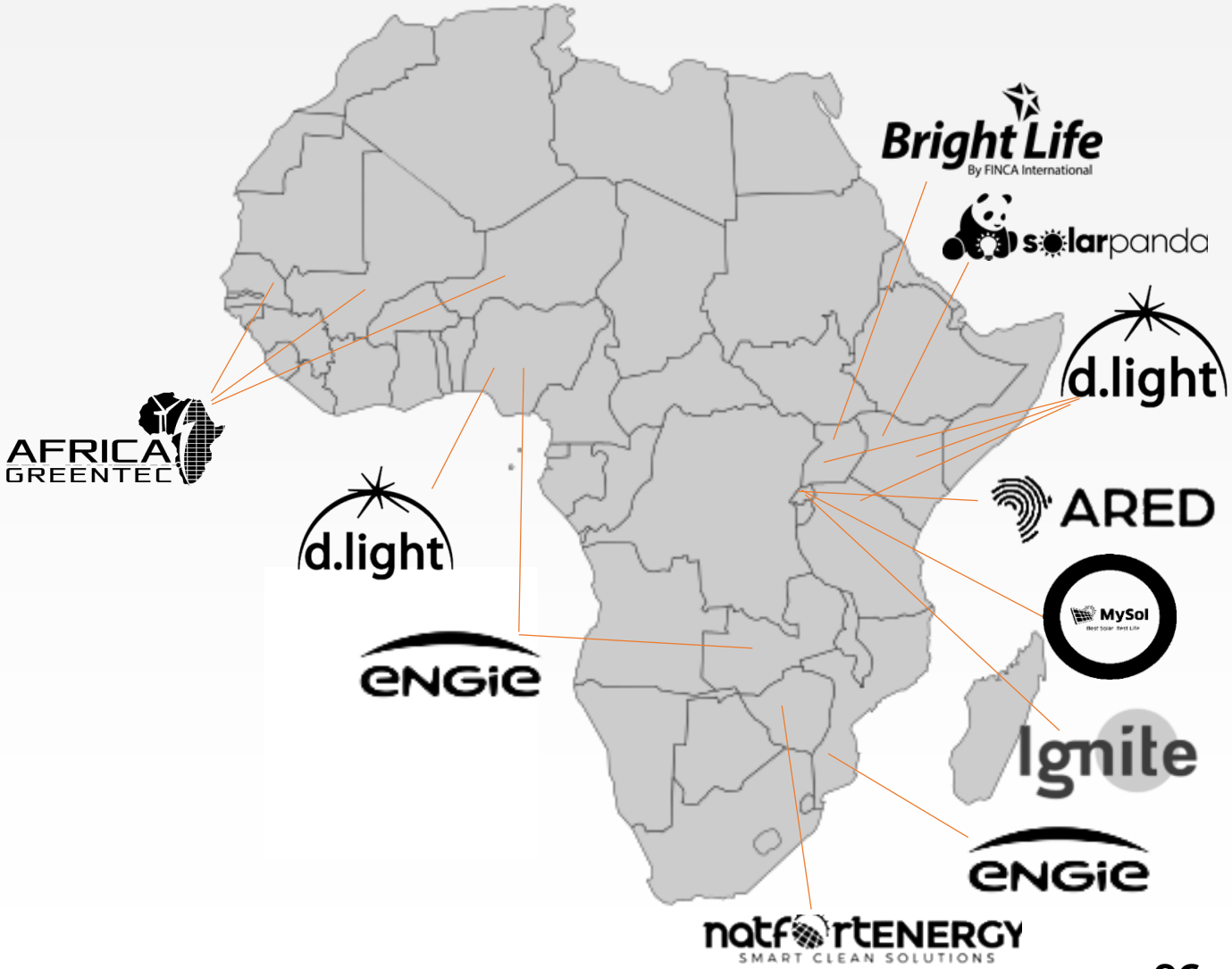


Photo credits: African Renewable Energy Distributor (ARED)

TESTIMONY

Phone charging

Sembemba Jean Pierre suffers from a disability. He had to remove his child from school because he wasn't earning enough as a watch repairman.

Thanks to the kiosk, his son is back in education and Pierre dreams of owning a house.

"I could go a whole day without getting someone to repair the watch for," Pierre told CNN.
"Now I am at least assured of a daily income – my family doesn't sleep hungry anymore."

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- Hairdressing
- Entertainment
- Transport
- Retail cooking
- Phone charging
- **Water desalination**
- Sewing machine

Water desalination

Clean drinking water is vital for human survival and wellbeing. However, many regions across Africa are struggling with a shortage of freshwater resources. To combat this issue, solar water desalination has emerged as a promising solution.

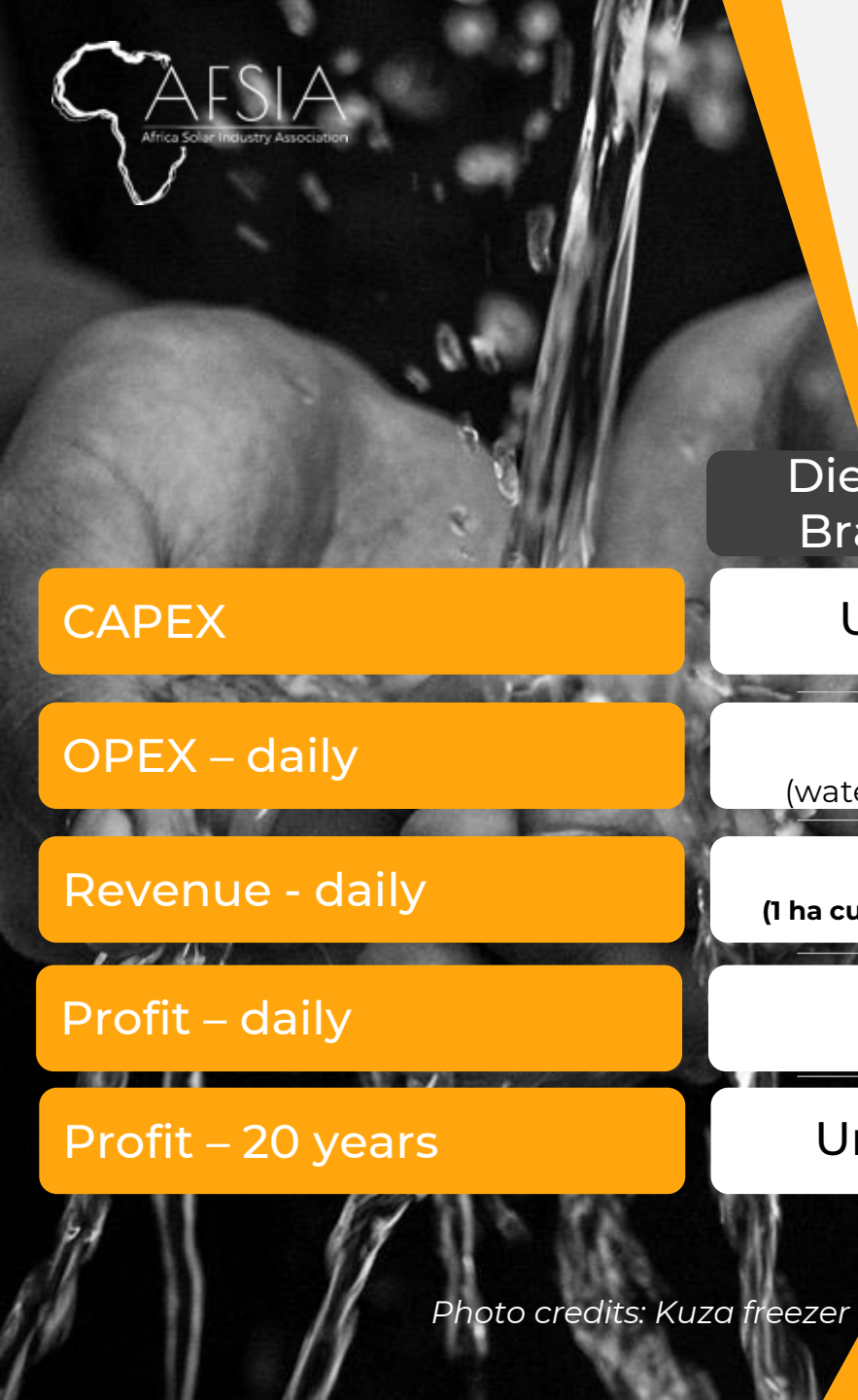
The process of reverse osmosis utilizes solar energy to eliminate salt and other impurities from seawater or brackish water. It is increasingly being recognized as an eco-friendly and sustainable way to produce clean drinking water.

Consequently, this technology has the potential to play a crucial role in addressing the rising demand for fresh water in Africa.

Photo credits: Genius Watter

Advantages of productive use of energy in water desalination

- Provides access to potable water
- Can be set up easily either onshore or offshore

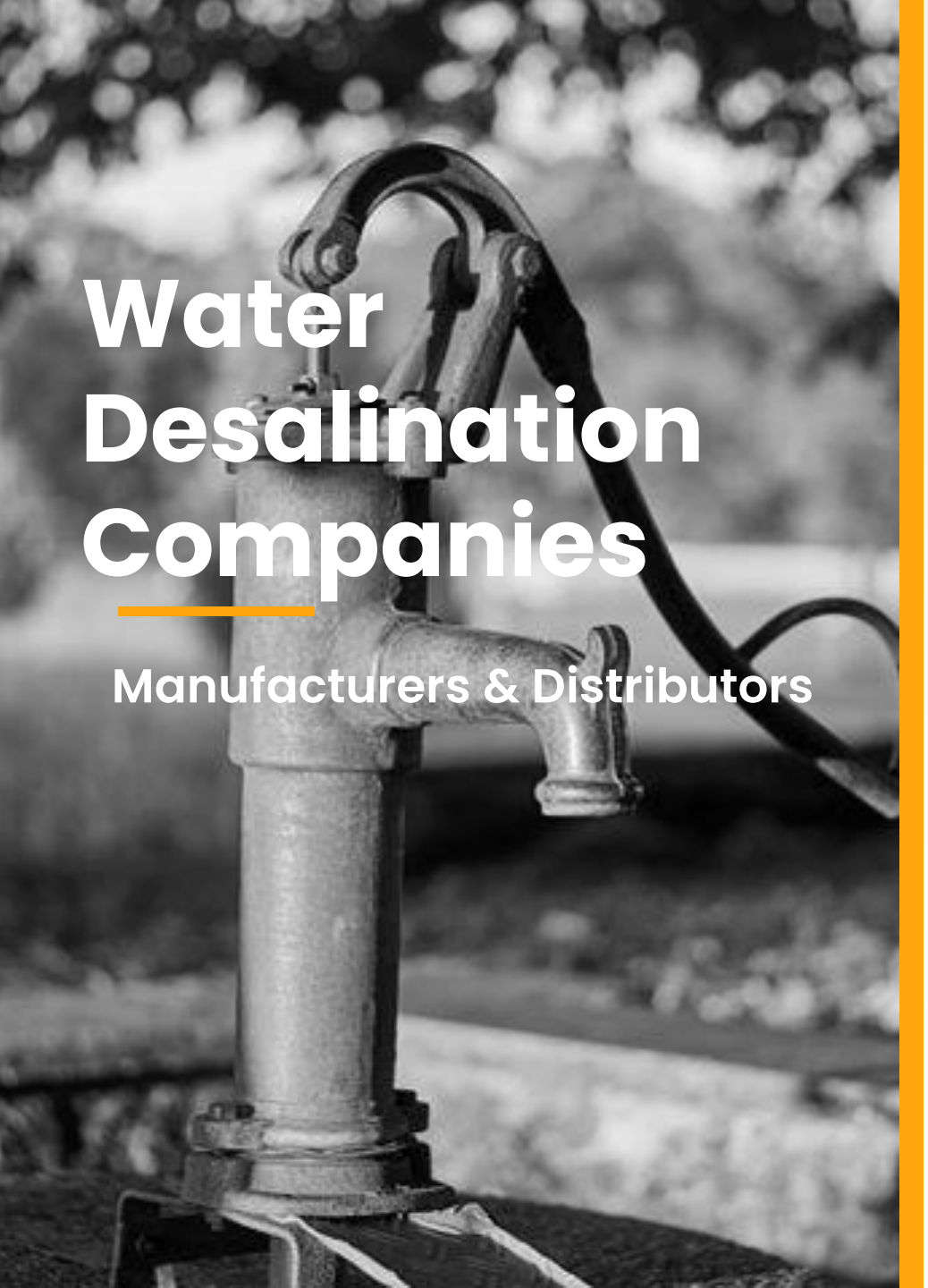


WATER DESALINATION
BUSINESS CASE
Farming with desalinated water

	Diesel pumping Brackish water	Diesel pumping + desalination	Solar pumping + desalination
CAPEX	USD 10,000	USD 110,000	USD 260,000
OPEX – daily	USD 7.18 (water-only related cost)	USD 69.50 (e and fuel costs)	USD 17.18
Revenue - daily	USD 12.18 (**1 ha cultivated land**, 9 farmers)	USD 67.50 (**4 ha cultivated land**, 27 farmers, + 60% crop production)	USD 67.50 (**4 ha cultivated land**, 27 farmers, + 60% crop production)
Profit – daily	USD 5.00	USD -2.00	USD 50.32
Profit – 20 years	Unfertile soil	USD -13,293	USD 334,479

Assumptions: pumping of brackish water 12.5 m^3/day vs desalination of 50 m^3/day, all costs related to farming are excluded, irrigation with clean water allows for the cultivation of high-value crops and an increase in land productivity. Thanks to availability of desalinated water, farmers multiplied by 4 the land they cultivate.
Illustrative date provided by Genius Watter

Photo credits: Kuza freezer



Water Desalination Companies

Manufacturers & Distributors

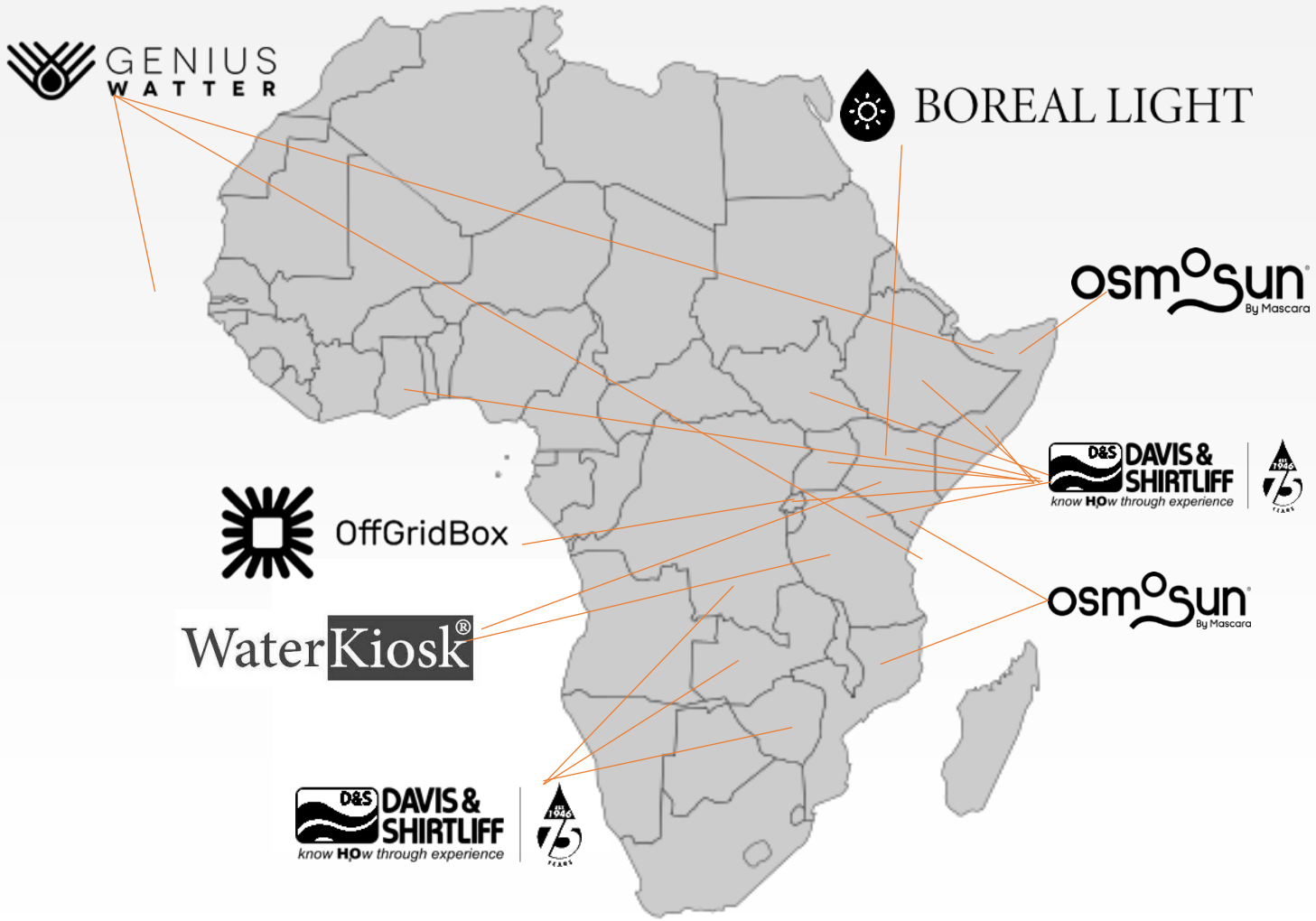


Photo credits: Genius Watter

TESTIMONIAL

Water desalination

“There was a lot of water, but it was saline water. After a while, many people asked us to stop. They no longer wanted to continue with agriculture because the water was salty. We were all asking ourselves: shall we go on? Shall we stop?

The solar water desalination plant has helped the people of Povoação Velha with agriculture. All those people who wanted to abandon started farming again.

Right now, we can grow tomatoes, which was impossible before. We are also growing peppers and fruit. The investment was truly worth it.”

– Henrique Cruz, President of Associação Varandinha, Cape Verde

Source Genius Watter

INTRODUCTION TO AREA OF APPLICATION IN PUE

Commercial

- Hairdressing
- Entertainment
- Transport
- Retail cooking
- Phone charging
- Water desalination
- **Sewing machine**

Sewing

This refers to the practice of manufacturing or mending shoes and sewing clothes with a sewing machine.

Solar energy in this context is used to power the sewing machines.

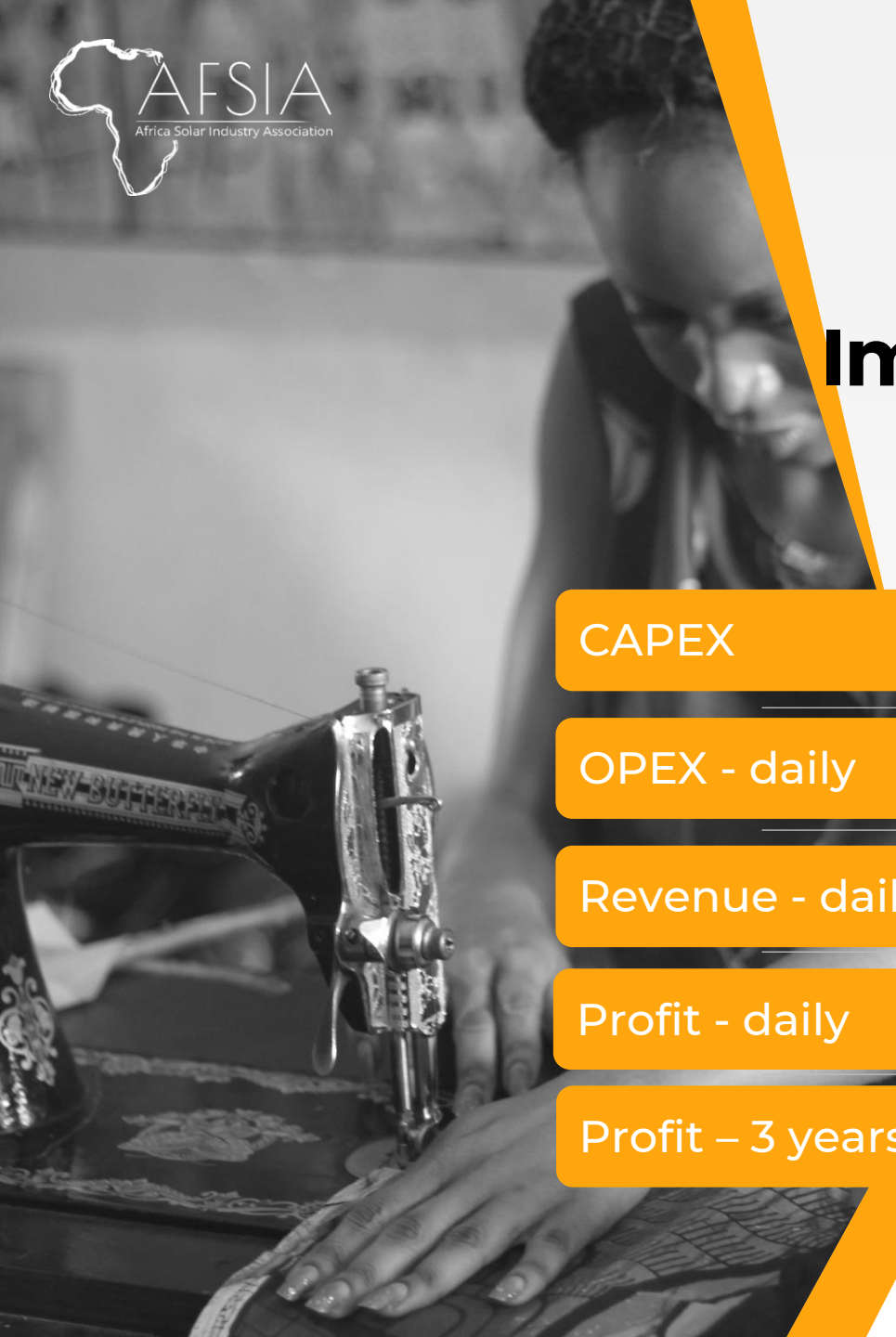
This type of solar-powered sewing machine is not easy to find, even though it is very convenient and economical when used.

Photo credits: Power Africa

Photo credits: Power Africa

Advantages of productive use of energy in clothing

- Create opportunities where people can generate income by providing sewing services
- People in remote areas can make and repair their clothes, reducing their reliance on imported clothes



SEWING MACHINES
BUSINESS CASE
Improved quality sewing with solar

	Manual sewing machine	Solar sewing machine
CAPEX	USD 100	USD 300
OPEX - daily	USD 0	USD 0
Revenue - daily	USD 3.75 (5 jobs * USD 0.75)	USD 6 (6 jobs * USD 1)
Profit - daily	USD 3.75	USD 6
Profit – 3 years	USD 3,275	USD 5,100

Assumptions: 6 days/week, solar sewing is faster and allows for more jobs/day, solar sewing allows for more complex stitching which have higher price
Illustrative data provided by MPower Ventures

Sewing Companies

Manufacturers & Distributors

TESTIMONIAL

Sewing machine

The Reencontro Association in Maputo, Mozambique runs sewing workshops using machines running on solar energy.

The grid electricity connection in the neighborhood is so chaotic that there are always power cuts. And the electricity cost is too high to afford. But now, members of the association are earning more and have solved the access to electricity problem.

“Benefits of using a solar powered sewing machines is that we do not spend a lot of money to recharge and use them. The only thing that we do is to point the panel to the sun, recharge the battery, and the machine works.” says Isabel Mutemba.

Source

Other PUE applications in commerce

As solar energy keeps gaining widespread attention as a promising source of renewable energy, one of the areas where solar energy is making a significant impact is in commerce. Businesses are increasingly adopting solar power as a way to reduce their energy costs, decrease their carbon footprint, and enhance their corporate sustainability.

Solar energy can be harnessed in various ways in commerce, including powering heating and cooling systems, lighting and much more. For businesses, the productive use of energy cuts energy costs and increases income while increasing energy independence.

Some were detailed in this catalog and below are another list of applications which are less popular but which could also result in interesting productive usage of energy subjects:

- Juicing machine
- Blender
- Solar powered boats
- Hair dryer
- Shaving kit
- Solar powered radio

INTRODUCTION TO AREA OF APPLICATION IN PUE

Services

- ICT
- Street lighting
- Health services

ICT

ICT stands for "Information and Communication Technology." It refers to the use of digital technology such as computers or phones to manage and process information and to communicate with others. It is used in various fields, including education, business, healthcare, entertainment and many others.

There have been some innovations in the few past years where computers that are solar powered were manufactured. For example, in Kenya, Zimbabwe and in other few countries in Africa.

Photo credits: SAMSUNG

Photo credits: SAMSUNG

Advantages of productive use of energy in ICT

- Employment of local manpower in IT sector
- Enables income and human capital development
- Access to modernity and information

ICT Companies

Manufacturers & Distributors

Photo credits: HENNY'S KIDS

TESTIMONY

ICT

Mr. Moyo, the headmaster of a kindergarten school, Ngamo Primary School in Zimbabwe.

"With these computers, we can only go from strength to strength in educating our students here at Ngamo Primary, as we now have access to digital technology, a first in this remote rural area," says Mr. Moyo, Headmaster Ngamo Primary School.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Services

- ICT
- **Street lighting**
- Health services

Street lighting

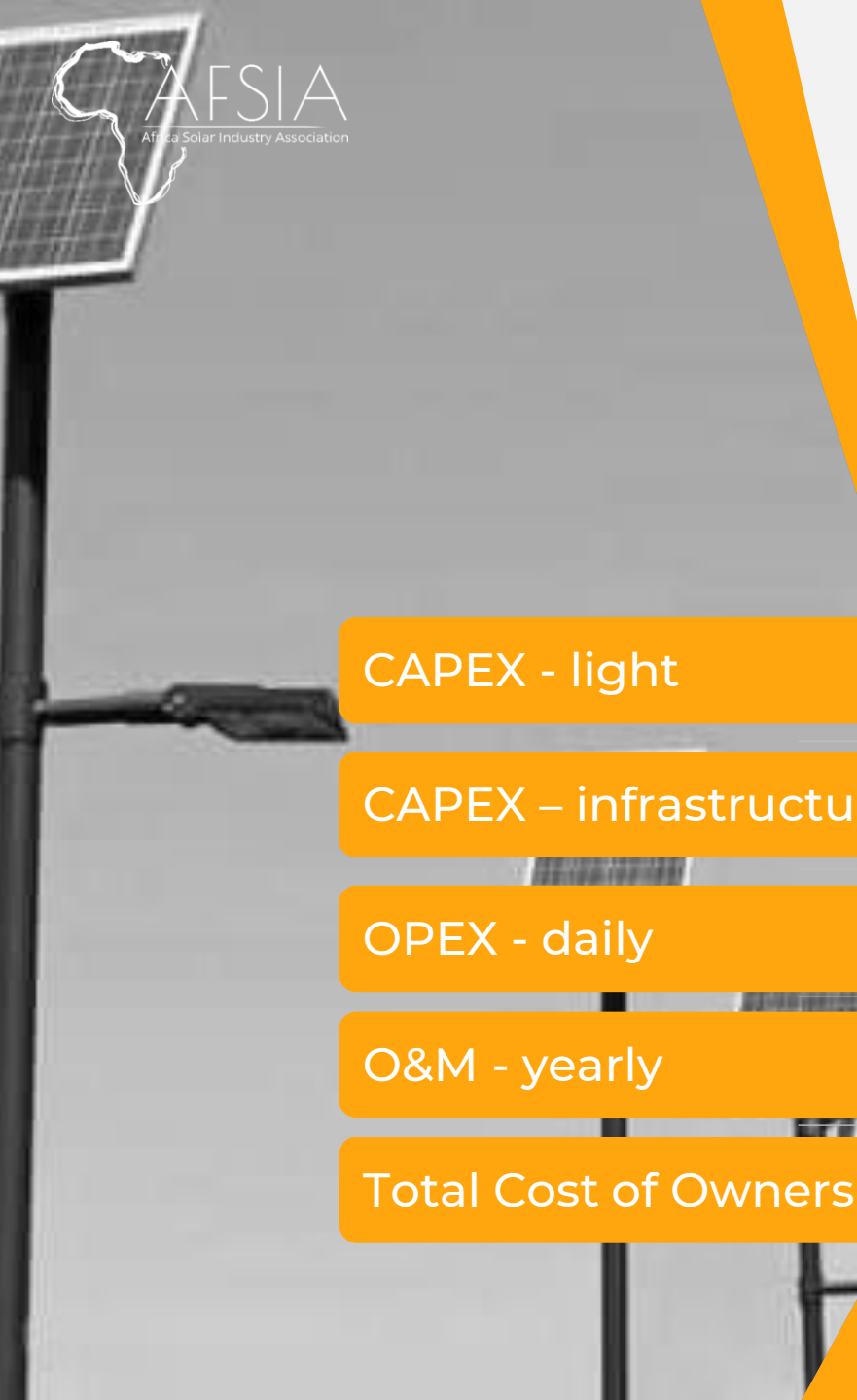
Street lighting has proven societal benefits in terms of improving neighborhoods, reducing accidents and crime and extending business operating hours.

However traditional street lighting requires significant infrastructure to be built, which can be very costly, and also requires the availability of grid electricity.

Solar street lighting offers a much easier and cheaper solution to roll out. Solar panels and the lighting head (with low-consumption LED bulb often capable of dimming) are mounted on the pole. The solar panels charge a rechargeable battery, which is sized to provide the require lumens throughout the night.

Advantages of productive use of energy in street lighting

- Road and public security benefits
- Creation and enhancement of social change in the community



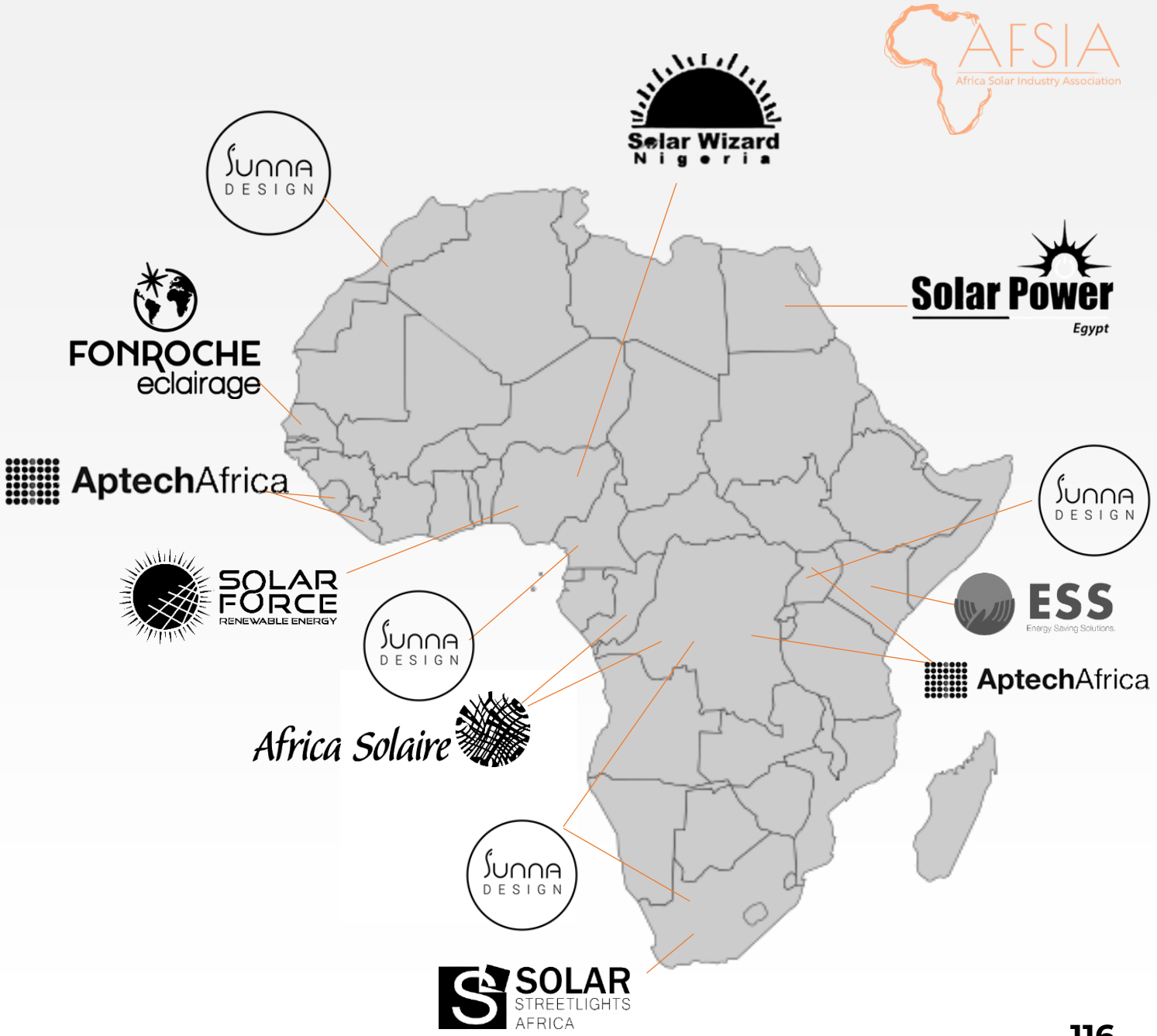
STREET LIGHTING
UNIT ECONOMICS new streetlighting

	grid connected street lighting	Solar street lighting
CAPEX - light	USD 350	USD 1,200
CAPEX – infrastructure	USD 1,000	USD 550
OPEX - daily	USD 0.216	USD 0
O&M - yearly	USD 80	USD 35
Total Cost of Ownership – 10 years	USD 2,938	USD 2,100

Assumptions: 120W bulbs, 12h/day, electricity cost $0.15 / kWh, 10 years lifetime of bulb and system,
Illustrative data provided by Sunna Design

Street lighting Companies

Manufacturers & Distributors



TESTIMONIAL

Street lighting

Edson Sebutozi Munyakarambi, who chairs the committee that represents the Kigeme refugee camp.

“The camp has come from the dark into the light,” says Edson Sebutozi Munyakarambi, a refugee living in the Kigeme camp in southern Rwanda.

“Before the solar-powered street lamps, the camp was dark. Some people would come and steal things from the houses. But now no one can rob people on the street corners and the children can study or play outside while they wait for their dinner.”

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Services

- ICT
- Street lighting
- **Health services**

Health services

It is estimated that only 6% of rural health posts and centers across Africa have access to stable electricity. This poses 2 major challenges with regards to keeping vaccines cold and with mortality during child delivery which often happens at night.

Solar-powered appliances offer an easy and cost-effective solution. Solar suit cases are an all-in-one solution for basic medical examination tools and emergency support. Other solutions include solar fridges which keep all medicines and especially vaccines in a cool environment to prevent any deterioration.

These solutions are relatively cheap and can revolutionize the quality of health care in rural Africa.

Advantages of productive use of energy in health services

- Reduced mortality rate
- Vaccines are kept at required temperature resulting in zero or less damage

Photo credits: We Care Solar

Photo credits: CLASP

HEALTH SERVICES

Electrifying Primary Health Centers

Example of basic kit for rural health centers

Lighting + charging

Telecom

Vaccine fridge

$1,000
+ installation
+ 5 years O&M
≈ $4,000

60,000 Rural Health Posts * $4,000 = **$240 million**

To bring basic health services to 700 million Africans living in rural areas = **$0.34 per capita**

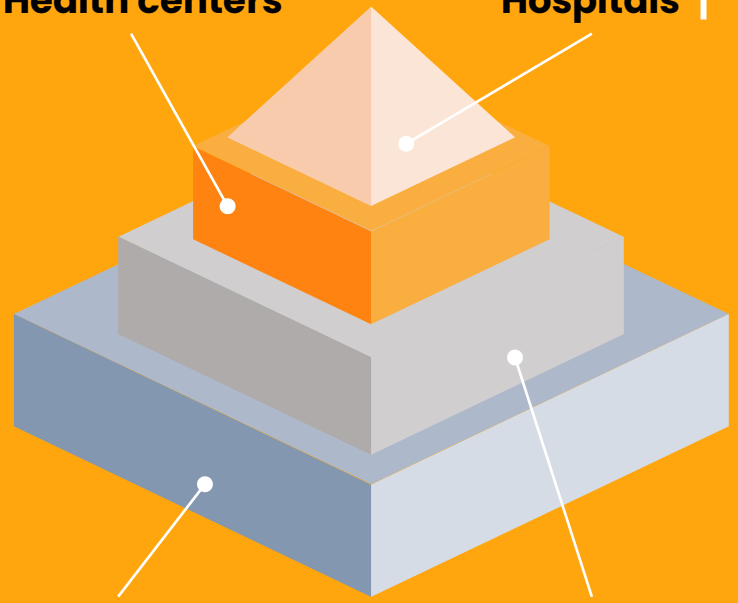
Assumptions: $4,000 all-in costs estimation by AFSIA, ~100k public health facilities in Africa, 58% of African population is rural

Illustrative data provided by d.light

AFSIA
Africa Solar Industry Association

7,000
Health centers

3,000
Hospitals



60,000
Rural Health Posts

30,000
Rural Clinics

Health services Companies

Manufacturers & Distributors

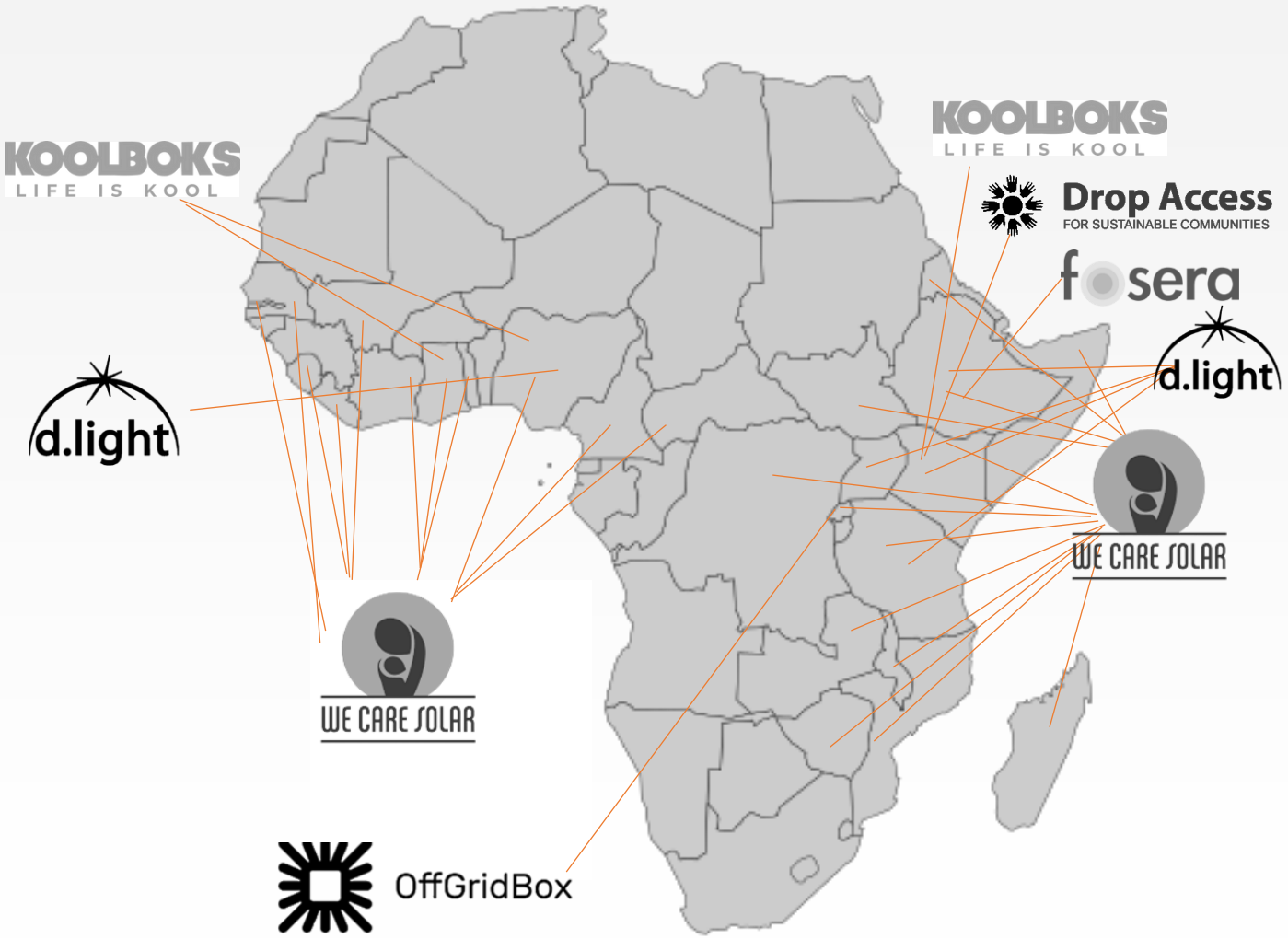


Photo credits: We Care Solar

TESTIMONIAL

Health services

Rosette Uwayezu, the 23-year-old midwife in charge of maternity services at Green Valley Health Center II, knows what its like to deliver babies in near darkness. Despite its small size and lack of electricity, Rosette and two colleagues provide health services for more than 3,000 people.

When Green Valley HC II received its Solar Suitcase in April 2021, Rosette was impressed with the brightness of the overhead lights and the accessory headlamps. “The Solar Suitcase has already made a big difference at the facility since it was installed"Rosette says. “Green Valley used to have 3-4 deliveries per month. Since installation, deliveries increased to 8-10 per month even during the lockdown.”

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Private

- **Washing machine**
- **Cooking**
- **Solar inflator**

Washing machine

Cloth washing represents a significant time commitment when done manually.

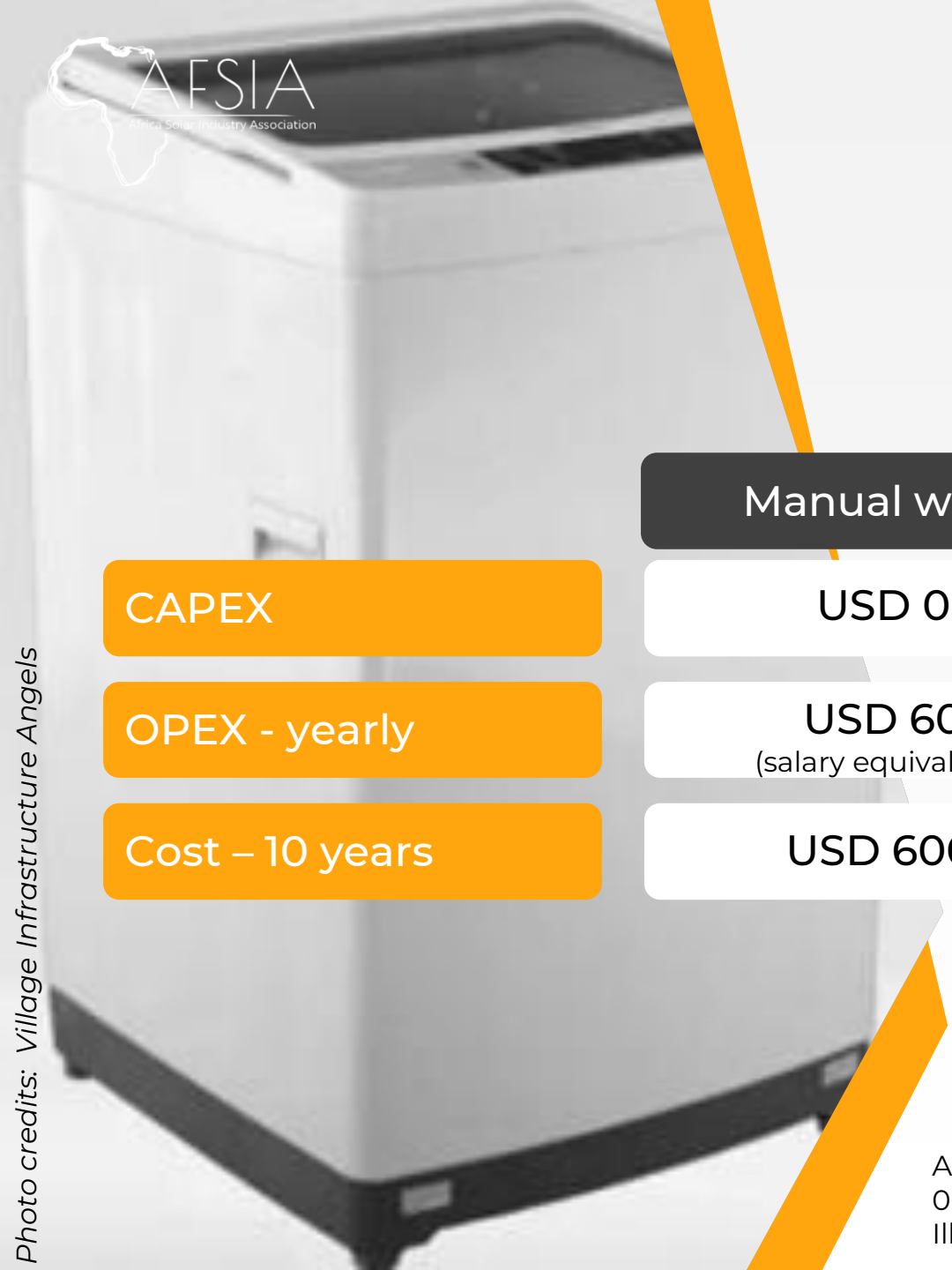
The invention of the electric washing machine is considered to have greatly contributed to women emancipation in the Western World around the 1950's.

Solar-powered washing machines could have a similar impact on African women living in both urban and rural areas, freeing up considerable time and allowing them to engage in more revenue-generating activities.

Credits: Zhejiang Newlight Solar

Advantages of productive use of energy for washing machines

- Can provide a degree of energy independence
- Reduced electricity bills



WASHING MACHINE
UNIT ECONOMICS

	Manual wash	AC washing machine	Solar washing machine
CAPEX	USD 0	USD 300	USD 1,500
OPEX - yearly	USD 60 (salary equivalent)	USD 110 (electricity)	USD 0
Cost – 10 years	USD 600	USD 1,400	USD 1,500

Assumptions: house staff $50/month working 10% of time on laundry, 220 washes/year, 0.25kWh/wash, electricity cost @ $0.20/kWh
Illustrative data provided by Village Infrastructure

Photo credits: Village Infrastructure Angels

Washing machine Companies

Manufacturers & Distributors

Photo credits: Erika P. Rodríguez for Direct Relief

INTRODUCTION TO AREA OF APPLICATION IN PUE

Private

- Washing machine
- **Cooking**
- Solar inflator

Cooking

Cooking poses a significant concern in Africa, where traditional cooking methods and fuels are still widely used. The utilization of open fires and biomass emit harmful pollutants that contribute to indoor and outdoor air pollution, leading to negative impacts on human health and the environment.

Clean cooking technologies like improved cookstoves, biogas, solar cookstoves provide a sustainable and healthier option, reducing the negative impacts of cooking on the environment and health.

Modern clean cooking solutions also allow for faster cooking, which frees up time to engaging in other revenue-generating activities.

Advantages of productive use of energy in cooking

- Reduce indoor air pollution
- Reduce local environmental degradation (deforestation)
- Reduce time spent cooking

Photo credits: Pesitho

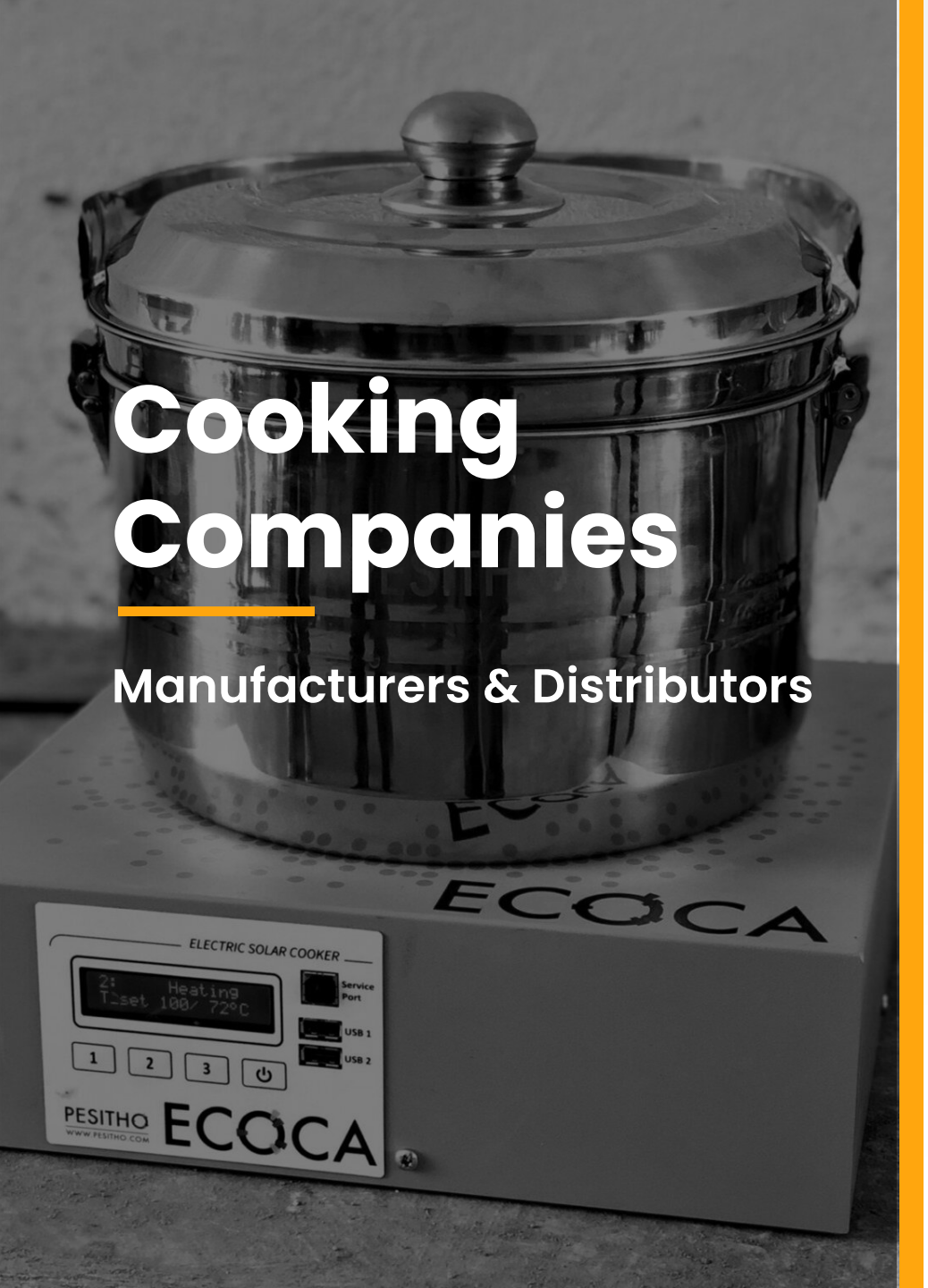
Cookstove technologies

Improved cookstoves: refer to stoves that are designed to be more efficient and produce fewer emissions than traditional stoves. Though they are not solar powered, these are conceived to reduce biomass consumption and exposure to harmful pollutants. That said, advanced improved cookstoves can have an additional solar component which helps to activate a fan which further improves the cooking efficiency.

Solar Electric Pressure & solar induction cookstoves: are both cooking appliances that rely on solar energy to operate the cooktop. They differ in that the electric pressure uses heat when an electrical current passes through to heat the cooktop while the induction cookstoves produce magnetic fields when an electric current passes through the coils to make induction cooktops cool.

Parabolic solar cooker: use solar energy to cook food and are made up of reflectors that focus sunlight onto a cooking surface. They are available in diverse designs and are suitable for regions with abundant sunlight, providing an eco-friendly and sustainable option to traditional cookstoves.

Photo credits: Pesitho



Cooking Companies

Manufacturers & Distributors

Photo Credits: Efficiency for Access

TESTIMONIAL

Cooking

Women and school children install and use solar cookers to preserve the Argan forest in Morocco.

Union of Women Cooperatives for Argan oil (UCFA) raise awareness among women and their children about local climate issues and the advantages of using solar energy and train them how to assemble cookers (delivered in kits) and how to use them.

Thanks to solar technology, CO_2 emissions and toxic fumes caused by wood burning are significantly reduced. This simple and affordable technical solution makes solar energy accessible to women and local populations. The project contributes to the fight against deforestation and its climate consequences: 5 to 10 kg of wood are saved per day and cooker.

Source

INTRODUCTION TO AREA OF APPLICATION IN PUE

Private

- Washing machine
- Cooking
- **Solar inflator**

Solar tire inflator

A tire inflator is a type of air compressor that is used to inflate tires of a vehicle or any other inflatable objects.

Solar energy can be used to power the whole inflation process. This one is designed to be used in remote areas where there may not be access to electricity or when there is a power outage.

Advantages of productive use of energy in solar inflator

- Can be used in emergency cases and for rural maintenance of vehicles
- They are portable and lightweight which makes them easy to carry around and use wherever needed

Solar tire inflator Companies

Manufacturers & Distributors

Thank you to our experts

AFSIA's fundamental principle is to establish networks and platforms for exchanging knowledge among all solar stakeholders. The goal is to facilitate quick access to information and partnerships, resulting in more efficient and effective business practices.

To all the experts in the productive use sector, AFSIA is immensely grateful for your contribution to our report. Your expertise and insights have truly enriched our work and helped us to produce a high-quality output. Thank you for your time, knowledge, and expertise.

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OmniVoltaics

Emmastella Gakuo

Savanna Circuit

Kim Gordon

We Care Solar

Aaron Leopold

EnerGrow

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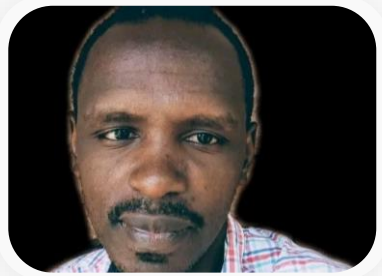

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