



Briefing: Potential value of
integrating monitoring and control
functionality into eCooking solutions

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Potential value of integrating monitoring and control functionality into eCooking solutions

1 Introduction

The Modern Energy Cooking Services Programme aims to facilitate the transition of as many people as possible from cooking with biomass to cooking with “modern energy”. This includes cooking with electricity. Our work includes seeking to facilitate cooking device companies understanding and bringing new or better products to these markets.

The Internet of Things (IoT) is a growing sector of technology that is seen by many to have widespread potential to add value to a range of existing manufacturing, appliance and public services domains. In the consumer appliance and home/lifestyle sectors, incorporating wifi or Bluetooth enabled technology is attracting a lot of interest in the drive to differentiate products by offering the end user greater control and ability to monitor them remotely.

In the context of the development of appliances for lower income households in the Global South, IoT technology can be transformative as a result of its ability to unlock business models that can substantially change the supplier-customer relationship and what can be affordable for low income households. This briefing sets out the benefits of incorporating monitoring or control functionality into cooking appliances or solutions. The focus is primarily on two areas of business that can benefit:

- **Pay As You Go (PAYG) or lease business models** that have been extensively adopted to enable households to access solar energy powered services and appliances by paying in instalments;
- The increase in funding sources that provide finance in proportion to the achievement of certain beneficial outcomes – **Results Based Financing** – and the associated concept of **Carbon Finance**.

The briefing touches on a number of points and highlights market leaders in this area.

2 Pay As You Go/Leasing

There are many technologies that can be life-changing for households in the Global South but that are out of reach as a result of the up-front costs required to secure them. In an analogous way to developments around mortgages, hire purchase, lease scheme and contracts have enabled those in the Global North to obtain (or obtain the services of) residences, cars and the latest smart phones, businesses are actively looking creatively at what can be done to overcome this obstacle, given the potential size of the markets.

Pay As You Go (PAYG) has emerged as a key solution type in this context, particularly for companies offering Solar Home Systems (SHS) sector, where the aim is to offer solar panels combined with a range of devices (such as electric cooking appliances) that can be powered from them. Figure 1 illustrates how these typically operate.

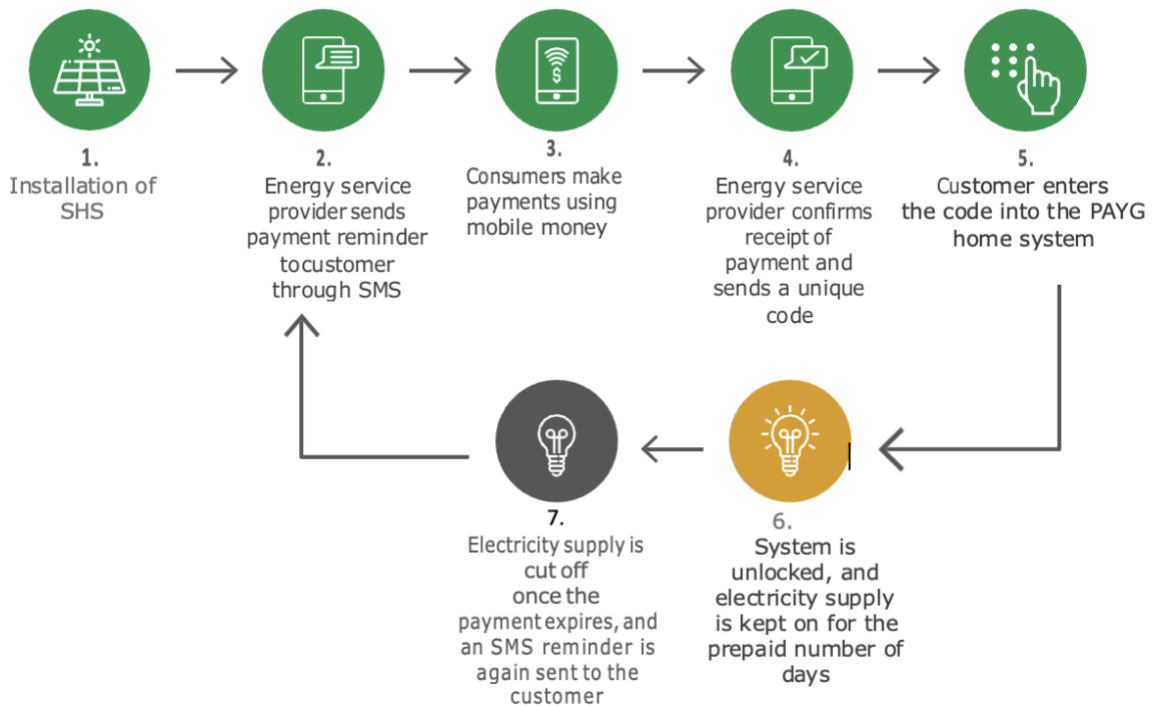


Figure 1 illustrates how the PAYG model works in the context of a Solar Home System (SHS)

Source: [Irena](#)

PAYG models can be applied at both the individual household and community or neighbourhood levels. PAYG systems can also be employed as a micro-grid option, in which a solar PV system plus battery storage is used to supply electricity to a small community. SharedSolar, a PAYG mini-grids developer in Sub-Saharan Africa, for example, uses solar PV panels with a 1.4 kW generating capacity and a 16.8 kWh battery storage system to provide electricity to 20 customers, including households, small schools, and businesses, within a 100-metre radius via underground cables. Prepaid scratch cards are purchased by end users from local merchants based on their needs and available budget. Each card has a code that, when delivered via text message to the ESP via a payment server, credits a smart meter installed within the premises of the solar PV power plant, which controls the flow of electricity to individual end users. The smart metre tracks usage until the customer's credit runs out, at which point the circuit is turned off until more credit is topped up.

The data is both key to enabling the business relationship between the company and the customer, and to providing incredibly useful market intelligence. Furthermore, payment data obtained through PAYG models can be analysed to gauge an individual customer's creditworthiness, which can then be utilised to upgrade to a larger solar PV system or secure additional financing for other activities.

Another way to look at these business models is as the supply of services rather than products, with the ownership and responsibility for maintaining the hardware being retained by the supplier, who has a vested interest in ensuring it remains functional given that their income stream depends on it.

PAYG models are also quickly emerging as one of the most exciting new areas in the e-cooking sector, with the potential to transform the sector as done for the off-grid solar

market in the past 5 years. The PAYG technology removes the upfront cost barrier of the e-cooking bit by allowing end users to pay a small deposit, or none at all, followed by affordable instalments over time. Many of the industry's leading clean cooking companies have created PAYG solutions for a wide range of appliances, including EPCs, induction stoves, LPG cooking kits, biomass gasifiers, biodigesters, and solar-biomass hybrid energy systems. The majority of businesses employ their PAYG model for end customers (the B2C model), while some also provide their PAYG solution to intermediaries (the B2B model). A good example of the latter is PayGo Energy, which offers an LPG PAYG solution to gas companies. The PAYG model must be customised for each clean cooking technology, however it often contains several of the following features:

- The distributor rents or sells consumers a clean cooking kit which could be just a stove or a stove plus related fuel dispensing equipment.
- Payments are made by customers on a daily, weekly, or monthly basis, using mobile money, cash dispensing machines, or other means.
- Customer payments are tracked. The cooking kit can be remotely enabled or disabled if a customer tops up or falls behind on their payments. The distributor usually has the right to repossess a device if a customer defaults on their payments. In practice, repossession of cheaper stoves is unlikely to happen due to the relatively high cost of repossession versus the cost of the appliance.
- In some cases, the cooking device can be remotely managed, and fuel or electricity usage can be tracked by smart meters. For modern fuel businesses, arrangements can be made to dispatch refills to customers before they run out.
- Some PAYGO providers do not use smart meters to track fuel usage because of the high cost. Instead, they use pre-existing metered PAYG technologies such as SHS to manage payments for nonmetered cooking solutions. Examples include non-metered biomass and gasifier stoves on the Angaza PAYG platform. There are also examples of PAYG for smaller LPG cylinders where the gas usage is not tracked.
- Customer service can be supported through the use of customer relationship management (CRM) software.

While this can seem like the ideal solution to address the challenges of enabling low income households to access sophisticated technologies and services, the model has its down-sides – see Table 1.

Pros	Cons
<p><u>For Companies</u></p> <ul style="list-style-type: none"> ○ Increases market for clean cooking devices, especially for lower-income households. ○ Increases scalability of business – potential economies of scale and increased access to finance. ○ Particularly attractive for more costly items. ○ Ability to track payments and disconnect non-paying customers. ○ Ability to manage remotely and track usage with smart meters, and 	<p><u>For Companies</u></p> <ul style="list-style-type: none"> ○ Asset financing is very capital intensive – it will constantly require new debt and equity to scale up. ○ Exposes companies to customer credit risk that the cash & carry and layaway models do not. ○ Requires different skills to core distribution business e.g. credit assessment, credit management, portfolio monitoring.

<p>potentially dispatch fuel refills in a timely manner.</p> <ul style="list-style-type: none"> ○ Can support customer service with CRM software. 	<ul style="list-style-type: none"> ○ Cost of repossession likely to be prohibitively high for some appliances. ○ Smart meters can be expensive. Some business models for PAYG still not proven.
<p><u>For Customers:</u></p> <ul style="list-style-type: none"> ○ Increases ability to afford larger and more efficient devices by spreading payments over 6-36 months. ○ Improved customer service. ○ Fuel refills can be managed more efficiently. ○ Provides an assurance that the device/system will be maintained and continue to be operational given commitment of the supplier to achieve this 	<p><u>For Customers:</u></p> <ul style="list-style-type: none"> ○ Higher cost versus cash payments – need to pay the cost of financing (interest, fees, commissions). ○ Need to be confident of meeting payment obligations. Potential to be remotely disconnected by seller or device could be repossessed.

Table 1. Pros and Cons of PAYG Model

Leading examples of companies in this field are:

- M-KOPA: [M-KOPA](#) started out over a decade ago as a supplier of Solar Home Systems (SHS) using a PAYG model but is increasingly operating as a financial services company that uses the provision of hardware (from partner companies) based around SHS of increasing scale to establish the credit-worthiness of households and enable them to grow the range of appliances that can be run off the SHS on the basis of the level of monthly payments they can make. Hence it describes itself as an “asset financing platform” with a focus on households without established banking services. The model results in their clients gradually acquiring ownership of the products they use through making micro-payments. They have provided nearly 400m USD in financing to 3.7m people, operating across Kenya, Ghana, Nigeria and Uganda.
- Fosera: [fosera](#) is a German company providing Solar Home System solutions using PAYG. Solar Home Systems have the PAYG functionality included, currently operating in over 40 countries. They are sold to companies in the markets that provide SHS for households. The PAYG software backend tracks customer payments and offer Customer Relationship Management (CRM) functions, to support the PAYG service providers. The backend can include warehousing, service management and many other functionalities.
- ATEC*: [ATEC*](#) specialises in developing clean cooking products (powered by electricity or biogas) aimed at Base of Pyramid households, enabled by its ability to incorporate GSM connectivity into the devices. This allows live data such as payments, GPS, electricity consumption and unit health updates to be sent back to the supplier. Based in Australia, ATEC* aims to work with partners in countries with strong market demand for these solutions, developing fit for purpose cooking devices that integrate with the partners’ PAYG business model.
- BBOX: [Bboxx](#) focuses on addressing households needs for energy across 11 African and Asian countries by providing decentralised energy solutions through their Bboxx Pulse

platform and reaching over 2m people. This platform supports PAYG business models that allow customers to pay purely on the basis of the energy consumed with the option of switching units on or off based on payments made. It also provides flows of data that support business management. It can work with companies providing SHS or larger scale energy provision installations for communities.

- PayGo Energy: [PayGo Energy](#) provides “cylinder smart meter” (CSM) solutions for companies selling LPG in cylinders that address their needs to maintain control over their inventory and offer PAYG terms for customers. This enables those companies to address the main challenge their potential low income customers face - the way LPG is packaged. LPG is only sold by the cylinder with a typical 6kg cylinder of LPG being too expensive for households with no income security. They have developed Tag and Trace – an integrated web and mobile platform that enables companies offering cylinders to fully control their inventory. This, in turn, unlocks the potential for offering customers PAYG terms as the locations of cylinders is never in doubt and payments can be guaranteed.
- Angaza: [Angaza](#) is a sales and customer management software platform that enables businesses to operate PAYG businesses by incorporating all the functions associated with sales, payment options, loan management, monitoring and control. This includes the ability to enable/disable appliances where they incorporate keycodes or GSM technology.
- Lumeter: The [Lumeter](#) PAYG Technology is a system that can be incorporated into various devices to enable PAYG business models. The technology combines hardware with customisable software. Off-grid energy solutions may be adapted with this product to allow end-users, who lack access to electricity, buy time on a solar home system, or other energy products. Meters have a payment mechanism similar to a pre-paid cell phone system, where customers can use their cell phone’s text message service (SMS) to buy electricity credit (i.e. Pay-As-You-Go). This product will function until the purchased credits are depleted, and then the metering system will disable it until more credits have been purchased.
- PaygOps: [PaygOps](#) provides services and technologies to enable businesses to send and receive SMS messages and receive mobile payments. They provide software solutions for operation management and a mobile app. The system is compatible with a range of branded products including ATEC* and fosera.

3 Results Based Financing and Carbon Finance

Given challenges in delivering financial support to the Global South without it being diverted for private gain, many Development/Aid organisations look for ways to make the finance they provide contingent on outcomes being achieved – Results Based Financing (RBF). These programmes are generally based on an assessment of what kinds of targeted incentive structures will best achieve widespread change and on identifying outcomes that can be objectively monitored and reported on. Typical features of RBF are illustrated in figure 2 below.

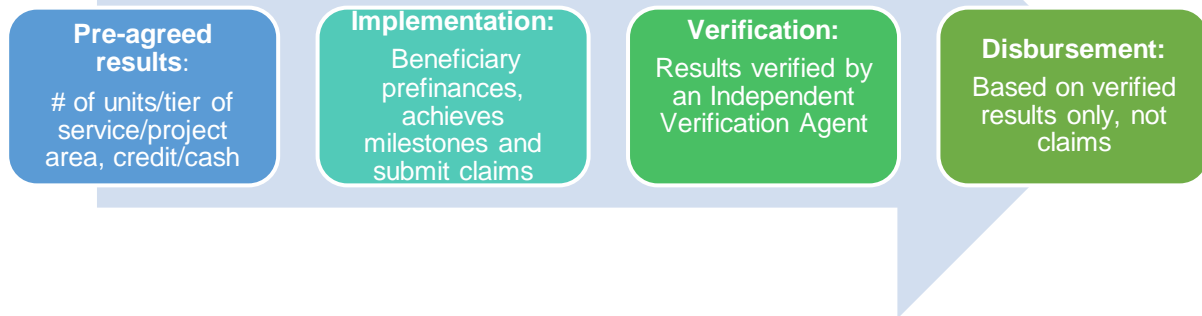


Figure 2 Features of Results Based Financing programmes.

In terms of RBF programme financing mechanisms, it can be concluded that, while it is theoretically desirable to link grant payments to specific outcomes and thus have a higher potential to generate certain desired impacts, this type of programme necessitates more administrative and verification resources than output-based programmes or those that provide upfront grant financing. Furthermore, measuring specific outcomes, such as long-term adoption of new technology, remains difficult, but it is increasingly beginning to benefit from technological progress, particularly in terms of smart data collection. This technological advancement includes the present trend of developing PAYG cooking solutions, specifically PAYG LPG, but also applies to ethanol and electricity. This process is led by companies and is based on the insights learnt from off-grid solar rural electrification. The use of PAYG technology pretty much ensures that data collection is inbuilt into the operations, thus addressing the data challenge, in addition to yielding many other advantages, including increased affordability, convenience and better service provision.

In addition to the smart data functionality provided by new technologies such as PAYG, mobile technology can be used to improve clean cooking financing for low-income consumers by removing barriers to accessing traditional forms of consumer finance, such as collateral requirements, high loan transaction costs, and other operational costs associated with screening customers and assessing repayment risk levels. [Micro Energy Credits](#) mobile platform, [Chaguzi](#), is an example of a promising mobile technology that uses machine learning, big data, and predictive modelling to build risk profiles for diverse low-income clients of sustainable energy products.

Carbon Finance, on the other hand, is aimed at unlocking funds from carbon-emitting businesses on the basis of a Carbon Market that enables trading of emissions in one context with savings in another. It must also be noted that Carbon Credit, a form of Carbon Financing, can be considered as RBF because it involves grant payments made by donors contingent on the achievement of pre-determined objectives. Due to a number of market and operational constraints, this is a largely untapped possibility in the clean cooking sector. However, the transition towards modern energy cooking solutions provides an opportunity to simplify the calculation of emission reductions using a smart data methodology. MECS collaborated with ClimateCare to develop a new approach that simplifies the process of obtaining carbon credits for electric and metered cooking appliances. Previously, the approach for determining emission reductions was based on assessing emissions resulting from the amount of fuel consumed in a sample of houses and then calculating emission savings by comparing this to emissions similarly calculated after the project. The baseline

and follow-up kitchen surveys had to be extensive and accurate, so they were normally conducted in 100 families or more and then repeated at least every two years. The procedure was time-consuming, costly, and prone to data gathering errors. The new approach evaluates emission savings for each unit of energy consumed in cooking, thus calculations can be made simply and correctly with actual usage monitored. Metering devices that monitor actual usage (and hence the equivalent of carbon reduction under the new approach) may be technically difficult for Improved Cook Stoves (ICS) that still rely on biomass but is more feasible and cost-effective for electric and metered devices.

Climate-related funding is directly tied to GHG emission reductions and comes from sources that are dedicated to achieving these goals. Other notable positive Sustainable Development Goal impacts promoted by clean cooking projects include health advantages, gender impacts, environmental benefits through reduced black carbon emissions and biomass depletion, and livelihood benefits. These may present chances for clean cooking projects to seek funding from other sources. Development Impact Bonds (DIBs) or outcome purchase programmes are one way for realising such opportunities. DIBs extend debt capital to clean cooking companies in exchange for ownership rights to the outcomes created by the sale of the appliances or services.

The common factors in both RBF and Carbon finance are:

- They can provide additional funding options for businesses, that can subsidise the cost to the end user
- They depend on means of accurately (and as cost effectively as possible) collecting data about the intended benefits being realised and/or the reductions in carbon emissions.
- They involve grant payments made by donors contingent on the achievement of pre-determined objectives

4 Value of monitoring capabilities

In summary, monitoring capabilities built into cooking devices offer a range of potential value propositions that can be harnessed by businesses within a market. These could include:

- Enabling business to monitor device location, electricity consumption, faults
- GSM connectivity support the payment process and can make payments directly visible to the end user on the cooking device – supporting transparency and long-term trust with customers
- PAYG facilities makes cooking tech affordable to bottom of pyramid households – as can offer payment by instalments – opening up massive additional segments that would otherwise not be able to afford sophisticated devices that could make a huge difference to their lives
- Identifying devices that are not working or not being used so can offer support – critical if payment is contingent on the device being used
- Enabling flexible or customised financing models, payment by phone apps, etc.
- Informing customers of the savings they are making by showing clearly the comparison with alternatives, eg charcoal costs.

- Monitoring trends and analyse customer segments – provide evaluation and marketing intel and evidence to support investment pitches. Getting more granular information about customer usage - consumption information can be used to better understand customer consumption patterns and identify sales opportunities

5 Monitoring and other capabilities

We do not have a detailed understanding of this and many technologies used are very commercially sensitive and represent key IP that differentiates particular businesses in this sector. We have observed the following in the market:

- **Real time data collection and monitoring of system activities**– time, kwh, GPS location, tamper detection, faults. Providers are notified of present or upcoming issues; corrective steps can be taken immediately by contacting end users (cutting field technician costs) or sending agents on-site for more severe problems.
- **Integration with PAYG software platforms:** A PAYG platform is always required. Let's take the case of ATEC International's PAYG model. ATEC partners with Angaza ATEC, but there are other options such as Solaris, Paygee, and Bboxx Pulse. Angaza is in charge of the PAYG intellectual property and expertise. Each PAYG device is assigned a 9-digit Angaza ID. Angaza provides ATEC with access to an online dashboard, or Hub, where they can review all customers' accounts. When clients make payments, credit is added to their stove. Angaza also contributes to the design of eCook stoves by ensuring that proper PAYG hardware and software are built and implemented into the stove.
- **Mobile money** – provides simple, easy payment options to customers, avoiding the situation of having to collect cash payments from customers monthly. Customers can make their payments via either in-person agents, mobile applications or even USSD codes
- **GSM SIM card integration** – GSM facilitates data transmission over large distances using cellular networks. GSM's standardisation and interoperability, near universality of coverage (approximately 90 per cent of the world's population), wide availability of modules, and reasonable cost (USD 6-8 per module) make it the go-to solution for remote connections. The SIM card also provides a secure identity to the systems connected to the mobile network
- Metering system to **disable the device** if payments are not made
- **Display panel** showing energy use, possibly converted to cash value, payment status, credit status, etc.

At this stage in the market development, we do not believe there are any standards, making it harder for appliance suppliers to incorporate a generic capability that will offer good prospects of integration with multiple platforms. Hence, there will need to be detailed discussions, in confidence, with potential partners to inform decisions regarding what technologies to incorporate.

MECS is considering facilitating a dialogue that could result in standards that would open up the market and enable a wider level of interoperability between systems that could drive down prices, etc.