EFFICIENCY FOR ACCESS

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# BUSINESS MODEL INNOVATIONS ADDRESSING AFFORDABILITY: CASE STUDIES

**MARCH 2021**

EFFICIENCY FOR ACCESS COALITION

# CONTEXT

This report is part of a series of publications derived from the Business Model Innovations for Productive Use and Cooking Appliance Access research project. The report focuses on business model innovations that can help overcome challenges in providing rural, off-grid communities with productive use and electric cooking appliances. It was commissioned by the Low Energy Inclusive Appliances (LEIA) programme.

Efficiency for Access is a global coalition working to promote high-performing appliances that enable access to clean energy for the world's poorest people. It is a catalyst for change, accelerating the growth of off-grid appliance markets to boost incomes, reduce carbon emissions, improve quality of life and support sustainable development. The Low Energy Inclusive Appliances programme is Efficiency for Access' flagship initiative.

Efficiency for Access consists of 16 Donor Roundtable Members, 16 Programme Partners, and more than 30 Investor Network members. Current Efficiency for Access Coalition members have programmes and initiatives spanning 44 countries and 22 key technologies. The Efficiency for Access Coalition is coordinated jointly by CLASP, an international appliance energy efficiency and market development specialist not for-profit organisation, and UK's Energy Saving Trust, which specialises in energy efficiency product verification, data and insight, advice and research.

## About this report

**This report includes five case studies of companies with innovative business models that help make off-grid appliances affordable for people in low-income contexts.**

Other publications and tools derived from this research project include an **analytical report** summarising the research findings, a **database containing about 110 companies** engaged in innovative business models, a **report** documenting case studies on the theme of environmental sustainability and circularity, a **report** documenting case studies on the theme of resilience, and **three podcasts** featuring experts' views on the various innovation-related themes that have guided the research.

The research project overall explores **business model innovations (BMIs) relating to a variety of different themes**, thus featuring up to five case studies for each of the following thematic areas: 1) environmental sustainability and circularity, 2) affordability, and 3) resilience to regional and global shocks.

This research project was conceived by Richa Goyal. This specific report was authored by Claudia Knobloch, Christian Pirzer and Benjamin Hötzel (all Endeva), Rustam Sengupta, Komal Makkad, and Akanksha Khurana (all Boond) as well as Richa Goyal and Andrew Tod of Energy Saving Trust.

We thank Leo Blyth, Emilie Carmichael, Chris Beland, Charles Miller, and Sarah Hambly from Energy Saving Trust, as well as Jane Spencer and Louise Medland from Modern Energy Cooking Services Programme for participating in the peer review process and kindly providing feedback that strengthened the analyses presented in the report.

This report has been funded by UK aid and the IKEA Foundation. The Modern Energy Cooking Services Programme (also UK aid funded) provided funding for mapping innovations related to e-cooking appliances and developing two e-cooking case studies. The views expressed do not necessarily reflect the UK government's official policies or the IKEA Foundation's positions.

Title picture: Micro-irrigation systems such as sprinklers attached with ONergy Solar Pumps are integral for climate smart agriculture (West Bengal, 2020) © ONergy

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# ABBREVIATIONS

**AGRA** ..... Alliance for a Green Revolution in Africa
**B2B** ..... Business-to-business
**B2C** ..... Business-to-consumer
**BASE** ..... Basel Agency for Sustainable Energy
**BMS** ..... Battery management system
**BMI** ..... Business model innovation
**CaaS** ..... Cooling-as-a-service
**CEO** ..... Chief Executive Officer
**COO** ..... Chief Operating Officer
**DC** ..... Direct-current
**EV** ..... Electric vehicle
**FCDO** ..... Foreign, Commonwealth and Development Office
**FLDG** ..... First-loss default guarantee
**GSM** ..... Global System for Mobile Communications
**Hp** ..... Horsepower
**IDCOL** ..... Infrastructure Development Company Limited
**JLG** ..... Joint liability group
**kWp** ..... Kilowatt peak
**LEIA** ..... Low Energy Inclusive Appliances Programme
**MFA** ..... Mobility for Africa
**MFI** ..... Microfinance institution
**NGO** ..... Non-governmental organisation
**PPA** ..... Power Purchase Agreement
**R&D** ..... Research and Development
**RBL** ..... Ratnakar Bank
**S4S** ..... Society for Society
**SDG** ..... Sustainable Development Goal
**TMF** ..... Toyota Mobility Foundation
**USAID** ..... United States Agency for International Development
**PAYGo** ..... Pay As You Go
**USD** ..... US Dollar
**USSD** ..... Unstructured Supplementary Service Data

# THE SUSTAINABLE DEVELOPMENT GOALS

The 2030 Agenda for Sustainable Development, adopted by all United Nations Member States in 2015, provides a shared blueprint for peace and prosperity for people and the planet, now and into the future. At its heart are the 17 Sustainable Development Goals (SDGs), which are an urgent call for action by all countries – developed and developing – in a global partnership. They recognise that ending poverty and other deprivations must go hand-in-hand with strategies that improve health and education, reduce inequality, and spur economic growth – while tackling climate change and working to preserve our oceans and forests. Source: https://sdgs.un.org/goals


**No Poverty**
End poverty in all its forms everywhere


**Zero Hunger**
End hunger, achieve food security and improved nutrition and promote sustainable agriculture


**Good Health and Well-being**
Ensure healthy lives and promote well-being for all at all ages


**Quality Education**
Ensure inclusive and equitable quality education and promote lifelong learning opportunities for all


**Gender Equality**
Achieve gender equality and empower all women and girls


**Clean Water and Sanitation**
Ensure availability and sustainable management of water and sanitation for all


**Affordable and Clean Energy**
Ensure access to affordable, reliable, sustainable and modern energy for all


**Decent Work and Economic Growth**
Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all


**Industry, Innovation and Infrastructure**
Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation


**Reduced Inequalities**
Reduce inequality within and among countries


**Sustainable Cities and Communities**
Make cities and human settlements inclusive, safe, resilient and sustainable


**Responsible Consumption and Production**
Ensure sustainable consumption and production patterns


**Climate Change**
Take urgent action to combat climate change and its impacts


**Life below Water**
Conserve and sustainably use the oceans, seas and marine resources for sustainable development


**Life on Land**
Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss


**Peace, Justice and Strong Institutions**
Promote peaceful and inclusive societies for sustainable development, provide access to justice for all and build effective, accountable and inclusive institutions at all levels


**Partnerships for the Goals**
Strengthen the means of implementation and revitalise the Global Partnership for Sustainable Development

# AFFORDABILITY IN THE OFF-GRID APPLIANCE SECTOR


ONergy solar pumps are installed after thorough inspection of the sites to provide maximum benefit to the farmers (West Bengal, 2018)

While global poverty rates have fallen by more than half since 2000,[1] the number of people who live on less than USD 1.90 a day increased for the first time in over 20 years in 2020, as a consequence of the COVID-19 pandemic. According to a preliminary estimate provided by the World Bank, an additional 88 to 115 million people will be pushed into extreme poverty, bringing the total to between 703 and 729 million, up from 689 million in 2017.[2]

A closer look at global poverty shows that 24.1% of the world still lives on less than USD 3.20 a day, and 43.6% on less than USD 5.50 a day (2017).[3] Moreover, four out of five people below the extreme poverty line of USD 1.90 a day live in rural areas.[4]

Affordable and high-performing productive-use appliances can help people escape poverty. Industrial, agricultural and commercial appliances, such as solar-powered water pumps, refrigerators, and electric vehicles have the potential to improve people's quality of life, increase productivity and earnings. However, purchasing electric appliances can be challenging, especially for people with low incomes (on average, between USD 2 - USD 5 per day).

Costs for affordable and high-performing productive-use appliances vary significantly based on the type of appliance, its quality, and the customer's region. However, they are all typically too expensive for people who live near or below the poverty line. A standard electric pressure cooker costs around USD 100,[5] while the price of a refrigerator, which varies depending on appliance size, averages between USD 310 and USD 550[6] (average price for a capacity of 100 – 250 litres). Costs for productive-use appliances such as solar water pumps range between USD 600 and USD 800[7] (average price for a capacity of 200W - 500W) at the entry level, and between USD 1,000 and USD 3,000[8] (average price for a capacity of 2kW to 4kW) for higher-performance products. Electric mills are even more expensive, costing around USD 2,500[9] (1.5kW to 2.2kW).

In many cases, the affordability barrier for low-income customers is not simply a matter of a device's cost. Low-income customers also have difficulties paying large sums in one instalment. Smallholder farmers and low-income workers spend their daily incomes meeting needs for food, electricity,

1 United Nations. Ending Poverty, https://www.un.org/en/sections/issues-depth/poverty/. Retrieved 02/12/2021.
2 World Bank. Poverty, 2020, https://www.worldbank.org/en/topic/poverty/overview. Retrieved 02/16/2021.
3 World Bank. Poverty and Shared Prosperity 2020: Reversals of Fortune, 2020, © World Bank, https://openknowledge.worldbank.org/handle/10986/34496 License: CC BY 3.0 IGO. Note that the most recent numbers on higher poverty lines are from 2017.
4 World Bank. Poverty, 2020, https://www.worldbank.org/en/topic/poverty/overview. Retrieved 02/16/2021.
5 PowerGen Renewable Energy and Efficiency for Access Coalition. Electric Pressure Cooking: Accelerating Microgrid E-Cooking through Business & Delivery Model Innovations, 2020, https://efficiencyforaccess.org/publications/electric-pressure-cooking-accelerating-microgrid-e-cooking-through-business-delivery-model-innovations
6 Efficiency for Access Coalition. The State of the Off-grid Appliance Market, 2019, https://storage.googleapis.com/e4a-website-assets/Clasp-SOGAM-Report-final.pdf
7 Efficiency for Access Coalition. Solar Water Pump Outlook 2019: Global Trends and Market Opportunities, 2019, https://efficiencyforaccess.org/publications/solar-water-pump-outlook-2019-global-trends-and-market-opportunities
8 Efficiency for Access Coalition. Solar Water Pump Outlook 2019: Global Trends and Market Opportunities, 2019, https://efficiencyforaccess.org/publications/solar-water-pump-outlook-2019-global-trends-and-market-opportunities
9 Efficiency for Access Coalition. Solar Milling: Exploring Market Requirements to Close the Commercial Viability Gap, 2020, https://www.gov.uk/research-for-development-outputs/solar-milling-exploring-market-requirements-to-close-the-commercial-viability-gap

mobile-phone charging services, and other functions. This leaves little flexibility to accumulate the savings that would allow them to afford substantial one-off payments, even for appliances that in principle could permanently eliminate some of their daily expenditures. For example, once having purchased a solar-powered refrigerator or electric vehicle, they would no longer have to purchase diesel fuel on a daily basis.

## Solutions designed to overcome the affordability barrier

Companies have developed a broad spectrum of business model innovations aimed at overcoming the affordability barrier for a large portion of population in emerging and low-income markets. Some progress has been made in reducing the absolute cost of electric productive-use appliances. Examples include companies such as Proximity Design or Mobility for Africa that started producing and assembling appliances locally to reduce costs. Another solution is to reduce the cost of materials, as is the case with the e-cooking company, AMPERES, which uses upcycled batteries to make its products less expensive. The business models innovations in this report highlight opportunities to improve affordability along the electric appliance value chain that range from mechanisms reducing upfront payment barriers to ways of increasing customers' incomes.

Models that provide effective access to end-user finance, interoperable pay-as-you-go (PAYGo) platforms, service models, community based shared-use models, and those that promote income-generating activities among customer are among the most promising and popular approaches to helping low-income clients afford productive-use appliances. The most relevant and innovative solutions are listed below, and in the table at the end of this chapter. The companies associated with each specific business model innovation are identified in brackets. Case studies in the next chapter provide more detail on these selected companies and their innovations.

- **Service models** (Koolboks): In service-based models, customers pay for a service instead of purchasing and owning an appliance themselves. The service provider retains ownership of the appliance being used, and assumes responsibility for its installation, operation, and maintenance. In cooling-as-a-service (CaaS) models, for example, instead of paying for the refrigerator itself, customers pay per amount of chilled or refrigerated air used, or pay a service fee based on the device's cooling capacity. Service models are in their infancy compared to most business model innovations that address the affordability barrier. They hold the promise of being especially relevant for productive appliances such as refrigerators, solar water pumps, or electric mills that are expensive, or used only intermittently. Service models can also help alleviate doubts for customers who might be sceptical towards new technologies, such as solar panels or thermal storage solutions. In CaaS models, the specific technologies and service details vary significantly between companies. Some service providers offer centralised, solar-powered walk-in cold rooms in which customers can store perishable foods in plastic crates. Other companies, such as Koolboks, offer smaller, decentralised cooling solutions that can be used by individuals or small groups of customers directly at the marketplace.



The police victim friendly unit uses Hamba to fight against gender-based violence and violence against children. (Zimbabwe 2019)

- **Interoperable PAYGo platforms** (KPay Innovation): PAYGo technology adapts payment structures to the needs of customers with low or seasonal incomes. It allows companies to control access to an appliance remotely, while managing financial transactions in the form of small instalments transferred via mobile applications. The appliance connectivity also enables remote performance monitoring, preventive maintenance, and the creation of credit histories for customers, which in turn facilitates end-user access to finance. Over a decade ago, PAYGo technology helped revolutionise the energy access sector. Since then, it has helped more than eight million people install reliable electric lighting worldwide.[10] While a few PAYGo leaders, such as Bboxx, d.light, Greenlight Planet, M-Kopa, and Mobisol, have developed their own PAYGo solutions to sell solar home systems and electric appliances to low-income customers, many small and medium-sized appliance providers have been unable to afford developing their own proprietary software solutions. In response, companies such as Solaris Offgrid and Indian fintech company KPay have in recent years developed interoperable PAYGo solutions that can be embedded into a broad spectrum of electric appliances. The KPay-as-you-go technology, for example, works with a variety of different payment gateways, and does not require the appliance's end user to have a smartphone or internet access. This model allows smaller companies to adopt and customise state-of-

10 International Renewable Energy Agency (IRENA). Pay-as-you-go models, Innovation landscape brief, 2020, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jul/IRENA_Pay-as-you-go_models_2020.pdf?la=en&hash=7A2E7A7FF8B5BAB77486708766676 28A39DE40D5.


Women use ONergy solar pumps for safe drinking water (West Bengal, 2018)

the-art PAYGo payment solutions without having to invest in a costly software-development process. This business model offers vast potential to expand the use of electric appliances in emerging and low-income markets.

- **Community based shared-use models** (Mobility for Africa): Most people in rural parts of the world, especially women, spend large parts of their day walking in order to access essential goods and services, as transport is very costly and slow. This has a direct impact on community development, reducing accessibility to essential goods and services, and consumes time that could be used for other productive or leisure activities. E-mobility solutions powered by renewable energies could be an environmentally friendly means of transportation in off-grid areas. However, this technology remains expensive, and may be unaffordable for people with low incomes. Shared-use models that offer e-vehicles with microfinancing options can be a solution. Mobility for Africa (MFA) has successfully created a platform of this kind to deploy electric vehicles in Zimbabwe. The e-vehicles are charged using off-grid solar installations, and are distributed on the basis of a shared-use and community-based service model. MFA offers long-term, low-interest financing and multiple leasing options for their e-tricycles to small groups of women or smallholder farmers (who have a common productive use for the vehicles). The company also provides driving courses. The e-tricycles are designed to meet the driving and transport needs of rural African women, and are assembled locally and serviced by trained technicians from within the community. MFA also invests in off-grid community-based renewable power solutions, thus lowering the electric vehicles' energy costs. In combination, these features help make the vehicles affordable for mass adoption, with a highly scalable aggregated-demand model.

- **Guarantee funds for end-user finance** (ONergy Solar and SwitchON): Providing access to end-user finance is a popular and effective mechanism for helping low-income customers overcome affordability constraints. Many companies partner with microfinance institutions and banks to facilitate loans for their clients. However, these financial products have been slow to scale up, as they are constrained by financial institutions' low appetite for risk, the requirement that borrowers provide collateral in order to mitigate risk, and high interest rates. To overcome these barriers, pioneering actors, such as such as Indian solar solar-energy company ONergy Solar, have begun using first-loss guarantees to help persuade national banks to extend finance to end users. Under this model, a risk guarantee fund minimises the probability of non-repayment for the bank, reducing the credit risk associated with low-income consumers. Such funds typically cover between 50% and 70% of a loan's value, and are often connected to an underlying productive asset. To reduce risks further, ONergy helps its customers create joint liability groups, and actively provides financial literacy education to its clients. In recent years, this mechanism has been used successfully to drive microfinance investment and investment in the agriculture sector. However, the use of risk guarantee funds in the off-grid appliance sector is fairly new, and presents a unique opportunity with regard to unlocking financing that facilitates energy access for low-income populations.

- **Income generating opportunities** (S4S Technologies): For companies that sell electric appliances to low-income people on a lease-to-own or service model, it is critical that customers are able to repay their loans in a timely manner, or are able to make service fee payments. However, many people with low, unstable incomes find it difficult to do so. Selling productive appliances (rather than appliances used purely for consumption purposes) can make a huge difference in this regard. In an ideal scenario, customers could use such appliances to increase their productivity, sales, and earnings, and would thus have greater ability to repay a loan or pay regular service fees. Yet even when equipped with such appliances, many people with low incomes find it difficult to access markets, and are unable to sell enough of their products or produce to generate more income. Some innovative companies have turned this challenge into a business opportunity. In addition to selling productive appliances, they offer their customers a buyback option for their manufactured products or agricultural produce, providing a guaranteed market. Social enterprise S4S Technologies goes a step further; it provides its customers with an entire support ecosystem that helps them produce higher-value products. It then repurchases and aggregates the intermediate goods and sells them to industrial food and beverage companies. For the company, this business model reduces the risk that its customers will default on payments, while additionally opening up new revenue channels in the agri-food sector.

The challenges and opportunities associated with each of the business model innovations are further detailed in this publication series' analytical report. It is important to note that several of the business model innovations categorised under the themes of "environmental sustainability and circularity" and "resiliency to regional and global shocks" also include elements that could potentially make appliances more affordable, such as local manufacturing or the circular use of production materials.

# OVERVIEW OF CASE STUDIES IN THIS REPORT

The research on business model innovations that help overcome the affordability barrier involved a review of more than 50 appliance companies engaged in innovative practices in this area. The largest shares of these companies were active in either Sub-Saharan Africa or South Asia, with fewer companies operating in multiple regions. Five examples were selected from this overall group of companies. These either have a unique and innovative approach to overcoming the affordability barrier, or have pioneered solutions with great potential for replication and scaling. Table 1 offers an overview of the five case studies selected for this study.

### Overview of cases studied under the theme of affordability

| | Organisation | Business model innovation | Productive appliance | Region |
|---|---|---|---|---|
|  | **Koolboks** | Service models | Solar-powered refrigerators | Nigeria |
|  | **KPay Innovation** | Interoperable PAYGo platforms | Digital software solution enabling PAYGo technology | South Asia, Sub-Saharan Africa |
|  | **Mobility for Africa** | Community based shared-use models | Electric tricycles | Zimbabwe |
|  | **ONergy Solar** | Guarantee funds for end-user finance | Solar water pumps | India |
|  | **S4S Technologies** | Income generating opportunities | Solar conduction dryer | India |

# SERVICE MODELS


Frozen food seller is satisfied with her Koolhome freezer

## Key challenges

Productive appliances for agriculture (e.g. water pumps) and retail businesses (e.g. refrigerators) have the potential to increase productivity and earnings of people significantly. Yet for low-income people with limited ability to accumulate savings, purchasing productive appliances is a challenge. A household with an average monthly income of USD 100, for example, cannot afford to spend between USD 600 and USD 800[11] for a solar-powered water pump (average price for a capacity of 200W - 500W), or between USD 310 and USD 550[12] for a refrigerator (average price for a capacity of 100 – 250 litres).

Models such as lease-to-own have revolutionised this market for low-income customers. This is when customers purchase the appliance with a small upfront payment of around 10% to 20% of the product value, and then pay back the remaining amount in instalments over two to four years. However, individual ownership may not always be the most cost-effective approach, especially for productive appliances that are not used regularly or at full capacity.

## About the innovation

Cooling as a service (CaaS) is an innovative business model whereby customers pay for cooling or freezing services instead of purchasing and owning the refrigerator themselves. Ownership of the system stays with the service provider.

11 Efficiency for Access Coalition. Solar Water Pump Outlook 2019: Global Trends and Market Opportunities, 2019, https://efficiencyforaccess.org/publications/solar-water-pump-outlook-2019-global-trends-and-market-opportunities

12 Efficiency for Access Coalition. The State of the Off-grid Appliance Market, 2019, https://storage.googleapis.com/e4a-website-assets/Clasp-SOGAM-Report-final.pdf

CASE STUDY COMPANY
**Koolboks**

PRODUCTIVE APPLIANCE
**Solar-powered refrigerators (158 litres, 210 litres, and 540 litres)**

SIMILAR BUSINESS MODEL INNOVATIONS
**CIAE, ColdHubs, CoolCrop, Ice Make Refrigerator, Sokofresh, Tessol**

The service provider also remains responsible for installing, operating, and maintaining the appliance. Customers only pay for the amount of chilled or refrigerated air or cooling capacity actually used. Depending on the contractual model, they can purchase cooling services on the basis of periodic quarterly, monthly, weekly, or even daily payments.

Customers benefit from this service model as they do not have to make an upfront investment in the system, and only pay for what they use. The model makes cooling affordable, even for low-income clients who have not accumulated savings. It also helps to alleviate doubts among customers who might be sceptical towards new technologies such as solar panels or thermal storage solutions.

Customers do not need to worry about the details of installation, maintenance, or operations. The service provider pays for the electricity used by the appliance. Since service fees are tied to the outcome delivered by the appliance, the provider has an incentive to perform high-quality maintenance, maximise uptime, and avoid system breakdowns. Moreover, the service provider is incentivised to


© Koolboks

Fish traders watch with excitement as Koolhome solar freezer is installed at Ijora Market in Lagos, Nigeria

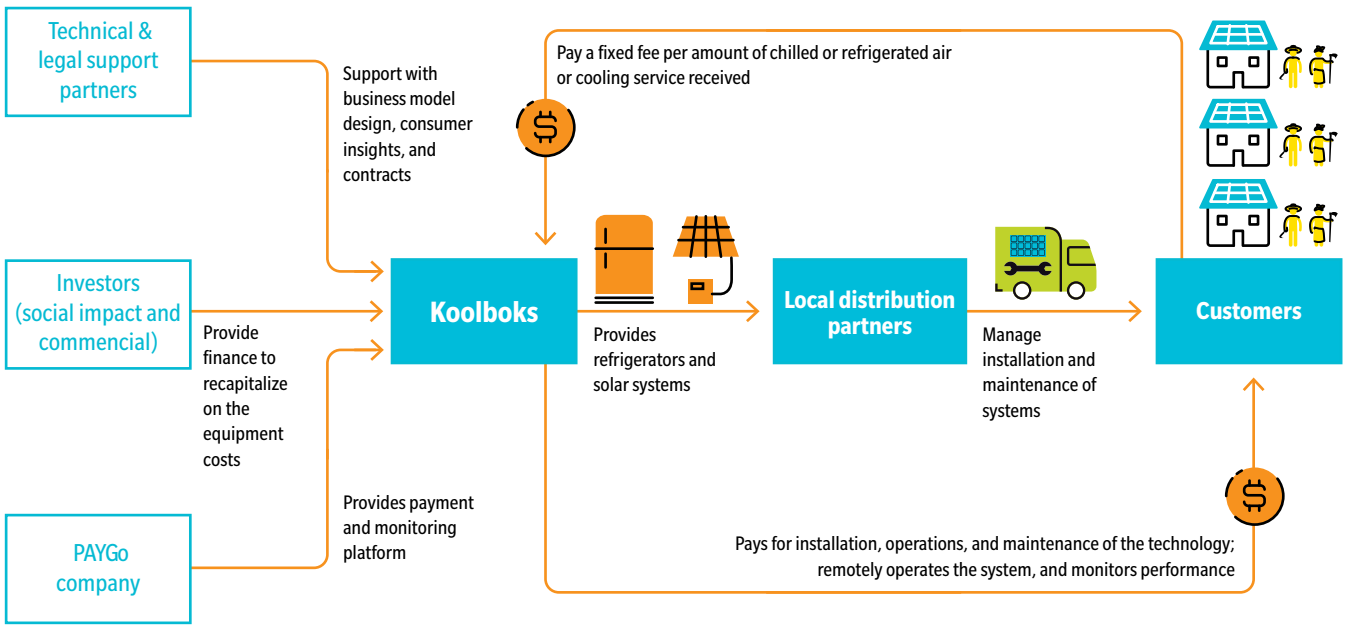
install the most energy-efficient equipment in order to save on electricity costs. In this way, the CaaS model also benefits the environment, as more energy-efficient technology is installed, and the $CO_2$ footprint for cooling (both from energy usage and refrigerant leakages) can be reduced.

For service providers, the profit margins associated with the CaaS model have to date matched or even exceeded those of traditional lease-to-own models. Providers can reduce electricity costs by using energy-efficient equipment and solar power, reduce maintenance costs through remote monitoring and preventive maintenance, and increase the utilisation rate of their equipment. Depending on the size of the system, the service provider can typically recover investment costs after approximately three years of usage.

Despite these potential advantages, it is important to note that the CaaS model is a relatively nascent business model in the off-grid sector. Most companies are in the preliminary years of operation, and commercial viability has not yet been definitively proven. Substantial upfront costs associated with obtaining the appliances can generate cash-flow difficulties for companies. Moreover, risks related to economic crises or natural disasters can lead to high service-agreement cancellation rates. There are other risks that will only become evident after a few years of operation related to customer acceptance of a reuse model. Therefore, care has to be taken to deploy smart contracts and pricing models that deliver value to all stakeholders involved: the user, the service provider, and the investor. This case study presents some strategies that may help entities pursuing CaaS models gain access to financing and de-risk their investments.

The specifics of the CaaS model vary from service provider to service provider. Companies such as ColdHubs offer centralised, solar-powered, walk-in cold stations in which customers can store perishable foods in plastic crates. The cold stations are installed in major food-production and consumption centres such as farmer markets or farms. On the other hand, Koolboks offers smaller, decentralised cooling solutions (solar-powered fridges and freezers ranging between 158 and 540 litres) that can be used by individuals or small groups of customers directly at a marketplace such as a local fish market or retail store.

## Illustration of business model innovation



CASE STUDY

# KOOLBOKS

## Helping to enhance access to affordable refrigeration


© koolboks

Fish trader charges phone with the Koolhome freezer USB port

## Koolboks at a glance

Koolboks is a private, for-profit company that develops affordable cooling systems. The company offers two main types of refrigerators: the Koolhome and the Kareboks system. The refrigerators range in capacity between 158 and 540 litres and can last without a supply of power for up to three days. Besides their traditional lease-to-own model, Koolboks also offers an innovative cooling-as-a-service (CaaS) model. The main target groups of the CaaS model include small businesses and health centres.

## Innovation at Koolboks

In 2020, the for-profit company, Koolboks, launched an innovative cooling-as-a-service (CaaS) model that allows customers to access cooling services at an affordable cost. In contrast to other service providers that offer CaaS models based on centralised cooling hubs, Koolboks' CaaS model focuses on decentralised cooling solutions that can be used by individuals or small groups of customers.

The startup provides solar-powered cooling and freezing services to two major types of customers in Nigeria. For commercial customers like fish traders, Koolboks offers a service model for refrigerators ranging up to 540 litres in size. The traders can use the fridges called Koolhome directly at their points of sale. For healthcare centres and pharmacies in remote parts of the country, Koolboks has designed a service model using the Kareboks refrigerators. They have a remote temperature-monitoring and alarm function that monitors the cold chain for critical medicines and vaccines.

**Key figures**

- Key geographies: Based in France with operations in Nigeria
- Team: 14 employees
- Turnover: USD 94,380 (2019); USD 498,000 (2020)
- No. of beneficiaries: 90 signed CaaS contracts (2020)
- Year founded: 2018

**Business model innovation**

- Product: Solar-powered refrigerators
- BMI: Cooling-as-a service (CaaS) model that reduces upfront payments and makes refrigeration more affordable
- SDGs addressed:


**Contact details**

- Website: https://koolboks.org
- Ayoola Dominic, CEO

> "With our CaaS model, we aim to democratise cooling".
>
> Ayoola Dominic, CEO, Koolboks



Koolhome solar refrigerator/freezer with ICE Battery (responsible for energy savings)

Both systems are specifically designed for use in the Sub-Saharan African context. Depending on the size of the system, they are powered by up to two 150-watt solar panels and can provide up to three days autonomous use without sunlight, allowing for a consistent cold chain and high cooling quality. The 540-litre systems work with a combination of thermal storage or "ice batteries" (utilising phase change materials or PCM) and 200 AA batteries, while smaller systems work exclusively with thermal storage batteries. All refrigerators have an integrated USB port that can be used to charge small devices and power or charge LED bulbs from the power surplus.

Koolboks' CaaS model enables customers to make payments on a monthly, weekly, or even daily basis. With fees as low as USD 10 per month for the 158-litre fridges, customers can access reliable cooling services without worrying about upfront payments, technological risks, or issues such as installation, operation, and maintenance. A deposit equal to one month of fees is required, which is then repaid at the end of the contract. As the cooling solution is directly located at the marketplace, it saves customers from having to waste time travelling back and forth between a centralised cooling hub and their retail point of sale, and even allows them to increase sales (see box on beneficiaries). For Koolboks itself, the CaaS model has allowed it to expand beyond its traditional lease-to-own business segment, which focuses on domestic users.

To ensure high-quality cooling services and friction-free processes, Koolboks collaborates with several partners, most notably local distributors that serve as the direct link to the customers. These partners maintain the relationship with the customers, provide customer outreach, and manage the installation and maintenance of the refrigerators and solar

"The main reason we offer CaaS is due to affordability. Upfront and operating costs for traditional refrigerators in Nigeria are high, affecting business opportunities, especially for women."

Ayoola Dominic, CEO, Koolboks

## Interview spotlight – A typical CaaS customer

**Question:** Who are your typical clients?

**Koolboks CEO Ayoola Dominic:**
We currently run a lease-to-own and a CaaS model for different customer groups. Typical clients for the lease-to-own model are domestic users who can afford the small upfront payment. These customers do not need cooling for revenue generation, but want cool drinks and fresh food at home. For the CaaS model, we primarily work with commercial clients that have several refrigerators in their store, and want to reduce their operating costs. We also work with institutional clients, such as health centres and local pharmacies.

panels. Koolboks retains ownership of the technology and devices.

- **Installation:** Specialised engineers working for Koolboks or its distribution partners install the refrigerators and the energy systems. This allows Koolboks to ensure that the systems are installed correctly and safely, reducing the risk of damage or breakdown.

- **Operation:** Solar panels power the refrigerators provided by Koolboks as part of the CaaS model. This allows Koolboks to ensure that the systems are run efficiently with the most suitable technology, and with the right power capacity. Using energy-efficient equipment enables Koolboks to save an average of 40% on electricity costs as compared to use of a generator.

- **Payment:** As with traditional lease-to-own models, payments in the CaaS model work with PAYGo software. Customers pay via a token-based software application, and enter the token in the form of a number into the refrigerator keypad. The system is remotely activated when payment is complete. If an instalment is not paid, Koolboks sends a reminder before remotely deactivating the cooling device. Koolboks uses token software provided by Solaris Offgrid.

- **Remote monitoring and maintenance:** Koolboks offers lifetime maintenance service as part of its CaaS model. Providing this service is in Koolboks' best interest,




Koolhome refrigerator/freezer displaying the PAYGO device

as it retains ownership of the cooling devices, and thus has to replace any systems that break down. To avoid system breakdowns, Koolboks remotely monitors system performance to detect potential issues as early as possible. For example, a warning is sent when the device temperature rises above a critical limit. Remote control of the systems allows Koolboks to carry out maintenance visits only when there is an actual need.

## Interview spotlight – Strategies to safeguard appliances

**Question:** Refrigerators are expensive products. How do you ensure that your property is not stolen or damaged?

**Koolboks CEO Ayoola Dominic:**
In most cases, our customers are members of women's associations. The association engages in the contractual relationship with us, and our clients have registered shops. Peer pressure also helps to safeguard the products. In addition, we have developed very clear contracts with a liability clause that our clients understand.

Koolbok's traditional lease-to-own model still accounts for 70% of the company's revenue, with the CaaS model accounting for the remaining 30%. Launched in 2020, the CaaS model is only just beginning to gain traction with customers in Nigeria, most of whom are not yet familiar with service-based models. However, demand for CaaS is high, particularly in the commercial and healthcare sectors, and turnover increased swiftly in 2019 and 2020. Uptake of CaaS for domestic use has been slow, as potential customers in Nigeria, as in most other places, have a strong cultural belief in ownership. However, even this seems to be shifting, particularly among female customers.

Koolboks expects to develop its CaaS model significantly over the next several years, with a forecast of 3,400 signed contracts in 2021 and 9,760 signed contracts in 2022 (up from 90 refrigerators under Koolboks management in 2020) being drawn from their primary target groups, fish traders and healthcare facilities. The company is currently exploring new partnerships with large pharmaceutical companies, with the aim of scaling the business line further. Ultimately, Koolboks aims to scale and replicate its business model to include other target groups such as owners of small and medium-sized businesses (restaurants, livestock farmers and those engaged in retail trade) and other countries in Sub-Saharan Africa.

> "Particularly for productive uses and healthcare applications, we see a high demand and growth potential for the CaaS model".
>
> Ayoola Dominic, CEO, Koolboks

## Impact

**Community:** The CaaS model is helping to enhance access to affordable refrigeration. The service-based model is especially interesting for low-income customers who lack the financial resources to make an upfront investment in their own system. Commercial users in particular, can significantly increase their revenues.

With its recently introduced CaaS model, Koolboks has already created 155 jobs for women as full-time employees or commission-based sales agents, and has helped 220 women fish traders increase their income by an average of 43%.[13] By working with local pharmacies and healthcare centres,

13 Dominic, A. Koolboks at the Global CaaS E-Summit, Koolboks, 2020, http://koolboks.org/koolboks-at-the-global-caas-e-summit/.

## Spotlight on beneficiaries

The CaaS model is primarily used by small commercial customers, such as Mrs. Tobi. Mrs. Tobi is a local fish trader who works at an Ijora market in Lagos, one of over 600 markets in the city. Before using the Koolhome technology, Mrs. Tobi had to travel two kilometres by bicycle every day to the nearest cold-storage facility to get her fish. This bicycle ride was dangerous and time-consuming. At the cold room, her fish were sometimes mixed up with other fish, went missing, or were already half defrosted because the facility's doors had been repeatedly opened and closed. Afterwards, she had to ride the two kilometres back to the market in the full sun.

With a Koolhome system in the marketplace, the situation is very different. As Mrs. Tobi says, "The Koolhome technology is great, as it allows me to store my fish at the marketplace directly. I share the costs for the refrigerator with two colleagues. In this way, we save a lot of money and time. I can now store my fish for a longer time, have less food spoilage, and higher revenues."

Many women fish traders have also reported that the CaaS model has brought them benefits. Their fish stays fresh for longer because the appliances acquired through the CaaS model provide consistent and reliable freezing. Moreover, costs associated with the CaaS model are lower than those of traditional refrigerators, which were often powered by diesel generators to cope with the market's frequent power cuts.

© Koolboks

The Koolhome system allows Mrs Tobi to store her fish at the marketplace

Koolboks has provided over 400 rural communities with access to essential medicines and vaccines.

**Organisation:** Projections for the CaaS model indicate that it will ultimately have a profit margin 20% higher than that of Koolboks' traditional lease-to-own business. This would allow the company to have an average gross profit margin of approximately 50%. The main reason for the higher margin is that Koolboks is using highly energy-efficient systems, which allows the company to save up to 40% on electricity costs. In addition, remote system monitoring reduces the frequency of monitoring visits, along with the associated costs. However, working-capital needs associated with inventory are higher under the CaaS model as compared to the lease-to-own model, because reimbursement from customers takes longer.

**Environment:** The CaaS model provides companies with incentives to install energy-efficient and robust systems, because the technology provider is responsible for operation and maintenance of the devices. This results in a significant reduction of $CO_2$ emissions as compared to traditional refrigerators, which are often inefficient and powered by diesel generators. With its CaaS model and the use of energy-efficient systems and solar power, Koolboks has already avoided 15,400 metric tonnes of $CO_2$ emissions as compared to the use of refrigerators being powered by diesel generators. In addition, the use of thermal storage batteries instead of traditional acid batteries reduces production-related and end-of-life environmental impacts.

## Partnerships

"Partnerships are critical for our CaaS model to work successfully".

Ayoola Dominic, CEO, Koolboks

Koolboks has entered partnerships with a large number of players to deploy and manage its CaaS model, including impact investors, commercial banks, Nigerian distributors, a Nigerian law firm, and technical partners. Local distributors play a critical role in deploying the appliances distributed under Koolboks' CaaS model. Koolboks works with two Nigerian distributors that have a deep understanding of the local market. This allows them to tap existing networks and sales channels to increase sales. A key partner in operationalising the CaaS model in Nigeria has been the Basel Agency for Sustainable Energy (BASE). Koolboks adapted the CaaS pricing model to its operations as a part of BASE's CaaS incubator programme, launched in 2019. As part of the programme, Koolboks has also worked with a local Nigerian law firm to create a CaaS contract tailored to Koolboks' customer base and local regulations.

### Role of partners in the business model innovation:

| Type of partner | Collaboration model and role |
|---|---|
| **Finance providers** | In a CaaS model, the service provider is subject to enormous upfront costs associated with the purchase of its inventory. This can create cash-flow difficulties for the company. Finance providers are therefore among the most important type of partner, as they help the service provider to fund equipment purchases or recapitalise following equipment-purchase costs. Koolboks has a partnership with the Nigerian Sterling Bank, a full-service commercial bank in Nigeria, and is currently looking for additional investors and institutional funds. When piloting its CaaS model, Koolboks also received funding from donors, including the Efficiency for Access Research and Development Fund.<br>**Role:**<br>▸ Provide finance to fund equipment purchases or pilot business model innovations. |
| **Local distributors** | Local distributors are critical in most CaaS models and often function as the direct link to customers, taking responsibility for customer engagement functions, sales, and after-sales services. Koolboks has a partnership with two local distributors in Nigeria, Novel Solar and Nicanor, both of which are among the biggest solar-energy technology distributors in Nigeria, collectively with more than 46 stores and 40 engineers.<br>**Roles:**<br>▸ Conduct customer outreach and sales of service solutions under the CaaS model.<br>▸ Conduct installation and maintenance of technical equipment.<br>▸ Bring deep understanding of local markets, helping the company increase its reach through their existing networks and sales channels. They are well-trusted partners with good local reputations. |
| **Technical partners** | Technical partners can assist with the development or refinement of the business model, or provide unique services such as PAYGo software needed by the technology provider to run its business smoothly. Koolboks has worked closely with the Basel Agency for Sustainable Energy (BASE)[14] in developing its business model.<br>**Roles:**<br>▸ Provide customer and market insights.<br>▸ Support development and adaptation of the CaaS business model.<br>▸ Facilitate partnerships and raise awareness of the organisation and its model. |
| **Legal partner** | Contracts play an essential role in CaaS models. Without solid contracts adapted to local rules and expectations, new customers are less likely to engage. Koolboks has partnered with a well-established Nigerian law firm to tailor contracts to the requirements of its customers, and to ensure that it is complying with Nigerian regulations.<br>**Roles:**<br>▸ Support the design of adequate contracts for the CaaS model.<br>▸ Support the enforcement of contracts. |

## Replication and scalability

The CaaS model is more complex than a traditional sales model. However, over the long run, the model has been seen to generate higher profit margins, while allowing access to new customer segments. Important preconditions and success factors for scaling and replicating a CaaS model include:

- **Access to finance:** Appliance companies that deploy service models such as CaaS, are subject to significant working capital costs associated with retaining ownership of assets. Access to patient capital is therefore critical to scale the business model. Financial structures such as special purpose vehicles can help to keep assets of the balance sheets and use them to leverage further investment in place of debts. To pilot its CaaS model, Koolboks has received funding from donors, including the Efficiency for Access Research and Development Fund. Koolboks is currently looking for investors and institutional funds to scale the model.

- **Reliable and efficient technology, in order to reduce operating and service costs:** The technology used for a CaaS model should be highly reliable and energy-efficient, so as to reduce operating and maintenance costs. Koolboks uses an integrated PAYGo payments technology, and has deployed thermal storage batteries to increase energy efficiency and reduce the overall costs of owning solar refrigerators by 40%.

- **Knowledge about customers, to help unlock and de-risk investment:** The more companies know about their customers, the better you can calculate the potential risks of payment default. Technology providers should choose their

14 BASE. Reducing food waste and vaccine spoilage through cooling solutions, 2020, https://energy-base.org/news/reducing-food-waste-and-vaccine-degradation-through-caas/

customers wisely, especially the preliminary ones. Koolboks is working with Sterling Bank, a commercial bank with over one million active customers in Nigeria and a 90% loan recovery rate. The bank will take responsibility for vetting and approving new customers.

- **Strong local partners, to provide critical services:** Technology providers are only as good as the on-the-ground partners that work directly with customers. To scale a CaaS model successfully, technology providers should partner with stable local firms that have strong networks and good reputations within their target groups. For example, Koolboks is working with two of the biggest solar-energy technology distributors in Nigeria, both of which have a strong presence in the markets that include Koolboks' target customers. Koolboks is also collaborating with local market associations in Nigeria to boost customer awareness and enhance acceptance of its model.

## Strategies for accessing finance and de-risking CaaS investments

An interview with Dimitris Karamitsos, senior energy-efficient business development specialist at BASE

**Question:** Finance providers are critical in order to fund equipment purchases in a CaaS model. In doing so, they take on substantial risk themselves. How can CaaS technology providers reduce the risk to their financing partners?

**Dimitris Karamitsos:** Payment-default risk is an essential factor in as-a-service models, because rather than receiving the payment upfront, as in transaction-based models, the service provider receives payments in pay-per-use schedules over several years. Relevant risk-mitigation mechanisms include contractual clauses, the possibility of reallocating the equipment or interrupting the provision of cooling through remote monitoring, and the use of payment guarantees when available and applicable. Another important way of mitigating the payment-default risk is conducting proper due diligence and carefully selecting the first CaaS clients, in order to build a successful track record. The more you know about your customers, their demand for cooling, and their financial profiles, the more accurately you can evaluate their default risk. The first customers need to be strong partners and advocates of the model, and be willing to join the service provider on their journey.

A few additional factors to consider:

- It helps if the economic impact for the end user is high. A strong business case makes it less likely to end a contract.
- As more customers are onboarded, it is critical to diversify the customer base with regard to industry sector and geography in order to de-risk the portfolio of clients (especially in severe scenarios such as global pandemics or economic crisis).
- In a CaaS model, the service provider can improve the utilisation rate of its assets. This, in return, can yield a higher return on investment for the project.

**Question:** What type of investors are most suitable for CaaS models?

**Dimitris Karamitsos:** In our experience, it is easier to work with investors who have already financed other service models (e.g., for lighting or solar-panel power purchase agreements (PPAs)). These investors often understand the specific requirements associated with a service model better, and can compare targets with other models. Other aspects that investors usually like to see in such models include sustainability, the ability to lower $CO_2$ emissions, and the promotion of green solutions. If your investor is interested in some of these elements, along with the industry you serve (for instance agriculture or energy access), it might be a good match. We at BASE are also working to increase banks' interest in funding CaaS opportunities. Commercial debt must be unlocked in order to really scale up the adoption of CaaS.

**Question:** When an appliance provider finds a promising investor for its CaaS model, are there specific contractual arrangements that can help to lower investment risks further?

**Dimitris Karamitsos:** Contracts between investors and technology providers in a CaaS model typically take the form of traditional project financing, or use asset-backed financing models such as sale-leaseback. When set up as special purpose vehicles, customer contracts can be bundled to increase the ticket sizes of the investments and diversify the risk. This can reduce the costs of lending and also de-risk investments.

# INTEROPERABLE PAYGO PLATFORMS



A family in rural India eating under the light from a solar lamp

CASE STUDY COMPANY

**KPay Innovation**

PRODUCTIVE APPLIANCE

**Software solution enabling PAYGo technology and remote performance monitoring. The software can be used with all electric productive-use appliances**

SIMILAR BUSINESS MODEL INNOVATIONS

**Angaza, Eseye, Naefos, Paygee, PaygOps (Solaris Offgrid)**

## Key challenges

Electric productive-use appliances have the potential to improve peoples' quality of life and increase their productivity and earnings. However, purchasing these appliances is generally challenging for people who earn only USD 1.9 to USD 5.5 per day. They have limited flexibility to accumulate savings and cannot afford large on-off payments.

## About the innovation

Payment models adapted to the earning and spending realities of low-income populations can help to finance the purchase of productive appliances, which can, in turn, help people permanently escape poverty.

Lease-to-own models and service models are both solutions that, overcome the obstacles associated with the high upfront costs of productive appliances. In a lease-to-own model, customers buy the appliance with a small upfront payment of around 10% to 20% of the product's value, and repay the remaining amount in small instalments over two to four years. At the end of the payment period, the customer owns the appliance. In a service model, the service provider retains ownership of the device and takes responsibility for installation, maintenance and repairs, while the customer pays a service fee to use the appliance.

PAYGo technology can help make lease-to-own and service models more effective and scalable by allowing providers to activate the appliances remotely and digitally manage small financial transactions. This can, overall, increase the financial viability of lease-to-own and service models. The appliance needs to be equipped with a small microchip that enables remote communication with a centralised control centre. The technology provider can remotely switch off the device if the customer stops paying. This also allows the technology provider to monitor the device's performance remotely, and conduct preventive maintenance before the appliance starts malfunctioning. This can help reduce maintenance costs and ensures that appliances work more reliably and efficiently. Software can be used to build customer profiles and track financial transactions. Consequently, this can be used to develop credit histories for customers. It can also facilitate engagement with microfinance institutions (MFIs) or banks that might otherwise be hesitant to lend to low-income clients without collateral or credit histories.

Innovative sector leaders such as Afrisol, Bboxx, M-Kopa, and Mobisol have pioneered PAYGo models on the African continent, often with the goal of making solar home systems and appliances, such as radios and TVs, affordable to low-

© KPay Innovation

Rural women being trained as distributors of KPay enabled solar systems

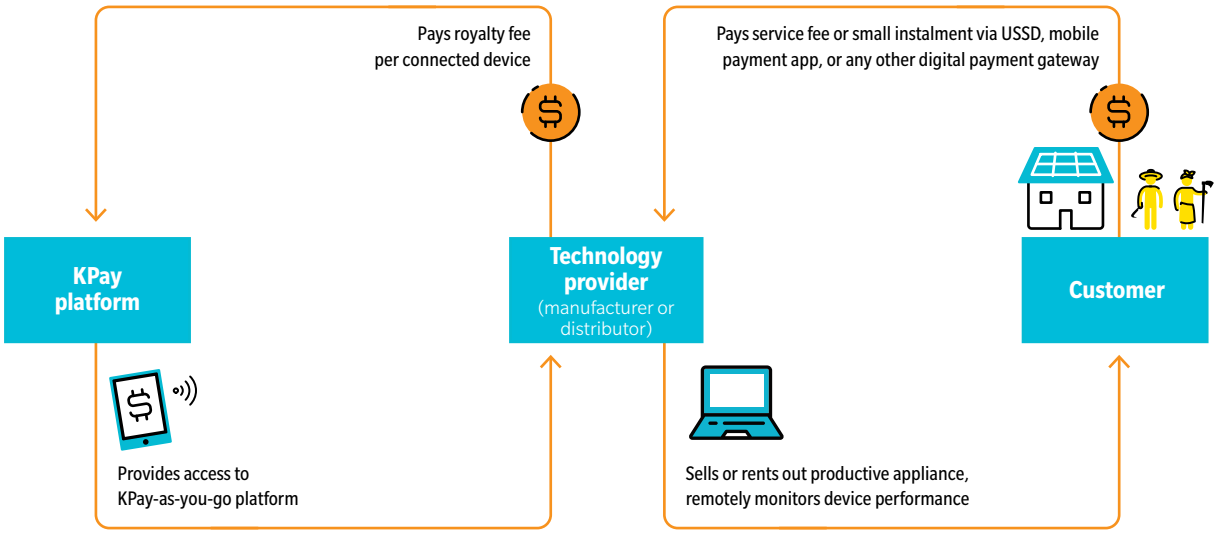
income customers. A variation on these PAYGo models is also seeing increased uptake in the productive-use space, with Sun Culture developing its "Pay As You Grow" approach, and companies such as Koolboks PAYGo platforms for cooling-as-a-service offerings. Between 2010 and 2015, many off-grid companies developed their own digital software solutions in parallel to their core business selling solar home systems and appliances, in the process connecting over 8 million people worldwide with PAYGo technology.[15]

Over the last few years, some companies have begun developing digital PAYGo platforms, offering these as a B2B service to technology providers operating in low-income markets. Companies such as KPay and Solaris Offgrid, for example, have developed B2B software solutions. These allow even small companies to use state-of-the-art PAYGo financing solutions without having to invest in a costly software development process themselves.

For this case study, we are focusing on Indian fintech company KPay and its KPay-as-you-go platform. KPay's technology can be embedded into a broad spectrum of electric appliances, and works with multiple payment gateways that do not require end users to have their own smartphones or internet access.

15 International Renewable Energy Agency (IRENA). Pay-as-you-go models, Innovation landscape brief, 2020, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jul/IRENA_Pay-as-you-go_models_2020.pdf?la=en&hash=7A2E7A7FF8B5BAB7748670876667628A39DE40D5

## Illustration of business model innovation



## CASE STUDY

# KPAY INNOVATION

Offering PAYGo solutions that unlock markets for appliance companies



An electric motorcycle being tested with KPay's technology

## KPay at a glance

KPay is a private, for-profit company that developed KPay-as-you-go, a digital PAYGo platform for businesses. By enabling manufacturers and distributors to include PAYGo technology in their off-grid appliances, the platform enables them to reach low-income customers who would not otherwise be able to afford the devices. KPay-as-you-go is hardware-agnostic, and does not require internet access or a smartphone. It enables consumers to use and pay for any powered device over time, based on individual needs, via GSM-USSD[16] codes or digital-payment gateways.

## Innovation at KPay

In 1993, Aditya and Ravi Pittie, two brothers from Pune, India, founded Agni Solar, an energy company specialising in off-grid solar and solar water heating systems. Its pioneering energy business led them to work closely with low-income customers in the rural areas of India. Aditya and Ravi saw how access to electricity and off-grid appliances transformed peoples' lives by creating income opportunities and improving living conditions. However, they also realised that many of their low-income customers were unable to afford such products. These individuals were earning a daily income, but were unable to save enough money to pay the full upfront costs for the appliances.

16 Global System for Mobile Communications (GSM) is a standard for digital mobile networks developed by the European Telecommunications Standards Institute in 1991. GSM is the most commonly used mobile network standard in the world.
Unstructured Supplementary Service Data (USSD) is a communications protocol used by GSM cellular telephones to communicate with the mobile network operator's computers.

**Key figures**

- Key geographies: Based in Pune, India, with global operations
- Team: 11–50 employees
- No. of beneficiaries: Approx. 100,000 end-user benefitting from KPay-as-you-go technology (2020)
- Year founded: 2018

**Business model innovation**

- Product: Interoperable PAYGo platforms
- BMI: Interoperable PAYGo platform
- SDGs addressed:


**Contact details**

- Website: www.kpayasyougo.com
- Aditya Pittie, cofounder and COO

"We encountered difficulties in selling our off-grid systems to customers living at the bottom of the economic pyramid because they were unable to afford large lump-sum upfront costs".

Aditya Pittie, COO, KPay



A machine operated under the "KPay-as-you-go" model

Agni Solar was not the only company facing this problem. Despite high levels of demand, manufacturers and distributors of off-grid appliances around the world encountered difficulties in selling their products to customers at the bottom of the economic pyramid. Banks and microfinance institutions proved reluctant to give out loans to low-income customers who lacked collateral or credit histories. Even if loans were issued, customers were forced to pay annual interest rates ranging from 40% to 60%, with short repayment periods. From the banks' perspective, lending to low-income clients was too complicated.

In the search for good solutions to make their products available to poor rural communities, Aditya and Ravi explored the pioneering work of PAYGo companies in Africa. In Kenya, M-Kopa had used this innovative technology to make higher-capacity solar home systems affordable for low-income customers by allowing them to pay in small instalments via a mobile-money platform. This financing model helped to revolutionise the sector, because it was adapted to the income-generation patterns of smallholder farmers and low-income workers.

> "We saw the business potential to create a universal and ubiquitous PAYGo platform that would allow companies to use PAYGo solutions without having to invest in software development".
>
> Aditya Pittie, COO, KPay

Having seen the benefits of PAYGo solutions first-hand, the brothers realised the business potential associated with creating an interoperable software platform. Such a platform would allow all manufacturers and distributors of off-grid products to use PAYGo technology without the need to invest in a costly software development process. This led them to establish the award-winning[17] KPay in 2018.

KPay is an innovative PAYGo platform that makes pay-as-you-go technology accessible to all businesses. The KPay-as-you-go technology is hardware-agnostic, meaning that it does not require hardware adaptations and can be embedded easily into a large number of productive use devices ranging from solar home systems and televisions to water irrigation pumps and smart toilets.

The appliances can be remotely activated via the KPay platform. The platform also allows manufacturers and distributors to choose from a variety of languages, currencies, and payment methods, including pay-per-use, pay-per-time, and pay-per-amp.[18] In this way, businesses can adapt the KPay technology to their specific needs, appliances, business models, and geographical markets.

Technology providers can also use the KPay software to collect and analyse device performance data, create individual user profiles, and build up customer payment records and credit ratings. These insights can help companies reduce maintenance costs and improve service delivery by developing a better understanding of energy consumption and spending behaviour. The software also includes customer relationship management, inventory management, and workflow management features.

> "KPay technology can be integrated easily into off-grid appliances at the manufacturing level or the distribution level".
>
> Aditya Pittie, COO, KPay

To integrate the KPay-as-you-go technology into an appliance and allow the software platform to function on the device, KPay can code the existing microchip in an appliance or add a separate microchip to the device. Appliance manufacturers can directly integrate KPay coding into their devices at the manufacturing stage. This does not require changes or additions in the existing hardware or any change in the design and manufacturing process, and is an easy and low-cost option. Distributors can integrate a KPay microchip into their devices as well. In this way, a distributor can test the new PAYGo solution without having to go back to the manufacturer.

17 KPay. KPay Innovation won an Outstanding Achievement award at Suryacon Pune, 2020, https://kpayasyougo.com/suryacon-pune-award/

18 Pay-per-use: Customers pay for each use of the device. Pay-per-time: Customers pay to use the device for a fixed amount of time. Pay-per-amp: Customers pay for the energy they consume when using the device.




A water dispenser using the KPay-as-you-go technology

> "Our aim was to create a PAYGo solution that works even in remote, disconnected areas of the world, without internet connectivity and smartphones".
>
> Aditya Pittie, COO, KPay

Customers do not need a smartphone or internet connection to make a payment. With multiple payment gateways integrated into the KPay platform, customers can choose between using a GSM-USSD code (that can be used with a feature phone), a mobile payment app, or other suitable options based on the functions available to them. The running time of the appliance can be flexible; either based on the number of hours or the amount of electricity that has been paid for, once the client enters the code. Input methods are also flexible, with clients able to use a built-in keypad or external remote control, or enter the code automatically via a combination of GSM and internet-of-things technology.

> "We see the buy now, pay later movement becoming much more important than credit cards in the future. PAYGo is the technology to enable this movement and unlock tremendous market potential".
>
> Aditya Pittie, COO, KPay

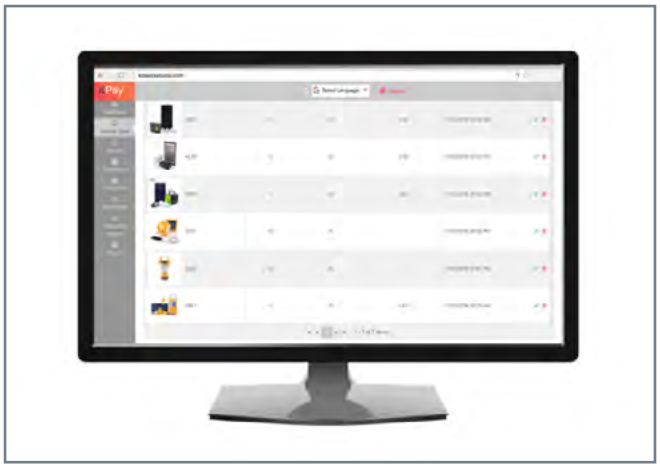
KPay's business model is built around royalty fees. For each device connected to the platform, the company earns a small royalty fee, paid by the manufacturer or distributor, for each year the connection remains active. The payment of the royalty fee stops when the appliance is paid off by the end user and disconnected from the platform. The royalty fee varies by device, but is generally lower than 1% of the appliance's production cost. This means that the extra charges associated with the end customer's use of the KPay technology are relatively small.

## Impact

**Communities:** As KPay is a B2B company, it only indirectly impacts people with a low income via its KPay-as-you-go technology, which makes electric appliances affordable and accessible. At the time of writing, less than one full year after the technology's release, the KPay software was being used by six companies and had enabled PAYGo functions on more than 20,000 devices. Consequently, KPay has helped more than 100,000 people afford appliances that promise to improve their living conditions and generate income.

For business customers, the interoperable KPay-as-you-go technology can help reduce R&D costs associated with the development and operation of proprietary PAYGo solutions. Partnering with a dedicated PAYGo technology company, such as KPay, allows the manufacturer or distributor to focus on its core business, keeping ahead of the sector's rapid technological advances.

**Organisation:** For every device connected to its platform, KPay earns a royalty fee of around 1% of the device's retail price. As in all royalty-fee-based models, profitability increases with scale. In recent months, KPay has begun scaling up rapidly. The company expects to embed KPay-as-you-go technology into more than 100,000 devices in 2021, and into more than 4 million devices by 2025. KPay has an asset-light business model, and expects to be profitable by 2024.



Screenshot of KPay software application




Agni Solar lighting system with KPay technology

## Spotlight: Interview with a KPay B2B client

### Interview with Michael Job, head of business development, MinJu TV

MinJu TV is a medium-sized company that manufactures low-power DC televisions that can be powered with a solar-charged battery pack. MinJu TV works with distributors whose main customer segments are low-income earners without reliable access to the power grid.

**Why did MinJu TV decide to work with KPay, and what makes KPay an ideal partner?**

**Michael Job:** Televisions are among the most wanted appliances for low-income customers in China and other markets. To reach these large customer segments, our distribution partners asked for PAYGo technology to facilitate lease-to-own models. As we are a medium-sized company, it was not easy to invest in the R&D for our own PAYGo system. KPay offered a much more reliable, easy-to-use, and cost-effective solution. They instantly replied to our requests, allowing us to move fast. They also offered the best technology with the lowest development, hardware, and maintenance costs.

**What do you see as crucial success factors for replicating and scaling the KPay-as-you-go model?**

**Michael Job:** For manufacturers like us, a key success factor is the flexibility to adapt the technology to our specific needs. For distributors and end users, the systems' reliability and ease of management make all the difference for scale. The different payment options at KPay make the technology easily scalable across geographies.

## Replication and scalability

PAYGo models such as KPay-as-you-go have revolutionised the market for off-grid appliances in recent years. For the growth trajectory of B2B PAYGo solutions to continue, the following preconditions and success factors will be necessary:

- **High-quality, reliable PAYGo platform solutions:** Companies such as KPay that develop PAYGo platforms using a royalty-fee model can rapidly scale their operations and respond to increasing demand. The focus on software development allows the companies to create high-quality, reliable PAYGo services that are easy to implement, intuitive to use, and resistant to hacking attacks.

- **Interoperable, adaptable PAYGo platform solutions:** To facilitate rapid scaling and replication, PAYGo models need to be adaptable to many different contexts and requirements. One success factor underlying KPay's software platform is the fact that the software is hardware-agnostic, and thus can be used by any manufacturer and distributor, for a very wide variety of different devices. It can be used in conjunction with a number of different payment gateways, and companies can choose between a variety of languages, currencies, and payment methods.

- **Mobile-phone uptake:** Although internet access and smartphones are not needed to use KPay's PAYGo technology today, customers need mobile connectivity to receive SMS codes. Mobile-phone uptake and connectivity is still a challenge in some parts of the world, especially in rural areas.

- **Awareness of PAYGo solutions:** Despite the great opportunity that PAYGo technologies offer to companies and customers alike, the financing model has only achieved mainstream use in the energy sector, and specifically for solar home systems. Companies like KPay that offer PAYGo software for a variety of electric appliances still have to do considerable explaining and convincing when approaching new business clients. If awareness of the benefits of PAYGo can be expanded beyond the use-case of solar home systems, this will significantly accelerate efforts to scale and replicate the model.

# MOBILITY SOLUTION WITH A COMMUNITY-BASED DISTRIBUTION AND SERVICE MODEL



A community based solar charging station installed by MFA help charge the e-tricycle batteries in off-grid conditions (Zimbabwe 2019)

CASE STUDY COMPANY
**Mobility for Africa (MFA)**

PRODUCTIVE APPLIANCE
**Electric tricycle (customised for women)**

SIMILAR BUSINESS MODEL INNOVATIONS
**WeTu (Siemens Foundation)**

## Key challenges

Transportation in rural Africa is very costly and slow, with few established players in the market and a strong dependence on fossil fuels. These conditions are perpetuated in part by the current state of infrastructure across the continent, with fewer than 40% of rural Africans living within two kilometres of an all-season road. This by far the lowest level of rural road accessibility in the world.

Rural women in particular suffer of mobility. According to UNDP estimates, women in rural Africa collectively spend 40 billion hours every year walking to collect water, travel to fields, take family members to health clinics, or bring children to and from school. Elderly people and people with disabilities also have difficulty in accessing safe and sustainable modes of transport. This directly impacts local communities, reducing economic opportunities, hampering access to essential services such as drinking water, education, health, finance, and limiting social interaction.

The high cost of transport also makes goods expensive. The rural economy is heavily dependent on agriculture, and most rural residents are smallholder farmers, 50% of whom are women. With most agricultural land located far from potential markets and paved roads, the need for last-mile transport solutions is clear.

E-mobility development gains elsewhere in the world, such as in China and India, have not taken hold to the same extent in Sub-Saharan Africa. Adoption of electric mobility devices is slowly increasing in the region as a whole, but the focus to date has been primarily on cities, owing to the more reliable supply of electricity there, and the presence of more potential customers with the level of income required to afford mobility products. Additionally, e-vehicles are generally not well-adapted for use in the rural Sub-Saharan African context, lacking the sturdiness and other design characteristics required for use in rural regions with poor roads. Numerous other challenges have made expansion into rural areas difficult. For example, electric vehicles (EVs) need access to power that is both reliable and affordable, which is lacking on the African continent.[19] For use of these vehicles to become practical on a large scale, significant infrastructure investments (such as dedicated charging stations) are needed, along with grid integration and strong enabling policies including tax incentives and subsidies.[20]

19 Electricity blackouts are frequent occurrences in 30 of the 48 countries in Sub-Saharan Africa. Moreover, electricity prices can sometimes be double those in the United States or China;

20 Hill, K., et al. Is sub-Saharan Africa ready for the electric vehicle revolution?, World Economic Forum, 2018, https://www.weforum.org/agenda/2018/07/sub-saharan-africa-electric-vehicle-revolution-evs/.


MFA's new factory after its makeover, making it a clean and safe working in environment (Zimbabwe 2019)



## About the innovation

With rich renewable energy resources, soaring diesel prices and constrained fuel availability, minimal transport infrastructure, and most people travelling an average distance of less than 30 kilometres daily, rural Sub-Saharan Africa is well suited to an electric vehicle revolution. To build a strong business case that can generate rural demand and bring affordable electric mobility solutions to the region, it is essential to think beyond traditional sales-based business models, and instead establish community-based e-mobility use cases that will drive investment in local electric infrastructures.

Mobility for Africa (MFA) has successfully developed a business model for the deployment of electric vehicles in rural areas based on a shared-use, community-centred service model that relies on off-grid solar installations to charge the vehicles. MFA leases e-tricycles called Hambas to productive groups of up to five people who then share its use. The tricycle is custom designed to meet the driving and transport needs of rural Africans, especially women. The shared-use model allows the cost of operations to be split across a number of individuals, while additionally aggregating demand and ensuring better maintenance and higher utilisation rates. Local assembly of the vehicles further reduces ownership costs, making the Hamba an affordable option for its target market.

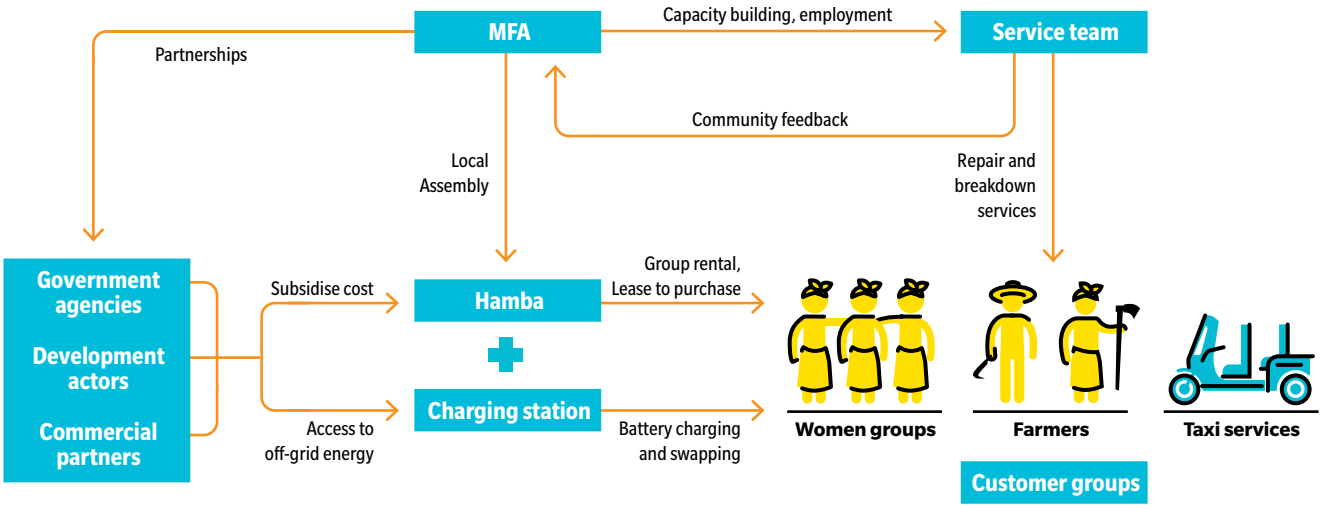



A women team testing transport and logistics service model with Hamba (Zimbabwe 2020)

"With the cost of renewable technology falling, breakthroughs in electric batteries, and mobile technology making microfinancing options available to rural populations, the wave of electric mobility should not bypass rural Africa".

Shantha Bloeman, Founder and Director, MFA

## Illustration of business model innovation




A number of Sub-Saharan African countries have made significant gains in adopting e-mobility innovations. However, most efforts are focused on urban areas, where grid power is readily available. A few notable initiatives have addressed rural e-mobility, including Powerhive and WeTu, both of which are based in Kenya. WeTu is a social enterprise owned by Siemens Stiftung and focuses on incubating e-mobility solutions in rural western Kenya with a focus on fishermen, small-scale farmers, and women's trading groups. The organisation has three major business verticals, including 1) WeMobility, which offers a range of e-mobility solutions such as e-cargo bikes and e-Boda-Bodas; 2) WePower, which provides renewable energy for e-mobility solutions and leases solar lanterns for use in small-scale fishing operations; and 3) WeWater, which helps furnish communities with clean drinking water produced by commercial solar-based water filtration systems.

Powerhive is a green energy startup that aims to provide communities with affordable energy storage solutions. The company currently operates 25 village-level microgrids that provide energy for households, income-generating activities, and electric vehicles such as e-boda-bodas and three-wheeler vehicles. In addition to providing an hourly rental service for the electric vehicles, the company also plans to develop an app that will enable rural community members to purchase excess electricity when prices are low, and use it to power productive appliances.

### Background

The presence of usable roads is a critical precondition for economic development that also produces a number of indirect benefits such as access to healthcare, education, credit, work opportunities, and social interaction. A baseline survey by MFA in the Wedza district discovered that people earning less than USD 3 a day spend about 50% of their income on transport, while still taking an average of two to four hours to reach the nearest local market. The lack of an affordable mobility solution hinders people from accessing markets and jobs that could help increase their incomes, and help them escape poverty.[21]

21 Government of Kenya. National Climate Change Response Strategy, 2010, https://mirror.unhabitat.org/downloads/docs/12672_1_595425.pdf.

CASE STUDY

# MOBILITY FOR AFRICA

## Bringing affordable and clean mobility solutions to rural Zimbabwe with a community-based distribution and service model



MFA's battery swapping and delivery service to the customers helps maximize Hamba's demand (Zimbabwe 2020)

## MFA at a glance

Mobility is critical to economic and social development in Africa. While political leaders in Africa are developing continental transport routes with the aim of expanding internal trade and commerce, smallholder farmers – the backbone of Sub-Saharan African agriculture – are underserved.

MFA is the manufacturer and supplier of electric tricycles called Hambas that are well suited for Sub-Saharan Africa's rural and peri-urban areas. The company leases its Hamba electric tricycle to productive groups at an affordable price, thus maximising capacity and lowering the shared ownership cost. The typical clients include women-run trading groups, small-scale farmers, organisations providing local services, healthcare workers, police, and community organisations. MFA also invests in the establishment of off-grid charging stations, provides microcredit support, trains customers in use of the bikes, provides maintenance services, and offers advice on income generation.

**Technology:** MFA's electric tricycle has a 1000-watt electric motor with 48-volt wiring, and uses 66 AmpHr li-ion packs that weigh 35kg. The Hamba device has a maximum load capacity of 400kg, and can cover 50–60 kilometres with a full charge, depending on the load carried. The current charging station has 13 Kw capacity using solar energy. In 2021, MFA will be

**Key figures**

- Key geographies: Wedza and Chipinge districts, Zimbabwe
- Team: 15 staff members
- Turnover: USD 8,590 in 2020 (from initial pilot test site in Wedza with a fleet of 45 Hamba over 7 months)
- Installed systems: 60 electric vehicles (as of Jan 2021)
- No. of beneficiaries: 1200 (2020)
- Year founded: 2018

**Business model innovation**

- Product: Lithium-battery-powered e-tricycle
- BMI: Affordability, inclusive community model, clean technology
- SDG addressed:


**Contact details**

- Website: https:/mobilityforafrica.com
- Shantha Bloeman, Founder


MFA offers a 5-day free Hamba driving lessons to the women (Wedza, Zimbabwe 2019)

"We know that the technology alone will not transform the lives of rural women. We needed to tailor our approach to address cultural and gender barriers through proactive communication, community engagement, the provision of affordable renting and shared-use options, and investment in training. We also needed to factor in a responsible and green circular-design lifecycle for the batteries, which are a valuable asset, are made from precious minerals, and need to be recycled responsibly".

Shantha Bloeman, Founder and Director, MFA

testing an integrated design at its new sites in Zimbabwe and Tanzania. Each Hamba vehicle currently requires six hours to charge. A new bespoke battery will be tested in 2021 that will improve energy efficency, charging and be more durable for local conditions.

MFA manages one pilot in Wedza. It is expanding to two more sites in Zimbabwe: one site will be in rural Chipinge where MFA will be working with small scale dairy farmers and the other site in peri-urban Domboshawa where MFA will be working with small scale egg producers. In addtion, MFA will expand to Tanzania where it will work in Mwenga district.

## Affordable, green mobility solutions through a community-based shared-use model

MFA's Zimbabwe operations were established in 2018. The parent company is in Mauritius and oversees Zimbabwe and Tanzania operations. It started its first electric three-wheeler pilot in January 2019 in the rural Wedza district of Zimbabwe. Students from Tsinghua University and Zimbabwe Midland State University designed the pilot. The Zimbabwean company Solar Shack did the design and installation of the solar off grid charging system. The pilot initially deployed 30 electric tricycles with the aim of assessing the suitability of the vehicle's design for local conditions, the efficiency of the solar recharging model, the adequacy of a leasing model for local conditions, and the ability of the product itself to improve project participants' economic productivity and livelihoods. The goal was to help rural women reach their potential, and to bridge gender inequalities within the community. A charging station with 30 solar panels was set up in 2019. It can charge up to 10 batteries with a capacity of 6.6kWh every day. The use of solar charging hubs was critical, as most of the target villages did not have grid access. The solar hubs facilitated battery charging and battery swapping, practices that encouraged the adoption of the electric vehicles. An important lesson learned was that the shared use of the vehicles for productive activities enabled the participants to increase their incomes, and effectively served to aggregate demand for the e-tricycles. The customers were able to pay on time, and the collective dynamics generated by the shared-use model helped to improve productivity and community engagement.

The second phase of the pilot started in Jan 2020 and ran for 12 months. In this portion, MFA tested several additional business models including rental transport services for agricultural produce and general taxi services. The organisation also used this leg of the pilot to measure the project's financial viability, improve charging capacity, and explore battery efficiency and shelf life.

As a result, the current business model has four major revenue strands:

1. Rental or longer-term lease of vehicles to end-user groups (productive groups of women and small farmers). This business model innovation is the largest contributor (42%) to the company's revenue.

2. Solar charging and battery swapping.

3. Management of transport and logistics services that use its vehicles (Hamba taxis). This business model innovation is also a major source of revenue, with the Hamba vehicles rented to individuals for shared commercial use.

4. B2B model with government partners. In this case, the Hamba is rented to public administrations for use in delivering services such as policing, healthcare, or agriculture-department functions. This business model innovation is currently in the pilot stage.


© Mobility for Africa

The technician team at Harare for assembling e-tricycle (Harare, 2019)

The following table provides an overview of clients and vehicles.

| Description | Description of service |
|---|---|
| Group rental model | 31 groups for nine months |
| Transport & logistics service | 10 taxis for seven months |
| Battery-swapping service | 70 batteries |
| Non-refundable security deposit | |

In 2019, MFA received USD 100,000 from the Expo Live (Dubai Innovation Impact Grant Programme. The company used the grant to develop its evidence base further by expanding its existing pilot, improve its off-grid energy supply, explore battery technology, and build a better shared-use model.

## Innovations to achieve affordability

The successful adaptation of e-mobility solutions requires innovative business models that go beyond the traditional direct sales model. Circular- and shared-economy approaches offer new opportunities, especially in low-income markets where users have only limited cash for investment.

MFA operates under a shared-use model, with group rentals and lease-to-own options. Groups with a shared productive use rent the Hamba from a central distribution centre, with the aim of cutting down on their transport costs. There is some evidence that groups using the vehicles have increased their incomes, enabling them in some cases to purchase the vehicle outright. The ownership cost is further reduced by the presence of a locally trained service and maintenance team, as well as affordable off-grid battery charging.

The Hamba costs USD 1,500 (without the batteries) if bought with an upfront capital payment. Alternately, groups pay a monthly rental fee of USD 15 (without batteries), making the device 30% to 40% more economical than traditional petrol-fuelled motorcycles, taxis, or public transport. MFA retains ownership of the batteries, enhancing affordability and improving service efficiency. This is a crucial innovation, as the batteries are the biggest cost component in EVs, requiring significant maintenance and complex end-of-life handling. Charging the batteries at a solar-powered station costs USD 0.15 for enough power to support an average daily commute of 30km. This is much lower than the operating cost of diesel-run bikes, which totals USD 5.50 for the same distance; thus, use of the Hamba provides significant cost savings to the end user.

MFA has also successfully deployed a PAYGo for battery charging, similar to those used for the small home solar systems provided by companies such as M-KOPA. The system accepts most locally common payment methods, including cash, and EcoCash transfers (a mobile payment service that uses a merchant account). MFA also offers microcredit support, trains drivers how to use the vehicles, provides maintenance services, and offers advice on income-generation opportunities. The company's primary target customers include smallholder farmers, workers in associated agriculture sectors (dairy, horticulture, poultry), and goods-trading groups. Small-scale farmers lease the Hamba in order to transport produce such as milk, fruits, tea, or coffee to market aggregators. This leads to less food spoilage, improving the farmers' bargaining power. Moreover, it improves farmers' access to agricultural inputs, other market participants, and credit institutions.

BUSINESS MODEL INNOVATION **MOBILITY SOLUTION WITH A COMMUNITY-BASED DISTRIBUTION AND SERVICE MODEL**
COMPANY **MOBILITY FOR AFRICA (MFA)**

**3**

© Mobility for Africa

Nurses at the Wedza hospital have manged to reduce infant mortality rates in their areas by using the e-tricycles to ferry pregnant and sick people to the hospital. (Zimbabwe, 2020)

## Success factors for business model innovtion

1. User-centric design: MFA's user-centric product design, developed in collaboration with its technical partners, played a big role in ensuring that the product meets the needs of the company's rural target market, especially for rural African women who often have little experience driving motorised vehicles, and have different transport needs than men. The Hamba has a comparatively small engine (1,000 watts), and has a maximum speed of 20km per hour, which is well suited for rural African road conditions and is safe for inexperienced drivers and children. The vehicle is easy to operate, and does not require women to straddle a seat, as they can drive while sitting on a bench-style seat, with both feet on a covered platform as opposed to motorbikes that are designed for men. Additional product-design alterations have improved the product further, for instance by adding cushions on the bench seats to improve comfort, and increasing the vehicle's load capacity for agricultural purposes. Constant product-design innovation, made possible by MFA's strong community engagement, is a major success factor in the company's business model innovation.

2. Exploring and expanding the potential of battery technology: Electric mobility is dependent on the availability of electricity, with battery-charging stations requiring much more power than what is typically available at the household level or in off-grid areas. MFA is working closely with battery manufacturers, providing them with insights on how their products are used for last-mile transport. The company is also exploring the potential of second-life battery technology for energy storage, working with a German startup, Betteries (www.betteries.com), in this area.

3. Cultivating partnerships: For electric vehicles to be viable in rural areas, off-grid solar partners must be available in order to power the vehicles. MFA has thus sought to develop partnerships with minigrid developers to build charging stations. These stations are equipped with battery-swapping facilities and spare batteries. This approach has provided minigrid operators with a steady stream of income, while reducing MFA's capital requirements, as the company does not have to build the charging stations itself. Currently, the company has partnerships with Zenergy and Solar Shack in Zimbabwe. Working with such partners helps make MFA's model both scalable and affordable.

4. Strong community engagement: Community engagement helps develop the local population's capacity to use and maintain the vehicles, while additionally speeding adoption. Such activities also help to counter gender bias and enhance inclusion. MFA's community engagement has enabled it to build a strong technical team that can provide maintenance services and assist with battery-swapping technology. This is a key aspect of the business model innovation's service model, and enables it to be scaled.

## Impact

**Community:** To date, MFA has created 43 new jobs for entrepreneurs, and impacted over 1,200 people's lives. By choosing to import low-cost components from China and assemble the electric tricycles locally in Harare, MFA has also created job opportunities and helped enhance local workers' skills.

As a part of the second pilot, around 20 Hambas were used by community service providers such as healthcare providers and local police representatives, with driving training provided by MFA. Women subsequently reported that the rate of in-hospital and safe births had increased. The police's "victim-friendly unit" used the vehicles to investigate cases of child abuse, and met their awareness campaign targets. During the COVID-19 pandemic, with the help of Hamba vehicles, a few women-run trading groups managed to obtain essential supplies from the nearby market during the country-wide lockdown, and sold them in villages.

**Organisational:** The organisation has grown to 15 full-time staff members, and established a pilot site in Zimbabwe with 60 vehicles and 150 female riders. It has collaborated with Solar Shack and Smart Building Solutions to create a solar charging station, and with Ziva on GPS tracking functions, and is working with Zenergy to explore battery-charging and efficiency improvements.

> "The Hambas are already shifting gender dynamics in the communities where women have access to them. Now it is the men who have to ask the women for a lift".
>
> Shantha Bloeman, Founder and Director, MFA

## Spotlight on beneficiaries

MFA's initial focus was and continues to be on rural African women who frequently spend much of the day on their feet either carrying out their housework or doing agricultural work. With its introduction of an affordable mobility solution, MFA has enabled the creation of several productive microenterprises, and has made it easier to transport produce to the local market. The company has expanded its target segment to include small-scale farmer groups that own less than six hectares of land, dairy farmer collectives, community service providers, women-run trading groups, and taxi-service groups. Most areas in rural Zimbabwe lack access to the power grid. More than 50% of unused cultivation-ready land is located more than six hours away by foot from the nearest market.

The Vandudzo group, a trading group made up of three women in Igava, was created after they had leased the Hamba. The group sells clothes, shoes, and other everyday materials. To avoid competition with products already sold at the local marketplace, the women travel door-to-door in villages and visit remote households. They accept all methods of payment, including barter trade. For example, a client who lacks any cash money can exchange clothes for maize or grain. "Without the Hamba, it would have been impossible to sell any goods. We have successfully created a market for ourselves in our community," one of the members of Vandudzo said.

Monica Zivoora joined the Zimbabwe Department of Agricultural Technical and Extension Services (AGRITEX) in 2010. She was excited to be one of the beneficiaries of the MFA pilot for service providers. Previously, Zivoora would spend six days assessing just 16 farmers, generally by hiring a bike from a local business for 3 USD per day, or by using her own vehicle once a week. With the Hamba, she now spends only two days to assess 16 farmers. Using the Hamba has thus reduced her transport budget, and reduced the time taken to execute her duties. "My job as a female extension officer is now much easier than before," she said. "Farmers are also benefiting as I promptly attend to their requests. Farmers appreciate the good gesture by MFA."

## Partnerships

Partnerships with minigrid operators and technical companies are essential for the company's business model and scalability. Additionally, MFA wants to demonstrate that mobility can enhance customers' ability to generate income, and partner with community organisations, development actors and local government to improve access to service delivery. MFA's e-tricycles can assist with critical development programmes, for instance with the last-mile transportation of vaccines. The company is also developing partnerships with agricultural companies and government agencies.

MFA partnered with the Toyota Mobility Foundation (TMF) in June 2019. In addition to providing a grant of USD 150,000, TMF provided hands-on technical support in the creation of an online data-management system; helped improve the manufacturing facility's safety measures and processes; invested in the development of a GPS-based tracking system; provided engineering-design consulting services for the Hamba; and supported in developing the business model.

In 2021, MFA will establish a second site in Chipinge. It will partner with Dairbord, a large national dairy company, We Effect, a Swedish NGO that invests in smallholder farmers, and the Zimbabwean Dairy Association. The plan is to deploy and test a fleet of 100 Hambas that small scale producers will use to get their milk to the milk collection points.

The following table describes MFA's partnerships and their roles in enhancing the company's business model innovation.

| Partner | Type | Role |
|---|---|---|
| Rift Valley Energy, Third Way Africa | Investors | ▸ Equity, debt and hybrid financing<br>▸ Strategic counselling and management, technical expertise |
| Zenergy | Private company | ▸ Supply-chain integration, provides modular battery pack |
| Solar Shack | Private company (Solar company in Zimbabwe) | ▸ Technical expertise |
| Betteries | Private company (Germany) | ▸ Developing circular-use model for batteries/second-life batteries |
| Toyota Mobility Foundation | Foundation | ▸ Grant<br>▸ Technical support<br>▸ Business adviser |
| Tsinghua University, UN Environment | Academic partners | ▸ Research and teaching<br>▸ Stakeholder education |
| The Energy and Environment Partnership Trust Fund (EEP Africa), | Trust/donor | ▸ In partnership with Rift Valley and Betteries, MFA has received a grant of EUR 500,000 to set up operations in Tanzania |
| The Africa Enterprise Challenge Fund (AECF) | Development institution, donor | ▸ The grant agreement provides MFA with USD 350,000 over three years to scale up operations in Chipinge (Zimbabwe) for small-scale dairy farmers |

# CUSTOMER FINANCE WITH LOAN GUARANTEE FUNDS


Women use ONergy solar pumps for safe drinking water (West Bengal,2018)

## Key challenges

One of the main factors limiting the use and ownership of productive appliances by last-mile customers[22] in low-income settings is the high upfront capital costs associated with acquiring this equipment. The National Sample Survey Office[23] in India estimates that the net average annual income from farming hovers around USD 1,100. Additionally, while the area of land farmed by a single individual or family has, on average, been shrinking every year to currently about one operational hectare per farmer, the cost of a typical three-horsepower (hp) submersible solar-powered water pump has remained at around USD 2,500. Despite various government subsidy schemes that reduce the cost to about USD 1,000, this is still unaffordable for most farmers. In October 2019, the Union Minister from the Ministry of Power, India announced that more than 180,000 solar-powered water pumps were operational in the country at that time, and the government had set a target of 1 million by the end of 2022. Today, nearly nine million pump sets still use diesel fuel, and an additional 21 million are connected to the electric grid.[24] Demand for sustainable irrigation far exceeds current available pumping capacity, and uptake has been slow.

CASE STUDY COMPANY
**Punam Energy (ONergy)**

PRODUCTIVE APPLIANCE
**Solar-powered water pumps (3 and 5 hp)**

SIMILAR BUSINESS MODEL INNOVATIONS
**Selco, Boond, Claro, Jain Irrigation**

To improve affordability, access to low-cost customer finance is needed, with mechanisms that tie repayment amounts to the amount and frequency of the income generated. Many companies partner with microfinance institutions and banks to offer such finance, but efforts to expand these financial products further have been hampered by financial institutions' low risk tolerance and the requirement that farmers provide collateral in order to mitigate their credit risk. Separately, water pump sales dependent on financing schemes or service models are often bottlenecked by the lack of intermediary asset management companies.

22 The term 'last mile' is used to describe the short geographical segment associated with delivering communication and media services or delivering products to customers located in dense areas. Last-mile logistics tend to be complex and costly for the providers of goods and services that deliver to these areas (Last Mile Distributors Collective).
23 National Sample Survey Office data from 2013.
24 Institute for Energy Economics and Financial Analysis (IEEFA). India: Vast Potential in Solar-Powered Irrigation, 2018, https://ieefa.org/wp-content/uploads/2018/08/Indias-Vast-Potential-in-Solar-Powered-Irrigation-.pdf


Farmers are providing adequate irrigation to their crops with ONergy solar pumps and saving by elimination of recurring diesel costs. (West Bengal, 2019)

## About the innovation

The transition to solar pumps is essential in order to reduce emissions and avoid over-reliance on land-intensive utility-scale solar projects, which is an especially sensitive issue in a country as densely populated as India.

As of 2019, 96 companies had been selected[25] by the Indian government to offer solar water pumps on a subsidised basis, with larger companies such as Jain Irrigation Systems, Kirloskar Pumps, Tata Solar, Waree, and Topsun leading in terms of sales volumes. The target customer segments for these larger companies are mostly established landowners or commercial farms.

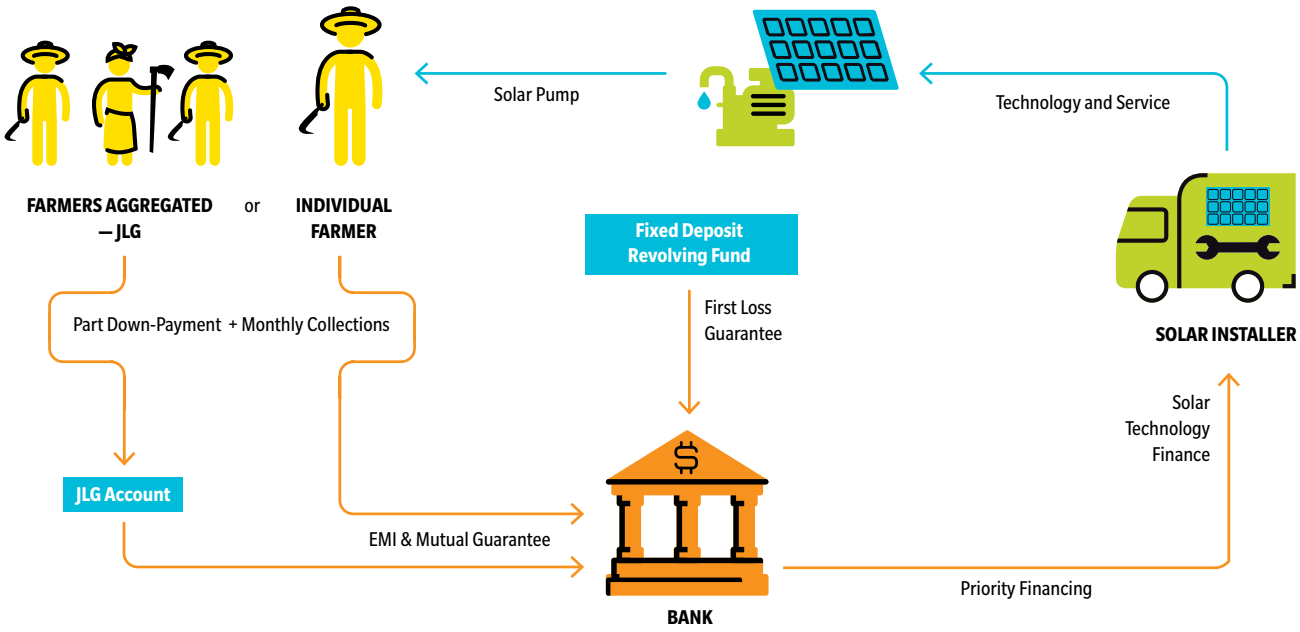
By contrast, companies such as ONergy, Claro, Boond, Selco, Oorja, and Alpex work primarily with small and marginal farmers. These companies' business models nearly always involve the development of strong relationships with banks and financial institutions which reduces the risk associated with last-mile customers. Some have also adopted a PAYGo model. Due to the high level of engagement required for last-mile relationship management, most of these companies are restricted in their geographical reach and have not scaled significantly. This highlights the need for a systemic and broad end-to-end solution that is independent of the characteristics of local regions or specific banks.

ONergy (along with its non-profit partner SwitchON) is championing a risk guarantee fund that minimises the probability of non-repayment for the banks by mitigating the consumer's underlying credit risk. Loan guarantee funds have been used internationally with varying degrees of success (often in the agricultural sector). They act as an enabler to establish a measurable, quantifiable market demand, and so the fund is professionally managed. These guarantee schemes typically cover between 50% and 70% of the loan value and are often connected to the purchase of an underlying productive asset. The real contribution by ONergy is providing client-education and loan-facilitation services (e.g. by taking responsibility for both collection and the creation of the joint liability group (JLG[26]) as a part of their distribution and sales processes. The use of this mechanism, by an energy-access enterprise, for the purpose of distributing productive appliances such as solar-powered water pumps, is novel and can go a long way towards unlocking end-customer financing.

25 The government of India selects companies (often using a tender process) that are offered subsidies and loans from government banks. This selection is performed so as to ensure quality and delivery-process standardisation.

26 A JLG is a group of four to 10 people from the same village or locality of homogenous nature, generally coming from a similar socioeconomic background, who come together to form a group for the purpose of taking a loan from a bank without any collateral.

## Illustration of business model innovation




Loan guarantee funds have been successfully used in several other countries within the microfinance and agricultural sectors. In Nigeria, the Agricultural Credit Guarantee Scheme Fund was established in 1977 with the aim of increasing the level of bank credit available to the agricultural sector. It provides a refund of 75% to the lending bank of any amount in default (principal and interest), after recovering any amount realised from the collateral held. The Alliance for a Green Revolution in Africa (AGRA) has used USD 17 million in loan guarantees to reduce formal financial institutions' lending risks. Its partners (local energy-access organisations) successfully leveraged this to obtain USD 160 million in loan funds from commercial banks in Kenya, Uganda, Tanzania, Ghana, and Mozambique.

In the context of energy access, the most successful models have been driven by funding organisations, such as the Infrastructure Development Company (IDCOL) in Bangladesh, in collaboration with NGOs such as the Bangladesh Rural Advancement Committee[27] and Grameen Shakti. These non-governmental organisations (NGOs) sell solar home systems to households and small businesses, mostly on a cash-sale basis or through the use of microcredit schemes. IDCOL provides refinancing facilities to the NGOs, and also gives funding to the NGOs that help reduce the cost and increase the affordability of the systems for rural customers.

When most of the guarantee funds in the market are aimed at making the banks lend at all, SwitchON and ONergy take this innovation further by working with the banks and persuading them to lend at lower than market rates and making appliances more affordable for smallholder farmers.


© ONergy

Farmers are satisfied after installing ONergy solar pumps (West Bengal, 2019)

27 BARC is an international development organisation based in Bangladesh. In order to receive foreign donations, BARC has been registered with the NGO Affairs Bureau of the government of Bangladesh.

CASE STUDY

# ONERGY (PUNAM ENERGY), WITH PARTNER SWITCHON FOUNDATION

First-loss default guarantee fund helping banks extend low-cost loans to farmers

© ONergy

ONergy solar pumps are installed after thorough inspection of the sites to provide maximum benefit to the farmers (West Bengal, 2018)

## ONergy at a glance

According to the Indian Council of Agriculture Research, the area under irrigation in India accounts for just 48.8% of the 140 million hectares of the country's agricultural land, with the rest rain-fed. This prevents farmers from maximising potential gains from their land. The high cost of water pumps is cited as the main factor slowing access to irrigation. Customer financing for the purchase of solar pumps has been promoted, but with little overall success. This is because financial institutions are averse to extending loans to this customer segment without collateral or a repayment guarantee.

The first-loss default guarantee fund was set up to de-risk lending by commercial banks and facilitate below-market interest rates.

**Key figures**

- Key geographies: India (currently working in 13 states)
- Team: 140 staff members
- Turnover: USD 2.5 million in 2019
- Installed systems: 7,081 units
- No. of beneficiaries (2017): 500,000
- Year founded: 2009

**Business model innovation**

- Product: Solar water pumps
- BMI: Guarantee funds for end-user finance
- SDGs addressed:


**Contact details**

- Website: www.onergy.in
- Vinay Jaju, Cofounder

"Solar pumps have doubled farmers' incomes in less than a year. For the technology to scale, consumer financing was critical, because banks were unwilling to finance a 'risky technology' for 'unbankable' customers. That is where the guarantee fund became particularly important in helping capital flow into the sector".

Vinay Jaju, cofounder, SwitchON and ONergy


More women entrepreneurs are placing their trust on ONergy solar pumps (West Bengal, 2018)

## Innovation at ONergy

ONergy has worked on last-mile solar energy access for the past 11 years. The company's key focus has always been to ensure affordability for their customer segment, which predominantly consists of smallholder farmers earning less than USD 10 per day. To reach this target group, the company has increased innovation, with a special focus on facilitating last-mile distribution through agent networks. Additionally, unique full-service distribution infrastructure points (called renewable-energy centres) have also been established which provide distribution, installation, and after-sales services. The company also partners with banks and Microfinance Institutions (MFIs) through its non-profit arm, called SwitchON, to provide consumer loans for its rooftop and home solar system products. In addition, it has been working collaboratively with the government on several national renewable-energy schemes.

In 2014, the company started exploring solar-powered water pumps, which is of high relevance to Indian smallholder farmers. It is widely acknowledged that solar water pumps are extremely beneficial to farmers, as they allow growers to increase crop yields and accommodate three annual crop cycles without depending on rainfall.
With high levels of insolation and a preference for growing water-intensive rice (at least in one agricultural season) in the area, water-pumped irrigation substantially increases farmer production, thereby generating higher incomes.

According to ONergy CEO Piyush Jaju, the biggest challenge with regard to banks is their unwillingness to take risks with underserved populations, many members of which lack credit histories and collateral or security enabling them to access loans.

In 2018, the company realised that a first-loss guarantee fund could be effective in reducing banks' perceptions of risk associated with marginal farmers. ONergy thus decided to develop a first-of-its-kind fund supporting the sales of solar-powered productive appliances. With funding from the Pacesetter Fund from USAID and the Indian government's Ministry of New and Renewable Energy, the company, in partnership with the non-profit SwitchON Foundation, set up a first-loss default guarantee (FLDG) fund. The aim was to enable national banks, such as Ratnakar Bank and Axis Bank, to extend loans to marginal farmers, enabling them to acquire solar pumps from the company at below-market interest rates. The initial amount of the FLDG was USD 50,000, but the fund was recapitalised to a sum of USD 250,000 in 2020.

The company launched a challenging pilot project in 2018. This involved the identification of adequate sites for the intervention, thorough research including a baseline survey of 289 villages and 1,880 socioeconomic surveys of farmers in West Bengal and Jharkhand, numerous awareness-raising programmes, exposure visits, and meetings with bank employees and farmers about solar pumping systems.

The 224 farmers who expressed interest in acquiring solar pumps were grouped into 30 JLGs or water committees – these being informal groups preferably comprising between four and 10 individuals – to access bank financing. The company selected these farmers based on a detailed analysis of their water use, payment capacities, asset ownership, and history with bank services.

These farmer groups then accessed bank loans on the basis of a mutual guarantee and support through the FLDG. The FLDG acts as a catalyst for banks, building their confidence in solar pump lending and allowing farmers to access the much-needed technology. This fund provides a first loss guarantee (partial guarantee) topping out at a maximum of 80% of the farmers' total loan, while the farmers need to provide the remaining 20% as a down payment.

The loan payback period is typically five years and is calculated based on the savings relative to diesel consumption, and does not take into consideration the increase in productivity and income associated with aspects such as water storage, fisheries, etc. The calculation also excludes any type of subsidy involved either in the purchase of the fuel or the solar pump. The figure can be expressed as the minimum annual savings accrued by a farmer after installing the solar pump.

In 2019, a total of 10 out of 65 farmers supported experienced delays in loan repayment often due to low agricultural yields, thus requiring intervention by the company. Given this history, SwitchON is now taking the approach of buying back the assets from farmers as a last resort for those who are unable to pay back their loans. SwitchOn then sells these assets on the secondary market. However, in most cases, they seek to support the farmer to boost yields/revenues and offer payment holidays if the arrears are caused by a temporary issue, such as a bad season. SwitchON Foundation monitors the repayment of JLG loans on an ongoing basis and works closely with the banks for collections.

### Success factors for business model innovation

- **Strong product expertise:** ONergy has considerable experience working with decentralised renewable-energy products, a fact that has strengthened its understanding of the market for solar pumps. The company's focus on customer support ensures that any issues requiring maintenance or repair are handled swiftly.

- **Partnerships:** As financing is usually the biggest constraint for almost all productive appliances especially solar pumps, securing buy-in from banks has been one of the most crucial enablers for the guarantee fund. An important initial success factor was the fact that banks already had an existing interest in solar energy and solar pumps. The work the company has done with regards to customer profiling has helped to understand the actual level of risk. This has been critical in repairing financial institutions' lack of trust in farmers and solar pumping technology.

- **Community engagement:** Few smallholder farmers in eastern India have sufficient land to be able to afford a solar pump themselves, no matter how small-scale it may be. The farmer group or JLG model has made them 'bankable' customers, as several members share the financial burden and benefits, collectively making contributions towards repayment. This financial innovation, the creation of an associated ecosystem, and parallel technology innovations, have led to greater water conservation and better soil health. SwitchON plans to implement a Ground Water Recharge Program through a participatory groundwater management programme in six locations where water-table depletion may be an issue in future.

## Spotlight on beneficiaries

ONergy (SwitchON) caters to smallholder farmers who typically own less than two hectares of arable land. A typical smallholder farmer in eastern India, where ONergy operates, holds an average of 0.6 hectares, earning an average of around USD 1,633 annually.

"I had to worry about water before solar pumping. My husband would have to go and look for more work. With access to solar pumping through the first-loss default guarantee model, I am able to earn extra income and have a better quality of life".

Sonali Biswas, 36, from Hoogli district in West Bengal

Sonali Biswas is one such farmer who has benefited from this SwitchON innovation. Previously, two of her four hectares of land remained unused given the lack of access to pumping technology. Irrigation of the additional area has generated extra income. This has resulted in an improved quality of life, for instance allowing her to upgrade from a kutcha (raw mud) house to a pucca house (built with bricks and cement). She is also able to save more and use the extra money for her family's education or health care. Solar pumping has also enabled her to expand the variety of crops grown to include six or seven more types of vegetables, thus increasing her resilience to demand shocks.

© ONergy

Micro-irrigation systems such as sprinklers attached with ONergy Solar Pumps are integral for climate smart agriculture (West Bengal, 2020)

Quotes from other farmers:

**"We struggled to earn profit from farming because of the high amount of investment in inputs and irrigation. With water available at a press of a button, we have been able to grow an additional crop".** Haradhan Samanta, Narith Karmargaria Village, Howrah district, West Bengal

**"When SwitchON (ONergy) told us about the drip-irrigation project, I wasn't sure it would really work. I also knew these types of systems are expensive, so I didn't think I would have the capacity to pay for one. But now we're happy to see how much progress we've made. We are now able to cultivate more varieties of crops and make a profit by selling water to other farmers. Not only am I producing more, but there are also fewer economic and environmental costs".** Dhrubaprasad Latua, Sut Chhara Village, Paschim Medinipur District, West Bengal

## Impact

**Community:** ONergy has financed more than 70 JLGs to date, impacting the lives of around 1,000 people. Beneficiaries saved approximately 25% compared to the expense of running diesel pumps. The social impacts can be clearly seen in the form of improved living conditions and household savings. Traditionally, farmers in eastern India used to grow crops three times per a year. Increasing demand has compelled them to shift from traditional irrigation techniques to diesel-powered pumps.

However, the recurrent expense of the diesel fuel has reduced their growing capability to only twice per year. Following installation of the solar-powered pumps, they have returned to their traditional practices. The elimination of the recurring diesel-fuel costs also allows farmers to use the optimum amount of water for irrigation, thus increasing their output.

**Organisational:** The ONergy team has grown to 140 members, working across 13 states in India. Partnership with banks supported by the loan fund has enabled the company to build relationships with farmer groups, joint liability groups, and other actors in the agricultural sector, further fuelling the scale-up of the company.

**Environmental:** The environmental impact has come largely in terms of $CO_2$ emission reductions. The company believes that implementing the water pumps supported by their loan guarantee business intervention has helped to reduce annual $CO_2$ emissions by 115,000 tonnes in comparison to use of diesel-powered pumps.

## Partnerships

To implement the FLDG model, SwitchON partnered with Ratnakar Bank (RBL). RBL is recognised as one of the leading banks in the country for the funding of agricultural activities. As part of its social and environmental commitment, the bank has promoted the installation of solar pump sets, by helping to replace old and energy-inefficient diesel pump sets. The bank also helps farmers access credit through formal channels which helps them to avoid exploitation by money lenders. Nevertheless, it has struggled to provide loans to small and marginal farmers lacking collateral.

Most banks consider this customer segment and technology to be risky. As a result, the most important part of the partnership was the trust RBL Bank placed in SwitchON to select the right customers and ensure timely repayments. The fact that RBL Bank's senior management was already interested in the solar pump market was an enabling factor that was strongly supported by the loan guarantee fund. SwitchON signed a business correspondence agreement with RBL Bank that also assigned the responsibility for collecting loan payments from the farmers to SwitchON.

RBL sees these activities as important in meeting its goal of leading the banking sector in the promotion of sustainable development, while also potentially broadening its customer base to include previously untapped market segments. The company hopes that the model will help bring millions more underbanked and unbanked farmers into the formal system, thus improving their lives and financially empowering them for the future.



Women Farmers have started earning more after installing ONergy solar pumps (West Bengal, 2020)

"RBL Bank is committed to providing financial services for supporting sustainable energy-efficient irrigation systems and renewable-energy programmes for farmers".

Manoj Rawat, General Manager – Agri-business, RBL Bank.

Role of partners in the business model innovations

| Partner | Type | Role |
|---|---|---|
| Pacesetter Fund (USAID), Indian Ministry of New and Renewable Energy | Funding organisations | ▸ Provided initial grant for FLDG fund |
| Ratnakar Bank (RBL), Axis Bank | Financial institutions | ▸ Extended the credit to last-mile customers |
| SwitchON (environment conservation society) | Non-profit organisation | ▸ Provided FLDG to the bank as collateral<br>▸ Identified customers and facilitated (and created if required) the JLGs<br>▸ Conducted awareness and promotional campaigns<br>▸ Collection of instalment payments as bank correspondent |
| Punam Energy (ONergy) | For-profit energy-access enterprise | ▸ Installation and sale of solar water pumps<br>▸ Service and maintenance as required |

## Replication and scalability

ONergy's vision with SwitchON is for the Indian government to adopt the guarantee scheme as a fully-fledged policy intervention. The company's experience in working with national banks and JLGs on this initiative could serve as a template for other banks and renewable-energy companies across the country, and even in other countries. However this is feasible only if supportive financial institutions are identified.

SwitchON's site selection matrix (see table below) is an essential tool in replicating the concept of the fund, as it helps to identify the right kind of customers, and thus increase banks' trust. The accumulation of loan performance data over time provides banks with the confidence to see this historically neglected segment as a new customer base.

### Site selection matrix[28]

| Assessment criteria | Highest score | Explanation for scores |
|---|---|---|
| Type of pump | 15 | Replacement of conventional fuel pumps will reap highest cost-benefit ratio |
| Grid connectivity | 10 | Reliability/access to grid |
| Water availability | 5 | Perennial source of water is a minimum requirement for maximum resource utilisation |
| Alternative use of land | 5 | Not suitable if the land has potential for use with commercial value greater than that of agriculture |
| Crops grown per year | 20 | Type of crop grown is often the most crucial criteria for the commercial success of the solar pump |
| Months of use of pump/year | 15 | The current envisioned used of pump should be calculated for at least nine months |
| Pumping hours | 10 | Minimum 1,080 hours of irrigation water pumping hours per year |
| Area of land under cultivation | 5 | A minimum of 2.5-3 acres of land should be under cultivation to optimise use of the solar water pump |
| Potential of JLG formation | 15 | The group should consist of at least four members with adjoining land and a similar socioeconomic background, who are willing to cooperate |

Another important initial success factor has been the renewed interest in solar and solar pumps, mostly due to the launch of government schemes and subsidy programmes. The company's work in profiling potential customers and helping to analyse risk (initial due diligence and identification of appropriate customers) has also been critical in bridging financial institutions' lack of trust in farmers and solar pumping technology. In addition, the innovative use of the joint liability method helped the company overcome these barriers to success.

To further improve the ecosystem for scaling and replication, several other factors should be encouraged:

**a) Awareness should be increased at all levels:** There is still much to be done with regard to raising awareness of the long-term viability and economic benefits of solar energy, both among financing providers and farmer groups. The government can play a role here by raising awareness through promotions, exposure visits, and other means. Furthermore, the government could provide support by recommending that banks simplify and standardise the loan application, documentation, and credit disbursal processes.

**b) Subsidies should be redirected:** Funds currently utilised to provide electricity or fuel subsidies to smallholder farmers can also be provisioned for the provision of interest subsidies for the purchase of solar pumps and other such products. Support for interest rather than capital subsidies would go a long way towards establishing trust between the banks and target customer groups.

28 Site selection matrix designed for farmers currently using diesel pump sets.

# INCOME GENERATING OPPORTUNITIES



S4S Technologies' microentrepreneur partners dehydrate agricultural produce with a solar conduction dryer

CASE STUDY COMPANY
**S4S Technologies**

PRODUCTIVE APPLIANCE
**Solar conduction dryer**

SIMILAR BUSINESS MODEL INNOVATIONS
**Jain Irrigation Systems Ltd., Resham Sutra, Ankur Scientific, JUMEME, DESI Power**

## Key challenges

Productive appliances have the potential to improve people's lives and increase productivity and earnings. Yet for low-income people with average daily incomes of between USD 1.90 and USD 5.50, and consequently limited ability to accumulate savings, purchasing productive appliances is a challenge. Lease-to-own models, in which customers purchase the appliance with a small upfront payment of around 10% to 20% of the product's value, and repay the remaining amount in instalments over the course of two to four years, can significantly lower the entry barriers. However, even in such cases, customers must generate earnings in order to be able to pay back the loan.

## About the innovation

Companies that sell productive appliances to low-income people using a lease-to-own or service model have a strong interest in ensuring that customers can pay back the loan or afford the service fee. Selling machines for productive use instead of household use can make a big difference. In an ideal scenario, customers will use the appliance to increase productivity, sales, and earnings, and are therefore more likely to pay back the loan or pay the regular service fees. However, in reality, customers often struggle to access markets, and are thus unable to sell their goods and generate enough income to repay the loan despite having the new machinery.

Some innovative companies have clearly understood this customer challenge, and have turned it into a business opportunity. In addition to selling productive appliances, they offer customers a buyback option for the manufactured products or agricultural produce, and hence provide guaranteed access to markets. For example, in a contractual arrangement, they may agree to purchase a certain amount of produce for a predefined price. For the customers, this model provides secure market access and a reliable income as they can be certain that they will have paid back the loan after a specific period of time. After that, they can use their appliances to generate profits that can be reinvested in their business or for their families.

For the company, this business model reduces customer payment default risks, and opens up new revenue channels, for example, in the agribusiness sector. It can also be an entry point to new customer segments for appliances, and an effective way to increase customer retention. For example, Jain Irrigation, India's largest drip-irrigation company, offers farmers a guaranteed agricultural-produce buyback option with pricing above the market rate. Its primary aim is to sell drip-irrigation technology that can increase farmers' productivity and yields. Growers that have a guaranteed buyer for their produce feel more comfortable in investing in a productive appliance. This allows Jain Irrigation to maintain a close relationship with its clients, growing with them and continuously providing them with the equipment they need at different points along their growth trajectories.

S4S Technologies women workforce

However, this new business model also requires that the company undergo a wholesale transformation. Instead of solely selling productive appliances to customers, it takes on a role in a completely new value chain, becoming an aggregator or trader of intermediate goods. The Jain Irrigation example, in which these intermediate goods are agricultural products, is quite common, as the great majority of low-income customers are farmers.

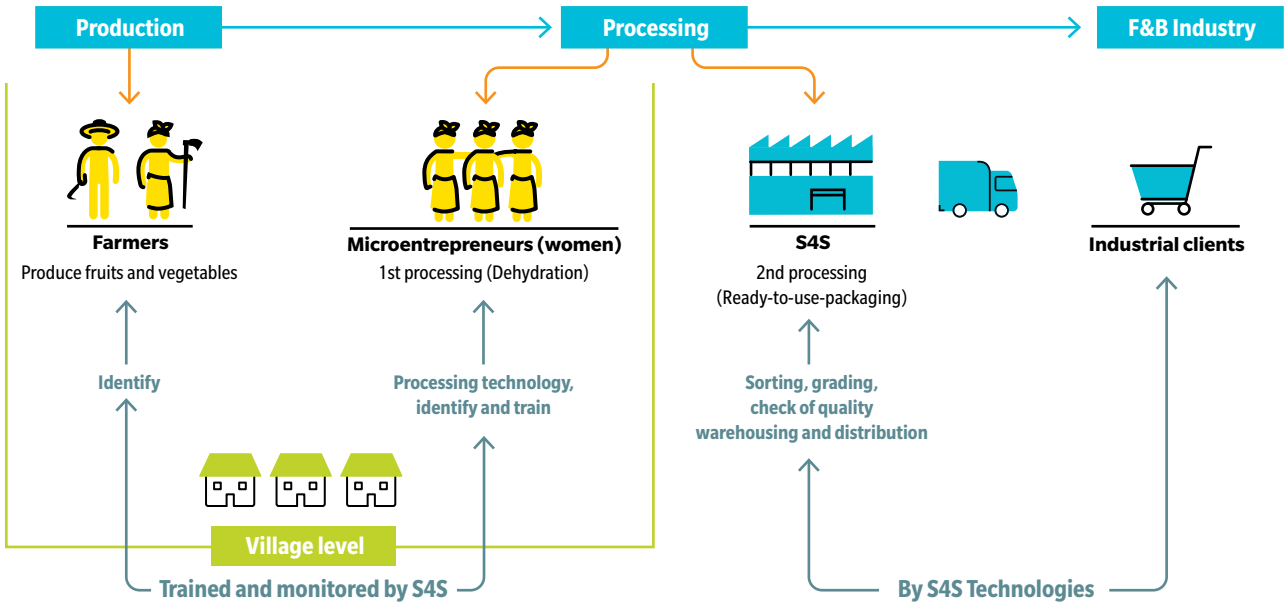
Companies such as Indian social enterprise S4S Technologies go a step further. Rather than simply purchasing agricultural produce, the organisation provides its customers with an entire support ecosystem to help them produce higher-value products. For example, S4S sells solar conduction dryers to microentrepreneurs, while also linking them with financial institutions providing a lease-to-own financing model; supplying them with raw materials such as onions, turmeric and ginger; training them to cut and dehydrate the products effectively; and paying them a fair price for processing the produce.

S4S has transformed its own business model, going from being a traditional seller of appliances to becoming an agricultural processing company that generates revenues through the sales of dehydrated perishables to the food and beverage industry. This business model has allowed S4S to become more resilient, and has significantly increased its scale and profitability.

A business model transformation of this kind is not possible for all productive use appliance companies, and indeed only works in some contexts. In fact, many appliance companies are reluctant to become agricultural-product aggregators, because they see this as outside of their core businesses, and because such activities are associated with a number of risks, ranging from new regulations to additional funding requirements for transportation and equipment. As an alternative, some companies have developed innovations around access to market information, or provide capacity-building support focusing on good agricultural practices; in either case, the goal is to ensure that their customers have good market access, thus minimising credit-default risks.

We selected S4S Technologies as a case study because its experience demonstrates the business potential associated with creating income-generating opportunities for customers by providing them with a comprehensive set of support mechanisms, ranging from access to machinery and inputs to the guaranteed purchase of value-added intermediate goods. S4S Technologies has designed a business model that aligns its commercial interests strongly with its customers' interests, and which includes risk-sharing mechanisms. Even though S4S's solar conduction dryer is an electricity-free appliance, the business model can also work with similarly priced electrical productive appliances.

## Illustration of business model innovation



CASE STUDY

# S4S TECHNOLOGIES

## Reducing food waste and generating income opportunities for women microentrepreneurs with solar conduction dryers



S4S Technologies' cofounders Dr. Shital Somani, Nidhi Pant, Swapnil Kokate and Ganesh Bhere (left to right) with grower women farmer

## S4S Technologies at a glance

S4S Technologies is a for-profit social enterprise. The company has developed an award-winning electricity-free solar conduction dryer that can dehydrate food products and increase produce shelf life by one year without the addition of any chemicals or preservations. To enhance ffordability, S4S Technologies has developed an innovative business model around microentrepreneurs and provides customers with an entire support ecosystem that helps them produce higher-value products. S4S Technologies further processes the dehydrated perishables and sells them to companies in the food and beverage industry. For the company, this business model reduces the risk that its customers will default on payments, while additionally opening up new revenue channels in the agri-food sector.

## Innovation at S4S Technologies

In 2011, S4S Technologies cofounder Vaibhav Tidke started with a bold idea. Having grown up in rural India, and having seen the dramatic levels of food waste in the country, the university graduate wanted to develop a low-cost technology that would allow farmers to increase the shelf life of their perishable produce. Subsequently, Tidke and six other technology entrepreneurs founded Science for Society (S4S) Technologies as a social enterprise, and designed a patented solar conduction dryer that can dehydrate a wide range of harvested crops, including fruit, vegetables, grains, and spices.

**Key figures**

- Key geographies: Based in Navi Mumbai, Maharashtra, India; operation in Aurangabad, India
- Team: 65 employees
- Turnover: USD 1.64 million (2019)
- No. of clients: 800 industrial customers producing 1 million meals per day using S4S products
- Year founded: 2011

**Business model innovation**

- Product: solar conduction dryer
- BMI: Income generating opportunities
- SDGs addressed:


**Contact details**

- Website: https://s4stechnologies.com/
- Nidhi Pant, cofounder




S4S Technologies performs secondary processing of the dried produce at its own factory

"Over 40% of all fruits and vegetables in India are lost because of short shelf life, lack of preservation, and unattractive fruits. This results in immense income losses for low-income farmers."

Vaibhav Tidke, cofounder, S4S Technologies

The low-cost dryer uses solar power to convert fresh fruits and vegetables into dehydrated products so that they can be used as processed-food ingredients or convenience foods. The process works through conduction, convection, and radiation, and increases the shelf life of fruits and vegetables to more than one year, while at the same time maintaining more than 85% of the nutrients.

The dryer is manufactured in India, and its 10-by-6-foot design is designed for a rural farming context with little need for maintenance. The electricity-free dryer incurs minimal operating costs. It can dry two to three batches a day, converting 200kg of perishables a day into dehydrated food. The dryer can dehydrate onions, garlic, ginger, and turmeric, as well as other fruits, vegetables, or even meat and fish. The company has won several awards for its technology innovation, including the Dell Social Innovation Challenge Award in 2013.

S4S Technologies began selling its dryers in 2014, and rapidly sold 2,700 machines in more than 15 countries. However, the company soon realised that the smallholder farmers that its founders had in mind when designing the dryer were not able to afford the technology, in many cases because they did not have access to a market for dehydrated products. Thus, S4S Technologies founders began to explore ow they could make the productive appliance more affordable, and decided to offer farmers guaranteed market access by turning S4S Technologies itself into a trader in specialised agricultural products.

"It was challenging to sell our award-winning technology to smallholder farmers, as they did not have enough money to buy it, and had limited access to markets for fresh, let alone dehydrated products".

Nidhi Pant, cofounder, S4S Technologies

In 2018, S4S Technologies developed an innovative business model focusing on women microentrepreneurs. Instead of regarding their potential customers as sitting only at the end of the value chain, S4S Technologies aimed to integrate them into the enterprise's business model. S4S Technologies buys fresh produce, especially onions, garlic, ginger, and turmeric, from smallholder farmers, providing them with a secure market for their agricultural products. Field executives collect the raw materials once a week and deliver it to selected women microentrepreneurs who are equipped with a solar conduction dryer, a cutting machine, a pre-processor and a second processor.

S4S Technologies trains these microentrepreneurs on how to use the equipment effectively, and pays them a fixed service fee of INR 130 (USD 1.8) per 60kg batch of dehydrated product. Subsequently, S4S Technologies aggregates the dried produce, performs a secondary processing step at its own factory, and sells the final product to its customer base, a group of more than 800 entities that includes food and beverage companies, consumer goods companies, distributors, hotels, and restaurants. In this way, S4S Technologies eliminates waste, acts as a guaranteed buyer, and enables farmers to create a higher-value product.

"Instead of being a seller of solar conduction dryers, we are now a decentralised food processing platform that converts food losses to value-added products".

Nidhi Pant, cofounder, S4S Technologies

For the women microentrepreneurs, S4S's business model is straightforward. The women need to pay a small initial fee to demonstrate their seriousness, and then purchase the solar dryers and the other processing equipment using a lease-to-own model. They are supplied with raw material at least once a week. When delivering the dehydrated produce to S4S Technologies, they are reimbursed for the costs, and paid an additional value-added fee.

To provide the microentrepreneurs with low-interest loans, S4S Technologies collaborates with Avanti Microfinance, a leading Indian microfinance institution (MFI). The MFI lends

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S4S microentrepreneurs Mrs. Prabhavati Padul and Mrs. Shakuntala Ganesh Ghayati were two of the early adopters

INR 100,000 (around USD 1,356) to the women, who then make monthly repayments of INR 3,300 (around USD 45) over the course of 24 months. S4S Technologies pay the instalments to the MFI on behalf of the women and recovers the amount by deducting it from their processing service fee. As such, S4S Technologies acts as a guarantor for the microentrepreneurs. If one of the entrepreneurs is unable to pay the remaining balance on her loan, S4S Technologies offers the option of repaying the full loan on her behalf, and recovering it from the processing service fees over an extended period of three to five years. Therefore, microentrepreneurs do not have to make a direct cash payment to S4S Technologies or the MFI, but can repay via the deductions from their processing service fees.

## Impact

**Community:** At present, S4S Technologies is working with more than 3,000 farmers, 270 women microentrepreneurs, and 13 field executives in the districts of Aurangabad and Maharashtra in India.

An economic-impact study by the Bill and Melinda Gates Foundation found that women could increase their income by between 50% and 200% by becoming microentrepreneurs with S4S Technologies.[29] A survey by the Shell Foundation and the UK's Foreign, Commonwealth and Development Office showed that this increased income has significant social effects for the women.[30] For example, it has allowed them to gain independence from money lenders, earns them more respect

## Spotlight: Benefits of working with women microentrepreneurs

Interview with Nidhi Pant, cofounder, S4S Technologies

**With its buyback mechanism, S4S Technologies buys suitable crops from local farmers and trains agricultural entrepreneurs, usually landless women farmers, to dry them. Why does S4S Technologies focus on women entrepreneurs?**

**Nidhi Pant:** Our business model is intentionally designed around female entrepreneurs. It is our experience that women are more dedicated to providing for their family, and we want to give them the opportunity to do so. Most of the men migrate to the cities in search of alternate income opportunities. However, the money they earn hardly reaches their families back in the villages. This is different for women: most of what they earn goes directly to their families. The additional income empowers women, giving them a better standing in the community and more decision-making power in family matters. We also work with women because, in our experience, they are more reliable and have greater skills in food processing operations.

**How do you select the microentrepreneurs?**

**Nidhi Pant:** We select the women microentrepreneurs with the support of NGO partners that have a good standing in the farmer communities. An S4S Technologies field team works with the NGOs to identify sites that allow relatively convenient road access in order to manage the supply of agricultural produce. We also check which crops are and can be cultivated in the area, to make sure we can meet the demand. The microentrepreneurs are selected based on three main criteria. First, we check if their homes have access to the single-phase electricity needed to power the cutting machines. Usually, most of the areas we work in are connected to the grid. In addition, they need to have a bank account for the transfer of payments, and we check that there is no alcoholism in the family.

29 S4S Technologies' economic impact on the women microentrepreneurs was studied by the Gates Foundation and the National Institute of Nutrition. Information provided by S4S Technologies.

30 S4S Technologies' socioeconomic impact on the women microentrepreneurs was studied by the Shell Foundation and DFID. Information provided by S4S Technologies.

from family members, and enables them to make decisions within the family. Moreover, the families can invest more money in healthcare and education.

**Organisation:** From an economic perspective, S4S Technologies' new business model is more profitable and sustainable than just selling solar conduction dryers. The company has increased its revenue seven-fold since the adoption of the microentrepreneurship model. This is primarily due to the new business model which generates recurring revenues rather than one-off payments. Furthermore, this business model ensures a reliable uptake of solar conduction dryers thanks to the steady growth of the number of microentrepreneurs. In 2019, before the COVID-19 pandemic, S4S Technologies had 800 customers in two cities with average monthly revenues of USD187,000, and a profit margin of between 15% and 30%.

**Environment:** S4S Technologies has a direct impact on environmental sustainability as it reduces the volume of food waste. Through its operations, the company eliminates 13,500 tonnes of food waste and offsets 108,000 tonnes of $CO_2$ emissions every year.

## Spotlight on beneficiaries

"Integrating women microentrepreneurs into the value chain enables them to earn additional income".

Nidhi Pant, Cofounder, S4S Technologies

Mrs. Sunita Rambhau Kolte is one of S4S Technologies' 270 microentrepreneur partners. The 35-year-old does not have any formal education and had no work opportunities in her small village in Maharashtra. She relied on minimal income from farming on her family's small plot of land. With earnings of USD 120 a year, she lived well below the poverty line. Her attempts to offer household tailoring services failed, as there were no customers in her village. Since joining the S4S Technologies microentrepreneurship initiative she has increased her income. She now earns USD 55 to USD 70 per month, this additional income of USD 2 to USD 4 USD per day makes a huge difference. She earns more respect from her family and people in the village. Her new business has empowered her to make better decisions for her family and she is now using the money earned to provide her daughter Taluka with further education, something she could not previously afford.

© S4S Technologies

Mrs. Sunita Rambhau Kolte is one of S4S Technologies' 270 microentrepreneur partners

## Partnerships

"Creating a trust-based partnership network is critical for the success of our business model".

Nidhi Pant, Cofounder, S4S Technologies

## Interview with B2B client

### Interview with Dipan Dalal, Director for food and health business, Azelis India

Azelis is a multinational corporation that works in the food and beverage industry and supplies business clients such as Unilever and Nestlé with specialised ingredients. Azelis is one of S4S Technologies' industrial partners.

**Why did Azelis decide to work with S4S Technologies, and what makes the organisation an ideal partner for you?**

**Dipan Dalal:** S4S Technologies has developed a platform solution to deliver food products that are in high demand. They not only offer high-quality products, but can also ensure product consistency, which is very important in the food & beverage industry. S4S Technologies also offers a buying basket that we can use to bundle orders for ingredients from large players which adds real value for us. It is impressive to see how they have built reliable and robust supplier networks over recent years.

Dr. Tushar Gaware, cofounder of S4S Technologies, trains women microentrepreneurs

## Replication and scalability

S4S Technologies' business model is more complex than that of a traditional appliance provider. However, the comprehensive range of services that S4S Technologies offers its partners serves as a crucial differentiating factor, enabling the company to grow and increase the sales of its appliances organically. The model allows S4S Technologies to scale operations with a low risk of customer payment default and establish trust-based service relationships. It has further opened up new customer segments for high-end processing technology, including smallholder farmers.

In 2019, S4S Technologies had a gross profit margin of 24%, and an annual turnover of USD 1.64 million. The company returned to its pre-coronavirus growth trajectory at the beginning of 2021, and is aiming for 10% month-over-month growth. It expects a gross margin of between 20% and 40% in 2022, with annual revenue of USD 10 million. The main reason for the higher margin and turnover projections is that S4S Technologies plans to expand its product range from four to 10 ingredients, and expand its supplier network from its current two Indian cities to more than 10. By the end of 2022, the company plans to be working with over 2,000 microentrepreneurs and more than 1 million farmers.

## Spotlight on success factors for replication and scalability

Essential preconditions and success factors enabling S4S Technologies' business model to be scaled and replicated include:

- Catalytic funding for piloting and scaling the business model: the Shell Foundation played an important role in structuring the microentrepreneurship model. Grant funding allowed S4S Technologies to carry out pilots and helped bring the model to the point that it was ready to scale. Subsequently, the company has raised USD 1.75 million in equity funding from the Acumen Fund, Factor E Ventures, and C-SAW.
- Remaining user-centric in order to understand customer needs: understanding the specific circumstances and needs, both of smallholder farmers and large industrial customers, has been a critical success factor in the business model. The industrial partners have particular requirements with regards to quality standards and certifications. To successfully grow its business, S4S Technologies needed to adapt and implement new quality-control mechanisms at its central food processing plant. To better understand farmers' needs and opportunities, the team partners closely with local NGOs and conducts regular home visits to meet the microentrepreneurs in person.
- Engaging in trust-based partnerships with mutual benefit: to make its business model work at a large scale, S4S Technologies needs relationships built on trust and partners who recognise the model's value for everyone involved. According to the cofounder, Nidhi Pant, this mode of engagement requires considerable empathy and a willingness to collaborate. Trust-based partnerships are essential, as aspects of the work often fail to go according to plan, take longer than expected. In these situations, the company appreciates that it can rely on its partners.
- Expanding the product portfolio and exploring export markets: India's domestic market for fruits and vegetables is currently worth USD 168 billion, and is growing by 15% every year. With this in mind, there is a vast opportunity for scaling up. S4S Technologies could grow its business by expanding its product range of dehydrated fruits and vegetables and introducing new produce. For example, protein-rich ingredients such as eggs, chicken and plant-based proteins represent markets with high growth potential. Another means of scaling operations would be introducing certifications such as halal, kosher, or organic - providing added value. Expanding exports to international markets could also enhance growth.

31 Cision PR Newswire. S4S Technologies announces $1.75 Million pre-series A from Acumen, Factor[e] Ventures, and Centre for the Spread of Affordable Wellness (C-SAW), 2020, https://www.prnewswire.com/news-releases/s4s-technologies-announces-1-75-million-pre-series-a-from-acumen-factore-ventures-and-centre-for-the-spread-of-affordable-wellness-c-saw-301172983.html

32 Information provided by S4S Technologies.

# APPENDIX: INTERVIEW LIST & BIBLIOGRAPHY

## List of interview partners and reviewers

| Organisation | Interviewee(s) |
|---|---|
| **Azelis India** | Dipan Dalal |
| **Basel Agency for Sustainable Energy (BASE)** | Dimitris Karamitsos |
| **Basel Agency for Sustainable Energy (BASE)** | Thomas Motmans |
| **Boond** | Kunal Amitabh |
| **Farmer** | Sonali Biswas |
| **Koolboks** | Ayoola Domonic |
| **Koolboks** | Deborah Gael |
| **Koolboks** | Ufuoma Emonena |
| **KPay Innovation** | Aditya Pittie |
| **KPay Innovation** | Ravi Pittie |
| **MinJu TV** | Michael Job |
| **Moblity for Africa** | Shantha Bloeman |
| **RBL Bank** | Manoj Rawat |
| **S4S Technologies** | Nidhi Pant |
| **S4S Technologies** | Nikita Khairnar |
| **S4S Technologies** | Ghandali Deshmukh |
| **S4S Technologies** | Manju Dai |
| **SwitchON** | Mahasweta Chakraborty |
| **SwitchON and ONergy** | Vinay Jaju |

## Bibliography


BASE. **Reducing food waste and vaccine spoilage through cooling solutions,** 2020, https://energy-base.org/news/reducing-food-waste-and-vaccine-degradation-through-caas/.

Cision PR Newswire. **S4S Technologies announces $1.75 Million pre-series A from Acumen,** Factor[e] Ventures, and Centre for the Spread of Affordable Wellness (C-SAW), 2020, https://www.prnewswire.com/news-releases/s4s-technologies-announces-1-75-million-pre-series-a-from-acumen-factore-ventures-and-centre-for-the-spread-of-affordable-wellness-c-saw-301172983.html.

Efficiency for Access Coalition. **Solar Milling: Exploring Market Requirements to Close the Commercial Viability Gap,** 2020, https://www.gov.uk/research-for-development-outputs/solar-milling-exploring-market-requirements-to-close-the-commercial-viability-gap.

Efficiency for Access Coalition. **Solar Water Pump Outlook 2019: Global Trends and Market Opportunities,** 2019, https://efficiencyforaccess.org/publications/solar-water-pump-outlook-2019-global-trends-and-market-opportunities.

Efficiency for Access Coalition. **The State of the Off-grid Appliance Market,** 2019, https://storage.googleapis.com/e4a-website-assets/Clasp-SOGAM-Report-final.pdf.

Institute for Energy Economics and Financial Analysis (IEEFA). **India: Vast Potential in Solar-Powered Irrigation,** 2018, https://ieefa.org/wp-content/uploads/2018/08/Indias-Vast-Potential-in-Solar-Powered-Irrigation-.pdf.

International Renewable Energy Agency (IRENA). **Pay-as-you-go models, Innovation landscape brief,** 2020, https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2020/Jul/IRENA_Pay-as-you-go_models_2020.

Koolboks. **Koolboks at the Global CaaS E-Summit,** 2020, http://koolboks.org/koolboks-at-the-global-caas-e-summit/.

KPay. **KPay Innovation won an Outstanding Achievement award at Suryacon Pune,** 2020, https://kpayasyougo.com/suryacon-pune-award/.

ONergy Solar. **8 years of excellence,** https://www.onergy.in/. Retrieved 02/16//2021.

PowerGen Renewable Energy and Efficiency for Access Coalition. **Electric Pressure Cooking: Accelerating Microgrid E-Cooking through Business & Delivery Model Innovations,** 2020, https://efficiencyforaccess.org/publications/electric-pressure-cooking-accelerating-microgrid-e-cooking-through-business-delivery-model-innovations.

Ranganathan, T. **Farmers' income in India: evidence from secondary data, A study submitted to ministry of agriculture,** 2015, http://iegindia.org/ardl/Farmer_Incomes_Thiagu_Ranganathan.pdf.

United Nations. **Ending Poverty,** https://www.un.org/en/sections/issues-depth/poverty/. Retrieved 02/12/2021.

World Bank. **Poverty and Shared Prosperity 2020: Reversals of Fortune,** 2020, © World Bank, https://openknowledge.worldbank.org/handle/10986/34496 License: CC BY 3.0 IGO.

World Bank. **Poverty,** 2020, https://www.worldbank.org/en/topic/poverty/overview. Retrieved 02/16/2021.

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