Industry Insights

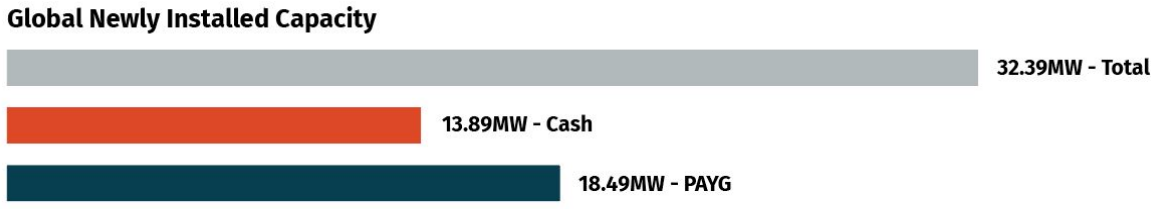
Solaris Offgrid

Currently 1.7 billion adults in the world remain unbanked, thus limiting their ability to access affordable life-changing amenities and to leave poverty.

With digital finance innovations such as mobile money and "pay-as-you- go" (Paygo) technologies in the fields of energy, water supply, or even agriculture, millions of people at the Bottom-of-the-Pyramid are now able to access essential services through affordable financial transactions.

Indeed, expanding access to a clean, safe and affordable energy is key in reducing poverty and can improve the lives of millions, especially those of children and women.

While the Paygo model has already proven to be an impactful payment collection method for off-grid technologies to bring a greater access to energy in developing countries, some key challenges remain to enable companies to deliver essential services to the poor, in profitable and sustainable ways.



GOGLA Offgrid Solar Market 2018 Report

Solaris Offgrid was founded in 2014 by 3 disruptive entrepreneurs with the aim to develop technology to scale up energy access solutions for the 1.1 billion people at the bottom of the world economic pyramid still lacking electricity.

Already deployed in nearly 20 countries through PaygOps, its in-house software solution built “In the Field, for the Field”, and its hardware consultancy services, Solaris Offgrid supports companies to run profitable operations, in the most efficient way.

Solaris Offgrid supports companies to build strong customer traction and greater relations with investors through flexible and inclusive Paygo solutions.

This year Solaris Offgrid has been chosen by Enacces and Efficiency for Access (energy access global organizations), to develop a set of different technologies that will enable market players to sell PAYG products under unified standards.

In addition, Solaris Offgrid has been working the past months in design consulting projects, coming from the biggest companies in the sector. To develop energy access products, truly thought for the field.

Solar Products

PICO

Pico solar systems are much smaller and cheaper than traditional solar systems but have the potential to provide useful amounts of electrical power to charge the increasing number of low power gadgets such as calculators, toys, cameras, mp3 players, cell phones, tablets, and other portable electronic devices etc, as well as a variety of chargers all use pico solar cells to charge batteries.

Typically, pico solar cells have power outputs ranging from as little as 0.1 watts-peak (Wp) to 5 watts-peak for powering smartphones, portable devices or recharging batteries while systems up to 15 or 20 watts-peak are used for powering larger devices, multifunction systems and home use.

Smaller and less expensive, pico solar systems have the potential to overcome this barrier as pico-PV and small scale solar systems are much more affordable and easily accessible for many people around the world. Also being small and portable, pico solar systems are relatively easy for non-specialist shops and distributors to physically stock and sell pico solar products plus you do not need specialist technicians to install. Just buy, plug-in and switch on.

PICO solar lanterns are still the largest category sold worldwide. Sub-Saharan Africa accounted for 51% of the global sales with 1.4 million units of the total 2.8 million units sold in the second half of 2018. South Asia covers another 41% of the global sales with 1.14 million lanterns sold in the same period. While in the first region the sales are still increasing especially for lanterns with mobile charging, South Asia has noted a decrease compared to the first half of 2018.

Multi-light Systems

Multi-light systems are quite similar to SHS when it comes to form factor. However this systems are mainly limited by their price tag. As these products are intended to be sold under one-stop-shop and not under micro-credits (PAYG). The system capacity will be limited to the purchase capacity of people in each region. That's why normally you will find multi-light systems with a total capacity of <50Wp, allowing customers to charge their phone and have some light sources. Some manufacturers (i.e. Biolite) have found difficult to sell this systems without financing their clients, that's why now a days this category is also implementing the PAYG SHS strategy and multi light systems include keypad or other methods to insert PAYG token codes.

Multi-light systems are seeing a consistent growth compared to the last round across almost all Sub- Saharan Africa, registering a 47% expansion in East Africa with 430,000 units sold (now 24% of all the products sold in the region) and an over 50% increase in Central Africa reaching almost 10,000 units sold, which are only 7% of the total sales in the region though. The only sub-region that witnessed a decrease of this product category is West Africa with a decline of 32% but still with over 45,000 units sold.

In South Asia 50,000 units were sold which was a smaller volume than in 2016, but consistent with 2017. Meanwhile sales consolidated in East Asia and Pacifc at 60,000 units.

Generic multi-light system 20Wh capacity

Solar Home System (SHS)

SHS is one of the most complete approaches in the market, intending offgrid users to own his/her particular energy system to satisfy most energetic necessities in their house. Because this system tends to be more expensive in comparison to previous categories, companies have implemented mobile-money payments through micro-credits (PAYG). Allowing the vast majority of habitants to access great technology at a monthly payment.

Sub-Saharan Africa is still the major market for these systems. East Africa leads the pack in terms of sales volume at 63% of the total - 300,000 units against 480,000 reported globally. This is a major increase in the region, setting new records compared to previous reporting rounds. The increase can be observed in all SHS categories besides the category 50-100 Wp.

It is worthy to mention that SHS clients are on the top of the pyramid when it comes to closing the energy breach. When this market emerged (10 years ago) clients acquiring SHS where obtaining their first access to energy. However, all this “senior” clients currently have different needs and look for bigger systems that satisfy their necessities. Nowadays the SHS sector is considered to range between 50Wp to 1.5KWp, and will keep incrementing as far as clients keep scaling up their solar home systems.

Solaris SHS activated through PaygOps (2018)

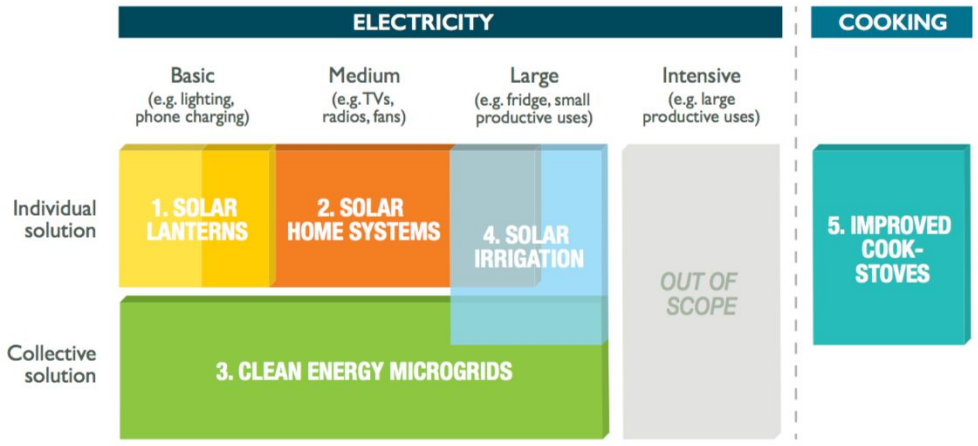
Insights

Purchase Motivation

After understanding the different segments of hardware offered in this market, it is key to study the different factors that push people to invest in this market.

It is understood by sector investors and NGO that the main purpose of reducing the energy breach is solving people basic necessities (i.e. sanitation, light for education, cooking, etc.) which is totally understandable when it comes to fundraising. However, from my personal experience in the field, people also buy these products not only to cover to entertain themselves and obtain better status across their relatives. I once installed a system myself in a complete offgrid rural scenario where the acquisition of the SHS was mainly driven by the ability to reproduce videos on a screen.

When performing my personal surveys in the field I discovered that potential clients are also willing to invest according to the novelty of the product offered. (i.e. TV's and sound systems are products which are completely new for their culture, considered of great status and novelty. In comparison to LED lights or fans, need which have been already solved in a less efficient but non-electric way millennials ago).



Energy access solutions normally considered by private business (Hystra Energy Report)

Last-mile Distribution

Last mile distribution limitations need to be acknowledged prior to any decision making. As offgrid energy systems, most likely require to transport lead-acid batteries and large solar panels into non-urban field. It is imperative to consider the available last-mile distribution channels in each country where the product wants to be deployed. Even if those means are not property of your company, sometimes it is good to know if motorcycles can carry 0, 1 or multiple systems/ products at the same time. This will allow to save resources and foresee, how will your products arrive at your clients hand.

On one side, PICO and P&P (plug & play) products can be easily sold through one-stop-shop methodology as there is relative low knowledge needed to make the devices work. Or the installation is aided by an intuitive graphical manual (as many clients are analphabet).

On the other side PAYG (*Pay-as-you-go*) enabled products are directly delivered to the

clients address by a technician who can also perform the electrical installation. Otherwise, as soon as the user starts modifying the system the warranty will expire, as distributors cannot rely on clients expertise to perform a complete PAYG SHS installation.

Another important factor to take into account when beginning the design process, it is packaging and protection of goods. As products may be carried with less care by a distributor, or a bumping car may damage the internals of your product. In addition, weather conditions may damage the packaging or the product itself (i.e. Vacuum sealed boxes when Monsoon season is hitting the Asian countries).
When projecting the packaging take extra care on the materials your company decides to pick, as it is most likely that all packaging will be directly discarded into nature, so degradability is an important factor.

To avoid exaggerated delivery expenses or product damage:

- With systems above 200Wp or implementing batteries heavier than 40kg total, require transport over a 4 wheels vehicle.
- Offgrid systems under 200Wp can be carried by motorcycle. Everything fixed to the motorcycle luggage frame. Use of bags and backpacks to maximize space.
- Heavy rain weather cancels all motorcycle distribution channels. Muddy roads are also a threat for staff which most likely lacks any insurance.
- Systems of 400Wp or more, need dedicated tools or a second employee to unload and settle the system in position.
- Distribution always needs to be arranged with the client so as not to waste time in locating the house or waiting for the client to arrive.

Security & After-Sales Service

To acknowledge the importance of warranty service to PAYG enabled distributors and micro-financing business is key when projecting offgrid products.
Given that customers are financed by a microloans whereas contract smartphones, customers pay a fixed rate per month to finally own the device at the end of the payment period. It is primordial for any business of this nature to keep customers satisfied during this time. As the client perception is more of a service till the total amount is paid.
That's why companies designing such products need to deploy a pack of specific measures to avoid any confusion on the customer side and keep them paying till completion. Some of them are:

- Live feedback: GSM monitoring platforms, after sales call center or sound messages *(i.e Solarworxs SHS)* are different methods to acknowledge the status of your device in offgrid scenarios. Most likely companies will pursue to have a direct communication which each device, avoiding client cheating or misunderstanding *(Analphabet clients won't know how to read the screen message)*. Take into account, monthly cost of this service may not be profitable.

- Impossible to hack: Other valid approach is to sell products which are impossible to open unless there is some sort of mark or irreplaceable component to go through. This will allow distributors to instantly realize about tampering attempt and cancel warranty coverage.

- Token status: Most companies which implement PAYG on their products have access to block any of their devices if the customer has not paid or isn't taking care of the product provided.

These are just a few examples on how companies deal with misuse and tampering attempts which can increase the overall after-sales service to well behaved customers.

Designer Considerations

System Sizing

While nowadays it is more and more common to find DC appliances for most home use, elements such as fridges, fans or subwoofers are still easier to source in AC (used in conjunction with an inverter).

Beyond 200Wp AC options are necessary (even more if the system is used as a back-up to the grid) and beyond 400Wp 24V instead of 12V starts to be interesting as it may also be used for handcraft power tools.

It is vital for the design team to work closely with electrical engineers, which can accurately pick all electrical components, batteries and solar panels to implement in the system. They will also know how to evaluate the discharge rate of your batteries depending on different user cases.

Take into account that there are always energy losses during voltage conversions reducing the capacity of energy stored to achieve a 24h cycle. This time frame is normally used in Sub Saharan Africa environments, as sun shines strongly everyday. How ever, for places with less sunlight or emergency systems, cycles tend to be much longer.

Weather and working conditions are the main driver at this stage as lab environment may not be the most accurate for testing. For example, an A++ freezer assumes a consumption of 600 - 700Wh per day in the European context, whereas in the off-grid African context distributors observed 2200Wh per day due to overuse and the hotter climate.

Modularity & Expansion

Sadly Solaris Offgrid is one of the few companies which is commercializing modular and upgradable SHS at the moment. Even if we hope to see in the near future a cross-brand standard where manufacturers agree to to reduce costs in proprietary connectors and expand the offer to final customers; this is not the current panorama.

As a sustainable design studio we suggest everyone to subscribe to this challenging practice which unlocks precious features to customers, who will really appreciate it in the long run.

Modularity gives customers the capability to expand their system in an organic way, going along with their budget (mostly limited by harvest conditions). Moreover it significantly extends the life-span of your products to sell, providing a better appreciation and reducing the amounts of e-waste generated by this sector. For example, closed enclosure systems which include batteries inside, have a life-span limited to the health of the battery pack. And newer systems which include lithium batteries are limited to the life-span of just one lithium cell. (If lithium cell fails, the whole battery pack fails).

Extreme Design

Designing offgrid systems and appliances is indeed a difficult process, as requirements are difficult to achieve with such little budget on the customer side.
As aiming for perfection, these products will need to be extremely reliable against misuse (i.e. short circuit on low quality USB cables), harsh weather conditions, etc.

It is suggested to experience by yourself the conditions where your product will have to operate, as even the smallest detail will drop the quality of your product. Two interesting cases to mention:

1. Wall-mounted SHS designs tend to include screws and wall-plugs to better fix the devices. However most walls in rural Africa come apart when trying to attach a screw to the wall, given the materials used to build most houses. Also drills are difficult to power in offgrid scenarios, making battery powered drills an expensive choice. Thus most manufacturers have chosen nails to solve this issue in the most practical way.

2. Most offgrid LED lamps have vents to cool the PCB. Others are completely sealed to protect circuits from humidity and cannot be disassembled. In this case, designers have not foreseen the “mosquito factor”. Lights tend to accumulate lots of dead mosquitoes attracted by light inside the lamp shade. This results in a dirty light source which cannot be cleaned given the enclosure design.
Diverse solutions have appareaded in the market, but because mosquitoes are so sneaky, the easiest solution has been a detachable lamp shade which can be cleaned.

Space Cooling Design

Sizing

If your cooling product will be powered by a solar energy system take into account the following points.

- Most solar home systems have power outlets which withstand up to 12V, 5Ah. This is given by the DC barrel connector used on most systems. Higher current may lead to failure or even melt the barrel connector.
  Some other SHS include high current DC outlets which support up to 20Ah. Yet these products are soon to launch or not popular at the moment.

- Power will be carried through wire, make sure the wire thickness (AWG) can comfortably carry the energy to reduce energy losses. Also, consider placing the cooling product close to the SHS, as DC energy is not adequate for carrying energy in long distances.

- Consider implementing motion sensors, a timer or smart switch as cooling appliances may be energy intensive, leading to energy scarcity when not powered off.

- Take into account the additional consumption obtained by other appliances powered at the same time.

- Identify the energy storage capacity of the SHS which the cooling appliance will be connected to.

Design For Extreme

If your cooling product will be sold in offgrid or rural context, use the following considerations:

- Identify where your cooling appliance will be used (Floor, roof, wall, outdoor) and study the materials which it will be in contact with. (i.e. if hung on a wall, consider non-flat walls made out of adobe and straw).

- If you pick a rotary type of solution (i.e. fan, jet, etc.) consider implementing protection to avoid cuts or accidents caused by sharp blades. Your product may be used by kids even if you advertise not to do so.

- Measure regular humidity, temperature and other conditions on the user scenario. Slightly over-engineer your products to perform in such working conditions.

- Excellence, analyze the features where your appliance can make a difference. (i.e. reduced noise, no heat buildup inside the room, integrated moisture spray, efficiency, etc).

- Expect the worse. Consider that users may not read the installation/user guide, misuse will happen or will probably be plugged to a different SHS.

- Acknowledge that governments do not provide any help to end users in regards to waste disposal and recycling. Think that your design will need to be easily dismantled for material separation. As most times there is no infrastructure to process e-waste locally.

- If your system/ appliance will operate under PAYG payment, consider anti-tamper features to keep your products yet under payment unhacked.

To Summarize

We have seen the three main types of approaches the market has to tackle energy access through solar energy. Portable PICO solar products, Multi-light systems bought through one-stop-shop delivery and Solar Home Systems sold through PAYG microcredits.

Your design will most likely be sold under one of these strategies and this will also affect the cost, capacity and size of your product. The type of energy outlets you will find in the field will also define the potency of your appliance, as well the customer traction towards status and novelty.

Work closely with electrical and mechanical engineers to provide the most durable solution at the most competitive cost, as other alternatives may have an unbeatable price.

As important as price, the endurance of your design will make your distributors succeed or fail at the end of PAYG contracts.