

The Value of Pay-as-you-go Solar for Mobile Operators

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Executive summary

The GSMA Mobile for Development Utilities programme has been working since 2012 to unlock new business models that leverage mobile to deliver affordable and improved energy, water and sanitation services in emerging markets. Through our Innovation Fund we have provided catalytic support to organisations across Asia and Africa to trial and scale these models. This support was particularly important for building essential partnerships between the mobile industry and the early pioneers of pay-as-you-go (PAYG) solar businesses. Quantifying the value of these partnerships for each industry can help lead to greater collaboration for mutual benefit.

The PAYG solar model has spread rapidly across developing countries as a means of delivering energy services. Over one million PAYG devices were sold during the first six months of 2019.[1] The growth of PAYG solar has only been possible with the rapid growth of mobile money and mobile connectivity that allows customers to pay by instalments, and companies to remotely control and monitor the solar home systems (SHS). And in turn, the PAYG solar industry has helped to drive the adoption and use of mobile money, by giving customers a regular and essential use case. Solar energy provides mobile subscribers with a convenient, safe and affordable way to keep their phones charged. Over the years we have shared lots of anecdotal evidence from our grantees that demonstrates how this synergy has achieved both social impact and business growth.

This report provides the first multi-country analysis to *quantify* the value of that synergy for the mobile industry. This was done by looking at mobile usage data from cohorts of PAYG customers starting six months before, and through the first six months of making SHS payments, and comparing this same analysis to a control group (not using PAYG solar). Five mobile operators from Uganda, Rwanda, Benin, Côte d'Ivoire, and Zambia worked with us to provide aggregated and anonymised mobile money and GSM data in order to measure the commercial value that the PAYG solar industry has for the mobile industry. The key findings from this analysis are as follows:

PAYG solar customers show significantly increased mobile money usage, beyond just solar payments

Across markets there is a clear trend showing that PAYG solar customers increase their mobile money usage from 27 per cent up to 113 per cent. Customers made more mobile money transactions not only to pay for the solar home systems, but more transactions overall. This shows that PAYG solar can drive a range of mobile money transactions, and therefore makes a very important use case to develop mobile money ecosystems. This surge in transactions did lead to increased revenues for mobile operators, although more modest than the growth in number of transactions. This likely reflects that that mobile money revenue depends on transaction fee structure, with not all transactions generating revenue, and the fact that PAYG solar customers are typically low-income and rural. Yet, data from Uganda also suggests that PAYG customers start to engage more in higher-value mobile money use case, like loans and savings, when compared to control groups. This is precisely why PAYG solar is such a key service for mobile operators to support - it increases mobile money activity for a new and often ignored market segment, helping to drive a mobile money ecosystem across demographics and increase financial inclusion.

1. GOGLA (2019) , Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data

PAYG solar drives adoption of mobile money

Across markets, 21 to 31 per cent of PAYG solar customers were new to mobile money, or reactivated their accounts (after being inactive for 90 days or more). This demonstrates that PAYG solar companies are laying the foundation of mobile money by introducing, or re-introducing customers to the service through their agents, and providing them with the essential training to keep making their payments for each PAYG solar instalment.

PAYG solar customers yield increased overall revenue for mobile operators

It is striking that overall revenue did increase at higher rates than the control group in all markets. This shows that PAYG solar customers increase their usage of other mobile services, such as voice, SMS, and data more than other customers. Specifically, in two markets where we had data (Côte d'Ivoire and Uganda), PAYG solar customers significantly increased their usage of mobile data. This finding is particularly important because it shows that in an era where mobile operators are struggling with declining voice revenues, PAYG solar can lead to broader digital inclusion.

PAYG solar demonstrates the case for strengthening and broadening collaboration

These findings provide robust evidence for the immense value that PAYG solar has for mobile operators to grow their business - helping them to reach more consumers and deepening their use of mobile services. Nonetheless, there are limitations to this kind of study, and we faced gaps in the data, for example we found it difficult to measure the impact of PAYG solar on reducing customer churn for mobile operators due to the limited timeframe of the study. We also were not able to include data from Asia in this study, or look beyond PAYG solar to the impact of other utility services, and hope to examine this in continued analyses. We look forward to building on this work to generate more evidence of the value that mobile operators and PAYG solar can gain from one another in order to inform greater collaboration between these linked industries.

While mobile money has been a necessity for the PAYG solar industry, this study demonstrates that the mobile industry has far more value to gain than previously understood from investing in these partnerships. This study, along with years of evidence from the GSMA Mobile Money programme and the broader GSMA Mobile for Development, show that mobile money can be a crucial engine of growth for both economic developments and the mobile industry. This huge opportunity for growth goes far beyond PAYG solar.

On the back of this industry, a transformation is underway through replication of the PAYG model to go beyond energy access, to driving livelihood development. This means that PAYG solar companies increasingly sell their customers income generating assets like solar irrigation pumps. Simultaneously, the mini-grid sector, and even traditional grid providers, which also rely on mobile money and connectivity, are driving energy consumption by offering appliance leasing through PAYG models. Our programme has also seeded PAYG models for clean cooking gas and pre-paid domestic water services - models that are now reaching the scale needed to attract investment from mobile operators preparing to ride the wave of innovation into the future.

Truly, this opportunity for the mobile industry has never been more important to seize, yet it depends on building robust and accessible platforms and services. The GSMA looks forward to continuing its support of the mobile industry's collaboration toward achieving energy access, and other sustainable development goals, while driving business.

THE VALUE OF PAYG SOLAR FOR MOBILE OPERATORS

The mobile industry and PAYG solar companies are natural business partners. Mobile money allows low-income households to make payments for their solar home system. In return, mobile operators get more value from PAYG clients by increasing and diversifying their mobile usage.

Analysis from five African countries on **mobile usage** before and after **PAYG adoption** shows **significant commercial value for mobile operators.**

The increased mobile usage for PAYG solar customers **always outperformed** the **control group**, which is is a group of clients that were NOT registered for PAYG solar services

Key Results:

76% PAYG group
27% Control group

Increased mobile money usage for PAYG customers in **Uganda** after adoption of the solar energy services.

Increased usage goes **beyond solar** payments. All types of **transaction increased in Uganda**.

- **97%** Cash-in
- **64%** Person to person
- **57%** Merchant Payments

31%

Of PAYG customers either **registered, or re-activated a mobile money account** to use solar services in **Zambia**.

31% PAYG group
9% Control group

Increased mobile internet penetration rate among PAYG users in **Côte d'Ivoire**.

9% PAYG group
1% Control group

Increased overall Average Revenue per User for PAYG clients in **Benin**.

Diversification of the revenue generation for PAYG clients in Benin: slight increase in Voice & SMS, and noticeably higher growth in data and mobile money revenue

- **4%** Voice and SMS
- **20%** Data
- **21%** Mobile money



Approach to measuring the value of PAYG solar for mobile operators

A multi-country, multi-operator study in Africa

One of the criteria for the study was to have a multi-country and multi-operator approach, meaning data would be collected from several MNOs present in different regions. It was important to assess if the value measured differs greatly from one country to another, or, if trends are consistent across different contexts and geographies.

The geographical scope of the research focuses on the African continent where most of the mobile money-enabled PAYG solar units have been deployed. Five countries are represented in this study, two in West Africa (Benin, Cote d'Ivoire), two in East Africa (Rwanda, Uganda), and one in Southern Africa (Zambia). All the insights in this report are based on data from mobile operators that met the quality requirements. In the future we hope to continue this research and expand the scope to other regions in Africa, as well as other continents, such as Asia in particular, where the potential for PAYG solar industry is promising.

Metrics: mobile payment frequency, mobile phone usage and revenue

Together with the participating mobile operators, we defined a series of indicators to measure the commercial value of PAYG solar in a way that is most relevant for the mobile industry.

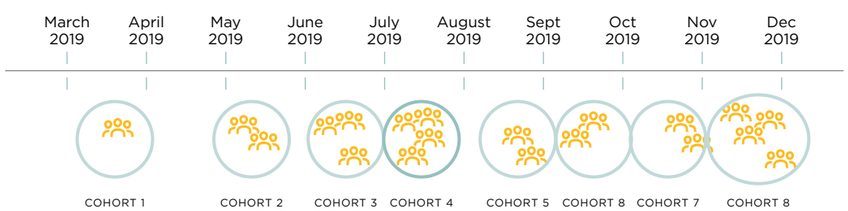
There are three main categories of metrics that we used to evaluate the value of PAYG for the mobile operators. The first, and most important category of metrics, measures if and how the mobile money customer journey changed for PAYG users. The second focuses on measuring if the broader mobile phone activity changed since customers started using PAYG. Lastly, the third category of indicators assesses how the overall revenue generated by the PAYG user evolved.

It is important to note that each MNO was responsible for calculating the indicators for their own clients. Unfortunately, it was not possible to obtain data covering all of the indicators for all MNOs.

A simple, four-step analysis

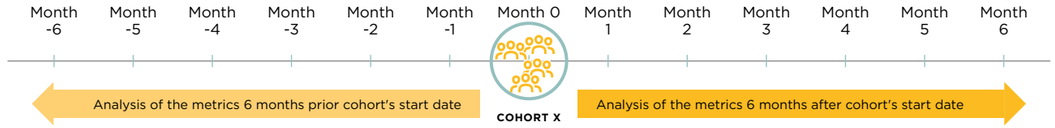
We conducted a four-step analysis that examined indicator data aggregated by cohorts of customers over time, and compared this between groups of PAYG customers and non-PAYG customers (i.e. control group). This methodology aims to collect data that is accessible to mobile operators and protects the anonymity and individual privacy of their customers. While more in-depth analyses would provide additional insights, this initial approach best fit privacy, resource and time considerations for the study.

Step 1: Grouping of cohorts



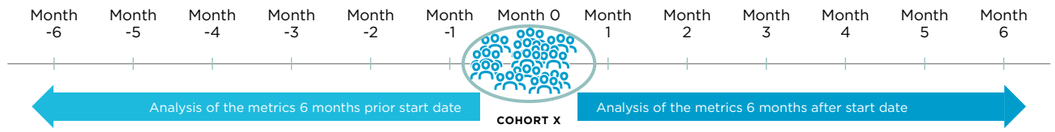
We asked MNOs to collect and aggregate data from their subscribers that initiated payments to a PAYG solar energy provider during the last 12 – 18 months. Ideally, to have a complete picture, the data profile ranged from six months before customers started using the service to six months after initial down-payment. In order not to breach individual privacy, we asked MNOs to group all PAYG clients that share the same subscription month into a single cohort.

Step 2: Measurement of indicators



Once the cohorts were formed, the MNOs' data analysis teams computed the series of indicators from the categories described above, six months before and six months after, for each cohort separately. This allowed us to anonymously measure the impact seen on multiple cohorts for the series of chosen indicators over time.

Step 3: Control group definition

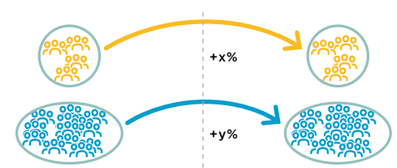


To confirm that the impact was likely caused by the introduction of PAYG and not by external factors, such as a seasonality effect or a temporary promotion from the mobile operator, we also asked the MNOs to compute the same indicators with the same methodology, but for a control group. This is a group of clients that have NOT enrolled in a PAYG SHS service but have a generally similar customer profile as the other group, in order to be able to compare across similar socio-geographic segments.

Forming a control group retroactively that is socio-economically comparable to the PAYG cohorts is challenging. In some countries, the operator chose to select customers randomly to form the control group rather than filtering the user base with geographic or revenue criteria. It is important to keep this reality in mind with regards to our comparison of indicators between the PAYG users and the control group. In this light, our research is not intended to be a pure, scientific randomised control study, but should rather be seen as a simplified version of it. Again, this approach was taken based on feasibility and individual data protection.

Step 4: Measurement of impact

Once all indicators were calculated for all cohorts and control groups associated, MNOs shared this data with us for a comparison of metrics before and after the adoption of PAYG. We have characterised the impact of these changes by measuring the percentage of change for each indicator.



In the following sections of the report, we will use the terms PAYG group, PAYG customers or PAYG clients to refer to the multiple cohorts of PAYG clients analysed by mobile operators.



Mobile money trends

Our Mobile for Development Utilities programme was conceptualised to support the unique synergies between mobile operators and PAYG utility service providers. From the early pioneers in PAYG solar, to new companies applying PAYG models in water, or clean cooking, we've seen these utility service providers as key drivers of mobile money activity in emerging markets. In many markets where mobile money is not ubiquitous, particularly in rural areas, PAYG solar providers drive mobile money penetration in five ways:

- They help customers register or reactivate their mobile money accounts;
- They educate customers on how to make solar payments using mobile money;
- They provide a use case for customers to regularly make essential payments;
- They often convert their own solar sales agents to mobile money agents to support registrations and mobile money top-ups; and
- They drive cash-in transactions in rural areas which helps agents maintain the cash supplies they need to balance the flow of urban remittances for rural family and friends to withdraw cash.

It's clear how these mechanisms result in PAYG driving mobile money activity, yet few studies have been able to precisely quantify this impact. In this section, we analyse data from our mobile operator members to measure the impact of PAYG on mobile money activity across these selected variables:

- Mobile money transaction frequency (with and without PAYG solar payments);
- New/reactivated mobile money customers due to PAYG adoption; and
- Increased mobile money revenue growth derived from PAYG adoption.

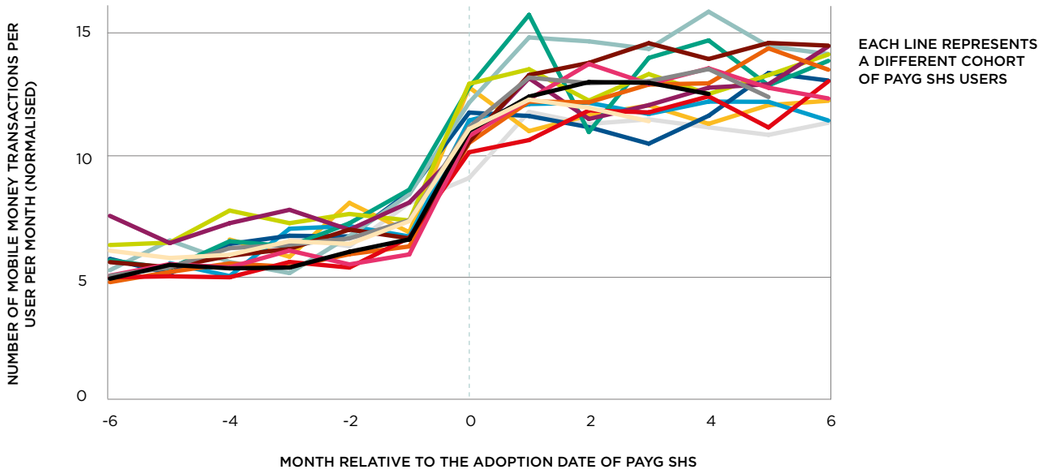
PAYG solar customers increase their frequency of mobile money transactions

In every country where we received data, we observed a dramatic increase in the frequency of mobile money transactions right after clients started using PAYG solar services.

In Benin, we analysed data from 15 different cohorts with an average size of 1,500 users per cohort between April 2018 and June 2019 (22,500 users in total). In parallel, we compared this to a control group of 9,500 clients randomly selected during the same time period. Figure 1 shows a strong positive impact of the introduction of PAYG solar on mobile money transaction frequency for all cohorts. The vertical axis is the average number of mobile money transactions per user per month, while the horizontal axis represents the month relative to the activation date (time 0) of PAYG. The growth in mobile money transactions per month varies between 71 per cent and 130 per cent across the cohorts. On average, we measured an increase of 113 per cent among the PAYG cohorts, while the control group only demonstrated a 27 per cent increase.

Figure 1

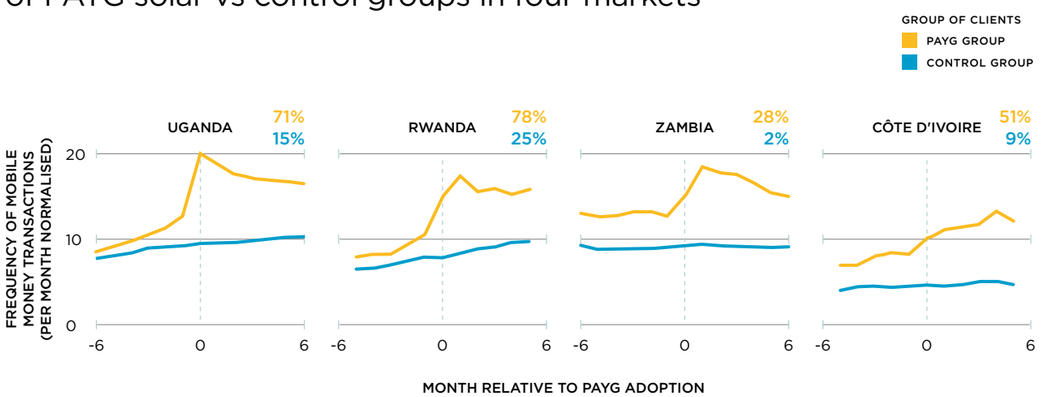
Frequency of mobile money transactions in Benin before and after adoption of PAYG SHS



While Benin is the market in our study that demonstrated the largest impact of PAYG solar on mobile money transaction frequency, data from MNOs in other study markets confirmed this strong positive impact (see Figure 2). In Uganda, mobile money transaction frequency among PAYG customers increased by 71 per cent, while transaction frequency among the control group only increased by 15 per cent. PAYG customers also demonstrated a substantial increase in mobile money transaction frequencies in Rwanda (78 per cent), Zambia (28 per cent) and Côte d'Ivoire (51 per cent), while the respective control groups only recorded marginal increases.

Figure 2

Frequency of mobile money transactions before and after adoption of PAYG solar vs control groups in four markets



However, it is important to note that the trajectory of mobile money transaction frequencies for PAYG customers can differ across markets. Among the PAYG users in Uganda, and Zambia for instance, there was a big jump in transaction frequency in month one and two after PAYG adoption, which was followed by a slight decrease in following months. Data from more markets is needed to understand whether the impact of PAYG solar adoption on mobile money transaction frequency is indeed amplified in the first two months following PAYG adoption, as compared to future months. In Côte d'Ivoire for instance, data from the PAYG group showed the mobile money transaction frequency increasing over time.

Further research is needed to understand what might cause the downward trend seen in Uganda and Zambia after the initial increase, but one reason might be that some new mobile money users in the PAYG group stop using their own mobile money account after the first or second PAYG solar payment cycle and instead ask others to make the payment on their behalf from another account, for example relying on an agent or a family member to make the transaction. Of course, customers might also lose the ability or interest in making their payments after the initial months for a number of reasons (from dissatisfaction to unaffordability, or absence of mobile money agents to cash-in). Additional research to see if this trend is present elsewhere and what might be the cause is important to improve commercial impacts for both PAYG solar companies and MNOs.

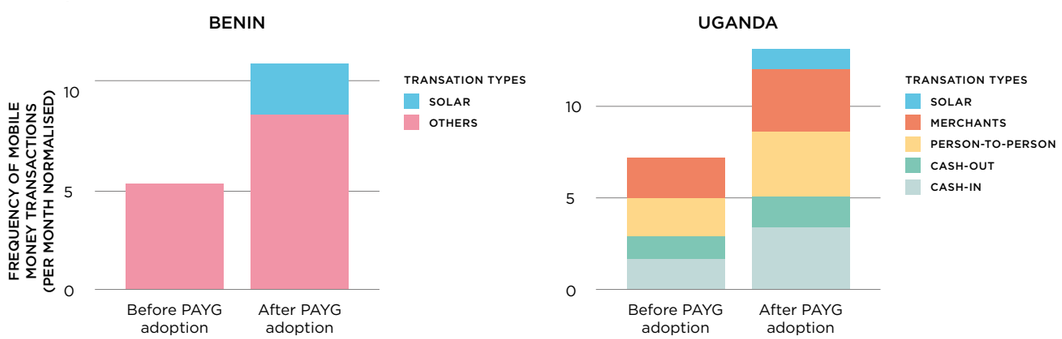
Overall, PAYG customers show a significantly higher increase in mobile money transactions per month, as compared to control groups across all markets studied. Another positive observation from our data is that PAYG solar seems to amplify an already positive market trend in mobile money transaction frequency.

Transaction frequency increases for transactions beyond energy

Data from multiple MNOs show that the increase in mobile money transactions reflects broader usage of mobile money, not just for solar payments. It was critical to understand whether the increase of mobile money transaction frequency was solely attributed to PAYG solar payments, or whether this increase was associated with an overall increase of non-solar payment-related mobile money activities. As Figure 3 shows, even after excluding PAYG solar payments from the total number of transactions, we observed a sharp increase in transaction frequency. In Benin, we observed an increase of 65 per cent after excluding solar transactions, and in Uganda the increase remained close at 60 per cent, as PAYG solar payments in Uganda only accounted for a small fraction of the overall increase in transaction frequency.

Figure 3 Note: We received more detailed data on the different payment types in Uganda than we did for Benin

Frequency increase per type of transactions before and after adoption of PAYG solar



The overall increase in transactions beyond energy payments is crucial for mobile operators as it means that PAYG not only drives mobile money transaction frequency through PAYG solar payments, but also generates other payment use cases that drive transaction frequency. It also confirms previous research from UNCDF[2] as well as CGAP, Dalberg and Karandaaz Pakistan,[3] which suggest that digitizing high-volume payments and person-to-government payments can be a key driver of mobile money usage among first-time mobile money users.

Furthermore, the break down of increased transaction frequency by type (Figure 3) shows that all transaction categories (cash-in, cash-out, merchant payment, person-to-person payment, airtime purchase) grew positively and outperform the control group. This demonstrates once again that the impact of PAYG goes beyond energy payments and enables users to engage in a broader range of mobile money activities. The following trends in other mobile money transaction types were observed:

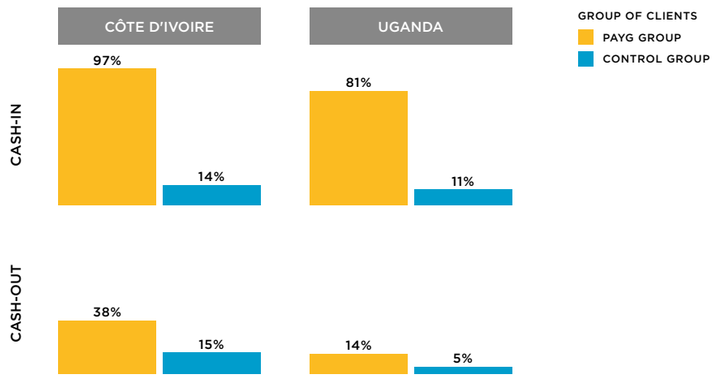
Cash-in frequency increases massively among PAYG customers

The growth in transactions was by far the largest for cash-in transactions, in both countries where we have data. As shown in Figure 4, in Uganda the cash-in frequency increased by 97 per cent among the PAYG customers, and in Côte d'Ivoire by 81 per cent. This can be explained easily as clients need to top-up their mobile money wallet in order to be able to send payment to PAYG solar companies.

On the other hand, cash-out transactions had the lowest increase across all transaction types in both countries (38 per cent increase in Uganda and 14 per cent increase in Côte d'Ivoire). This growth differential between cash-in and cash-out transactions suggests that most of the funds injected in the digital ecosystem by PAYG users stay in the ecosystem and is used for other mobile money activities.

Figure 4

Increased frequency of cash-in compared to cash-out



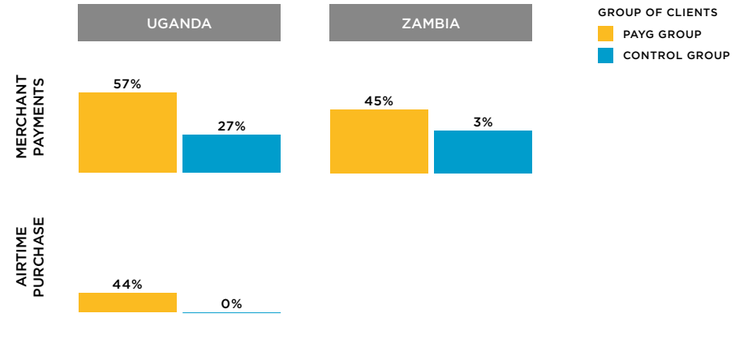
2. UNCDF (2018), Driving Digital Financial Services through High-Volume Payments
3. CGAP, Dalberg, and Karandaaz Pakistan (2017), Global Landscape Study on Digitising P2G Payments

Merchant payments and airtime purchases soar

In both countries where we had data for merchant payments, these transactions rose considerably among PAYG customers, by 57 per cent in Uganda and by 45 per cent in Zambia, as shown in Figure 5. The same trend was observed for the purchase of airtime via mobile money, with an increase of 44 per cent for the PAYG customers in Uganda. For mobile operators, this reduces the cost of managing scratch cards for airtime top-ups, which can be significant in remote areas. PAYG users are shifting their purchasing habits to mobile money, which in turn stimulates the mobile money ecosystem as a whole.

Figure 5

Increased frequency of merchant payments and airtime purchases

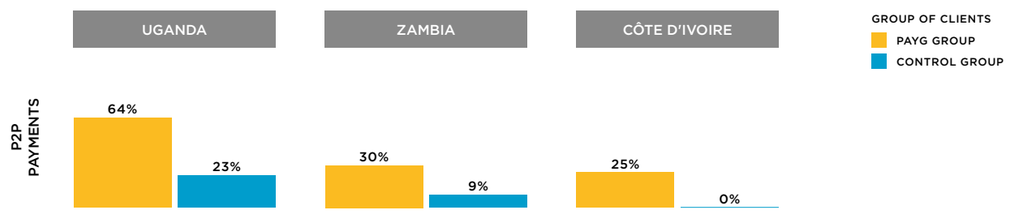


Person-to-person (P2P) transactions increase steadily

The steady increase of person-to-person (P2P) transactions observed in the three markets for which we have data reinforces the point that PAYG adoption drives mobile money usage across transaction types, and demonstrates that more value is circulating in the ecosystem in digital form. Figure 6 shows an increase in the frequency of P2P transactions by 64 per cent in Uganda, 30 per cent in Zambia and 25 per cent in Côte d'Ivoire.

Figure 6

Increased frequency of person-to-person payment



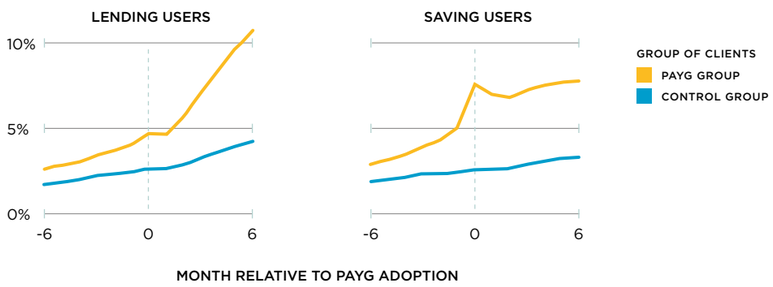
Adoption of high value financial products

In Uganda, the mobile operator has launched, in collaboration with a national bank, some advanced financial products. For example, customers can open savings account or request loans.

We observed growth in the penetration rate of these two products among PAYG clients, with the number of users making lending and savings transactions increasing by 117 per cent and 96 per cent, respectively. Both products reached a penetration rate of close to 10 per cent among the PAYG user base, compared to a 4 per cent penetration rate among the control group. Although the average frequency of these transactions was still low compared to the other activities, the growth in adoption is very encouraging when considering the impact of PAYG adoption on financial inclusion. It demonstrates that PAYG can accelerate the customer mobile money journey to more complex financial products, like saving or lending accounts.

Figure 7

Increased penetration rate of lending and savings products



In order for mobile operators to drive mobile money adoption, customers need to have multiple use cases. This analysis demonstrates that PAYG solar is a valuable driver of mobile money use cases, not just for solar, but for other types of transactions, therefore building the mobile money ecosystem. For consumers, this means financial inclusion, which can improve well-being for end users in a number of ways, as demonstrated by research from CGAP and others.

PAYG attracts new and previously inactive users

PAYG providers play an important role in driving mobile money penetration and providing customer education on mobile money in remote rural areas. Furthermore, PAYG providers are generating lasting mobile money use cases, which is paramount to sustain its adoption in the long-term.

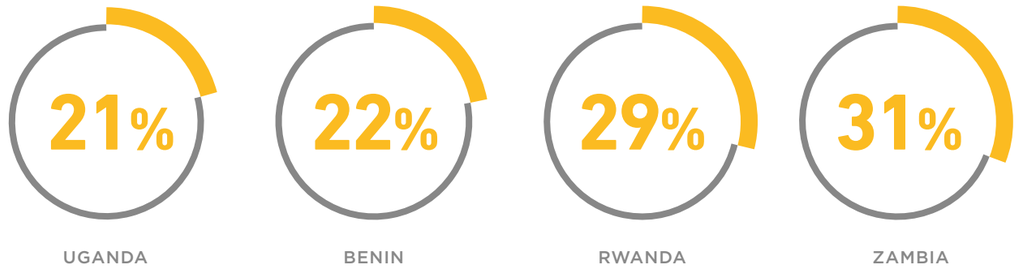
In Benin, among the 24,500 PAYG users' data included in this study, more than one-fifth (22 per cent) either created or reactivated their mobile money account (becoming active again after 90 or more days of inactivity) to pay for their solar home system. This trend is confirmed by comparable figures from other markets as shown in Figure 8. In Zambia and in Rwanda, almost one-third of the PAYG clients (31 per cent and 29 per cent respectively) registered or re-activated mobile money accounts.

In Uganda this figure reached 21 per cent, despite the mobile money taxation policies the country set up during the time of the study.

A rise in taxation is an important barrier to progress on energy access and financial inclusion. This was evidenced by a recent UNCDF study on the impact of Uganda's mobile money tax on PAYG uptake in Uganda. The tax was initially introduced at 1 per cent per transaction and then lowered to 0.5 per cent following public protests. It shows that mobile money taxes had a nationwide impact on the uptake of PAYG solar, because the mobile money activation rate from new PAYG customers decreased in 100 districts (of 112).

Figure 8

The proportion of PAYG customers that newly subscribed to, or re-activated, their mobile money account with selected MNO



Note that all mobile money activation and reactivation only considers mobile money accounts within a single operator. So it is possible that some customers previously used mobile money with a different mobile operator and were not entirely new to mobile money. Nevertheless, these figures reveal that PAYG solar can drive mobile money ecosystems, by providing customers with a reason to use mobile money, even if they had stopped using it previously.

We have witnessed this trend across PAYG energy services as well as other utility sectors through our Mobile for Development Utilities Innovation Fund grantees, as captured in the box below.

Box 1

How PAYG utility service models drive mobile money adoption and digital literacy

Mobile operators have found that there are two main hurdles for mobile money adoption: either people do not need it, or they do not know how to use it. Many utility payments naturally solve the first problem by providing subscribers with an important reason to use mobile money regularly. To solve the second issue, critical to their own success as well, many utility service providers build an agent network to register and train their customers to use mobile money.

For example, Fenix International has developed a close partnership with MTN in both Uganda and Zambia based on what Fenix does to drive mobile money adoption and digital literacy. This began during Fenix's grant from the Mobile for Development Utilities Innovation Fund in 2013 to scale up its PAYG SHS offering in Uganda. By delivering thorough training to its staff, who in turn, educate customers on mobile money, Fenix removes the burden of digital literacy from the mobile operator. According to a survey of Fenix's customers at the end of the grant in 2014, 13 per cent were new to MTN Mobile Money when they purchased the solar system, similar to the 21 per cent we saw across PAYG clients in Uganda when looking at the MNO data. As Fenix's customers make frequent payments, MTN has found that their mobile money accounts are among the most active in Uganda.

Similarly, Fenix recently piloted a model in Zambia with UNCDF where Fenix and MTN jointly trained agents to become mobile money agents and Fenix sales agents. The results suggest that the combination of selling PAYG solar and acting as a mobile money agent can drive agent profitability, with 82 per cent of the agents remaining active each month.

In newer mobile money markets this can be particularly important, as Mobile for Development Utilities grantee PEG found out when growing their business in Ghana in 2013. PEG detected that their revenue collection was at risk because agents were collecting cash from customers and sending PEG bulk mobile money payments. This led PEG to have their agents also become mobile money agents, even though initially they had worried about the agents having conflicting priorities between the two businesses.

Other utility models we have supported beyond PAYG solar home systems, also demonstrate a strong contribution toward mobile money adoption and regular use:

WATER:

- CityTaps provides prepaid smart meters and a backend platform to water utilities in Africa that require users to pay via mobile money. CityTaps found that 15 per cent of their customers in Niamey, Niger reported becoming new Orange subscribers as a result of the service, and 43 per cent reported being new mobile money users.
- In rural Ghana, Safe Water Network (SWN), operates mobile money-enabled prepaid household meters, and water treatment and distribution stations. Initially, their users lacked trust in the technology. To resolve this challenge, SWN partnered with MTN Ghana to educate users through interactive group workshops and one-to-one sessions, as well as a promotional campaign offering prizes for mobile money users. Through this partnership, MTN Ghana also agreed to reduce the transaction fees on mobile money payments for water by 50%, and SWN covered the remainder of the transaction fees. In combination, these led to 98% of SWN's monthly payments for household connections being made by mobile money. And when surveyed, 98% of those using mobile money felt that MTN delivered good services in line with what was promised during digital finance training.

COOKING:

- KOPAGAS launched its service in Tanzania providing LPG gas canisters and cook stoves to low-income households through its pioneering PAYG smart metering technology. KOPAGAS found that customers were making mobile money transactions every five days on average, with 73 per cent of their customers being women – representing a significant opportunity for mobile operators to better reach a missing customer segment, as highlighted in the GSMA Gender Gap Report.[4] Indeed, the business opportunity for mobile operators was clear to Safaricom in Kenya who is an investor in Circle Gas which recently acquired KOPAGAS' technology through a $25 million transaction.

4. GSMA Mobile Gender Gap Report 2020. https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/02/GSMA-The-Mobile-Gender-Gap-Report-2020.pdf

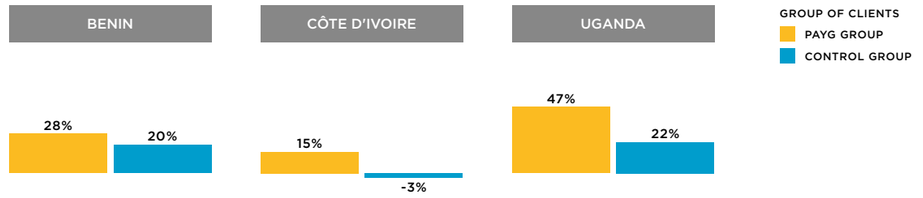
The total value of transactions per month increases, but not at the same rate as the frequency

The total value of transactions sums up the monetary value of all the transactions made by one user over a month. This is a good indicator to estimate the impact of PAYG on the total money that is exchanged in the mobile money ecosystem.

The growth among the PAYG customers was steady in all three countries (28 per cent in Benin, 15 per cent in Côte d'Ivoire and 47 per cent in Uganda) and outperformed the control group by a wide margin, as shown in Figure 9. However, the impact was significantly smaller than the growth measured for the mobile money transaction frequency. This disparity in growth means the average value per transaction has decreased, suggesting a trend towards making more frequent transactions of smaller value.

Figure 9

Increased total value of transaction for PAYG users



Further research needs to be carried out to confirm this trend and understand the reasons behind it. One reason could be that PAYG customers gain more comfort in making these transactions independently. For instance, with household access to energy, and thus easier access to phone charging, a user could prefer making multiple and smaller payments over time rather than one large single transfer of funds.

At the same time, we also shouldn't necessarily expect to see a huge jump in transaction value, as customers don't always generate more income or save money through PAYG solar (depending on the size and type of system) that would allow them to transact more money.[5] Although, increased focus in the industry strives to deliver and demonstrate these economic impacts through productive use appliances. It may also be hard to detect a consistent trend in this metric as it also depends on the income-profile of the customers, and we know that PAYG solar customers represent multiple market segments.[6]

5. GOGLA (2018), Powering Opportunity The Economic Impact of Off-Grid Solar
6. Lighting Global (2019), Pay-As-You-Go Market Attractiveness Index 2019

PAYG solar increases mobile money revenues, although the correlation is complex

Mobile money is a key revenue driver for mobile operators in emerging markets. In fact, in their most recent quarterly earnings updates, both Orange[7] and Vodacom[8] identified growth of their mobile money offerings in emerging markets as the key revenue driver. The results from our analysis on revenue generated are supported by the below context on how mobile operators derive revenue from mobile money transactions.

Mobile operators earn money from mobile money transactions by charging transaction fees, but pricing schemes can vary considerably based on market context and strategic objectives of different operators. Slab-based pricing, where transactions within a predefined range are charged a flat fee, are the most common mobile money pricing model, but sometimes operators may offer special rates for particularly small transactions. For instance, in Kenya, Safaricom introduced M-Pesa Kadogo, a permanent tariff that scraps all transaction fees for both person-to-person and merchant transactions below Ksh 100 (approximately $1). Pricing structures also vary by transaction type (P2P, cash in/out, merchant payment, etc.), and may vary across strategic partnerships that mobile operators have with merchants. They can also change rapidly, as they respond to different competitive and strategic mobile operator objectives, as well as the wider regulatory context. Low-income populations' mobile money transaction frequency and mobile money uptake is highly sensitive to changes in these pricing schemes, as well as to introduction of mobile money taxes that are becoming increasingly widespread throughout Africa. When considering the impact of PAYG on mobile money revenues across countries, it is important to consider these complexities, as pricing schemes are likely to vary across countries.

Figure 10

Increase of revenue generated by mobile money after adoption of PAYG

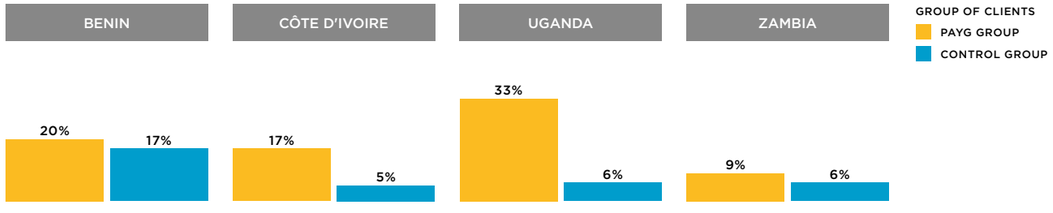


Figure 10 shows a clear positive impact of PAYG uptake on mobile money revenues, though the significance of this impact varies across markets. While in Uganda mobile money revenues from the PAYG group outperform the control group by a staggering 27 per cent, the PAYG customers in Zambia and Benin only outperform the control group by three per cent. As described above this does not mean that the impact of PAYG on mobile money is insignificant, but rather could be explained by the way that mobile money pricing rules interact with small PAYG solar transactions. Not all transactions, such as cash-in, necessarily generate mobile money revenue.

7. Le Monde (2020): *Banque mobile et téléphonie : l'Afrique porte la croissance d'Orange*
8. The Africa Report (2020): *Vodacom coining it with M-Pesa*

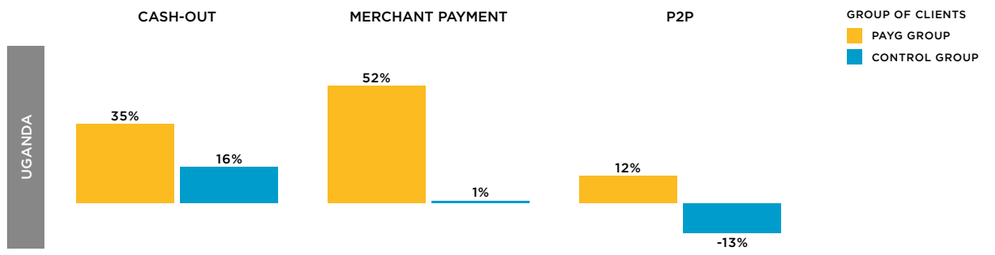
As the mobile money industry moves towards payments as a platform approach, it will become increasingly important for mobile money providers to position themselves as critical infrastructure in people's daily lives. With utility bill payments already accounting for 44 per cent of the total bill payments value processed via mobile money,[9] there is tremendous scope for mobile operators to leverage PAYG to feed into the industry's wider goals by expanding mobile money penetration and use cases.

Uganda is an exception with a high increase in revenue from mobile money

Despite the complexities discussed above, Uganda stands out in terms of the impact of PAYG uptake on mobile money revenue, given the 27 per cent revenue growth differential between the PAYG customers and the control group. If we take a closer look at revenue growth by type of transaction, the significance of the PAYG impact becomes even more apparent (see Figure 11). For example, while revenue from P2P transfers dropped by over 12 per cent for the control group, it increased by over 12 per cent for the PAYG group. Similarly, the PAYG customers in Uganda also strongly outperformed the control group when looking at other transaction types, such as cash-out or merchant payments.

Figure 11

Increase of mobile money revenue in Uganda per transaction type after adoption of PAYG



As discussed for the frequency of transactions, it is important to consider the value generated from increased activity across all transaction types, thanks to PAYG adoption, rather than focusing on the revenue generated from solar payments alone. From the Uganda analysis, 90 per cent of the increase in mobile money revenue was generated by non-solar transactions.

9. Add Footnote to SOTIR when out



Overall mobile subscriber trends

One key interest was understanding how PAYG solar might impact mobile subscriber activity beyond just mobile money transactions. For this, we received data from mobile operators about mobile activity such as the use of voice, data and SMS, and the associated revenue, for customers before and after PAYG, and again in comparison to a control group. The data indicates that PAYG customers appear to be more active customers overall. This decreases the risk of dormant subscribers that may eventually leave the service. In the two countries where data was available, PAYG customers also showed an increase in adoption of mobile internet services in comparison to control groups. In four markets, the PAYG customers out-performed the control group in terms of increased revenue over time. In an era when mobile operators face declining voice revenues, these later trends suggest that PAYG offers a very important new opportunity for mobile operators to diversify their revenue streams.

More research is required to understand the causality between PAYG solar and increased use of mobile services and revenue outside of mobile money. For example, it could be related to the increased access to power for charging in order for customers to use their phones freely rather than saving their batteries. Or perhaps it relates to PAYG service providers' agents supporting broader digital literacy of users as they support them to make mobile money payments. Or perhaps causality is limited due to self-selection, i.e. PAYG solar clients may be distinctively different from non-PAYG solar clients (for instance in terms of socio-economic characteristics) and their increased mobile consumption might be driven by other factors.

Nonetheless, we believe that our findings point to several indications of causality, and that with the trend of PAYG solar companies and PAYG minigrid providers, financing more energy appliances, this will become even more obvious. For example, these energy service providers, just like mobile operators, seek to foster a continued relationship with customers by up-selling them with value-add products based on their profile and consumption history, with add-on products like PAYG solar irrigation pumps. These trends and opportunities are described in more detail below.

Mobile dormancy among PAYG subscribers decreases in some markets

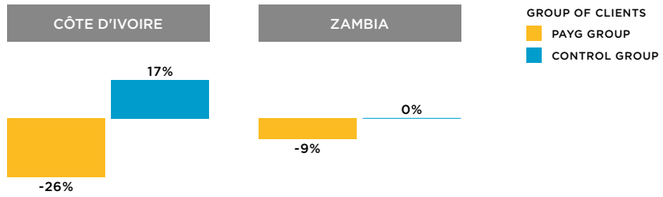
The dormancy rate measures the proportion of mobile customers that are inactive during a 30-day period, meaning these clients haven't used their sim card during this time. There are many reasons that can explain why a client becomes 'dormant', for instance: inability to top up their account or to use their mobile phone, or temporary or permanent switch to a competitor offering better prices. It is very common in developing markets that clients have multiple sim cards and will switch from one operator to another following the best current offer in the market.

Dormancy is a burden for mobile operators because a dormant client does not generate any revenue. But the greater risk is that dormancy will inevitably lead to client churn where the subscriber does not become active again. A service like PAYG solar can help mobile operators to build up customer loyalty and discourage dormancy and churn by giving them a service that they value that requires regular payments.

The data received from Côte d'Ivoire and Zambia, as shown in Figure 12, demonstrates that the dormancy rate decreased by 26 per cent in Côte d'Ivoire and by 9 per cent in Zambia after adoption of PAYG. During the same time period, the dormancy rate for the control group in Côte d'Ivoire rose by 17 per cent, and was stagnant in Zambia.

Figure 12

Change of mobile phone dormancy rate after adoption of PAYG



We encourage more operators to examine data on dormancy and churn rate among their PAYG clients to shed more light on this important indicator. It would also be interesting to combine the data with field surveys to better understand what drives the decrease of dormancy for PAYG users. For example, does increased access to phone charging through the SHS help keep customers active? Or is it more broadly related to the overall increased mobile money activity, as well as the increase in broader GSM services, as discussed in the next section.

PAYG solar may increase data usage, and opens the door to PAYG smartphones

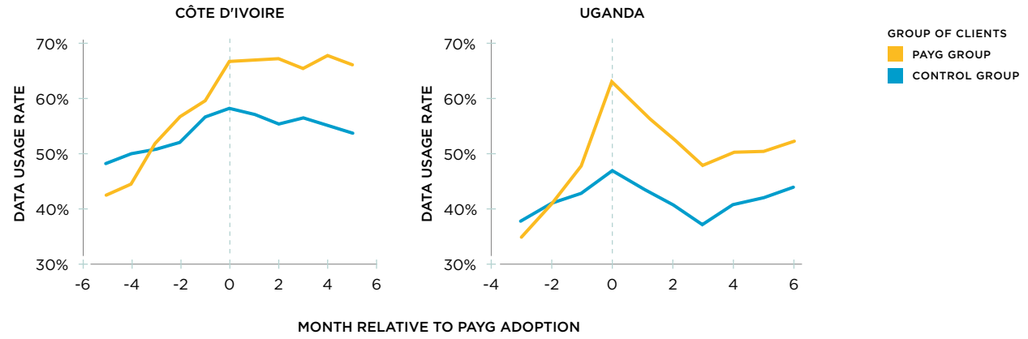
When it comes to stimulating phone activities of their clients, mobile operators today place a high priority on increasing data usage for mobile internet services. To counterbalance the overall decline of traditional voice and SMS services by their clients, operators need to diversify their offer and internet usage to unlock a latent but strong consumer demand.

To assess if PAYG adoption had an impact on internet activity, we looked at the penetration rate of internet service among PAYG users before and after use of the solar devices. In the two countries where this information was available, the growth of the penetration rate was strong and higher than for the control group. In Côte d'Ivoire, there was an increase of nearly 31 per cent of clients using data after adopting the PAYG solar service compared to 9 per cent growth for non-PAYG customers. Although the graph suggests the growth started before the adoption of PAYG, we can clearly notice another boost effect from the start of PAYG solar usage when the penetration rate jumped from 59 to 66 per cent for PAYG clients. A similar increase ocurred in Uganda where it jumped from 41 per cent penetration the month before the adoption of PAYG, to 49 per cent right after.

Figure 13

Note: We only received 3 month of customer data before PAYG adoption in Uganda

Mobile internet penetration rate before and after adoption of PAYG



Further research is needed to understand the exact reason why PAYG impacts data usage. For example, it could again be related to increased access to phone charging, or perhaps some PAYG companies support their clients with smartphones to install apps to help them make mobile money transactions or manage their PAYG solar accounts.

A very exciting opportunity for mobile operators is the rise of PAYG solar companies also selling PAYG smartphones, which could further amplify data usage among PAYG customers. For example, GSMA Mobile for Development Utilities grantee, VITALITE, piloted bundling PAYG smartphones and cookstoves with PAYG SHS in Zambia. The majority of VITALITE's rural customers were first time smartphone users who had previously used a feature phone or never owned a phone before. Consequently, VITALITE is also educating their customers on basic smartphone use at point of sale, thereby providing a triple benefit to their mobile operator partners – increased mobile money usage, new revenue from data, and building the digital literacy needed to use that data for internet access. VITALITE is not alone in this space, and companies like MOON, M-KOPA and d.light are also selling PAYG smartphones in addition to SHS.

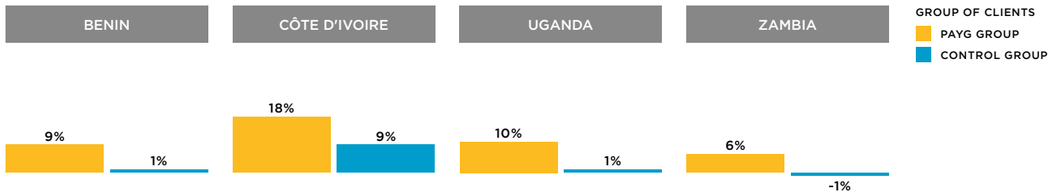
PAYG is driving new revenue streams for mobile operators

Mobile operators pay particularly close attention to their Average Revenue per User (ARPU). ARPU provides a granular view at a "per user" level and allows mobile operators to track revenue sources and growth. Mobile operators, particularly in emerging markets, have continuously tried to raise ARPU by launching new service offerings, building more strategic partnerships, and tapping into new revenue streams.

The PAYG industry represents such a strategic opportunity. As results from all four markets show in Figure 14, the PAYG customers clearly outperformed the control group in terms of overall ARPU. The difference between the PAYG customers and control group is particularly pronounced in Côte d'Ivoire where ARPU increased by more than 18 per cent among the PAYG users while, for the control group it only increased by eight per cent.

Figure 14

Overall mobile APRU increase of PAYG subscribers vs control group

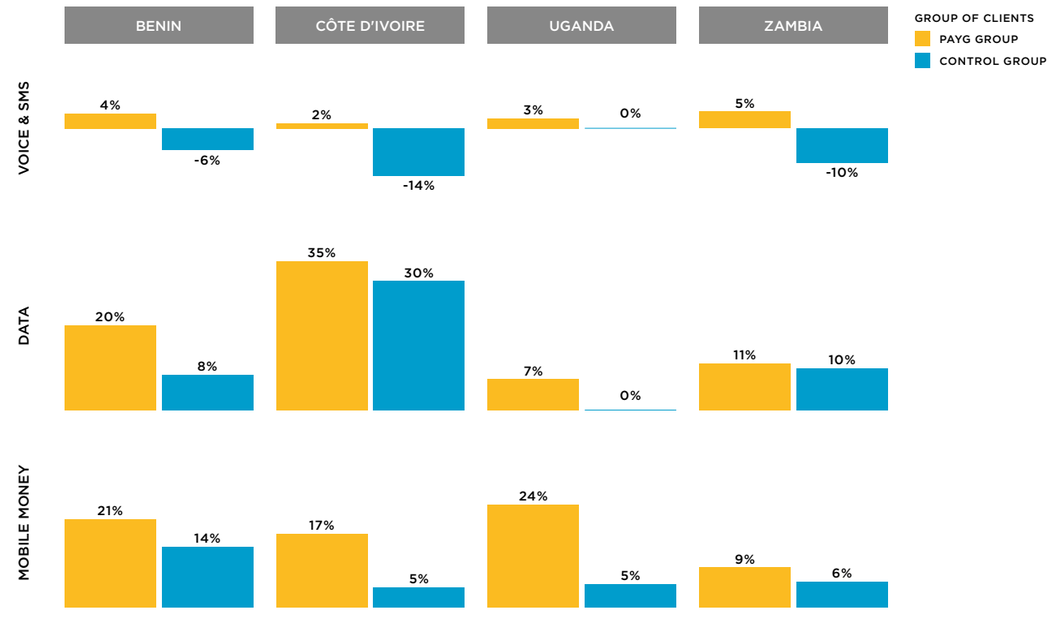


A key concern for mobile operators in emerging markets is that Voice and SMS services, which have historically accounted for the bulk of mobile operator revenues, are not going to be key revenue drivers of the industry going forward, due to fierce price competition and a shift toward higher value services. Mobile operators, particularly in emerging markets, are therefore looking for strategic opportunities to drive revenue across other revenue streams such as mobile money and data.

The downward trend in voice ARPU is also evident from our analysis shown in Figure 15. Across the control groups in all markets, we see a clear confirmation of the market trend of declining voice revenues. Interestingly, PAYG adoption seems to serve as a buffer against this trend, as voice revenues among the PAYG customers seem to show modest growth rates.

Figure 15

Change in ARPU per mobile service after adoption of PAYG



PAYG solar adoption also seems to unlock new revenue streams for mobile operators - though this revenue diversification effect might differ across markets. In Côte d'Ivoire, revenues from both mobile money and data services grew by over 17 per cent and 35 per cent respectively, while voice revenues barely expanded (2 per cent increase). Similarly, in Benin, we see that the revenue growth from mobile money and data among the PAYG group exceeded 20 per cent, while for the control group, revenue growth for mobile for mobile money (14 per cent increase) and data (8 per cent increase) are lower. In Zambia, the PAYG customers also outperform the control group, but by considerably lower margins than in Benin and Côte d'Ivoire. Overall, PAYG adoption seems to amplify an existing positive market trend of rising data and mobile money revenues, further catalysing mobile operators' transition from a reliance on airtime as a main revenue source.

Given the need for mobile operators to diversify their revenue base, our analysis of the impact of PAYG on overall ARPU suggests that PAYG adoption can drive new revenue streams, and make mobile operators less vulnerable to declining voice revenues.

The expansion of PAYG models to energy appliances

PAYG energy providers and mobile operators alike recognise that their low-income customers need income generation to consume more services. PAYG energy providers want to leverage their customer relationship to continue to sell services after a customer has completed the payment on their first solar home system. But this means that customers need support to keep making their primary payments, and a way to generate more income. The off-grid energy sector and its financers are placing a huge emphasis on impacting livelihoods through PAYG appliances associated with sophisticated mobile usage. For example, GSMA Mobile for Development Utilities supported SunCulture with a grant in 2015 to develop PAYG solar irrigation solution to improve the yield of farmers. Through an IoT platform, SunCulture is also now providing their farmers with advanced weather and market pricing information via mobile.

As mentioned, a range of companies have also begun to sell PAYG smartphones as a key compliment to solar energy. The off-grid appliance market is also an important commercial opportunity for PAYG providers and their partners, including mobile operators. CLASP estimates the addressable market for off-grid appliances will double from $12.6 billion at the end of 2018 to over $25 billion in 2030.[10]

The off-grid energy sector is also starting to support customers in urban areas with unreliable grid connections by selling them solar home systems, hybrid battery solutions to store power from the grid, and more efficient appliances. Enabled by mobile payments that underpin almost all of these models for asset financing, PAYG providers seek to go beyond just energy access to adressing energy poverty by unlocking access to a range of new products and services.

10. CLASP (2019), 2019 State of the Off-Grid Market Report Finds Appliances on the Edge of Transformational Growth

Conclusion and future opportunities

Our programme seeks to enable, and build evidence for the shared value of partnerships between the mobile industry and utility service providers in order to improve energy, water and sanitation services through financially sustainable models. Through many of our grantee case studies and reports, we have shared significant evidence of the role that mobile technology can play in improving essential energy, water and sanitation services for low-income populations. With the addition of this study, we have more definitive evidence across markets of the quantifiable and significant commercial value that these models bring to mobile operators. Assessing this dual social and commercial impact is important to driving the economic and human development needed in emerging markets.

In the first half of 2019 and for the first time, more than one million off-grid solar products were sold through the PAYG model, accounting for 24 per cent of all global sales, providing clean energy to millions of households, according to GOGLA.[11] Access to PAYG solar services positively impacts people's lives in a multitude of ways. According to a multi-country survey conducted by 60 Decibels,[12] close to one-fifth of customers are using their energy product or service for income-generating activities. Meanwhile, 86 per cent of customers feel safer in their homes, while 48 per cent of users reported improvements in their health. The off-grid solar sector is a whole is also a major job-creator in developing countries. GOGLA estimates that the sector could support an estimated 1.3 million full-time-equivalent jobs by 2022.[13]

Through this study we have also demonstrated positive trends for the value of PAYG solar businesses for mobile operators. PAYG solar significantly drives mobile money adoption and transaction frequency, not only for solar payments, but for a broader range of transactions, therefore acting as a catalyst for digital and financial inclusion. The study also shows that PAYG solar clients are important for mobile operator ARPU. While direct revenues from voice and SMS activities show some level of increase, it is most encouraging to see that PAYG solar clients show a significant increase in ARPU compared to control groups, particularly around data usage and mobile money. This demonstrates that PAYG helps mobile operators achieve more value from subscribers that might have previously lacked the energy, or the financial inclusion to access advanced mobile services.

Thus the full value of this opportunity for mobile operators may lie just ahead, as PAYG models are being rapidly expanded to broader energy appliances, and to other service models. Increasingly, PAYG solar companies are financing other appliances like smartphones and seek to impact income generation through agricultural infrastructure like water pumps and processing machinery. PAYG models are also permeating urban services like clean cooking through PAYG LPG and piped water services. This proliferation of innovation that is driving digital ecosystems represents an unparalleled opportunity for mobile operators, with governments in countries like Togo taking note of the economic development possibilities, and building strong enabling environments.

For the mobile industry, we hope these findings support three key actions toward PAYG partnerships:

- **For mobile operators already working with PAYG solar providers, there's a need to look at how deeper collaboration with these partners can further drive these mutual benefits.** For example, through more strategic joint training and placement of agents, through more promotions, or joint consumer insights. In an era where PAYG solar companies are all rapidly expanding their product offerings to sell even more appliances and services through their platform, there's huge opportunities for collaboration. And through the years these companies have spent a lot of time and resources on the ground teaching their customers about new technologies and loan products, they have deep knowledge on the customers they share with mobile operators, and the sales strategies needed.

- **For all mobile operators, investing in mobile money as a full business platform is essential to attract innovative service providers, and allow them to quickly and affordably put it to work.** From our years of work with all kinds of energy, water and sanitation service providers, across both urban and rural contexts, challenges in accessing mobile money platforms is still one of the biggest barriers, and biggest opportunities. It is an ongoing reality, despite the quantitative and qualitative evidence that shows that these mobile-enabled utility services bring returns to mobile operators. Insufficient investment in these is an opportunity cost in an era where the mobile industry is rapidly changing, with a race to drive new revenue streams beyond airtime.

- **Mobile operators can gain unique business intelligence on their partnerships from their data.** The findings in this report are based on anonymised and aggregated user data, and a relatively simple methodology which we encourage mobile operators to repeat regularly to measure the performance of these partnerships. Mobile operators have access to a wealth of information, that can be balanced with their responsibility to protect individual data privacy, in order to provide a valuable business feedback loop. Mobile operators sit at the centre of many opportunities to use big data analytics, and the GSMA looks forward to supporting their efforts in this space by providing guidance and frameworks for collaboration.

We hope that this analysis provides the groundwork for deeper research on synergies between mobile operators and PAYG solar providers, as well as other PAYG services that are gaining traction in emerging markets, such as prepaid water and cooking gas. Related to PAYG energy, valuable additional insights could be gained from examining consumer behaviours to understand more around the causality of PAYG solar, for example why PAYG solar customers increase their data usage, in order to better design services that support this. Further research could also look at trends beyond the initial six months of PAYG to understand the permanence of these trends. An expanded scope could also look at more regions, more service delivery models, such as minigrids, and the specific impact of energy appliance financing. Following the evolution of PAYG into other utility sectors, there's a range of associated business impacts to be understood from these. The GSMA looks forward to supporting its mobile industry members and broader stakeholders to collaborate more on these opportunities.

We would like to express our sincere gratitude to the mobile operators that supported this study, as well as the PAYG providers who supported our work, and have led a new era of businesses that hold great potential for true economic development by driving synergies between the mobile industry and energy access.

11. GOGLA (2019) , *Global Off-Grid Solar Market Report Semi-Annual Sales and Impact Data*
12. 60 Decibels (2020), *Why off-grid energy matters*
13. GOGLA (2019), *Off-Grid Solar. A Growth Engine for Jobs*



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