

Escaping Darkness

Understanding Consumer Value in PAYGo Solar

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Acknowledgments

It takes a significant amount of trust to open your own business—and customer base—up for scrutiny by a team of researchers. All the providers who participated in this research were supportive of this work, open to learning, and generous with their assistance as our team planned and executed this work. Thank you, M-KOPA, PEG, Off-Grid Electric, and BBOXX. Thanks also to our research assistants, drivers, and transcribers who helped us navigate new terrain and bring these stories to life. Finally, we thank all of the respondents who welcomed us into their homes for this research and who shared their time, stories, and views with us.

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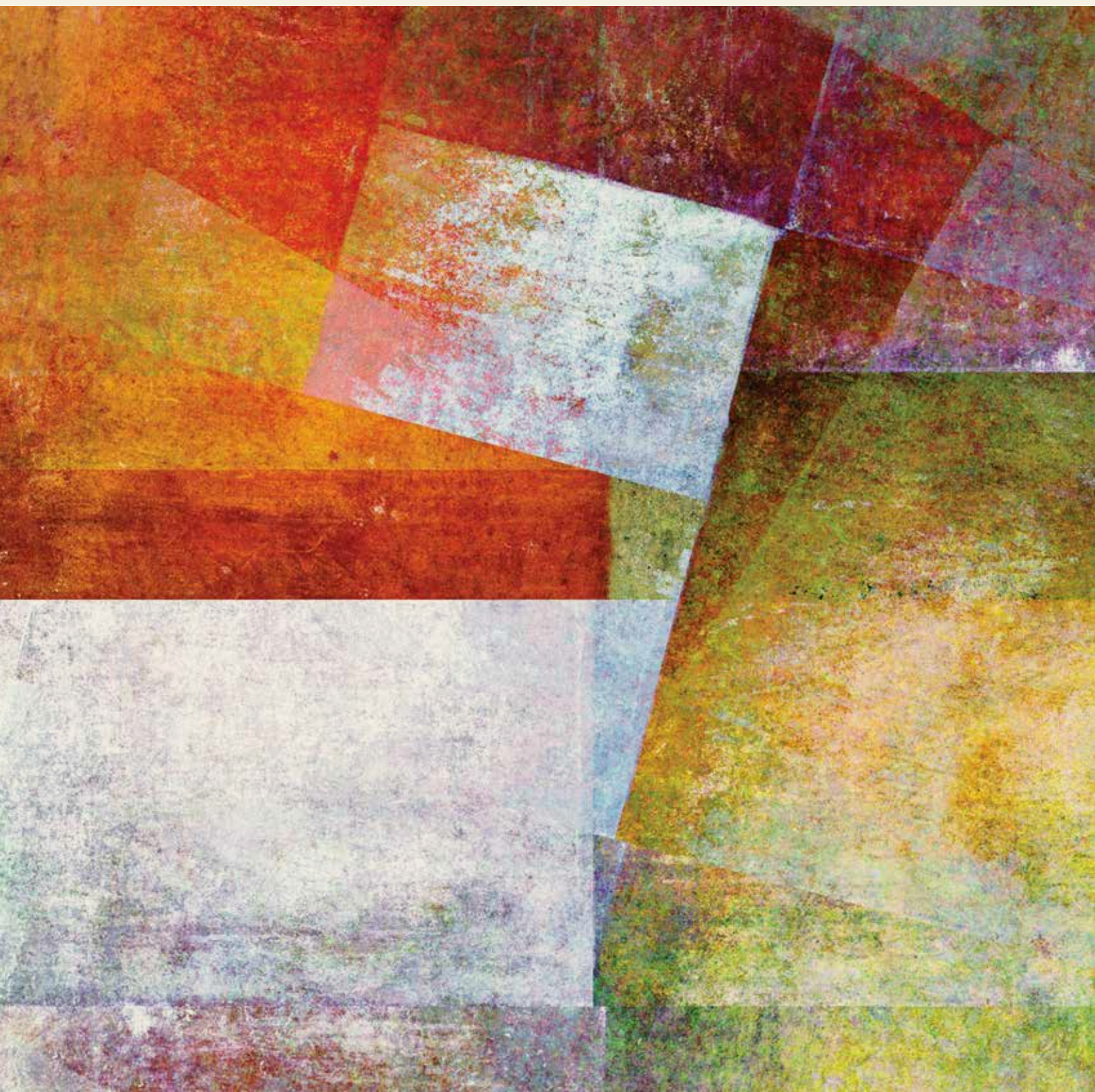
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Executive Summary

Over the past five years, pay-as-you-go (PAYGo) solar providers have sold more than 1.1 million solar home systems to customers worldwide (Climatescope 2017). These providers have leveraged mobile payments and remote lockout technology to build scalable business models that make solar home systems accessible for low-income customers. Customers pay for their units over time with small, high-frequency payments, often on terms far more flexible than those of traditional lending models and microfinance.

This is no small feat. PAYGo customers typically are rural, and many are low-income. The rapid expansion of these companies implies that they deliver real value for large numbers of customers, many of whom live in areas with poor infrastructure. In 2017, CGAP and FIBR worked with BFA to explore why customers acquire PAYGo solar and how they afford it.

Methods

BFA conducted in-depth interviews with 138 households to explore purchase decisions, assessments of value, and individual cash flow patterns before and after acquiring solar. Researchers sampled households from at least two geographic areas in each of four countries: Côte d'Ivoire, Ghana, Kenya, and Tanzania. The sample covered customers of two providers per country with the exception of Ghana, where there was only one provider.

The study aimed to cover a range of customer types, including those who paid on time or early, those who sometimes fell behind, and those who were struggling to keep up, as identified in providers' payment records. Researchers also sought out referrals from customers and sales agents to locate customers with very low incomes, to help researchers learn about the limits of affordability. This sample design was intentional, and was meant to help uncover challenges around payment

performance. It disproportionately reflected the experiences of customers who were struggling to pay and did not represent providers' wider portfolio of clients. In addition to customers, the sample included a small number of families who bought solar home systems outright and a small number of families who were not using solar home systems or grid electricity.

Key takeaways

- 1. People invest in solar to escape darkness.** In a literal sense, solar home systems delivered reliable and clean overhead lighting that was of far better quality than available alternatives. Solar home systems were much safer because they eliminated the risks of house fires or children burning themselves with kerosene. Solar produced no smoke, no odor, and no permanent residue left clinging to walls and roofing sheets.

"We were used to the tin lamp but now when I see how the solar lights the house, I wonder how we used to survive before. . . ." KENYA

A stable energy source allowed customers to charge their phones, listen to news and music on the radio, and watch television—it provided a connection to the world. Customers valued these figurative kinds of illumination. They reported that it was important for them to know what was happening in current affairs, locally and globally. TV was not merely a luxury in their eyes. They viewed TV as a window to the wider world, and many felt ashamed if they could not expose their children to that window.

"I have light, my friends can come charging [their phones] and that is development." KENYA

This reliable, modern source of energy transformed respondents' lifestyles. It gave them a strong sense of pride, dignity, and achievement. Customers could show off the systems to their visitors and make them feel more welcome, which was highly valued by many of the families interviewed.

2. **Paying over time brings an expensive asset within reach.** Many respondents would not be able to buy solar home systems if they had to pay in full at once, which would then force the purchase to compete with other kinds of lumpy investments like housing, furniture, and land purchases. PAYGo allowed low-income households to take on multiple projects simultaneously. The financing option also let customers test the quality of the system and the providers' warranties before committing to the entire purchase price.

"[Paying in installments] is very important because, if they asked us to pay once, it would not be possible as we cannot afford [it]." TANZANIA

3. **Respondents want to own their energy system.** Customers were willing to increase their energy expenditure temporarily to acquire a useful device, yet it was clearly viewed as a device, not as a service. They saw the equipment in their house. They understood that they were buying a device that converted sunlight into energy. Providers that wish to sell solar as a service to this customer segment may struggle to change that mindset.

"Yes, those staff told me very good things. They told me we are getting old and us buying kerosene daily will be very expensive for us. So, we are very happy because I know in three years I will have completed making my payment. So, I decided to install the solar." TANZANIA

4. **Energy budgets can expand to fit in PAYGo.** An examination of three datasets in Kenya revealed that purchasing a PAYGo solar home system was unlikely to reduce energy spending in the short

term for low-income households. Gubbins and Zollmann (2016) found that average monthly kerosene spending was \$2–\$4 for the typical Kenyan, only breaking \$5.45 for the top 20 percent of kerosene-spending households nationwide. In comparison, PAYGo expenditures are about \$6–\$15 a month.

A few respondents in the study earned some income using the system—mostly by charging phones and, in a few cases, by extending business hours. Overall, solar income did not play a major role in helping buyers in the sample to pay for their devices.

For many, purchasing a PAYGo unit required temporarily increasing overall energy expenditures. Where providers were closer to matching their price points to borrowers' prior energy expenditures, they did so by stretching the loan term from one to three (or more) years, thus lowering monthly payments. However, longer loans create more risk for lenders, which translates into higher interest expenses for the customer. That can mean lower net savings over the life of the device.

"I am okay with the price of the solar. With the solar when you finish paying that's that, and it is more beneficial than [other energy sources]. It is as if you have borrowed a bank loan. When you're done paying, it becomes yours." GHANA

How do low-income families make this work? Several business models involve daily payments and no penalty for missed days. Some customers leveraged that flexibility to reduce their effective monthly costs and help the payments fit into their budgets. Poorer families reported that they reduced other expenditures, such as meat or sugar, for the duration of the loan.

No respondents reported that this new burden was unbearable. Conversely, sacrifices were both manageable and "worth it" to acquire a solar device. Paying for solar was high on families' lists of priorities, but did not seem to displace spending on essential food, school fees, or healthcare needs. If it came to making those kinds of trade-offs, respondents said they would stop paying for the solar unit until they were in a better financial position.

Even customers who did not reduce their short-term energy spending appreciated the products because the *value* of the solar home system was much greater than that of their previous energy sources. The primary driver of their purchase decision was not to save money but to make a lifestyle change.

"If you pay for solar, the other money you get you use for other things. We don't have any specific budget so we buy what we need with the money we have. What I have done is, when we cook rice during the day we eat it for both lunch and supper. That is how we economize. If the solar had affected our life so much, I would have told them to come and take it away." KENYA

5. The decision to purchase solar is primarily made by men.

The purchase decision was often made by husbands despite the initial protests of their cost-conscious wives. Households often met payments by reducing women's budgets and purchasing power in the day-to-day household budget. Women in the study did not outwardly complain about this situation, and most seemed to appreciate the devices. Still, the purchase did cut into women's budgets. Should husbands choose to acquire more assets through the solar provider, this could be a persistent issue with more profound implications.

"When I went to [the] market I met the sales people there.... They kept on explaining to me the prices and I left. I came and told my wife, and she refused saying it will give us problems. I called customer care anyway and gave them my names while I was consulting with my wife." KENYA

6. Payment performance is determined by several factors.

Beyond mere affordability, other factors affected customers' payment patterns:

- *Playing catch-up.* Having to catch up on missed payments before being able to use the solar device created significant barriers for low-income customers. Daily, flexible payment plans allowed customers to skip occasional payment days without shame about their

short-term cash flow problems. Many of those customers could still finish paying for their loans, even if they are late. Furthermore, they wanted to finish their loans, because they felt understood and appreciated by their providers.

- *Experiencing mini-shocks.* Temporary health issues, missed days of work, and other unexpected expenses caused many to miss payments. A short-term advance on solar credits could help keep lights on during these mini-shocks.
- *Misunderstanding terms.* Some customers in the sample fell behind because they did not fully understand contract terms. Sales agents may not sufficiently explain the terms of the loan, consequences of nonpayment, or less-attractive contract terms. Buyers who feel misled are more likely to stop paying.
- *Managing the logistics of payment.* All the providers studied relied on mobile money for collections. Where mobile money is new and unfamiliar for PAYGo customers, such as in West Africa, the logistics of making payments can be a major reason why customers fall behind or stop paying.

7. PAYGo financing is more vulnerable to different forms of risk to both lenders and borrowers than traditional lending.

Lenders face significant repayment risks in this model and need to manage that risk over many months and years. They make lending decisions using only limited data about specific borrowers' repayment capacities, especially over long periods. The large datasets and strong analytical capacities that are required to calculate repayment risks and set prices under such flexible conditions are still being developed. For borrowers, the risks lie in understanding contract terms for such a complex product. Those risks are exacerbated by agent-based sales, embedded interest rates, long contract durations, and the choice by some providers to not share updated total balance information after every payment.

There are reasons to be both excited and cautious about PAYGo lending models. Given the high potential value for customers, it is worth figuring out how to manage these risks well.

Recommendations for providers

Implement an explicit strategy to reach low-income customers. There are trade-offs between profitability and affordability in the PAYGo model. This is seen in provider choices around loan tenor: longer loans mean lower monthly costs to customers, but they also come with higher financing costs and default risks for providers. Prioritizing profit over scale can encourage providers to focus on higher-income customers and to incentivize agents to sell predominantly larger, more-expensive systems. Providers (and investors) who want to reach the low-income mass market will do so only if their operations and internal incentive structures align with that goal.

Tailor operations to cash flow realities in the markets where they operate. In areas with highly seasonal cash crop production, it would be wise to market products months before scheduled harvests, to allow customers to plan. Offering large deposit payment plans that reduce the burden of low season payments would also be attractive.

Simplify contract terms and communications to ensure understanding. Providers should be explicit about incentives for prepayment and consequences for late payment. Some providers have staff contact every new customer and walk through a checklist of contract terms. Every provider should give customers confirmation of payment and updated loan balance information after each payment to reinforce that understanding throughout the term of the loan.

Communicate a realistic value proposition to customers, funders, and investors. Providers already deliver high-value services to customers, and most of the customers in this study were happy to have access to this new kind of financing. What really mattered to customers was the ability to invest in a lifestyle transformation. That was significant on its own, even apart from whether customers saved money on energy through their purchase. With price points above replacement energy costs, providers might not be reaching all the poor today. And that is okay. Being open about what is being achieved today makes it possible to think strategically about how to meet future goals and to think realistically about the trade-offs that pursuing those goals will entail.



Introduction

Over the past five years, pay-as-you-go (PAYGo) solar providers have sold more than 1.1 million solar home systems (Climatescope 2017).¹ These providers have leveraged mobile payments and remote lockout technology to build scalable business models that make solar home systems available to low-income customers. Customers pay for their units over time with small, high-frequency payments, often on terms that are more flexible than traditional lending models and microfinance.

This is no small feat. PAYGo customers typically are rural and live in areas with low population density and limited infrastructure. Many customers are low-income, even if few may be living in absolute poverty.

PAYGo companies manage complex businesses. They provide financial services by extending credit to customers and collecting payments through mobile money services managed by telecommunication partners. They tackle challenging issues around physical distribution, including managing remote sales and service agents. There is a significant customer service component to the business, including through call centers and a network of sales agents and service technicians. Moreover, many providers develop their own solar hardware and software for customer and staff management.

The rapid expansion of these companies seems to demonstrate that they are delivering something valuable for large numbers of customers. That is particularly interesting, because existing data on energy spending in at least one country (Kenya) suggested that most households would need to increase their energy expenditures to be able to acquire a PAYGo system. In 2017, CGAP and FIBR worked with BFA to understand why customers invest in PAYGo solar and how they afford those investments. The team hoped to learn lessons appli-

cable both for PAYGo energy providers and financial services providers more broadly.

Methods

To explore these issues, researchers led and analyzed in-depth discussions with customers about purchase decisions, value assessments, and household-level cash flow patterns before and after acquiring solar. Researchers visited study participants in at least two different areas of four countries: Côte d'Ivoire, Ghana, Kenya, and Tanzania. In most of the countries, participants were customers from two providers; though in Ghana, there was only one provider.

Because this study was about depth rather than breadth, it applied a qualitative approach with a relatively small number of households. The sample was purposely selected and was not intended to be representative of the universe of PAYGo customers. Since the central research questions were around affordability, the team sampled primarily on payment performance, oversampling for customers who struggled to pay. Sampling categories included those who pay on time or early (the majority for most providers), those who sometimes fall behind, and those who regularly struggle to keep up.

The sample also included another category of users: customers identified as having very low incomes. These customers were often identified through referrals from agents and neighbors. Including this category enabled researchers to learn about the limits of affordability. Not all of the “low-income” customers referred for this study were actually low-income, so adjustments were made in the analysis stage based on income levels reported by respondents themselves.

The study focused on those PAYGo customers who used the basic solar home system, which

1. PAYGo solar providers sell solar home systems in installments. They use technology, such as rechargeable prepaid codes or cell phone SIM cards, to disable the solar units if customers fall behind on their payment plan. In most cases, the customer ultimately owns the hardware after this period of paying for use.

included 2–4 overhead lights, a radio, phone charger, and sometimes a hand-held flashlight (torch) or rechargeable light. A few television users in Côte d’Ivoire were included because they make up a large share of PAYGo customers in that market.

In addition to interviewing PAYGo customers, researchers interviewed a small number of families who bought solar home systems at once, or “outright” (typically from a market or supermarket), and a small number of families who were not using solar home systems or grid electricity in the areas included in the study. See Table 1 for respondent breakdown by country and category.

This sampling methodology allowed researchers to obtain a deep understanding of the range of experiences of customers, especially regarding solar home system affordability. The respondents did not represent providers’ full portfolios. For most providers, the study over-represented their lower income and slow payers.

The final sample comprised mostly men (76 percent), which reflects the customer profile of the providers studied (although there is significant variation by country). Respondents span the entire income spectrum in each country, with close to 30 percent in the top income decile. About 40 percent of the customers visited were in the bottom half of the income distribution in their country (see Figure 1).² This indicates that the solar companies reach some genuinely low-income customers. However, it is not a reflection of the full customer base, because those

behind on payments were oversampled. This sample likely included a larger portion of low-income families than the wider PAYGo universe of customers.

Contexts

Each of the markets studied was unique in ways that affected the viability and cost of a PAYGo model (See Table 2).



Kenya has been rapidly expanding electricity grid access. Historically, getting connected to the grid in rural areas was expensive, so only the rich could afford to connect. Households had to be willing and able to pay individually for the extra poles and lines to connect their homes to the nearest transformer. Those infrastructure costs (often reaching more than \$1,000 for rural families) were in addition to connection fees and often informal payments to utility employees to prioritize their connections. The national government has made a major push to increase electrification in the country. While the exact figures have been disputed (Wafula 2017), the country seems to have more than doubled connections since 2013, and the government hopes to reach 70 percent coverage by the end of 2017 (Kenya Power 2016). While population density in the country is overall quite low, most people live in a band of arable land along the southern part of the country, within an hour’s drive of a town or city. Kenya’s mobile money infrastructure is

TABLE 1. Overview of study sample





Country	PAYGo Customers					Noncustomers		Total
	Good payers	Inconsistent payers	Poor payers ^a	“Low-income” ^b	Television customers	Purchased solar outright	No solar, no electricity	
Kenya	9	7	8	7	0	5	5	41
Tanzania	10	9	6	8	0	3	3	39
Ghana	4	4	4	4	0	2	2	20
Côte d’Ivoire	8	8	5	7	4	3	3	38
Total	31	28	23	26	4	13	13	138

a. Customers who have fallen behind, but have not yet been blocked completely by providers. Many providers disable systems after more than 90 days of nonpayment and require a larger payment before the customer can resume using the PAYGo service.

b. As perceived by area sales agents, technicians, or neighbors. Some turned out to not to be in the low-income category.

2. These are estimations based on comparing household data to decile-level data from the World Bank’s PovCalNet database. The authors are not aware of larger quantitative studies available that measure income or consumption levels of PAYGo customers on a broader scale. Some providers use basic indices to make approximations for internal and investor reporting, though such data are not public and lack the precision needed to determine how this study’s sample compares to the broader universe of users.

TABLE 2. Summary of country contexts for this research

	 Kenya	 Tanzania	 Ghana	 Côte d'Ivoire
Population	38.6 million (2009)	44.9 million (2012)	24.7 million (2010)	22.6 million (2011)
% Offgrid	42.8% (infotrak 2017) 64.0% (WB 2014)	84.5% (WB 2014)	21.7% (DHS 2014)	44.2% (DHS 2011) 38.1% (WB 2014)
% Banked	55.2% (Findex 2014)	39.8% (Findex 2014)	40.5% (Findex 2014)	34.3% (Findex 2014)
% Mobile money	58.4% (Findex 2014)	37.7% (Findex 2014)	18.7% (Findex 2014)	24.3% (Findex 2014)
Median per capita monthly expenditure (PovCalNet)	\$44.53 (quite outdated, 2005)	\$19.95	\$68.47	\$35.09
Density (pop/km ²)	80	60	120	71
Rural settlement pattern	Concentrated in southern belt, but houses diffuse	Diffuse, but clustered in somewhat dense villages	Clustered in somewhat dense villages	Clustered in very dense villages

quite advanced, and most adults are capable mobile money users who are familiar and comfortable with paying bills on the service and who often leave at least a small balance on their wallets. Kenya is an outlier in this regard, making it unsurprising that PAYGo has been so successful there.



Tanzania has a larger population than Kenya, and its population is spread more diffusely throughout the country. Unlike Kenya, more Tanzanians are clustered in villages, which allows for some economies of scale when PAYGo providers make sales or service visits. Compared to Kenya, fewer Tanzanians are connected to the grid. Individuals seem to have less control over where the national utility chooses to expand, and the shared perception is that the grid expands very slowly. Median income in Tanzania is quite low, which works against affordability. However, the mobile money infrastructure is well developed, at least in contrast to the West African countries in the study.



Ghana is the most-connected country in the study. Only about 22 percent of the population lacks a grid connection. However, the country has recently recovered from a severe energy generation shortage that caused rolling blackouts, which sent even connected

households searching for supplementary energy sources. In the rural areas visited by researchers, people lived in relatively dense villages, even though their farms were often far from their homes. Mobile money use is growing in Ghana, but it is still new to many PAYGo customers. It can be challenging to learn the subtle differences in navigating payment menus from among the four mobile money providers. Perhaps because of the prevalence of cash crop (cocoa and palm nut) production, there was a greater mix of income levels in the rural areas of Ghana than in the rural areas that were studied in Kenya and Tanzania. In the research sites in Ghana, a significant number of relatively well-off families were living off-grid.



Côte d'Ivoire's rural areas lack both electricity and—often—mobile phone signals, which poses a significant challenge for the uptake and use of mobile payments, including those required for PAYGo solar. The areas visited by researchers in the southwestern part of the country were dense rural villages where entire village economies rose and fell with the seasonal cash crops of cocoa and rubber. As in Ghana, it was not uncommon to find quite wealthy farmers living in rural villages. But intervillage inequality could be high—with families that did not own farms barely scraping by. Those in the city complained that the

electricity supply was unstable and very expensive. Many peri-urban residents used solar as their main or supplementary source of energy. Solar—PAYGo and otherwise—was already quite prevalent in the communities that were visited, with a solar panel visible on nearly every roof.

Provider models

The study looked across four different providers. While each has unique features and offerings to customers (see Annex A), two financing models dominated.³ These models have important implications for the topics explored in this research.

One-year, day-to-day PAYGo financing (typical of M-KOPA and PEG). A customer pays a deposit, typically equivalent to just under three months' worth of payments, and then uses his or her mobile wallet to purchase daily energy credits for a small fixed fee. Credits are automatically deducted from the customer's energy balance by calendar day. The system is disabled when credits run out, but new payments reactivate the system even after days of inactivity. Customers can prepay or go without lights several days per week or month without penalty. However, after some period of no payment

(typically more than 90 days), units may be blocked, and a larger payment is required to reactivate them. In this model, there are no carried arrears and no compounded interest, which provides valuable flexibility to the customer. This means that while customers are meant to finish their loan value in full within 12–13 months,⁴ they can keep paying and finish later—inclusive of some days without use of the device—if needed.

Three-year, monthly financing (typical of BBOXX and Off Grid Electric). Customers may or may not pay a deposit and thereafter must make monthly payments to keep their devices working. They do not need to pay the entire monthly value at once, but it must be paid in full within three days of the due date for them to be able to keep using the machine. If a customer is late, he or she must catch up with all missed payments (although not any added interest) to reactivate the unit. Multiple months of missed payments may lead to the device being repossessed. The total monthly amount payable is typically lower on the three-year plan than on the one-year plan, assuming customers keep their lights on every day. In the case of BBOXX, customers are meant to pay an ongoing, but slightly reduced, monthly “service fee” after year three and through year ten.

3. Providers have changed their financing models over time. These were the two in place for the customers in this study, most of whom started their contracts between October 2016 and February 2017.

4. The percentage of those who finish within these boundaries is not publicly available.



2

Value proposition of PAYGo solar

Respondents were unambiguously clear that the main reason they invested in a solar home system was to end darkness—literally and figuratively. Many solar customers in the study lived in rural areas that were very dark at night, and they felt isolated from the rest of the world. The ability to illuminate their surroundings and have enough electric power to use devices—like phones, television, and radio—that enable connection provided enormous value.

“Because everyone likes light. It is important, especially at night. You can’t stay in darkness!”
TANZANIA

In a literal sense, solar home systems delivered reliable, high-quality, clean, overhead lighting, which was far better in quality than were available alternatives. It offered the ability to fully light several rooms and often a yard with light that was good enough to read, study, or cook by. It eliminated the need to carry a lantern or flashlight from room to room. Solar home systems were much less prone to theft than small lanterns that were left outside in the sun during the day and brought in at night. They were also safer because they eliminated risks of children burning themselves on kerosene (and being shocked by poor-quality electricity connections) and from house fires caused by candles and kerosene lamps. Solar produced no smoke, no odor, and no permanent residue left clinging to walls and roofing sheets. Solar home systems allowed customers to safely keep lights on all night if needed—this is important when babies need to be nursed and for outdoor security because lights deterred thieves and made it possible to see snakes and other dangers.

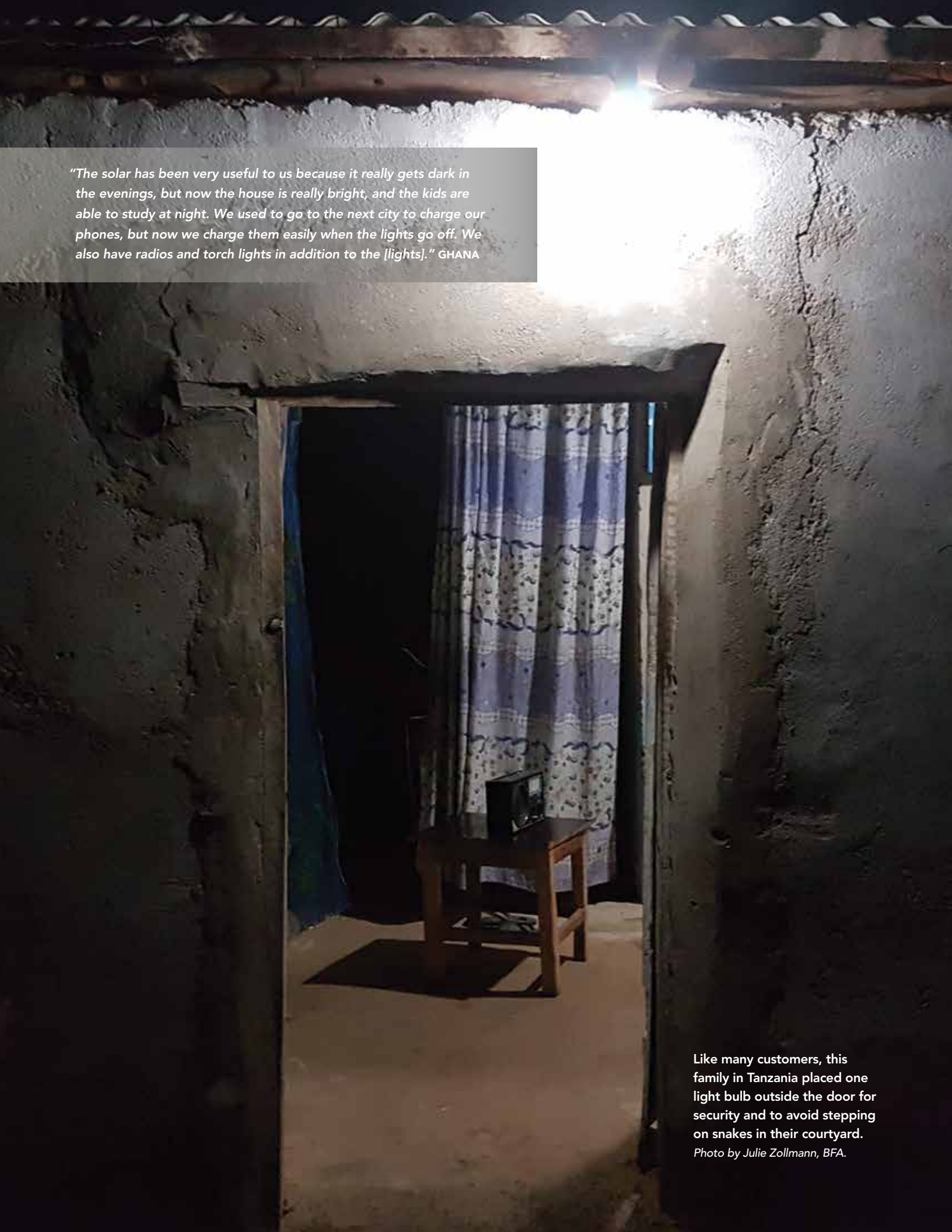
“As we are here in the village, we live in the dark. [The sales agent] brought the light and we saw it. . . . Also, not having to pay in full was helpful. But mostly, the motivation [for us to buy] was for the bulbs, the electricity.” TANZANIA

“We were used to the tin lamp, but now when I see how the solar lights the house, I wonder how we used to survive before. . . . [The small kerosene lamp] produces soot, which by that time we saw it as a normal thing because we have been using it since birth. But now, I don’t want it. When that smoke comes near me I feel like it is something very bad that affects me. I start coughing. It means we were in danger all that time we used it.” KENYA

“Whenever we left our children alone in the house, we were afraid that the house may catch fire if they mishandle the small lamp.” KENYA

“It is very beneficial. Now that I’m using the [solar] device, I’m in paradise.” CÔTE D’IVOIRE

In a figurative sense, solar home systems provided the illumination of connection in the often-isolated rural communities where customers lived. A stable energy source allowed customers to conveniently charge their phones, listen to news and music on the radio, and watch (or aspire to watch after a future upgrade) television. Respondents indicated how important—even necessary—it was to know what was happening in current affairs, locally and globally. They appreciated the ability to bring their solar-charged radios to the farm to make work more enjoyable, and—with television—to have the family together at home in the evenings, enjoying entertainment. Television was not just a luxury in their eyes. Instead, it was a window to the wider world, and many felt ashamed if they could not provide their children with that window, where they might be exposed to different ways of living and improve their English or French.



"The solar has been very useful to us because it really gets dark in the evenings, but now the house is really bright, and the kids are able to study at night. We used to go to the next city to charge our phones, but now we charge them easily when the lights go off. We also have radios and torch lights in addition to the [lights]." GHANA

Like many customers, this family in Tanzania placed one light bulb outside the door for security and to avoid stepping on snakes in their courtyard.

Photo by Julie Zollmann, BFA.

"Television is very important because even my children will learn a lot; that way they will also stay at home unlike loitering around even though I will discourage bad programs." TANZANIA

"What really attracted me was the television, but then my problem was that I could not afford as it was expensive. So, I decided to take the solar light which comes together with a radio. I convinced myself that with the radio, too, I will be able to listen to news, and I will not have the cost of buying batteries again. . . . I would really want to upgrade it to be able to use television. I have teenagers in my house, and they would love to watch the news or anything else to be informed of what is happening." TANZANIA

"We are in the dark; we do not have electricity. We often want to listen to information, we have nothing to listen with. [We bought the solar unit, with TV] because of all this. When it is here, it gives us a lot of courage. . . . At 8 pm I watch the news and 'France24'; I watch all that. Yes, that's it . . . information about the world, football. . . . I like the solar because it gives me access to information. That's it." CÔTE D'IVOIRE

"It helps with a lot of things, like charging the phone. Like our big phones (smartphones), the charge doesn't last. When it is finished, you can charge every day. If you don't charge you cannot communicate." TANZANIA

For study participants, having this reliable, modern source of energy was a significant lifestyle change. Respondents who had solar home systems had a strong sense of pride, dignity, and achievement. Customers reveled in the chance to show off the systems to visitors and make them feel more welcome, which was highly valued by many of the families interviewed.

"Even before saying [I have solar], when a visitor comes here, he says, 'Hey you've got solar!' and it makes me so happy." KENYA

"I have light, my friends can [charge their phones] and that is development." KENYA

"[Solar is a good deal] because we have light at night. Also, with solar you don't have to go asking round for [kerosene] when you run out, and there is also a sense of pride to have light in your home." CÔTE D'IVOIRE

These features made solar home systems very attractive. Because the benefits were better—and worth more—than those of previous forms of energy, many families were willing to increase their short-term energy spend to acquire them.

"The solar has benefits, and there is a saying that everything good is worth the price." GHANA

Concerns remain about the impact of loans that cannot pay for themselves on the financial health of borrowers. Many PAYGo loans fall into this territory, but PAYGo loans need not have negative implications for borrowers' financial health as long as the loan is ultimately affordable, the asset produces sufficient value to the customer, the customer fully understands the terms, and the lending does not become predatory. Risks escalate in more competitive lending environments, where borrowing is more frequent and multi-layered. It is important to get this kind of lending right, because it can bring important lifestyle gains within reach—things like metal roofs, mattresses, and smartphones—for many more people, even when economic returns on these assets are small or nonexistent.



3

Purchase decisions

Many of the important benefits of PAYGo systems can also be realized through the purchase of solar home systems that had long been available in local markets and supermarkets in the countries studied. What is it about the PAYGo model that made an aspirational product accessible?

Paying over time

Financing options played a large role. Being able to pay over time—even under monthly financing plans that were not particularly flexible—brought an otherwise expensive asset within reach for a much larger number of families. Many respondents reported that they would not have been able to buy the product if they had to pay in full at once, at least not without significant planning around lumpy income (those income sources that come in large, but infrequent increments, as in a one-time harvest) or savings. For many, postponing a solar purchase until one could raise the full sum would mean that the purchase would compete with other kinds of lumpy investments, like furniture, construction, motorbikes, and land purchases for which installment payments were not an option.

George (not his real name) was a great example. He told researchers that he could not have afforded to buy his solar unit at once. But he and his wife were still making big investments from their savings. They could afford to buy other things, apart from solar, when they got those rare lump sum payouts from their savings. While they paid in bits for their solar device, they were able to keep up their saving, investing in cows, and planning to build a house:

“[My wife] is in merry-go-rounds [rotating savings groups], and with the money she makes she is able to pay KES 400 [\$3.96] every week. That is how she saves her money, and when it is her turn, they give her the money. . . . With

the little money she has been saving in the chamas, we have been able to buy a cow. All my energy goes to work, and that is what I am concentrating on, to finish the house. . . . I am also in a savings group. One can save between KES 50 and KES 500 [\$0.49–\$4.95]. . . . The last payout I got was KES 14,000 [\$139], and I used it to buy a cow. . . . We now have six cows.” KENYA

Many respondents, like George, were very active savers. They did not purchase solar lighting on a PAYGo basis because they could not save. The challenge was that there were many good uses for that savings, things that were often planned well in advance. Kenyans called those planned investments—which can sometimes take many years to fully realize—“projects.” One of the benefits of PAYGo solar home systems—and other assets that these companies might finance on similar schedules—was that they allowed low-income households to pursue several projects at the same time. George’s family was able to work toward home construction, buy a cow, and acquire solar in the same year. Having the discipline to do all of that with cash savings alone would have been difficult. Lump-sum funds are rare and precious in their ability to fund important lifestyle and poverty-reducing investments, so enabling customers to make more of these investments faster is critical and something low-income families genuinely appreciate.

“[Paying in installments] is better. Sometimes you don’t have money to buy something at once. I don’t think I would be able to raise the KES 21,000 [\$207] for M-KOPA at once.” KENYA

“[The agent] told me if I paid at once, it’ll be XOF 140,000 [\$179]. But I don’t have XOF 140,000 to pay at once, so I have to opt for the payment plan that will permit me to pay as I can—to pay in bits as I get the money.” CÔTE D’IVOIRE



"[Paying in installments] is very important, because if they asked us to pay [all at] once it will not be possible as we cannot afford."
TANZANIA

The financing option also enabled field-based sales—the dominant means of distribution among the providers studied. Most customers had heard about the solar home system when a sales agent came to their community—often their home—to make direct sales. Agents might come back the next day with more units to accommodate the sales made, but purchase decisions often were made the same day or within a week. Few customers would have the entire sum needed to buy the unit outright within such a brief sales window. Customers tended to plan and earmark expected lump sums to direct toward large purchases. Being able to make same-day sales in the field is important for managing provider costs. Making many visits to customers as, one by one, they make a purchase decision can be extremely costly. Even where communities are dense, customers may not live near one another. One provider reported, for example, that technicians can visit only four customers per day.

"The people from [the solar company] came without notice, and I was given the solar products which I didn't plan for. I normally save money for the things I want to purchase later in time and plan on a budget." GHANA

"By the time they came, I had personally heard of the news in [another town], but they came and spoke to me. They had one of the devices, and they showed it to me. I was interested so I agreed and paid instantly." TANZANIA

Some customers needed time to make the decision and save up for the deposit value just to get started. This meant the salesperson had to make an extra trip to deliver equipment:

"There was one guy who used to talk about [the solar] around here. One day, they came to the market, and they did a demonstration on how it works with its bulbs, torch, and radio. I saw it was good. That day I didn't have money, and I went home. It took me one month until I got the money and sent it." KENYA

Even those who were able to afford an outright purchase said the financing option was attractive because it let them test the quality of the system and the providers' commitments to product warranties before committing to the entire purchase price. In some contexts, as in Côte d'Ivoire, many customers have had previous experiences with solar home systems whose batteries stopped working within a year of purchase. In many markets, customers have had experiences with other products for which guarantees have not been honored.

"Since I cannot read, that was a problem. I did not know what was going to happen if I pay for the solar at once, although I had the money to pay at once, so I decided to pay in bits.... This solar does not have a separate battery as compared to the others. Anytime [those batteries] get spoilt they can be changed. And with this one, nothing can be done to it when it gets spoilt. I did not know how the machine was going to work when something affects it, since we were not given the chance to meet the person who made the machine. That is why we had some doubts." CÔTE D'IVOIRE

INTERVIEWER: *"Why did you decide to pay bit by bit and not pay at once since you have the money?"*

RESPONDENT: *"It's a new product, so I wanted to try it first."* CÔTE D'IVOIRE

There was also a market segment that still required planning before deciding on what felt like a big investment. Still others were uncomfortable committing to an ongoing payment, because their incomes are both low and volatile. They worried that they already strained to meet everyday expenses and felt that committing to an ongoing payment was intimidating. This may explain why the Kenya Financial Diaries two-year update in 2015 found that, of 25 solar adopters (out of 281 households), only two were using PAYGo financing. However, those who were not using PAYGo might be able to make a purchase if it were timed correctly. For example, providers could allow (or encourage) customers to make large initial payments when they receive payments from their savings groups or after large seasonal harvests.

The combination of financing and field-based sales opened up a solar option for individuals who were not necessarily in the market for a solar home

system and who assumed that solar systems were for the rich. Their perception of solar changed when a sales person visited or when they heard about a new PAYGo option from a neighbor who had a system installed. Most places in the study did not yet have multiple PAYGo operators selling in the same communities, so customers did not typically shop around and compare options.

Device attributes. Where consumers did have exposure to multiple PAYGo providers (and outright purchase options), they seemed to assess them primarily in terms of the size and strength of the hardware. They were interested in buying units that had more lights, offered longer battery life per day, could charge more phones, and could power more appliances (especially televisions, as well as refrigerators and fans in wealthier markets). Nearly all respondents expressed the desire to upgrade from a basic system (lights, radio, flashlight, phone charger) to a system with television, even at a higher cost or longer loan term.

"I wanted a device which is strong and has a company [backing it up]. They told me if you have a problem come back to us. And for sure they have been true to their word like when they changed the charger." KENYA

INTERVIEWER: *"What happened when you delayed to pay [for your previous solar]?"*

RESPONDENT: *"They switched it off. If you delay for a month, they come and take it away. But I will not delay for [this solar] because it is strong."* KENYA

"[My PAYGo solar] has a 5-year warranty. You have to pay XOF 5,000 [\$8.60] a month for three years. We have confidence in the power supply of [this solar].... With regards to the first solar I bought [outright from the market], the company does not help in fixing problems associated with the device. In the case of [the PAYGo provider], they help." CÔTE D'IVOIRE

In fact, in areas where there were competing PAYGo offerings, respondents did not mention the differ-

ence in competitor loan terms (one versus three years) as a deciding factor in whether they would purchase. They assessed affordability based on the size of the regular payment. However, it was important to them to one day own the device and see their out-of-pocket energy expenditures go to zero.

"Yes, those staff told me very good things. They told me we are getting old and buying kerosene daily will be very expensive for us. So, we are very happy because I know in three years I will have completed making my payments. So, I decided to install the solar." TANZANIA

"I can say it is a good deal, but we cry for the price. Since we have it, we enjoy it whenever we pay.... With the solar, after making the payments, I'll be done paying. But with the batteries, I would always be paying. I prefer [solar] to batteries." GHANA

INTERVIEWER: *"Do you think this [solar arrangement] is a loan?"*

RESPONDENT: *"Yes. They have given it to me on credit, and once I finish the payment it will be mine.... I don't know the balance, but I will finish by the year 2019. I was thinking I collect the money and pay them at once and keep my solar."* KENYA

Respondents were willing to increase their energy expenditure temporarily to acquire a useful device; it was clear that they viewed the solar system as a device, not as a utility service. They saw the equipment in their houses, and they knew that warranties had expiration dates. They understood that they were buying a device that converted sunlight into energy; and monthly payment models that required catch up payments reinforced this understanding. Customers were buying equipment. Providers that wish to sell solar devices—rather than grids or mini-grids—as a service to this segment may struggle to change this mindset.



4

Affordability

Initial higher costs for greater value

How do low-income customers make space for solar home systems in their budgets? An examination of three Kenya datasets showed that it was unlikely for low-income households to reduce their energy spending in the short term through the purchase of a solar home system. Looking at kerosene spending in the Kenya Financial Diaries (2013), Kenya Integrated Household Budget and Expenditure Survey (KIHBS)(2005), and the national M-PESA panel survey (2008), Gubbins and Zollmann (2016) found that average monthly kerosene spending for the typical Kenyan ranged from KES 200 to KES 400 (\$1.98–\$3.96). The top 20 percent of kerosene spenders in rural off-grid households throughout the country paid about KES 550 (\$5.45) per month.

Including other energy expenditures, beyond kerosene, does not change the picture. Combining spending on batteries, candles, kerosene, and electricity from Kenya's nationally representative KIHBS dataset shows that less than 10 percent of Kenyan households could reduce their energy spending within the first year of a one-year solar purchase.⁵ Even with volatile energy prices, it is unlikely that any but the heaviest energy consumers would reduce overall energy spending within one year should they pay for their system on schedule.⁶

With such low typical spending on nonsolar sources of energy, there must be another source of

funds Kenyans and others draw from to make their solar investments.

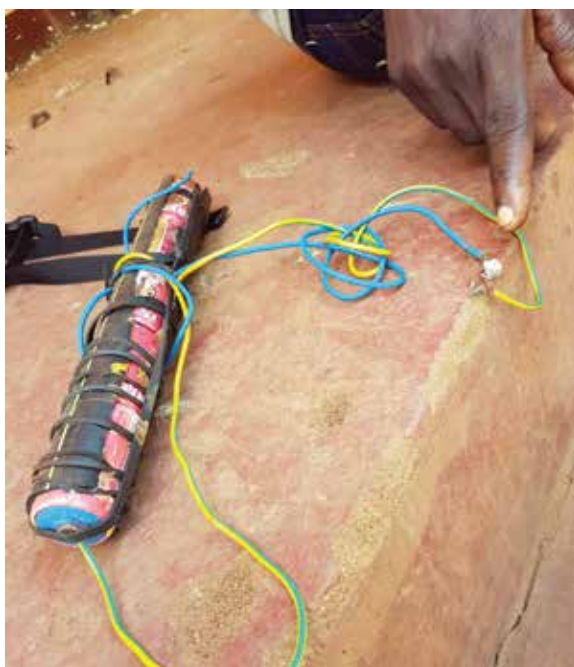
In this study, researchers measured household energy spending before and after solar and found that it was not common—especially among this lower-income sample—for customers to reduce overall energy spending in the first year of purchasing a PAYGo solar home system. There were several reasons for this. First, batteries and kerosene were inexpensive. Their use was rationed, because every time a family spent money on them, it felt like a waste. Kerosene was consumed and disappeared. Dead batteries accumulated on window sills and in yards. Families used them only as much as needed. Phones could remain without a charge. People without light went to bed early.

One respondent in Tanzania sent most of his income home as remittances. He wanted to minimize any expense on himself and had stopped buying fresh batteries. Instead, he scavenged for dead batteries, taping large numbers of them together to power a single bulb pulled out of a broken flashlight.

Respondents in several markets had shifted away from smoky, expensive, flammable kerosene long before they purchased solar. In Ghana, Côte d'Ivoire, and Tanzania, batteries were a more important source of light than kerosene before getting solar. The typical Kenyan PAYGo customer in this study's sample spent more on energy in absolute terms and relative to income before getting solar than in the other countries (Figure 2).

5. This figure comes from calculating energy spending on electricity, kerosene, candles, and batteries by household. In 2005, the 90th percentile of all Kenyan households spent KES 631/month on these items. Adjusted for inflation, this is equivalent to about KES 1,432 (\$14.18) per month or KES 17,184 (\$170) per year. The one-year systems studied cost customers \$207–\$244 in the first year, provided the customer pays on schedule.

6. Kerosene has not exceeded KES100 per liter since 2005 (TDS.GD 2016). According to KIHBS, the top 10 percent of kerosene-using households used 10 liters per month (the median used only 3 liters per month; the mean used 5 liters per month). Rural customers who buy kerosene in small quantities often pay more than government-reported prices for kerosene; one provider claimed that this is up to 25 percent more, though the authors cannot verify that figure.

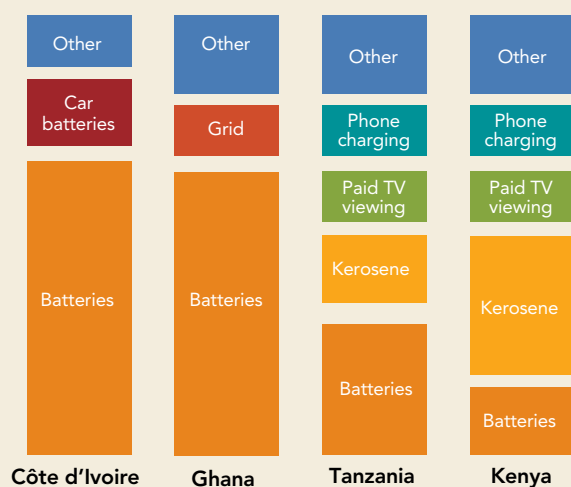


Cobbled-together make-shift light. It's very cheap, but not very useful. Photo by Julie Zollmann, BFA.

FIGURE 2

Many households had already shifted away from kerosene before they purchased solar.

Relative distribution of households' presolar spending by source and country (excludes cooking fuel). Note that many households in Kenya and Tanzania pay to have their phones charged by neighbors and businesses and to watch TV (especially "football"/soccer).



In addition, energy spending did not appear to increase as quickly as income (Figure 3). There were limits to how many batteries any family wanted to consume. That meant that mid- to upper-income households actually spent a small share of their incomes on energy and had extra space in their budgets to accommodate solar investments.

Only a few respondents financed their solar home systems by using the devices to make money—mostly by charging phones for neighbors but also in a few cases by extending small business hours past sunset. However, phone-charging revenue disappeared when solar penetration increased. Proliferation of solar tended to happen quickly, especially in more densely settled villages. Also, in some countries (Ghana and Côte d'Ivoire), asking friends and neighbors to pay to charge their phones was not socially acceptable. Solar income did not play a major role in helping buyers in the study finance their investments.⁷

Some providers have stretched the loan term from one to three (or more) years, thereby lowering monthly payments to levels that more closely approximate customers' prior energy expenditures. This strategy comes with important trade-offs, as shown in Table 3. Longer loan terms appear to make it easier to reach greater numbers of lower-income families with a more expensive starter system. However, this approach comes with higher costs of capital and higher risks of default, costs that are ultimately passed onto customers (or jeopardize profitability). Longer loan terms can make it difficult to retain customers for the long term and satisfy demand for other asset investments because it takes much longer for customers to complete their first purchase.

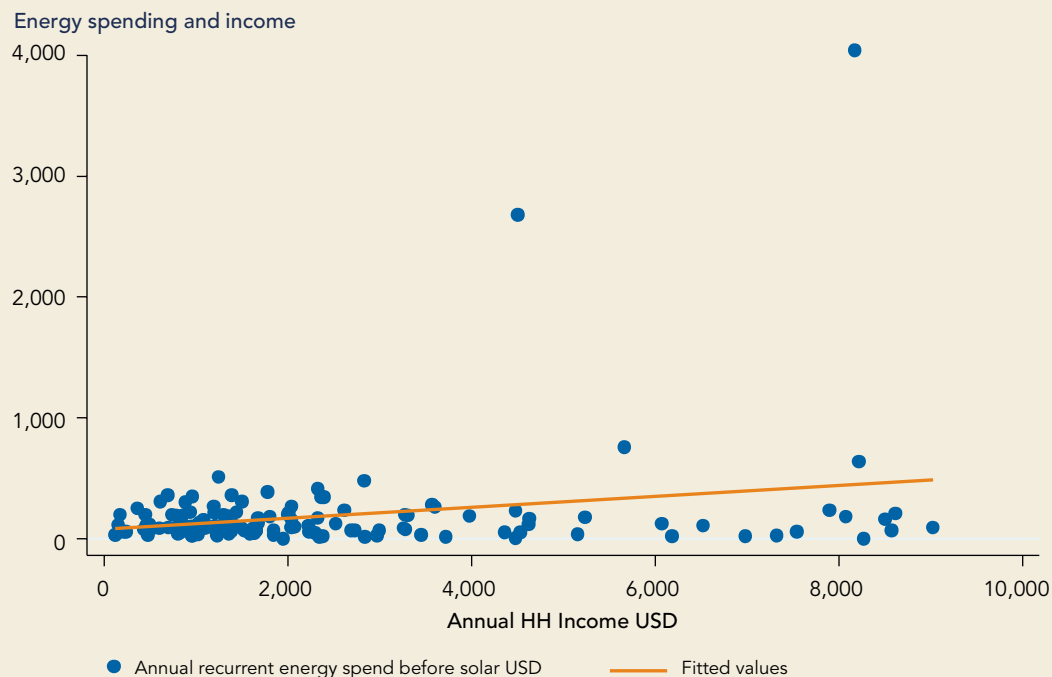
These are not trivial trade-offs. Monthly costs are not the only factors affecting whether low-income families can adopt—and complete payments—on PAYGo solar.

Understanding long-term expense reduction is more complicated. It depends heavily on the value of presolar spending, the amount of energy spending displaced by the new solar home system, and the useful life of the device. The first two parameters varied widely across the study sample and

7. Mobisol in Rwanda introduced a "business kit" to help buyers start a charging business. A GSMA case study on this work found high repayment rates for business kit buyers and an average income from charging of \$35 per month. GSMA notes that "[t]hese earnings exceed the monthly payment for the 100W system and comprise 66% of the monthly payment for the 200W system" (Cohen 2016).

FIGURE 3

Energy spending increased with income, but not as quickly as income did (study results).

TABLE 3 **Loan tenor trade-offs**

	1-year term	3-year term
Default risk—ultimately feeding into customer costs. Risk compounded by falling cost of solar, which can make competing products more attractive before the initial loan is complete	Lower	Higher
Cost of capital—ultimately feeding into customer costs	Lower	Higher
Time to upgrade/offer value-added services	Shorter	Longer
Affordability for low-income customers ^a	More difficult	Less difficult
Ability to offer larger product at outset on affordable payments	No	Yes

a. In the sample, the three-year contracts had significantly more customers in the bottom half of the national income distribution. This is a small, nonrepresentative sample, but the result is intuitive.

the third—the useful life of the device—was also not clear, although a five-year life span is a common estimate.

The question of energy spend displacement is important, but it should not be the only consideration when designing a solar loan or understanding its impact on customers. Table 4 summarizes the

output of a generic model for a solar unit that retails for \$125 and has a \$20 deposit.⁸

When financed over one year at a given rate, a household that was spending \$10 a month on energy must now spend \$12.25 on just solar. Combined with some residual spend on candles or lanterns, their energy budget will increase by \$3.75.

8. Determining the borrower's cost of financing (i.e., the interest rate) is difficult when a hard asset is paid for with a flexible repayment plan, but in general more transparency is needed about PAYGo interest rates.

However, over the usable life of the asset (modeled at five years), the unit will generate 3.1 times as much savings as expenditure. This is because, after the initial financing, the unit is paid off and there is \$8.50 in monthly savings for the remaining life of the product. In this case, the customer spends more at first, but the solar home system turns out to be a good investment in the long run, particularly when factoring in the higher quality of solar. (See Annex B for a full summary of the model outputs.)

If the unit is financed for five years instead, the hypothetical customer's solar payments are now just \$4.30 a month; the customer is saving money. Yet it is not that simple: The customer will pay \$111 more in interest, and the lifetime cash-on-cash return would decrease significantly. Moreover, the longer tenor raises the cost of borrowing and the risk of default, both of which would likely make a five-year loan more expensive than presented here. In developed markets, a longer-term loan with lower monthly payments does not necessarily result in a better deal for customers; that same logic applies here. Respondents in this study regarded their solar units as long-term investments. Providers should keep that in mind when designing their loans.

Even when customers in this study did not save money in the short term, they still appreciated the products. Some respondents believed they reduced their energy spending by buying solar and were surprised when they were walked through a calculation that revealed that they were not saving money.

One provider said that its internal customer surveys have shown that 87 percent of customers reported that they believed that they were saving money through their purchase of a solar home system. Some of these responses may be the result of misinterpreting the survey question. Respondents interpreted "saving money" and "reducing energy spending" quite differently. Some responses were intended to show overall enthusiasm for the service. And some responses were the result of misinterpretation and not doing the math accurately.

When customers were shown that they would not initially reduce their net energy spend, their surprise did not dampen their enthusiasm. The perceived value of the solar home system was greater than the value they got from their previous energy sources. Customers were comfortable investing in that value. For many, the primary driver of their purchase decision was not saving money, it was a lifestyle change.

Also, making payments for solar was less stressful than buying batteries, candles, and kerosene. Solar was a single expense, as opposed to multiple expenses in small, separate, daily increments for batteries, candles, kerosene, and phone charging. Solar's single expense was something customers could more easily plan around, and they understood that they were making payments toward a device that they would eventually own. It was a payment that felt better than paying for batteries that were constantly used up and left lying around.

TABLE 4 Financial analysis of consumers' PAYGo solar investment

Key assumption	Monthly cash flow implications			5-year total savings/expense		
	Monthly savings (on candles, kerosene, etc.)	Monthly SHS payments	Net savings/ (expense) during repayment	Total payments	Total savings	Cash-on-cash return
<i>\$10/mo. Prior energy spend 85% replacement rate</i>						
1.0	\$8.50	\$12.25	(\$3.75)	\$167	\$510	3.1x
3.0	\$8.50	\$5.51	\$2.99	\$218	\$510	2.3x
5.0	\$8.50	\$4.30	\$4.20	\$278	\$510	1.8x

a. In the sample, the three-year contracts had significantly more customers in the bottom half of the national income distribution. This is a small, nonrepresentative sample, but the result is intuitive.

INTERVIEWER: *"Do you think [your solar home system] has saved you money?"*

RESPONDENT: *"I cannot compare because I used little money to buy kerosene. [Solar] is much better than using [the kerosene] lamp."* KENYA

"[The solar] is good even if it's more expensive." TANZANIA

"The battery is less expensive because you do not take a huge amount to pay like the solar, but I prefer the solar.... With the battery, it spoils within one week, but the solar provides stability, and you will have enough time to pay the second installment." GHANA

"I know we spend more on energy now, but it is better than using batteries." CÔTE D'IVOIRE

"You can use 50 shillings [\$0.50] every day without knowing what you did with the money, but with the solar, you see the value for your money and at the end of the day, you will own it. It is a good deal." KENYA

"I am surprised [that I'm spending \$5.00 per month more than before] because I didn't calculate it. I only realized after you told me. I know I started using it in November, but I never calculated it till now to know the cost I spend in buying the units. Also, when I was buying the batteries I never calculated it, but I know [my spending on] batteries. So, I think I'll start calculating it from today." GHANA

Mechanisms for budget stretching

If customers are increasing their energy spending to pay for a solar home system, where are they getting the additional money?

First, even for those who struggled to make ends meet, PAYGo pricing was within reach for most households. The median household in this study spent 7 percent of its monthly income on the solar purchase. Less than 10 percent of households were spending more than 24 percent of their cash income on the investment.⁹

Many respondents—especially, but not exclusively, in Ghana and Côte d'Ivoire—were unsure where the extra money came from to make their investment. They may not have been sure what they were spending before and how it compared. They struggled to recognize any trade-offs in their budgets. Instead, they earned and allocated their money as it arrived—typically in larger sums. They squeezed the solar payment into their budgets without being fully aware of exactly how it fit.

Other customers could easily fit the investment within their budgets. There was no need to stretch particularly far to make solar payments. Even if their energy spend increased through the purchase of a solar device, the increase was too minimal relative to their income for this to be a strain.

Eva and Daniel (not their real names) are a great example. They were paying off their solar purchase in Tanzania with revenue from their business. They would regularly put aside a bit of money in the few days leading up to their credits expiring so that they knew they could pay for at least 10 days' worth of credits at a time. They said they were putting off buying unnecessary clothing for the duration of their loan, but that it was not a big strain. Making the solar payments—at 4 percent of their monthly income—did not cause them financial stress.

Some customers in daily payment models made the solar payments fit into their budgets by spending some days in the dark. When money was tight or needed for other things, they skipped a few days of payment without serious penalties or shaming from the provider. Since there was no compounding interest, late fees, or arrears accumulation to get started with payments again, customers could buy new solar credits, have lights, and continue paying down their loan when their finances allowed. This flexibility eased the trade-offs for families who would otherwise have to choose

9. Agricultural production for home consumption was not quantified in this study's income calculations.

between becoming delinquent on a solar loan or taking care of other pressing needs, like buying inputs for a business, paying school fees, or paying for an urgent medical expense.

INTERVIEWER: *"Has your [solar home system] ever been disconnected?"*

RESPONDENT: *"Yes, I have stayed for two days now without paying because I did not have the money. . . . If I get money now, I will first go and bring the materials for carving, not pay for solar. When my child is sent home for money, or if they don't have food, I will still buy the carving materials first so that tomorrow they can go to school and have food. . . ." KENYA*

"My daughter had given birth, and I had to look for money to discharge her from the hospital. So, I had to skip to pay [the solar company]." TANZANIA

INTERVIEWER: *"You are late in making your payments. Why have you delayed?"*

RESPONDENT: *"Because I do not have money. The teacher from my son's school called and said he doesn't have shoes. I decided to buy the shoes, thus the delay. But today I will pay!" KENYA*

For low-income households in Kenya and Tanzania, budgets were tight and tied to high-frequency income sources, meaning the flexibility in a household's budget varied from day to day. Even an extra few dollars per month could cause strain. Those families reported making sacrifices on other expenditures for the duration of the solar payment.

"We have reduced on house shopping. We used to shop for 500 [\$4.95] and now we do shopping worth 300 [\$2.97] to buy cooking oil, sugar, salt, so we have reduced on such things." KENYA

"We have cut on some things...like eating meat, fish, and chicken often like we used to so that we can be able to pay." TANZANIA

None of the respondents said that this new burden was unbearable. They felt that these sacrifices were both manageable and "worth it" to acquire a solar device. Paying for solar was high on respondents' list of priorities, but it did not seem to displace spending on things families deemed more important, especially essential food, school fees, and healthcare. Should it come to making trade-offs, respondents said they would stop paying against the solar unit until they were in a better financial position.

"If you pay for solar, the other money you get you use for other things. We don't have any specific budget so we buy what we need with the money we have. What I have done is, when we cook rice during the day we eat half for both lunch and supper. That is how we economize. If the solar had affected our life so much, I would have told them to come and take it away." KENYA

Gender and budget trade-offs

Repercussions of spending trade-offs can be gendered. Women in Kenya and Tanzania tended to manage the day-to-day household expenses, while men took primary responsibility for larger household investments, like solar, housing, and school fees. Men were the primary decision-makers when it came to buying solar across all markets, often against the initial protests of their wives who felt the units were too expensive and who preferred cheaper alternatives. Then—because the payment was recurrent—the payments were met by reducing women's budgets and purchasing power in the day-to-day household budget.

Women in the study did not outwardly complain about this state of affairs, and most seemed to appreciate having the lights. Still, this in effect decreased the money women managed, including what they might be able to save. This matters, because women decided how to use the money they saved. Saving gave women a say in household investments. Should their husbands choose to continuously acquire assets through solar providers, this could be a persistent issue with more profound implications on women's budgets and financial decision-making power in the household.

INTERVIEWER: *"So those people convinced you and you made a decision right there; or did you come home and consult with your wife?"*

RESPONDENT: *"I made a mistake and decided to buy it right there and when I came home I told her 'Look! I have got solar and they have said we pay TZS 1,200/- [\$0.53] daily!' But it has not been easy!"* TANZANIA

"When I went to [the] market I met the sales people there. . . . They said the first time you pay KES 1,40 [\$13.86] for solar and light, if it is solar and radio KES 2500 [\$24.75] they kept on explaining to me the prices and I left. I came and told my wife, and she refused saying it will give us problems. I called customer care anyway and gave them my names while I was consulting with my wife." KENYA

About his wife who sells fish in a market more than an hour walk away:

"When [she] wants to go to the market, instead of taking a motorbike, she prefers to walk so that we can use that money to pay solar." KENYA

Providers today have a higher share of female customers in Kenya and to a lesser degree in Tanzania, with few female customers in Ghana and Côte d'Ivoire. That might be explained in part by Kenya's migrant labor dynamics. In Kenya, it is common for men to work in the city while their wives live in the rural home, often earning an income of their own. Several female respondents in this situation purchased the solar home system independently, without consulting their husbands.



5

Other drivers of payment performance

The study oversampled for customers who struggle to pay to test the limits of PAYGo's reach in terms of income segments. The study found that payment performance has many drivers, not all of which are tied to income.

Flexibility

Payment terms affect affordability in complex ways. One way terms affect repayment is through loan tenor, as already discussed. Another way centers around whether the customer is expected to make daily equivalent or monthly payments. The daily payment mechanism is more flexible and allows customers to make payments they can afford at whatever interval they would like. Many customers in the study seemed to like this arrangement, saying "I can pay what I have." Customers on monthly payment schemes also liked the longer payment interval: "I pay, then I have time to plan." There were no clear preferences for one option over the other. However, those on monthly plans paid less per month in total than those on daily schemes. The ability to pay over time appeared to be more important to customers than the flexibility offered in payment terms.

Monthly payment plans were less flexible. Although it was reported that some providers allowed for grace periods or partial payments for partial credits, none of the respondents benefited from these options, which were available only when they called in and specifically requested them.

One respondent said that he was told the plan was flexible, but when he tried to make use of that flexibility he was denied:

"Before they make an installation, they are aware we don't really have that much money, but we are told it will take a number of days for the light to be cut [if we can't pay], but they don't stick to that and then cut the light. . . . When it is cut, [the local agent] makes the calls

to inform [the office] about it to let them know the actual location, and they also call me, but only to ask about how I can manage to make payment." CÔTE D'IVOIRE

Flexibility—though less important than financing the purchase over time—mattered to low-income customers. Offering flexible payment terms is challenging for banks and microfinance institutions, but PAYGo providers' payment systems and disabling technology make them uniquely positioned to deliver flexible financing. When low-income customers in this study fell behind, it was often because of a small disruption: a lost day or week of work, an unexpected fee at a child's school, an unexpected clinic visit. A short-term advance on solar credits could help them keep lights on during these periods or on the days they simply forget to make a payment when they are close to an agent.

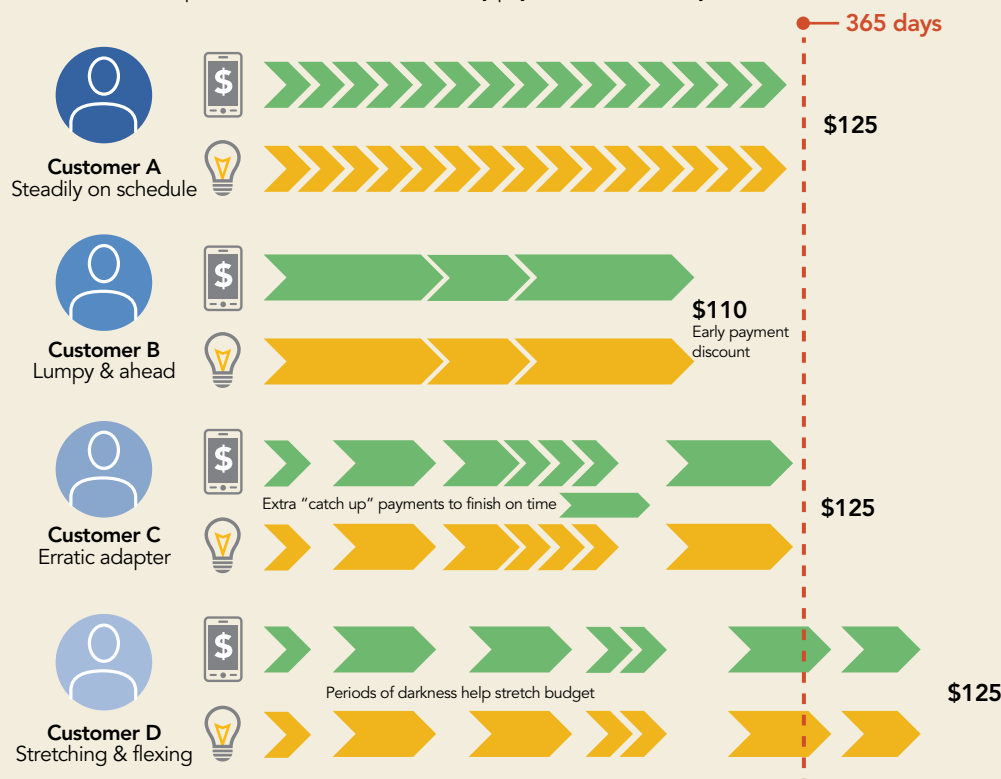
Daily payment models also allowed customers to fall behind—to not pay for some days—without any penalty (see Figure 4). During those days, the customer did not have lights. But, when customers were ready, they resumed paying and using their lights without making up for missed days. Having to catch up on missed payments to use the solar device again created significant barriers for low-income customers on monthly payment models to resume paying and finish their contracts. On daily payment plans, customers could miss payments, and their units were "blocked"—that is, the provider required a substantial payment to resume use—only after a long stretch (typically 90 days) with no payments. Customers skipped days without feeling ashamed about their short-term cash flow problems. This had important repercussions for the customer-provider relationship. Under this arrangement, customers felt especially understood and appreciated by their providers. They were committed to a long-term relationship based on the trust they felt that providers had placed in them.

FIGURE 4

Daily PAYGo models allow for a wide range of repayment patterns that are not necessarily considered "delinquent."

Possible payment patterns on hypothetical PAYGo plan

Loan with \$15.50 deposit + \$109.50 due in \$0.30 daily payments over 365 days



"There is something interesting about [the company], which is, there is no pressure on the payment.... It is to your own advantage to pay, but if you do not pay, it is your own disadvantage."
CÔTE D'IVOIRE

"You know when we delay to pay, I am called by [the company] and they ask, 'Mum, what is the problem? I can see your power is almost finished. What is the problem?' When I explain to them, they understand and tell me to try and send the money." KENYA

"I have come to trust them. Initially, I had bought a book so that I could record all of the payments to them, but when I realized that they send me notifications of how much I have paid so far, I knew this company is one of its kind and I started to trust them." TANZANIA

Providers required customers on monthly payment plans to catch up and make payments that were missed before they allowed the unit to function again. This lockout mechanism was a substantial barrier for low-income customers who fell behind on payments. Customers rarely were able to come up with a lump sum, and even if money did become available, it was typically earmarked for other competing expenses. Many customers never caught up, and their solar units were repossessed; they felt ashamed and lost their investment.

One very low-income respondent had her lights off for three months. Her monthly payment was \$7.60. Without solar, she spent about the same, sometimes more, on alternative energy sources. She was still able to use the rechargeable lantern she received as part of her PAYGo package, though, which meant she spent less on energy than she did before using solar. After falling behind on her

PAYGo plan for one month, she found herself unable to catch up. She could not come up with multiple months of payments at one time. At the time of this study, she was waiting for a large savings group payout to help her catch up on payments. At that point, she needed to pay \$22.80 to use the device again.

Given the expense of repossessing and redeploying equipment, providers may be better off offering their customers more flexibility and leveraging their long-term customer relationship rather than keeping rigid payment structures with repossessions that effectively sever relationships. Indeed, one provider began transitioning its customers from monthly payments to flexible daily payments shortly after this research. However, pricing for this kind of flexibility is not necessarily straightforward. Providers are challenged to build financial models that require accurate payment data on some level of scale, but it takes time to accumulate such data with longer-term loans.

One potential downside of this strategy is that a disconnect between customers' and providers' perceptions of "good" repayment behavior can contribute to lower repayment rates. While nearly all of the study's on-time payers thought they were good payers, many of those who were regularly behind on payments also thought they were good payers (Figure 5). When asked why, participants

said they were trying hard or missed only X days, weeks, or months of payments. Much of the flexibility that PAYGo providers offer is implicit, and sometimes the signals from providers about what makes a "good" payer are unclear. For example, one provider offered a "good payers club" that came with entailed monthly benefits and the option to take loans for new products. However, the marketing around the club did not define what makes a "good payer."

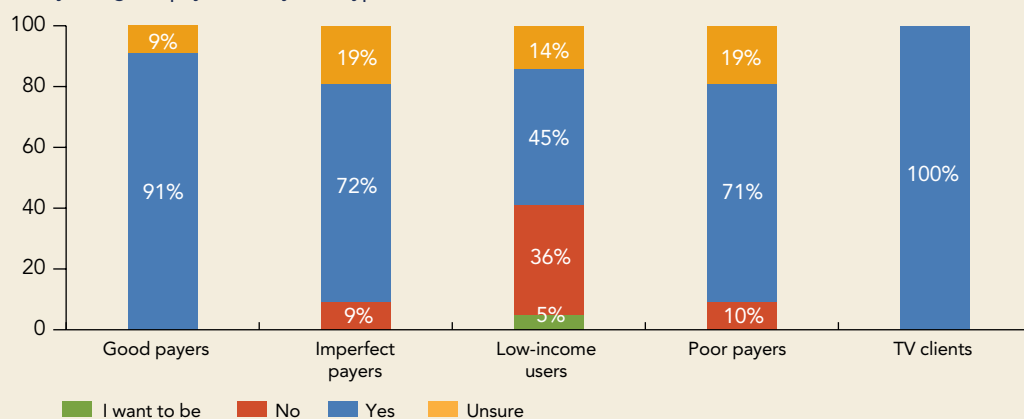
INTERVIEWER: "Do you think you are a good payer?"

- "Yes, because I do my best to pay when I get the money." KENYA
- "They may not consider me a good payer because of this month's delay but personally I think I am. I can't let my child stay at home for lack of school fees simply because I need light." KENYA
- "Yes, because I like to reduce my debt when I can, it's just that I don't have the finances at the moment." TANZANIA
- "I will say so, because the contract hasn't ended yet. So unless it ends and I am unable to finish with the payments, then I can say I am not a good payer." GHANA

FIGURE 5

Many imperfect and poor payers thought they were good payers.

Are you a good payer? (% by user type)



When the provider’s overall portfolio is healthy, defining “good” payment behavior loosely allows customers to fall behind without shame or penalty and can be a good strategy. It reinforces a positive provider-customer relationship in the long term and allows the customer to see this payment as the place he or she can find budget flexibility when cash is tight. However, if the provider’s portfolio is struggling, the provider may want to consider whether customers understand the behavior they are trying to incentivize.

Cashflow fit

Another challenge in keeping up with payments relates to a mismatch between customers’ cash flow patterns and PAYGo payment requirements. In the communities studied in Kenya and Tanzania, customers (and noncustomers) often had at least one high-frequency (defined as 12 or more times per year) source of income, which made high-frequency payments to a provider (at least monthly) manageable (Figure 6). This was not the case in West African communities that were studied. In these communities, more households relied heavily on low-frequency income sources from seasonal cash crops. Even those running small businesses, like boutiques, were subject to the ups and downs of the cocoa and palm nut season, with very little income at all in the off-season. For them, keeping up with any kind of regular payment was extremely difficult.

“All of us who bought it don’t have money now. . . . They brought it at the time that the cocoa season was bad, so I told them to bring the products around August–September when coming next time. This is because the folks will be able to buy outright without credit, at that season.” GHANA

“There are times when there is money and times when there is no money. Because we cultivate cocoa, if we harvest we will have money. But if we don’t harvest cocoa, then there is no money. The period where we are unable to pay is February–May.” CÔTE D’IVOIRE

These examples are a stark contrast to income flows that are dominant in Kenya and Tanzania. One study participant who depended on remittances from her husband, who drove trucks on a casual basis, had the following interaction with an interviewer:

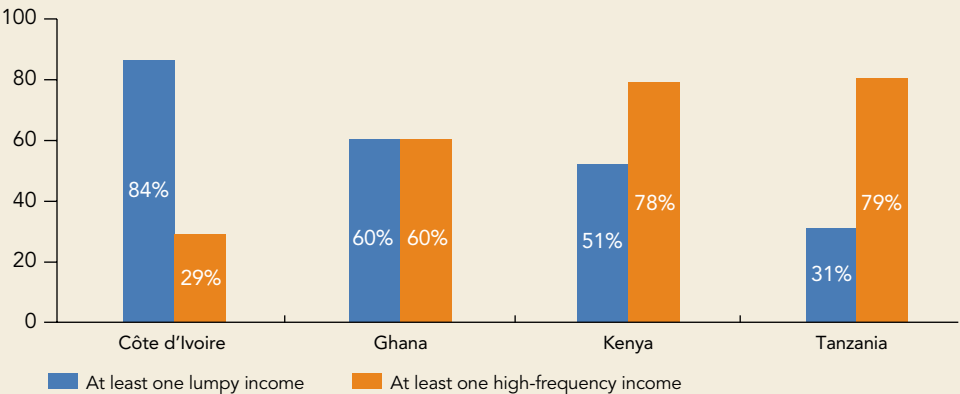
RESPONDENT: “When my husband sends KES 200 [\$1.98], I pay for [my solar], then if there is still some credit . . . he sends another KES 200 [\$1.98] to [the solar company]. . . . When he has good money, he sends like KES 500 [\$4.95].”

INTERVIEWER: “Okay so you don’t have a pattern; it varies. Sometimes KES 200 [\$1.98] or KES 500 [\$4.95].”

RESPONDENT: “Sometimes even KES 100 [\$0.99]. When it gets finished, we have to look for a way to get the money so that we load [more credits].”
KENYA

FIGURE 6

High-frequency and lumpy incomes, by country (%HH)



Fit was distinct from the adequacy or inadequacy of income. Many customers with lumpy incomes could afford to buy the solar unit in one or two installments. Many customers wanted to clear their remaining balance when lumpy income came in, but they rarely knew how much of a balance remained because few providers gave updated balance information after each payment. That made it difficult for lumpy-income earners to manage payments; it also undermined trust in the provider. A provider in one of the countries told some customers that they were not allowed to clear their loan early.

INTERVIEWER: *"How much do you still have to pay before you finish? How much remaining?"*

RESPONDENT: *"If they give me the receipt to show how much is remaining I will pay, but I do not know how much I am left to pay. I pay for [the solar] in cash [at the company's office] although I do not receive any receipt. But if not for this issue I would have been done with the payment. And because I cannot read, I am afraid to pay all at once, so the receipt has just delayed my payment process."* CÔTE D'IVOIRE

INTERVIEWER: *"When did you start paying for the Zola?"*

RESPONDENT: *"December this year."*

INTERVIEWER: *"Do you know how much is remaining?"*

RESPONDENT: *"I don't know."* CÔTE D'IVOIRE

INTERVIEWER: *"What does [the solar company] say in the text message when you make payment?"*

RESPONDENT: *"They state the amount that has been paid so far but not the balance."* TANZANIA

"I wanted to pay cash, but they said you can't buy in cash. It is only paid in installments. I further asked them if I get the lump sum you can't take it? They said no; I have to pay for a span of three years. I felt like three years for KES 740 [\$7.33] per month is a lot of money. What I wanted most was the lamp and television." KENYA

Trust

Trust matters when it comes to repayment. Some customers in the study sample fell behind on payments, not for lack of money, but because they did not understand the contract and thus felt the provider was taking advantage of them. This problem applied to all providers to different degrees. Part of this pertained to the incentives of sales agents who want to close a sale and who might not be honest about things like the length of the loan, consequences of nonpayment, capacity limitations of the device, or what they see as less-attractive contract terms. In other cases, agents may simply be in a hurry or assume someone who has sought them out already understands the terms. Providers should confirm that terms have been disclosed and that customers understand them.

"The only problem was that when they brought the device, I didn't read what was on it, but later when I read through all the documents, I realized I was supposed to pay GHC 139 [\$31.59] as deposit and GHC 2.50 [\$0.57] daily. But [the agent] only said [to pay] GHC 100 [\$22.73] [as a deposit], which will amount to different totals. Now I am wondering if the documents were inaccurate." GHANA

"It is not as we had agreed on in the written contract. The amount that we agreed on was TZS 12,500 [\$5.59] per month, but when they sent a message they said that I should pay TZS 17,000 [\$7.60]. So we are paying excess amount than what is in agreement." TANZANIA

"There was a time that I was not able to pay like for a month. They switched off my system and told me that I will not be able to use the product because I have not renewed my payment for a month and that I will be barred from borrowing anywhere in this company and that my details will be shared with other companies. I was not doing well financially. After receiving the message in the morning, I called them in the evening. I told them that they never shared such information with me when I was first acquiring the [device] that if I take one month without paying I will be disconnected." TANZANIA

Low literacy levels, which were common among respondents in all countries to varying degrees, exacerbated the disclosure and understanding challenges. Many customers recognized that their lack of literacy made them vulnerable.

INTERVIEWER: *[Discussing point of contract confusion.] "Did you sign anywhere?"*

RESPONDENT: *"There was a paper signed, but I did not read because I don't know how to read English."* KENYA

In one case, the respondent told the interviewer about a contract duration different from what was written clearly in a payment schedule on the first page of his contract, which he showed study researchers:

INTERVIEWER: "When you were given this paper [contract], did someone read and explain to you what it all means?"

RESPONDENT: "Yes they read to me but not all of it, but I read it myself especially the first page to understand how much we are supposed to pay and when. Also, I read what the [solar unit] entails and what it comes with." KENYA

Customers trust their local sales agent (and sometimes technician) to provide them accurate information. Customer-provider relationships, which are nurtured also through text messages and experiences with call center staff, further encourage repayment. In fact, most customers said that calls reminding them about late payments were welcome and "encouraging" rather than annoying. Customers wanted to uphold their end of the deal, especially when they knew that a provider who respected and trusted them awaits those payments. Companies that excelled at building trust had customers who are interested in maintaining a long-term relationship.

"You can be given something but the way you are talked to will either make you want to pay for it or not. They have good language and are not abusive. The way they talk to us makes me feel like I just have to pay. After all, it is helping us, and we are using it." KENYA

"Oh, I feel comfortable when they call me. Although they demand for the payment, when they call me I don't feel embarrassed." GHANA

Logistics of payment

All the providers studied rely on mobile money for collections. The logistics of making payments can be a major reason that customers fall behind or stop paying, especially where mobile money is new and unfamiliar for PAYGo customers.

This was most pronounced in the study's West African sites where the following were observed:

- Mobile money agents were far apart and not familiar enough with payment processes to help customers.
- Many customers did not have a network at their homes.
- Payment procedures were complicated and network-specific.

Few customers in West Africa had their own mobile money wallets, and if they had used mobile money before, it was through an over-the-counter transaction where an agent performed a transaction on behalf of the customer. These challenges meant that customers, sales agents/technicians, and mobile money agents needed to craft makeshift solutions that did not always work well. In many areas, sales agents/technicians collected payments in cash and then made the payments themselves. Several respondents said that there were delays in crediting their accounts when they used this type of service. The lack of receipts or immediate crediting to the customer account introduced the risk of theft. It also had an opportunity cost: it took time away from the agent or technician's other duties, particularly in less-densely settled areas.

"Actually, because their lines were not going through, I was going to pay the money into their account through a mobile money agent, even though I had a mobile money account. So when I got to the mobile money agent, he said he could not do it, so I called the [solar] agent and told him what had happened. [The agent] told me to put the money into his account so he pays for me. So I sent him [the money] and immediately I received a message indicating I have paid. The second time I sent it to [the agent] again, and it was successful. The third time wasn't successful. Up until now, I tried calling [the agent's] phone, and it is not going through. So I feel that [the agent] has squandered my money." GHANA

"Usually, [the agent] comes here himself. They were even asking me to register for mobile money or they will come and do it for me, but I have been waiting, and haven't heard from them." GHANA

INTERVIEWER: *"How do you make payments?"*

RESPONDENT: *"I give the 5,000 XOF to my brother to be given to the agent." CÔTE D'IVOIRE*

One customer in Côte d'Ivoire who was also a mobile money agent who helped other customers make payments said the following:

"[We call the area sales agent when] sometimes there are some difficulties, when one tries to make the payment and it doesn't go through."

The same respondent reported that misplaced SIMs were also a problem:

"The villagers do not understand how it works. They need a chip to do the transfer. They often travel with the chip. Some of them know they are supposed to have the chip. But after we make the payment, they say they have misplaced their chips. When that happens, I call [the agent]. Then he will see how to go about it."

Another respondent in Côte d'Ivoire, despite having a robust income, had fallen months behind on his payments because the agent had not come back to

collect the funds. The customer had called the agent several times and was not aware of any other method to make payments. He wanted to clear his debt and use the lights, but did not know how to do so. Because he lived in an area where there was no network, he never received outbound calls from the call center:

"Ever since I got the device I haven't been able to use it because I can't recharge it, and the man too hasn't shown up. Now, the subscription has lapsed. We actually want to pay, it's just that the man no longer comes around for the payment. . . . A lady called us last Saturday. She was saying something about paying via Orange mobile money but I couldn't really hear her properly because the network was bad."

In some areas of West Africa with payment challenges, provider agents outsource collections to informal collectors who are trained to make mobile payments for customers. These agents charge a fee of their choosing, which can vary from customer to customer. Similarly, in Côte d'Ivoire where mobile money agents are asked to make over-the-counter payments to providers even though they do not receive a formal commission, the agents tend to charge a discretionary cash fee. Customers in the study who depended on individuals to process their payments ran into problems when they traveled or when the individual was not available. The more frequently payments needed to be made, the bigger challenge this became.

RESPONDENT: *"I was in Abidjan for two weeks when I received a message from them that, they were going to cut off my light, but I was not able to pay there. So, on my arrival, my light was cut and since I did not have an account here, they directed me to someone who could help me with the payment and when I met him, I gave him money to pay before I had my light back."*

INTERVIEWER: *"Did you pay a fee or something extra to make the payment through that man?"*

RESPONDENT: *"No, I did not pay the guy, but after the payment, I added 100 XOF [\$0.17] which is like a charge for the government." TANZANIA*

RESPONDENT: "When I gave [the payment] to [my brother], he paid over [at the agent]. We had to pay 500 more [than the solar payment]."

INTERVIEWER: "So, it was 10,500?"

RESPONDENT: "Exactly, 10,500 XOF per month."

INTERVIEWER: "Why do you add an extra 500?"

RESPONDENT: "They said later that it was for MTN money."

INTERVIEWER: "As a fee?"

RESPONDENT: "Exactly, fees."

INTERVIEWER: "Do you always work with the same agent?"

RESPONDENT: "Yes."

INTERVIEWER: "Why?"

RESPONDENT: "Well, it is because when they came, they assigned only one place to go and make payment. [The solar company staff] are the ones who told us where to pay." CÔTE D'IVOIRE

Other customers were forced to travel to distant towns to find mobile money agents—or even the solar company office—to make their payments. This increased cost and time and made higher frequency payments less likely.

INTERVIEWER: "Can you tell me the steps you will take assuming you are to make a payment of XOF 10,000 [\$17.24] today?"

RESPONDENT: "This will be difficult, I will spend XOF 1000 [\$1.72] on transportation to the office, I will pay the XOF 10,000 [\$17.24] with a charge of XOF 250 [\$0.43] when I get to the office, and I will call to check if the payment has been made. I will spend another XOF 1000 [\$1.72] on transportation back home." CÔTE D'IVOIRE

RESPONDENT: "Sometimes I do it myself but other times, I send money to [the sales agent] to do it for me."

INTERVIEWER: "Why do you send it to him?"

RESPONDENT: "Sometimes I don't have money [on my mobile wallet], so I call Mr. Salif to make the payment for me, and then later, I go to [town] to pay him back."

INTERVIEWER: "Where is the nearest place you can [deposit into] mobile money?"

RESPONDENT: "It's at [town]"

INTERVIEWER: "I see. How far is [town]?"

RESPONDENT: "About 21 kilometers from here."

INTERVIEWER: "How long does it take you to get to [town] with your motor bike?"

RESPONDENT: "About an hour." CÔTE D'IVOIRE

In Kenya and Tanzania, where the mobile money ecosystem was more robust, customers often quickly learned how to navigate mobile phone menus to make payments on their own. Since payments were done often, they got frequent chances to practice.

"I deposit money to Tigo Pesa, and I choose the 4 numbers; with the instructions that come along and I pay.... I dial *150*01# then okay. [From the options] choose number 4 for paying the bill, and then it asks the amount, then send. It's very simple because it guides the user." TANZANIA

"The sales person showed me every process." TANZANIA

"I go to M-Pesa, then Lipa na M-Pesa, then Paybill, then Till Number, then M-Pesa PIN, and Send. Then I get the notification from [the solar company]." KENYA

Even in environments where customers were familiar with mobile money, elderly customers typically preferred that a child or other younger family mem-

ber make the payment,¹⁰ because they feared making a mistake. Participants did not tell researchers about any incidences where helpers stole money or otherwise interfered with smooth payments.

"I am not the one who makes the payments. All I do is deposit money to my M-Pesa, and then I ask the [mobile money agent] to help send, but I put the PIN myself." KENYA

INTERVIEWER: *"How have you been paying to BBOXX the last 3 months?"*

RESPONDENT: *"I deposit the money at the agent to my phone and send. But my son who is in school is the one who always sends."*

INTERVIEWER: *"Have you ever sent money even once?"*

RESPONDENT: *"No, I might send the money to a wrong number." KENYA*

All providers make a series of choices about how payments are to be collected. These decisions have important implications for customer payment experiences, depending on the context. The following are some situations where decisions need to be made.

Retail payment versus bill payment mechanism.

In some markets—Kenya in this study—a provider can receive payments over two different kinds of arrangements offered by the telco: one that is primarily used for retail purchases (Buy Goods), and one that is primarily used for bill payment (Paybill). In Kenya, Buy Goods charges 1 percent of the transaction value, which is typically borne by the recipient of the payment. However, this option does not allow a customer to enter an account number. PAYGo customers must send the money from their own SIM card to enable the provider to link each payment to the correct customer account. This makes over-the-counter payments or direct remitter payments impossible. Paybill prompts the customer to enter an account number during the transaction. The funds can come from any phone and still credit the appropriate customer's account. However, the costs for Paybill is substantial. Customers who send less than KSh 100 (about \$1, two

days of solar credit in Kenya) do not incur mobile money charges. However, sending KSh 101 costs KSh 17 in additional charges, thereby reducing incentives to pay for moderate amounts of credit.

Customer- versus agent-initiated payments.

In most cases, payments can be made either by an agent (as an over-the-counter transaction) or directly by customers through their mobile wallets. Where customers are not comfortable initiating their own payments, they are likely to prefer the over-the-counter option, but agents in the country may not have the incentive to learn and support these transactions. In some markets, for example, agents do not receive any formal commission for these payments. They may be less willing to help and less likely to remain in operation, and they may introduce their own "charges."

Mobile money agents versus company agents.

Ideally, PAYGo companies would like to rely on existing infrastructure—including agent networks—for collections. But this is not possible in places that have under-developed networks. In these cases, companies might register their own sales agents as mobile money agents or set up alternative networks for collections. This is not "wrong," necessarily, but it should be done intentionally to maximize efficiency and ensure the integrity of such mechanisms by doing things like providing customers with immediate proof of payment (SMS is sufficient), getting agent incentives right, and ensuring customers can pay through several agents, if necessary.

Activation to customer or device. This decision is built into the choice of hardware, with some devices activated or blocked via the Global System for Mobile (GSM) communications network, and others activated for specific periods when a code (generally sent through text message) is entered into the control unit of the device itself. Where GSM networks are poor, the code entry (rather than remote activation) can work better for the purposes of activation. But some problems come up in terms of where that activation code gets sent: to the sender or the account holder.

10. No respondents reported any problems or breaches in security doing this. Oftentimes the phone/mobile wallet account owner would input his or her own PIN even when the overall transaction was assisted by a relative.

BOX 1

Multi-payer accounts

One way to make solar and other assets more affordable for low-income households is to help these customers attract contributions from their relatively better off children and other family members. Researchers saw some evidence this was already happening, for example, when a son or daughter bought a unit for his or her parents. PAYGo providers can support and enable more of this by allowing—and encouraging—payments from multiple phones.

Beyond a payment mechanism that allows for multiple payers, other features to draw in the financial power of the social network might be to add a menu option to “Ask for help,” which informs others about an outstanding balance and how to make a payment. Marketing campaigns could talk about “giving light,” especially around the holiday season when those who work in cities visit relatives in rural areas.

Confirmations to senders versus customers. For example, a customer might pay over the counter with the activation code sent to his or her phone, which might not be with him or her, might not be charged, or has had its SIM card misplaced. Such situations prompt calls to area sales agents and call centers, all incurring a time cost. One possible solution is to have customers register multiple lines for all household users and send confirmations to all customer accounts. (See Box 1.) It may make sense in some contexts to send activation codes to senders in addition to customers.

All providers decide what information is included in their confirmation messages. Regardless of the payment mechanism, providers should confirm the amount of money received, the volume of credits it provides, and the overall outstanding balance on the account in a message to the account holder after each payment. The lack of a physical or virtual receipt leaves some customers questioning if they are being misled by their providers.



6

Generating more value for customers

How do providers reach larger numbers of low-income customers and deliver more value? This research has inspired a few ideas.

Reaching the poor requires an explicit strategy.

As many providers already understand, developing that strategy starts with a sharp focus on driving down hardware costs and obtaining operational efficiency. There are trade-offs between profitability and affordability in the PAYGo model. This is evident in choices around loan tenor: longer loans lower monthly costs for customers, but also require providers to build extra years of financing costs into these loans. Longer loans also come with higher risk of default, a cost also passed to customers. There are also trade-offs when it comes to the products that agents choose to sell most aggressively. When agents have an incentive to sell the largest systems, they may be satisfying higher-income customers and aspirational demand, while overlooking those who are able to afford—and who would really benefit from—only a basic solar home system. What incentives will drive agents to reach low-income customers?

Impact investors should keep in mind that reaching lower-income and more remote customers entails higher costs and lower margins. This is especially true at the acquisition stage, even if there is a healthy long-term business case for serving these customers. Pressure to deliver high returns quickly can mean shifts to peri-urban and higher-income customers, which some providers have already reported doing.¹¹

Reaching and benefiting women will not be automatic. Rather than asking providers to simply market more to female customers, impact investors and donors could invest in research to explore and understand the business case for serving women. Questions to be explored might include the follow-

ing: What product specifications could be an appealing entry point for female customers? What kinds of products would women like to buy as follow-on asset purchases? What are the potential implications of including both men's and women's names on credit agreements to help women build credit histories? What are the potential outreach and business implications of increasing the share of female sales agents within PAYGo companies?

Tailor provider operations to cash flow realities in the markets where they operate.

For example, in areas with highly seasonal cash-crop production, it would be wise to market products months ahead of scheduled harvests, thereby allowing customers to plan. Offering customers large deposit payment plans that reduce the ongoing burden of payments during low season would also be attractive. Providers might expand their reach to lower-income customers by marketing to laborers through cooperatives and formal companies and matching sales to the timing of salary and bonus payments. Similarly, marketing through savings clubs would allow customers to plan and make a large lumpy payment to begin using their devices, with smaller, more manageable recurrent payments to follow. Where networks are informal and only loosely organized—and where payments to customers are not already digitized—this can be a costly strategy. But there are clearly some situations where the scale of customer access justifies the coordination expense.

Simplify contract terms and communications to ensure understanding.

The practice of checking in with new customers to ensure that they understand their terms should become an industry standard. Low literacy rates and agent-based sales are leaving too many clients in the dark over the terms of contracts they have signed. Providers can also improve

11. Another report shows some evidence of the trade-offs between aggressive growth strategies and portfolio quality as well. See Lepicard et al. (2017).

how they communicate incentives and consequences for on-time payment. And, every provider should send customers confirmation-of-payment messages and updated loan balance information after every payment.

Build and maintain customer trust. The financing arrangements that PAYGo providers have brought into low-income customers' lives are powerful, and hold promise as a means of asset finance beyond energy. Long-term relationships with customers give providers a chance to amortize their relatively high acquisition costs. But, a long-term relationship with clients is predicated on trust. Many providers use professional, courteous communications through text and call centers. But they also need to clearly disclose contract terms, reinforce basic understanding through every payment interaction, honor their warranty promises, and offer customers a chance to continue growing and investing with them.

Communicate a realistic value proposition to customers, funders, and investors. Many providers deliver high-value services to their customers, and most of the customers in this study were thrilled that this new service model was available in their communities. The study showed that what really mattered to customers—and what many providers are already delivering—was the ability to invest in a lifestyle transformation. That is important on its own—even apart from the potential to save money on energy. Because of price points that are higher than those of replacement energy costs, providers might not be reaching all of the poor today, and that is alright. Being open about today's achievements makes it possible to think strategically about how to meet an organization's goals and to have thoughtful conversations about the trade-offs that may be needed to reach those goals.



7

Directions for future research and conclusion

Additional research could provide more concrete guidance to providers, donors, and investors as the PAYGo sector continues to grow. Randomized trials of the varying forms of impact that solar lighting can produce are likely to continue to be conducted and may shed more light on the socioeconomic impacts of solar lighting. There is still a need for a large quantitative survey that shows whom PAYGo is reaching through commercial solutions. It is important to know how many people and what kinds of people are most likely to be left behind in order to enable creative solutions for reaching the “last mile.” How tightly is income tied to payment performance? Just how much does flexibility impact performance? These questions remain unanswered.

USAID in India, UNCDF in Uganda, and GOGLA in multiple markets are conducting research that will track energy use with high-frequency data collection (USAID 2016; UNCDF n.d.; GOGLA n.d.). This type of work has the potential to reveal new ways of understanding the implications of solar lighting and may be a rich new source of learning about the gender issues reported in this study. More research could help develop an understanding of why so few women are PAYGo customers. What might help bring more asset finance opportunities to women in ways that fit their needs, cashflow patterns, and aspirations? Can providers bring in more women with a lower-cost entry-level product? How

can marketing strategies be improved to bring in more female customers or improve impacts on women?

In addition to demand-side research, much has been written about the supply-side barriers to the PAYGo model, particularly the need for commercial-grade, local-currency debt. Research that providers and local financial institutions can use to analyze their financial standing, accurately assess portfolio health, and create verifiable underwriting standards would help providers to reach scale. More research is needed around mobile money networks and payment interfaces, particularly in new markets, that would allow providers to sell in more rural areas.

There are reasons to be both excited and cautious about the expansion of PAYGo solar. By leveraging mobile payments and lockout technologies, providers have successfully introduced the possibility of truly flexible financing for low-income customers. Their future success will depend on managing the risks that come with flexible payment models and the customer-side vulnerability related to incomplete or misleading information sharing. It is worth figuring out how to tackle those challenges and continue to bring valuable assets within reach for a much larger number of low-income households. PAYGo solar does not always save customers money in the short term, but it does provide something that clients appreciate even more: light.



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ANNEX A

Provider models

(for targeted customers in this study at time of study)

	M-KOPA	PEG	BBOXX	Off-Grid Electric
System (wattage, bulbs, etc.)	8W solar panel 3 LED-upgraded light bulbs with cables and switches 1 LED-upgraded, portable, and rechargeable torch Phone charging USB with 5 standard connections 1 upgraded, rechargeable radio	8W solar panel 2 LED-upgraded light bulbs with cables and switches 1 LED-upgraded, portable and rechargeable torch Phone-charging USB with 5 standard connections 1 upgraded, rechargeable radio	50W roof-mounted solar panel 2 solar-led bulbs + junction box 1 rechargeable torch 1 phone charger 1 portable rechargeable radio	12W solar panel 3 LED-upgraded light bulbs with cables and switches 1 LED, rechargeable torch 1 phone charger 1 rechargeable radio
Tenor	12 months	12–13 months	36 months +7 years' maintenance fee	36 months
Deposit value	KES 3,000-\$30, TZS 49,000-\$22	GHC 139-\$32, XOF 19,000-\$33	KES 590-\$5.84	XOF 20,000-\$34.40, TZS 47,000-\$21
Regular payments	KES 50-\$0.50, TZS 1,200-\$0.50 (daily)	GHC 2.5-\$0.60, XOF 380-\$0.66 (daily)	KES 590-\$5.84 Maintenance: KES 440-\$4.35 (monthly)	XOF 5,000-\$8.60, TSH 17,000-\$7.60 (monthly)
Flexibility	Very flexible, daily equivalent payments on any schedule, no penalty for missed days (up to 90 consecutive days)	Very flexible, daily equivalent payments on any schedule, no penalty or missed days (up to 90 consecutive days)	Grace period of 3 days past monthly payment due date	Grace period of 3 days past monthly payment due date
Additional offerings	TV, stove, smart phone	TV, cook stove, smart-phone	LED TV	LED TV

Note: The exchange rate at the time of the study in each market was used to determine U.S. dollar amounts used throughout this report. Kenya Shilling (\$1=KES 101); Tanzania Shilling (\$1=TZS 2,238); Ghana Cedi (\$1=GHC 4.4); West African Franc (\$1=XOF 580).



ANNEX B

Financial analysis of consumers' PAYGo solar investment

Investment analysis summary

Key assumption	Monthly cash flow implications			Return on investment metrics			
Loan tenor (years)	Monthly savings (on candles, kerosene, etc.)	Monthly SHS payments	Net savings/ (expense) during repayment	Breakeven (months)	CoC return	IRR	NPV
\$10/mo. Prior energy spend 85% replacement rate							
1.0	\$8.50	\$12.25	(\$3.75)	19.6	3.1x	111.1%	\$194
3.0	\$8.50	\$5.51	\$2.99	6.7	2.3x	190.6%	\$171
5.0	\$8.50	\$4.30	\$4.20	4.8	1.8x	251.6%	\$149

a. In the sample, the three-year contracts had significantly more customers in the bottom half of the national income distribution. This is a small, nonrepresentative sample, but the result is intuitive.

Assumptions

SHS Financing interest rate	40.0%
Customer discount rate	15.0%
SHS cash cost	125.0
SHS deposit	20.0
Monthly energy expense before	10.0
Replacement rate	85%
SHS useful life	5.0



