

# REMMMP BRIEFING NOTE

## RENEWABLE ENERGY MICROFINANCE AND MICROENTERPRISE PROGRAM

### *Pay-As-You-Go Technologies in Consumer Energy Finance*

A key challenge facing many poor consumers is that they are obliged to spend a significant portion of their limited income on expensive, low-quality energy sources, such as kerosene, candles and batteries, because they can't afford to pay for cleaner alternatives. Kerosene for lighting in East Africa, for example, is the equivalent of US\$8/kWh, compared to US15¢/kWh in developed markets for grid electricity. Mobile charging is even less affordable, costing as much as US\$50/kWh. At the same time, while the price of small solar systems in developing regions such as sub-Saharan Africa and south Asia has fallen rapidly over the past decade, US\$70+ for a two-light system is still too high for most off-grid households to pay upfront (multi-light and appliance systems still cost several hundred dollars). While it would be more affordable for some customers if suitable financing could spread the cost over time, credit options aren't always appropriate or even available to fill this gap, and the provision of complex in-house asset finance can distract an energy company from its core objectives.

While they may use different terminology to describe it, the concept of Pay-As-You-Go (PAYG) is familiar to the majority of people in the developed and developing world alike due to cell phone usage. Cell phone penetration is at saturation point in most countries, and buying pre-paid credit for calls and SMS (and, increasingly, data) with a pre-paid SIM card is commonplace. The idea of paying for something in advance, only when needed, and in increments that match one's cash flow, is easy, flexible, and appealing to the energy poor. For poor people with uneven, unpredictable incomes, "affordability" is not simply a function of cost amount, but also a matter of flexibility.

On the supply side, PAYG not only unlocks affordability for customers; it also offers greater commercial viability

in the form of lower operating costs/higher margins and/or lower risks for energy companies. For example, PAYG technologies often enforce or prompt regular payment by consumers by automatically discontinuing service at the conclusion of a payment period, or when an allotted energy quota has been exceeded. This not only means that there is no "free-ride" period for non-paying customers, but it also eliminates the need for the company to deploy scarce resources to the field in order to manually disconnect or reconnect the system. Also, PAYG can convert energy (in watt-hours) into a commodity that can be sold through existing retail networks in the form of scratch cards or electronic top up. This can simplify the supply chain for providers by allowing them to sell energy to existing local retailers wholesale, rather than setting up their own payment infrastructure, thus reducing the total operating cost.

PAYG is increasingly being used as a mechanism for financing the purchase of small-scale renewable energy technologies, as well as facilitating payment for ongoing energy service by an energy producer or utility in energy poor countries – especially in the solar energy sector. Several companies are now offering consumers the ability to pre-pay for their energy, mitigating one of the main obstacles in providing solar technology to low-income people: their inability to meet up-front system costs, as in the case of stand-alone products, or to pay for service on an ongoing basis from either products or larger network-based solutions such as mini-grids.

This briefing note will profile six alternative PAYG solutions – those of Azuri Technologies, Angaza Design, Lumeter Networks, SIMPA Networks, M-KOPA and Fenix International – and outline some of the lessons learned associated with PAYG overall.

**SELECTED CASE STUDIES OF PAYG SOLUTIONS FOR CLEAN ENERGY**

## 1. AZURI TECHNOLOGIES

British technology company Eight19 came up with an innovative way to spread the cost of a solar system (US\$70 for a basic two-light system) using the Indigo PAYG Solar Home System (SHS) that is activated by weekly scratch card payments. Azuri Technologies ([www.azuri-technologies.com](http://www.azuri-technologies.com)) was spun out from Eight19 in August 2012 to promote Indigo in emerging markets. Azuri is based on the premise that if you combine mobile phone charging and solar technology, you can substitute directly the cost of kerosene and mobile charging. Azuri claims that with its scratch card model, consumers pay about half the cost of burning kerosene or other “dirty” lighting sources.

### *Business Model*

Azuri’s innovation lies in helping customers pay for solar power in small amounts with the aspirational goal of moving up the “energy escalator” by eventually purchasing bigger, more powerful clean energy devices. The customer pays a small up-front fee (around US\$10) to acquire the complete Indigo Duo SHS, comprising a 2.5 W PV module, long-life 3.3 Ah Lithium Iron Phosphate battery, and two 60-lumen LED lights. The battery and Indigo controller are housed in a distinctive, bright yellow case with a keypad on the front, along with sockets for the PV module and lights, and a USB socket for phone charging. The packaged system also includes a selection of common phone-charging plugs, which connect to a single USB plug.

The customer buys a scratch card from a network of agents for around US\$1.50 and sends the scratch card number by SMS, along with the unit number, to Azuri. The customer receives a one-time passcode which, when entered into the unit, provides access to solar energy for a week. Each week, customers buy another scratch card to top-up their units. After 18 months, customers can opt to buy out for a small amount, and then own the home system outright, or trade in their existing system for an upgrade to a system with four lights and a rechargeable radio. Other future upgrade options will include an Internet tablet or TV. So far,

the vast majority of customers are choosing to buy out their existing system, and then ask for an upgrade. Azuri’s research suggests the older system is often being given to another family member. When clients trade in their Indigo Duo, durable hardware components are repurposed in new units that are sold to future clients. The weekly cost for the upgraded system is higher: approximately US\$2.20 per week.

The Azuri business model is “rent-to-own”; the power system does not belong to customers until they buy it out after 18 months, so the company can potentially take it away if the customer ceases to purchase scratch cards over a sustained period. A cloud-based management system means Azuri has real-time information on whether customers are topping up. All Azuri’s customers are in rural areas of East Africa, and all are off-grid. Some customers use their systems as an income stream, charging other people’s mobile phones for a fee, and many use it as a security light. The main advantage for customers is the reduction in unnecessary energy expenditure, as the system largely displaces expensive, low-quality kerosene, candles, charcoal and wood, and fills in service gaps during periods of load-shedding and brownouts in areas where grid connection is more prevalent. As of the final quarter of 2013, Azuri had well over 20,000 systems in the hands of customers or in the supply chain, and anticipates sales of 50 to 70,000 systems by mid 2014.

## 2. LUMETER NETWORKS

Lumeter Networks ([www.lumeter.net](http://www.lumeter.net)) is developing a variety of pre-paid electricity meters and cloud accounting services to be sold to renewable energy companies so they can build microgrids and SHSs to extend energy access to Bottom of the Pyramid (BOP) customers. Renewable energy companies currently have trouble servicing this market because of the difficulty of managing small payments and the high degree of theft. Lumeter has solved these problems through an ultra-low-cost meter that incorporates innovative tamper protection across micro-grids and facilitates pre-paid capacity for SHS as well. Lumeter is currently conducting microgrid meter trials in Peru, Zambia and India.

### *Business Model*

Lumeter’s solution came about through recognizing that although there were some companies integrating PAYG meters into existing systems, there was no “off the shelf” mechanism to meet a broader range of clients’ needs that could then be integrated into existing products. Lumeter evolved by seeking to provide a meter (or family of meters) that can be integrated into a whole range of energy products, and a software package in the cloud that supports this family of meters. It is strictly b2b, and serves stakeholders in a variety of market segments and can be applied in any relevant location. As the technology facilitates transactions between rural electricity suppliers and consumers, its promise and advantages to drive scale lie in adaptability to any potential partner’s technological and business requirements. Lumeter believes b2b solutions that can address this, can leverage access and scale.

In addition to developing an “off the shelf” PAYG meter for microgrids, Lumeter has also developed a cloud-based software that enables companies to set custom parameters for service scheduling and energy budgeting for individual consumers or groups of consumers, a valuable feature when operating solar microgrids with limited power. Beyond metering power for household loads, Lumeter is also working with a pump manufacturer to integrate PAYG into water pumps. Lumeter’s “off the shelf” integration capacity is an important feature, but the demand management functionality of its software is arguably its key differentiator. The software allows Lumeter to facilitate power management on a per customer basis. For example, a solar minigrid operator would have the ability to set specific daily energy quotas or budgets for different customers (based on either time or use). Once these quotas are exceeded, service is discontinued until a new quota period begins. This flexibility allows vendors to differentiate tariffs for different customer segments, and reduces the costs and challenges inherent in manual disconnection.

At the technical level, Lumeter’s product consists of an affordable meter at each house, integrated into a SHS or as part of a mini-grid. The meters monitor and control consumption, immediately identify tampering and are controlled via codes obtained from the company’s

cloud-based accounting software. Lumeter has two broad categories of meter: one that measures power and time (predominantly for microgrids), the other only time (for SHS). It can therefore set maximum power levels, or time limits. At the business level, by contrast, the “product” consists of a web of relationships (and the stitching together of this network) facilitated by Lumeter, these include the renewable energy providers who install systems; hardware manufacturers who incorporate its technology; payments providers including mobile minute networks; village entrepreneurs; financing providers and of course the customers.

Pre-paid meter integration with renewable energy systems is not always overly capital intensive; hence the cost to enter rural electrification markets can be low, but the costs added can also be among the biggest barriers to penetration, alongside the extra complexity. The entry strategy can, however, further benefit from leveraging partners’ renewable energy systems operations, marketing, sales, installation and maintenance infrastructure and know-how.

### **3. SIMPA NETWORKS**

Simpa ([www.simpanetworks.com](http://www.simpanetworks.com)) is a Bangalore-based enterprise that offers a secure, pre-paid payment platform for clean energy in India. A customer pre-pays for electricity using Simpa’s metering technology on a “Progressive Purchase” basis: a pay-to-own model that unlocks a SHS for the specific amount of service purchased (defined either as an amount of energy consumed or time used). Like many PAYG models, the business model for Simpa purports to transform an “energy expenditure” into an “asset purchase,” offering consumers the opportunity for ownership of their energy resource and breaking their dependence on expensive, unhealthy, and inefficient sources of light and electricity. Simpa sells “solar-as-a-service” through an operating lease with the client.

### *Business Model*

Customers make a small, initial down payment for a SHS and then pre-pay for the energy service, topping up their systems in small, user-defined increments using a mobile phone. Each payment for energy also adds towards the final purchase price. Once fully paid, the system unlocks

permanently and produces free, unrestricted energy for the claimed ten-year life of the product. Simpa is now live with customers in the Indian states of Karnataka and Uttar Pradesh. The model is built upon what Simpa describes as a proprietary risk mitigation technology, which creates opportunities for financial and social investors to invest in the expansion of energy access.

Simpa has invented, built and field-tested the core technology that regulates usage of electrical loads based upon the amount of energy consumed and the flow of payments between the company and customers. A patent-pending technology entitled Progressive Purchase – a combination of product-embedded hardware plus cloud-based software – enables the consumer to purchase a SHS at minimal upfront cost and then to make a series of small payments over time using a mobile phone and mobile agents to complete the purchase of the system.

The hardware that supports this innovative business model is a meter called the Simpa Regulator, a tamper-proof, system-integrated microcontroller and user interface that regulates the function of the SHS based on proof of payments. The software is the Simpa Revenue Management System, a centralized software solution in the cloud, accessible via SMS gateway and over the Internet, for payment processing and accounts settlement. Like several other PAYG companies, Simpa is providing an integrated, Simpa-branded SHS product. Simpa sells through “Simpa Urja Mitras” (Energy Friends), who are Village Level Entrepreneurs (VLEs). The consumers sign a flexible operating lease agreement.

Progressive Purchase pricing shares some characteristics with familiar PAYG pricing models. Under Progressive Purchase, the consumer makes a series of payments, each of which unlocks the SHS for a paid amount of service, measured in time. Once the prepaid time is exhausted, the SHS is temporarily disabled until another payment is made. Once the customer completes the contract, the system is automatically unlocked permanently, and the customer enjoys full ownership of solar energy, free and clear.

#### **4. ANGAZA DESIGN**

Angaza Design ([www.angazadesign.com](http://www.angazadesign.com)) provides a PAYG solution to distributors of “pico-scale” energy

products in East Africa. Currently, Angaza’s PAYG technology integrates with the SoLite3 lantern, an ultra-low-cost lighting device developed in-house. The size of the product and the BoP segment it targets is arguably the key differentiator for Angaza. However, Angaza is actively pursuing partnerships with other manufacturers in order to integrate its PAYG solution into their products as well. An integrated product provider (like Azuri, but in contrast to Lumeter), Angaza offers PAYG-ready products that include custom Angaza hardware and software and cloud-based communication with the Angaza Energy Hub, the center of the Angaza technology ecosystem. Angaza’s ultimate goal is to be a B2B business, selling its PAYG technology to other companies who can reach more customers in more places.

Angaza Energy Hub software is equipped to facilitate customer payments through different mobile money platforms across multiple countries; it securely and automatically communicates with customers’ Angaza solar systems; and it provides a management, marketing, and analytics portal for distribution partners. The Energy Hub enables Angaza partners to track complete payment profiles of every unit sold, monitor customer usage and activity, assess payment trends, sort units sold by dealer or region, and more. Because every PAYG-ready product is capable of two-way data transfer between Angaza and each unit sold, partners can lower costs, increase product sales, and build a more satisfied customer base.

Beyond its software, Angaza’s embeddable modem can also turn any manufacturer’s SHS into a metered product that allows energy to be purchased in small, affordable payments as it is used. Through customization services, Angaza aims to work with manufacturers to effectively integrate PAYG into existing product lines, and offers full access to its complete PAYG platform to enable partners to effectively market, sell, and monitor PAYG sales.

#### ***Business Model***

The majority of PAYG products receive payment information from a remote system that manages each customer’s account status. Technologies developed by Angaza allow products to support this functionality with a negligible increase in their hardware cost. The Angaza solution leverages the wireless communication hardware

that end-users already possess – a mobile phone – to transfer data over the cellular voice channel. Angaza software automatically calls the phone of an end-user when communication is required. When the user places their phone near the product, the devices exchange data encoded in audio tones. This process takes place when a user purchases energy; for example, when the process is complete, the user's device has received notice of the amount paid.

## 5. FENIX INTERNATIONAL

Fenix International ([www.fenixintl.com](http://www.fenixintl.com)) is a San Francisco startup that has recently launched ReadyPay in Uganda, an “ultra-affordable PAYG energy solution,” in partnership with Africa's largest telco, MTN, to improve energy and telecommunications access for off-grid consumers. ReadyPay builds on a four-year partnership between the two companies. The rapid growth and adoption of Mobile Money across East Africa enables this partnership to make energy even more affordable by providing flexible payments to better match customers' needs. ReadyPay builds on the success of Fenix's first product, the ReadySet, a plug-and-play solar charging system that Fenix designed to empower entrepreneurs to charge phones and lights at kiosks in communities without electricity.

### *Business Model*

ReadyPay is a multifunctional solar power system that includes a solar panel, a smart battery featuring two USB ports, two car lighter adapter ports, plus a range of lights and phone charging accessories. Larger kits include a radio or TV. Additional accessories, such as hair clippers or flashlights, are sold separately. The ReadyPay Power System is available on a PAYG basis using MTN Mobile Money, a payment platform that allows mobile subscribers to send and receive money via cell phone. ReadyPay enables customers to make affordable, flexible payments for electricity on a daily, weekly or monthly basis.

Starting from 40,000 Ugandan Shillings (less than US\$16), a customer can take a ReadyPay kit home with seven days of power included. Additional days may be purchased via micropayments as low as 1,000 Uganda

Shillings (about 40 cents). Micropayments are credited towards customers' ownership of the solar kit over time, meanwhile powering their homes or businesses. On the most affordable kit, a payment of 1,000 Shillings (40 cents) will provide power for a day, and as a progressive ownership program, customers own their system outright at the end of the contract. Fenix prides itself on making the ReadyPay system easy to set up, with no technician needed, and including an 18-month warranty.

## 6. M-KOPA

M-KOPA Solar ([www.m-kopa.com](http://www.m-kopa.com)), founded in Kenya in 2011, is an innovative asset financing company that sells SHSs to off-grid households, on an affordable, one-year mobile money payment plan. The company was created as a solution to the founders' discovery that the average off-grid Kenyan household (living on US\$2 a day) spends a staggering Ksh 17,200 (US\$200) per year on kerosene. Certain there had to be a better way to supply safe light and power, M-KOPA Solar developed its solution. M-KOPA Solar works through Safaricom's mobile money platform, M-PESA, offering off-grid customers better energy at lower cost.

### *Business Model*

Under M-KOPA Solar's model, customers buy a SHS on an affordable M-PESA payment plan, with an initial deposit followed by daily payments for up to one year. After completing the payment package, customers own their systems outright. There are currently two systems available from M-KOPA Solar. The d.light d10g SHS is a 4W system with three lights and a phone and USB charging port. The user pays Ksh 40 (US50c) per day for a year with a deposit of Ksh 2,500 (US\$30). The d.light d20g SHS is a 5W system with three lights (two wall-hanging and one portable), a phone and USB charging port and a chargeable radio. The user pays Ksh 50 (US60c) per day for a year with a deposit of Ksh 2,999 (US\$35).

M-KOPA Solar's success is due to several factors, including: pricing set cheaper than the daily cost of kerosene, making the switch an “easy sell”; the convenience of Mobile Money; an extensive distribution network; a first-rate technology platform; and proficiency in delivering the “airtime” concept, something with which Kenyan consumers are extremely familiar and comfortable.

# LESSONS LEARNED

*These PAYG models in small-scale renewable energy have individual strengths and challenges, and together they present an exciting future for PAYG service provision of energy at the BoP. Although many of these companies are relatively new, some key lessons are emerging, which will be useful for entities seeking to replicate or adapt specific business models, or to begin offering PAYG finance within the energy space or for application to other sectors such as water.*

**1. Choosing the right business model.** The choice of business model – partnership or full-service – creates very different risk and profit scenarios. A partnership-based model, for example between an energy technology manufacturer and distributor, or with a payments platform, such as M-PESA or a Mobile Network Operator, spreads the responsibility for the core functions of the business; however, it also creates dependencies on partners for installation and servicing of solar/other products, the administration of micropayments, and requires profit sharing. A full-service model can realize potentially higher profits, but requires the complex development of a sales and distribution network, full responsibility for product-related issues such as after-sales support and warranties, and has higher capital needs.

**2. Choosing the right metering technology.** Meters themselves are not a new idea or technology; in fact, it was commonplace in the early 20th century for consumers in developed countries to pre-pay for electricity by coin-operated meter. What is new is the integration of pre-pay meters into small-scale renewable systems to bring PAYG beyond the grid, and to use modern platforms such as cell phones, in conjunction with cloud software, to facilitate such payments and monitor usage. What this means is that PAYG metering serves as a risk-management mechanism for an energy enterprise: it liberates the organization from default risk and aligns incentives of both consumer and provider.

**3. Managing costs.** While PAYG potentially adds important value and unlocks demand, technology imposes additional costs on products and services that struggle to achieve commercial viability due to the low purchasing power of BoP customers.

**4. Managing complexity.** Anything can (and often does) go wrong with complex electronics over time. In contexts where customers are expensive to reach, after-sales service is hard to deliver and customers may lack the education and technological understanding to fix problems themselves. Adding a new layer of technical complexity in the last mile could create additional unforeseen challenges for small-scale energy entrepreneurs.

**5. Responding to consumer demand for flexibility.** One of the most attractive aspects of PAYG – and the one driving mobile phone penetration – is flexibility, both in terms of timing (when one wants to buy) and in quantity (how much one wants to buy). However, using PAYG as a mechanism for financing expensive durable products such as SHSs is quite different from how it has been applied in the “razor” model common to telecom. An energy company wants customers to repay as quickly as possible, either for the asset or the use of the asset, given high product cost. Companies cannot afford to be too flexible in the payment terms they offer, both with regards to how much people can or must pay over any given period and how frequently. Put another way, successful sales depend on offering target customers something they value. In the BoP energy space, target customers place great value on the ability to make flexible payments. Any technology and payment platform which minimizes commitment on the side of the customer but incentivizes him or her to make small, flexible, regular and affordable payments, will succeed over a model that is unconnected to usage and that mandates fixed, larger installments irrespective of seasonal and income fluctuations.

**6. Leveraging mobile money.** PAYG solutions have much more opportunity in markets with mature mobile money platforms that enjoy wide penetration and serve large shares of the population such as in East Africa. Existing mobile money architecture can be a backbone for payment as well as for sales and marketing.

**7. Data gathering.** The communicative features included in all PAYG systems also provide the opportunity for firms to gather extensive data. Many providers have claimed that the data retrieved from the usage of their SHS was systematically recorded and analyzed for: (i) a better understanding of BoP customers and their consumption pattern; (ii) improving maintenance follow-up by flagging abnormal energy generation; and (iii) theft detection. Companies that use the data they collect prudently and efficiently will thrive.

To read an in-depth case study on Simpa, and to see other Arc publications, please visit [www.arcfinance.org/knowledge](http://www.arcfinance.org/knowledge).

This briefing note series is a core offering under the Renewable Energy Microfinance and Microenterprise Program (REMMP), which is implemented by Arc Finance and funded by the United States Agency for International Development (USAID). The central goal of REMMP is to increase access of underserved populations to clean energy products to improve livelihoods and quality of life, while minimizing climate-damaging emissions.