Grant funding to private sector market leaders as a catalyst of social impact

M-KOPA Labs was established in 2016 to accelerate the company's ability to innovate on its product offerings by conducting early stage research and development on higher impact products that are more difficult to find ways to commercialise in the market. M-KOPA at that time was growing rapidly, and any free cash was invested back into the core business to accelerate this customer expansion – and with it the life changing impact of lighting. With that context, M-KOPA Labs pursued several grant funding sources to enable its R&D on products that would expand the company's impact beyond lighting. The Shell Foundation with support from the UK's Department for International Development (DFID) provided funding to M-KOPA Labs to pursue R&D of larger capacity power devices capable of interfacing with grid energy and of larger off grid appliances. Together, R&D in these areas intended to provide customers with more affordable power, and the ability to do more with their power.

Grant funding plays a crucial role in supporting R&D for off grid markets. Although M-KOPA is reaching scale it does not yet generate free cash flow to invest in new product development beyond its immediate product suite. In addition, as new (larger) products require more up-front capital expenditure, the risks associated with bringing new products to market increase substantially – and become more challenging to fund from equity/debt capital. Grant funding has an important role to play until the market opportunity is fully proven.

The first product M-KOPA is developing with the most recent funding from Shell Foundation will have absorbed resources in excess of $1million to take from concept to launch, which is typical for new developments. M-KOPA is still not able to invest that amount in a totally new product (vs. improving the existing portfolio). The targeted investment of grant funds in the R&D efforts of market leaders such as M-KOPA, especially in nascent sectors, accelerates the development of these markets and brings forward the social impact accrued through market expansion, improving and increasing livelihoods for the world's most vulnerable at a more rapid pace.

In developing new products with support from the Shell Foundation, M-KOPA has had to explore and uncover additional understanding of its markets and the energy-use of existing and future customers. This note summarises the key findings of the research undertaken to date. Further findings relating to the specifics of the products under development will be shared once the commercial product launches have taken place.

The energy access landscape: a misunderstood gradient

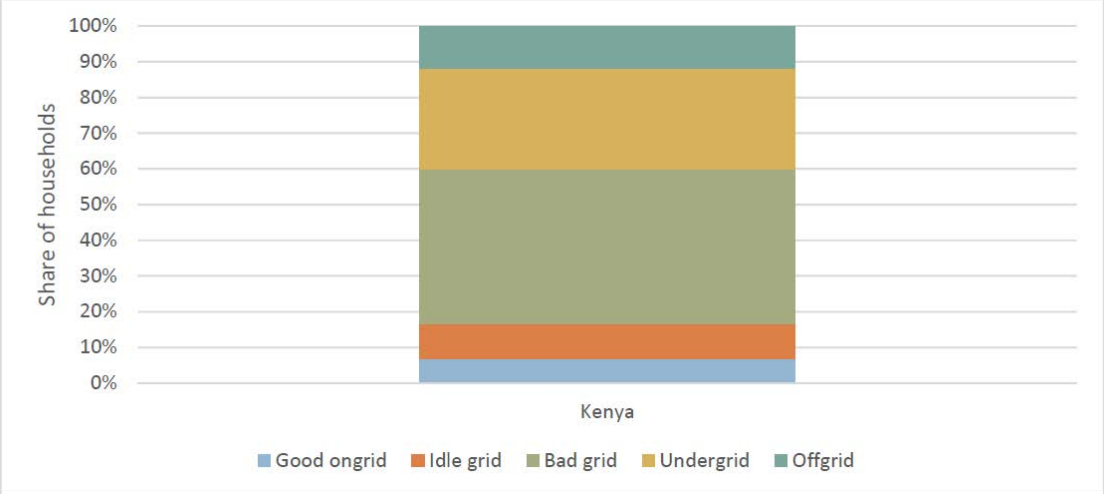
Whereas M-KOPA addresses the off-grid customer base with solar home systems, Kenya Power and Lighting Company (KPLC) addresses the on-grid customer base, providing power through traditional grid infrastructure directly into the homes of those who have been connected. Much of the discussion around energy access is focused on these two categories, dividing customers and households purely by grid connections. One of the central findings of M-KOPA's Shell Foundation funded market analyses is of a much more nuanced market segmentation between on grid and off grid; M-KOPA identified three additional and distinct groups of customers that do not fit cleanly into either category. These three segments have been titled "under grid", "idle grid", and "bad grid", and each has slightly different customer pain points that M-KOPA and companies like it can address.

Table 1: five customer segments

Grid status	Off grid	Under grid	Idle grid	Bad grid	On grid
Customer circumstances (domestic and small enterprise)	Live far from the grid	Live close to the grid, could be connected but current costs too high and capital intensive	Connected (through rural electrification programmes) but cannot afford appliances	Connected to the grid but suffer unreliable connections: frequent and extended outages	Connected to the grid

The needs/wants of on grid and off grid customers are broadly understood already, and research did not uncover significant new information about these two segments. However, research into the other three presented some new insights, and significant market opportunities which are set out here.

Figure 1: Percent of Kenyan households in each grid connection category



The under grid segment

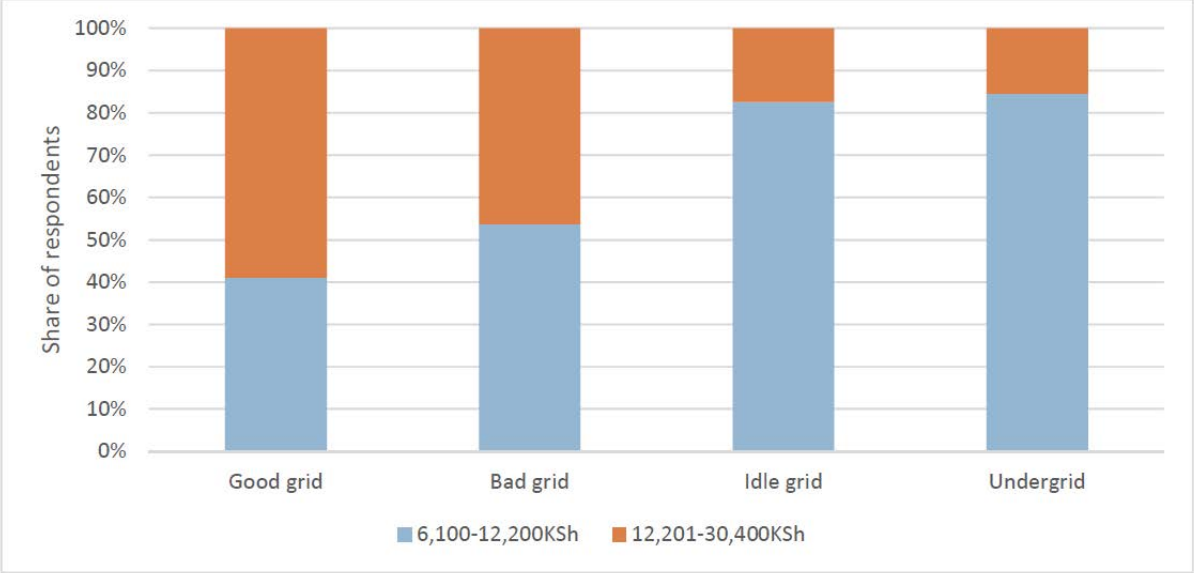
The Energy Institute (EI) at the Haas School of Business (UC Berkley) undertook research in 2015 on rural electrification efforts in Kenya and coined the term “under grid”. The term refers to households within connection distance of a low voltage transformer (600 meters in Kenya) but not connected to the grid. The EI research found that only 5% of households and 20% of businesses within 600 meters (in communities where a low voltage transformer been installed within 5 years) had grid connections via the transformer. There is a significant gap between the number of Kenyans who in theory *could* connect to the grid, and the number that has.

Subsequently, schemes to reduce connection fees, or amortise fees over the first few years of electricity bills have increased the percentage of connections in these communities substantially. More than 60% of Kenyan households are now connected to the grid. However, the problem of the under grid is persistent – according to recent M-KOPA research, 11% of the population can still be classified as under grid, and this is likely to increase to 16% with the

newest round of grid extension efforts, as planned grid extension efforts bring new transformers within striking distance of previously fully “off grid” customers.

As illustrated in Figure 2, the under grid population in Kenya is disproportionately lower income. Amongst households above the poverty line, more than 80% are in the “floating class” (making between $2 and $4 a day). These households are more likely to gain income from irregular sources, or from running businesses, and 50% have no lighting sources (including solar home systems or solar lanterns). This customer group shares many characteristics with purely off grid customers, and therefore, are prime candidates for solar home systems financed on the pay as you go model.

Figure 2: Distribution of floating class and middle-class households by each grid connection category



The idle grid segment

In early 2017, the Standard newspaper published an article asserting that nearly a third of the 3.5 million households KPLC claimed to have connected to the grid in the most recent Last Mile Connectivity Programme were inactive. This meant that they hadn’t topped up their pre-paid meters at any point in the first year after connecting. Their meters were preloaded with 30kWh of credit, meaning that 1 million households were using their KPLC connection for a single lightbulb or less during the period since connection. This group of customers typifies the idle grid segment.

The idle grid segment shares many features of the under grid segment, except that they have grid power already connected to their home. Generating electricity demand is the key problem for energy suppliers seeking to serve this segment; idle grid customers rarely have access to affordable appliances and they lack sufficient disposable income to afford large electricity bills[1].

[1] 40% of idle grid respondents in an M-KOPA survey said they need to limit their consumption because of the cost of electricity.

These two features make it difficult for idle grid customers to gain the full benefit of their electricity connections, or to generate revenues for connection providers.

The bad grid segment

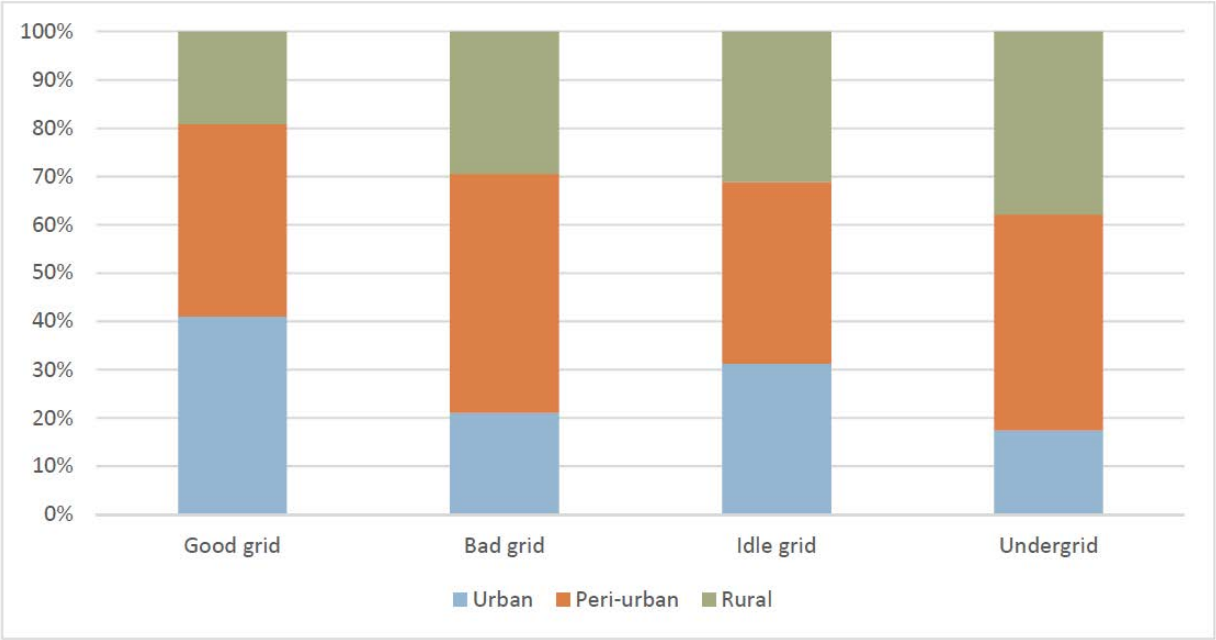
One third of grid connected households have connections that work less than half the time[2] representing more than a million households in Kenya without reliable power. Demographically the bad grid customer segment is between the good grid and idle grid segments. Although they have higher incomes and are more likely to earn a regular paycheck than idle or under grid segment households, they are disproportionately peri-urban and more likely to cite unstable power as a reason they don't own more appliances.

Visualising the segments

As illustrated in Figure 3, good grid is most pervasive in urban and peri-urban households (largely a result of the quality improvement efforts undertaken around Nairobi in recent years). Bad grid and under grid customers are found in peri-urban areas, while the idle grid segments have a substantial urban presence (largely indicative of the low incomes of customers in slum areas impacting their ability to afford appliances and electricity).

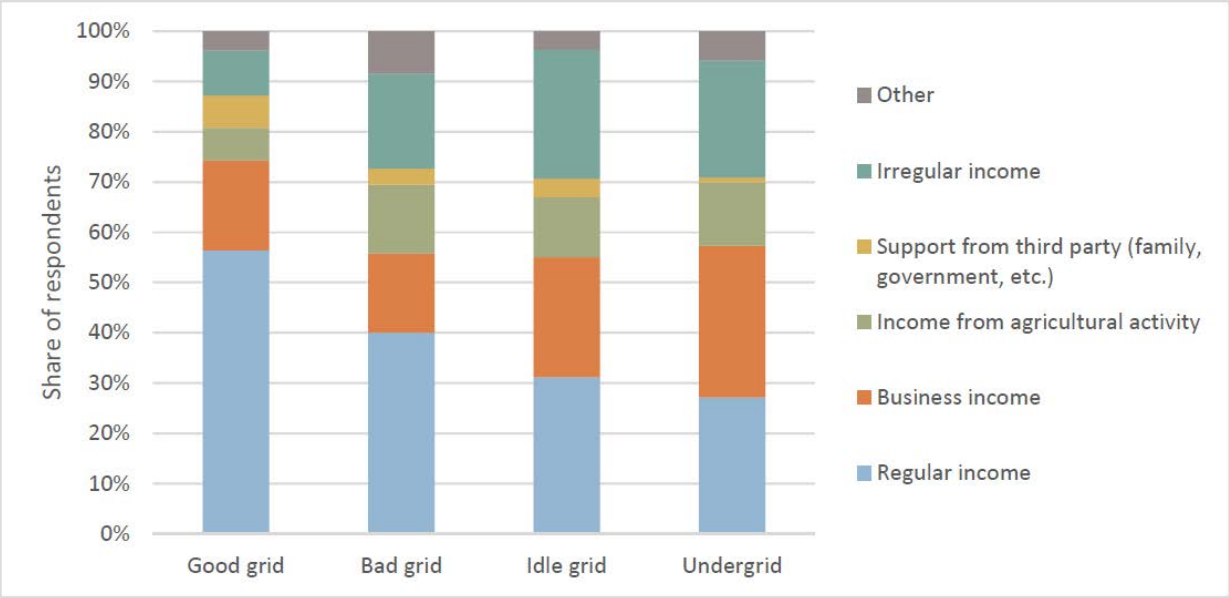
Under grid and idle grid customers have similar income levels, while bad grid and good grid customers enjoy higher incomes and, therefore, are more lucrative to service than either the idle or the under grid segments.

Figure 3: Percent of households urbanised by each grid connection category



[2] Afrobarometer study, 2017.

Figure 4: income sources by grid connection category



Regular incomes are common within the good grid segment since urban centres including Nairobi, with their larger employment markets, make up a substantial percent of good grid households. Irregular incomes are common within the other segments, with self-employment (through small business or agriculture) making up the largest share in the under grid segment, followed closely by the idle grid segment.

Conclusions on market segments

Each category of grid connectivity suffers from different challenges that companies have the potential to address with well targeted product offerings.

- The bad grid segment primarily needs more reliable sources of energy. This could come from solar home systems, running in parallel with the grid (indeed 17% of M-KOPA customers already have a grid connection in their homes), or from grid backup systems that can provide power during grid power outages.
- Idle grid segment customers are unable to use their grid connections beyond lighting. They need highly efficient appliances available either at a subsidised price, or through accessible financing schemes, to enable the affordable use of energy (including for productive purposes).
- Under grid customers can be targeted to be brought onto the energy ladder, starting with a solar home system and eventually graduating to a full grid connection. They also would benefit from affordable financing for grid connections and the wiring and appliances needed to effectively use electricity in the household.

Each segment is unique and presents different commercial opportunities for the private sector. Each also requires a different and nuanced approach from government, NGOs, and donor agencies to help them realise the benefits of energy services.

How PAYG mechanisms overcome the challenges of consumer finance for appliances

M-KOPA's recent research on financing options in Kenya uncovered very few loan products that provide low income customers with affordable options to acquire consumer goods on credit. As shown in Figure 4, only a third of the products available have a loan period more than 2 months. For loans of KSH20,000-100,000 (the range that most SHS and appliances fall into), a two-month loan period is too short to be affordable, since each payment would be more than most households would reasonably be able to afford. Of the seven options with loan periods more than two months, two have interest rates of 50 300% APR, making them unaffordable on the basis of financing costs.[3] Two of the other options are offered by commercial banks, which require collateral against the loan (most low-income people in Kenya don't own property, or any other valuable goods that could act as collateral).

Beyond the interest rate and loan period, traditional loan options generally come with high penalties. For higher value loans, any default or missed payment puts the borrower at risk of repossession without any return of loan payments made. Additionally, almost all of the formal loan companies will report default to the national credit board, and clearing a bad credit report costs KSH2,200 to each of the 3 credit rating agencies in Kenya. Because of the harsh penalties imposed, low income customers reported across the board that they are unwilling to take traditional loans for non-emergency purchases – things like school fees and funeral expenses make the cut, but appliances are considered a luxury purchase.

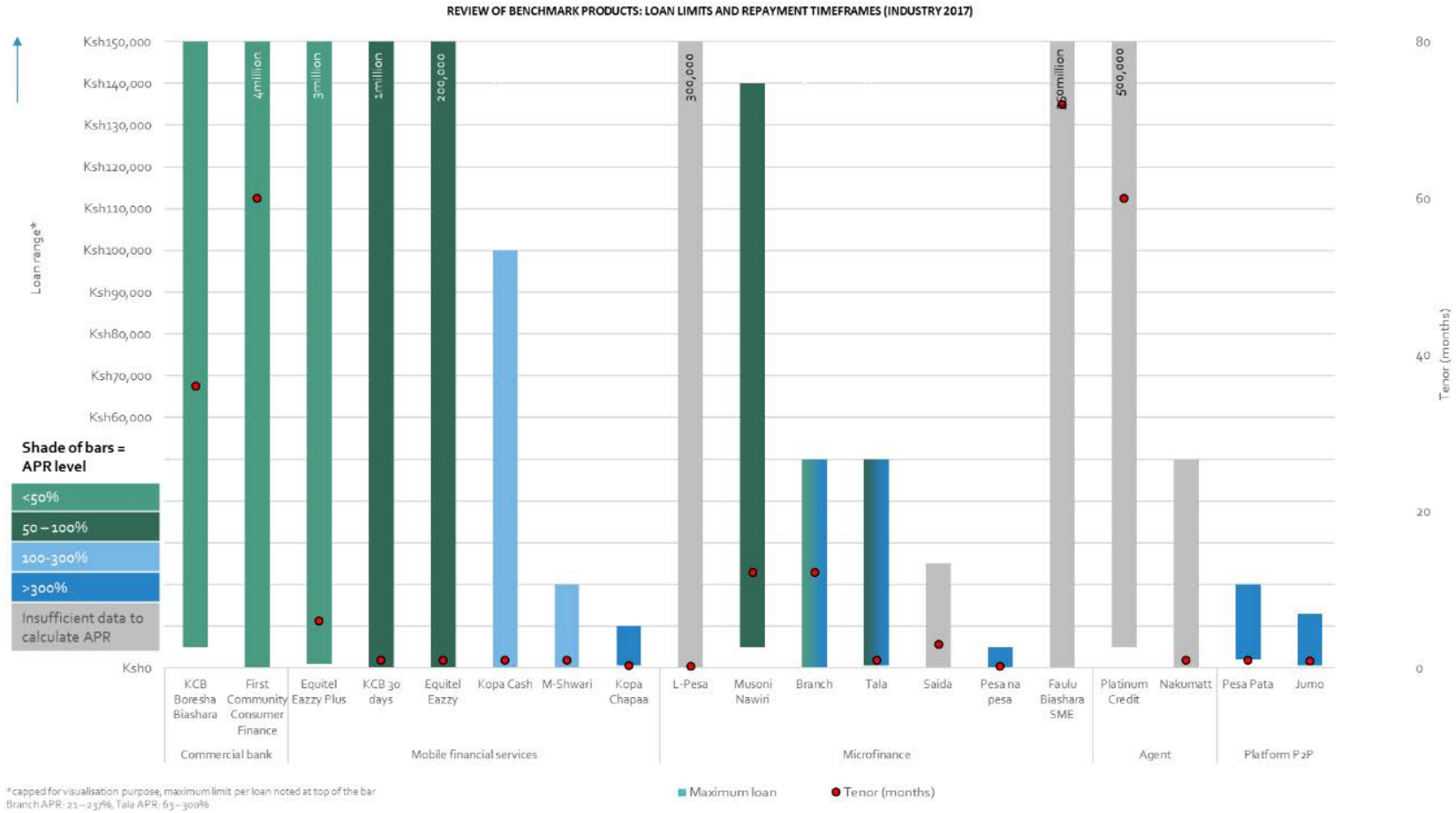
Compounding this resistance, most loans come with required regular payments on a weekly or monthly basis, and the penalties are triggered with as few as a single missed payment. Low income customers' income is often too irregular to make commitments to service loans on that regular of a basis.

The above factors show unequivocally why pay as you go mechanisms work for extending finance to low income customers. Each of the barriers is addressed through the structure that PAYG provides.

1) The repayment period of a PAYG loan tends to be 6 months to 2 years, keeping the loan affordable through lower regular payment amounts.
2) In a PAYG scheme, the device becomes its own collateral which means the risk is lower than a traditional unsecured loan. With no need to have someone interface with the customers face to face to collect payments, the operational costs of the loan are lower. Both of these combine to lower the overall cost of finance to the customer.
3) PAYG schemes don't have high penalties for missed payments. The device won't work until the next payment is made, but there is no repossession of the product and the customer is not reported to the credit boards unless they stop paying for the product entirely.
4) Because the implication of missing a payment is relatively low impact, customers can repay with more flexibility, corresponding to when and how they earn their income.

[3] Expanding the view to include all loans available at any amount doesn't improve the picture much; the average interest rate across all options is 159% APR

Figure 4: Consumer finance options available in Nairobi, April 2017



*capped for visualisation purpose, maximum limit per loan noted at top of the bar
Branch APR: 21 – 237%, Tala APR: 63 – 300%

Responding effectively to customer needs with new power products and appliances

The research set out here has enabled M-KOPA to identify customer segments with unmet energy needs, and without access to providers of products, or financing to meet these needs. With support from the Shell Foundation, M-KOPA has been able to undertake product development activities to address some of these needs. In this section we summarise some of the key lessons that have been learnt throughout the process to date. Further, more detailed lessons learnt will be shared once these new products have entered the market.

Building the technical team

Developing high quality, affordable, connected devices that offer reliable service to customers over a long period of time in challenging conditions requires high technical skills across mechanical and electrical engineering, battery technology, software and firmware engineering, form factor and product design and prototyping. Although M-KOPA has built a strong team in market with many of these skills, the Shell Foundation support has enabled M-KOPA to strengthen its core technical competencies in these areas. It has also enabled M-KOPA to work more closely with its suppliers to ensure that maximum advantage is gained in terms of quality, cost, and specification of new products.

Build, buy, or partner

There are several appliance technology providers in the market who have interesting off grid appliance product prototypes, but no large-scale manufacturing capabilities. Even with external grant funding support, M-KOPA cannot take on the very significant costs and risks of end to end design and manufacture of new appliances. Therefore, M-KOPA has sought to partner with reputable partners that have both manufacturing capabilities at scale and a commitment to serving mass market customers in sub Saharan Africa. This approach to co-development will result in high quality appliances being offered to M-KOPA customers, powered by M-KOPA devices, with M-KOPA's flexible financing spreading the costs of purchase.

Prototyping new products for off grid households

Off grid solar home systems have a very direct effect on household finances, whereby kerosene expenditure is displaced by a cleaner form of affordable energy. Other use cases for household appliances are harder to make – particularly where the value derived by households involve less direct cash savings, or where the appliance displaces household labour requirements (particularly by women). Further lessons learnt notes will set out the means by which the sales proposition enabled customers to realise these benefits – and invest in the purchase of low power off grid energy appliances.