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Insight

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CDC leads:

Julia Tobias and Martina Castro

jtobias@cdcgroupp.com

mcastro@cdcgroupp.com



What is the impact of solar home systems in Nigeria?

Practical thinking on investing for development

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Lumos offers clean and affordable solar power through its solar home systems to customers without adequate electricity access in Nigeria and Cote d'Ivoire.

Improving access to energy is critical for achieving Sustainable Development Goal 7 and provides opportunities for income generation, reducing expenditure, and improving safety and health. forty-six per cent of the population in Nigeria live off-grid with no access to electricity,¹ and even for those on the grid, services are often unreliable and inadequate. This can cut the day short and contribute to high costs for families to access light, phone charging, and other energy needs.

Lumos is addressing some of these challenges by providing homes and businesses that are not connected to the main electricity grid, or have low or unreliable power supply, with affordable and reliable access to electricity through its solar home systems. The company offers customers a simple way to pay for electricity in small instalments using their mobile phones.

This Insight study explores the impact of Lumos' solar power services for families in Nigeria. Through interviews with over 600 customers across the country, our research explores how Lumos serves the needs of its customers and improves their quality of life.

Key insights from our study include:

- **88 per cent of Lumos customers report improved quality of life** because of access to the solar home systems, saying that the reliability and quality of their electricity supply improved their daily lives and emotional well-being.
- **At baseline, 78 per cent of Lumos customers were connected to grid electricity** but experienced unreliable or inadequate service, with 69 per cent using generators. Both of these figures reduced slightly over time after accessing Lumos as an alternative energy source.
- **91 per cent of Lumos customers are first time users of solar lighting products** and 57 per cent report being unable to find a good alternative to Lumos' solar home systems. Nearly all customers say they rely on the home system, though most continue to use other sources of energy.
- **19 per cent of customers report using the Lumos solar home system for income-generating activities**, and 80 per cent of them report that their income has increased as a result.
- **Customers suggested Lumos could improve its products and services by offering a larger system with more power and battery capacity, different pricing options, and lower prices.** Lumos is already addressing some of these issues through expanding its range of products, and hopes to further improve marketing and customer targeting efforts to enhance product-customer fit.

Overall, our research finds that Lumos has an impactful business model and provides a service that is valued by the families and small businesses it serves in Nigeria.

We also identify some promising opportunities to improve the customer experience and build impact even further. We hope this study will provide some new insights on how technology delivered through financing can light lives.

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For questions please contact
jtobias@cdcgroup.com
mcastro@cdcgroup.com

¹ World Bank databank: <https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=NG>



01

Lumos' model: providing energy access through financing

Providing access to safe, reliable, affordable energy is critical for achieving development objectives in West Africa and globally. A lack of access to energy affects many areas of socio-economic development such as security, climate change, food production, health and livelihoods.

With 46 per cent of the population of Nigeria not connected to grid electricity, families and businesses can be inhibited in their activities and earning potential. Even for the on-grid population, unreliable or inadequate services mean people have to find an alternative source of power. Our baseline study found that while 78 per cent of Lumos customers were grid-connected, 69 per cent were also using generators for back-up or supplemental power. For those off-grid, generators were being used to light homes the majority of the time (62 per cent).

On average, off-grid families were spending around \$5.40 each week for lighting, phone charging and generator usage, with most of this (\$4.13) coming from petrol spending by generator owners. This was even higher for customers with grid electricity bills too – \$9.15 each week, of which \$6.93 was spent on petrol for generators.

By delivering solar electricity as a service with the costs spread over time to avoid high up-front fees, Lumos's solar home systems enable customers to enjoy affordable access to reliable solar electricity with a five-year repair service. For those customers using costly, inadequate and often dangerous sources of power (e.g. generators, kerosene lanterns, torches), Lumos' offering provides access to an affordable and reliable alternative.

91%

of Lumos customers are first-time users of solar lighting products.

Lumos commenced operations in late 2014 and currently has well over 100,000 active customers in Nigeria. The company connects the dots between the mobile revolution and solar energy. Once customers install the lease-to-own mobile solar home system, they can access electricity through a quick and simple purchase on their mobile phone. The systems have built-in technology which allows Lumos to remotely track and analyse each self-installed unit, eliminating the need for on-site technicians.

How does it work for customers? First, customers pick up the Lumos system at their local mobile operator store for a one-time commitment fee. The systems are simple to install and customers can do it themselves or with the help of one of Lumos's 700+ qualified technicians nationwide. The solar panel goes on their roof and the battery unit goes indoors, where it connects the cables and LED lights. After that, customers simply pay a monthly usage fee through their mobile phone. Access to electricity is provided throughout the payment period, irrespective of the actual consumption – Lumos does not charge per watt or based on usage. The electricity can be used day and night to power lights, mobile phones, fans, computers, radios, small televisions, and other small devices.

Lumos is providing a service for the first time for the majority of customers – both in terms of energy access and financing. Ninety-one per cent of those interviewed in this study had not owned a solar energy product before they purchased Lumos. For 59 per cent, the Lumos solar home system was the first time they had bought a product on credit or through instalment payments.



The Lumos solar home system is cheaper than other alternatives. I have kids in secondary school and in university, so I have other things to use money on. When I heard of Lumos and the payment plan, I got it.

Lumos customer



02

Lumos' impact

This section summarises the methodology and findings from interviews with users of the Lumos solar home systems to understand what they think of Lumos and how it impacts their lives.

2.1 Study methodology

The data used for the insights in this report come from phone interviews with 610 customers in Nigeria and was conducted by 60 Decibels, a data and impact measurement company. The survey captured both quantitative and qualitative data around customer profile, usage, satisfaction, feedback, and impact.

We randomly selected a sample from Lumos' customer database in Nigeria to interview based on the date of purchasing their home systems. This includes customers in 34 of Nigeria's 37 states, who live across all six of Nigeria's zones (Figure 1). The results in this report predominantly focus on a group of 261 customers who were interviewed in April – May 2019 within four weeks of installation, and then again six months later². 60 Decibels' team of local researchers surveyed customers in their local language.

² We interviewed 357 customers new customers (within four weeks of installation) through randomly selecting from the full customer database, and 261 of these same customers interviewed in baseline were surveyed again six months later as a follow up. The difference is related to attrition between the surveys. In addition, a separate (non-overlapping) group of 253 customers were interviewed in April 2019 who had purchased their Lumos home system 6-12 months previously. In total, 610 customers were surveyed through 871 interviews. The majority of this report uses the findings from the follow-up survey data, using comparison to baseline data. In these comparisons, we restrict the baseline sample to include only the same group of customers who were reached at follow up. The results were very similar for the 253 one-off interview group results, so these are used for sense-checking and validation.

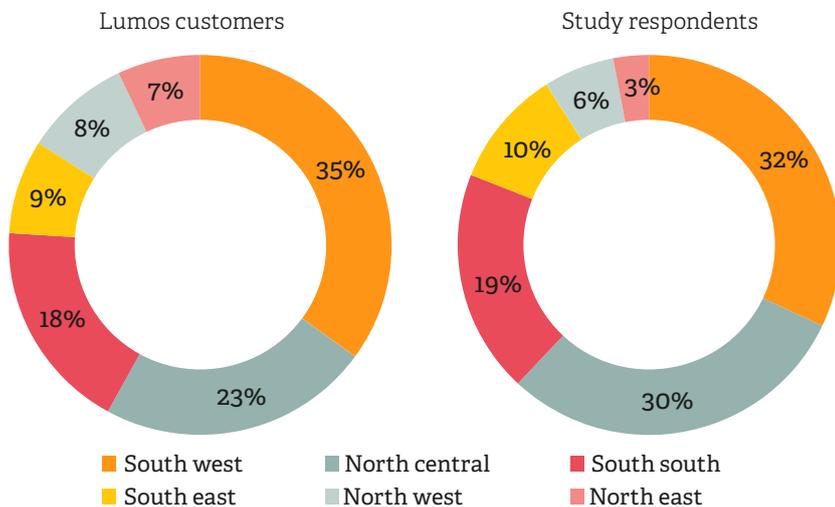


Figure 1: Zones where Lumos customers and study respondents lived

2.2. Who are Lumos' customers?

Our study finds that 42 per cent of Lumos customers interviewed joined Lumos because they were seeking a better alternative to grid electricity or generators because of lack of reliability, concerns for the pollution the generators contributed to, and for ease of use (Figure 2). 34 per cent were specifically looking for a backup or full-time energy source for lighting and appliances. 19 per cent of customers use their solar home system for income-generating activities. Of these, 16 per cent use the system at their place of work and 3 per cent use it at home. Most Lumos customers first heard about the solar home system from a friend or family member (74 per cent).

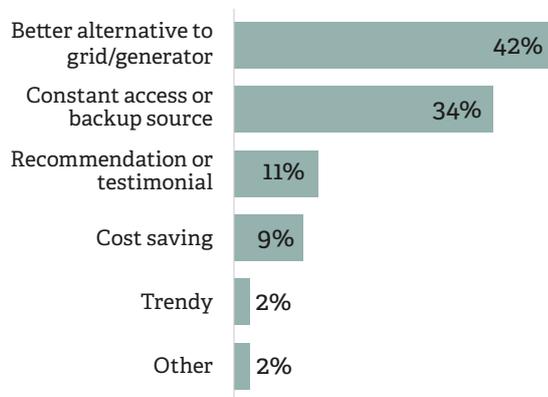


Figure 2: Motivation for Lumos customers to purchase

Using the Poverty Probability Index®(PPI), the study assesses the income distribution of Lumos customers compared to the national poverty rate in Nigeria (Figure 3)³. This helps us to understand how income-inclusive Lumos is, and which income segments the company is reaching. Our PPI data collected in the survey suggest that 51 per cent of Lumos customers live below the World Bank international poverty line of \$3.20 per person per day (2011 PPP). In relation to the national rate – 73 per cent of the population of Nigeria live below the \$3.20 poverty line – Lumos is reaching a slightly wealthier group. Twelve per cent of Lumos customers are estimated to live below the extreme poverty line of \$1.90 per person per day compared to 43 per cent of the Nigerian population.⁴ We note however that there is likely to be a significant margin of error around these estimates.⁵

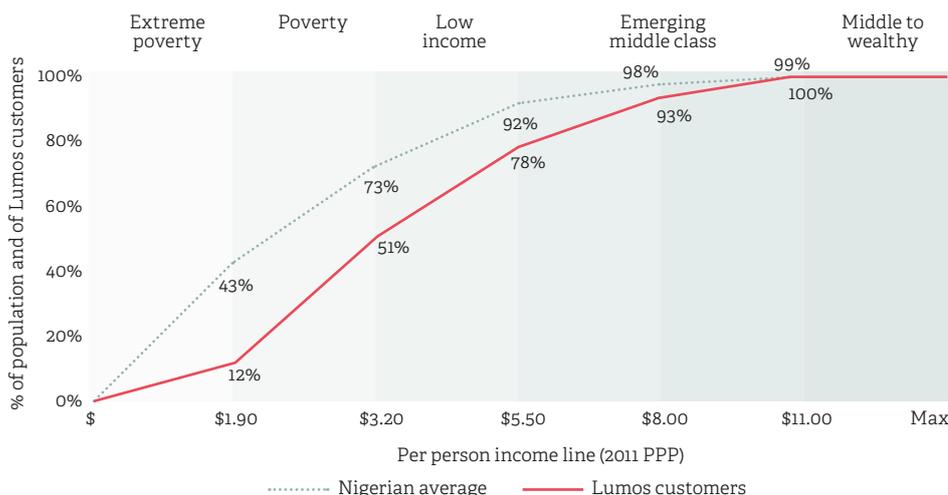


Figure 3: Income distribution of Lumos customers relative to Nigerian average

76 per cent of registered customers are men, though most expressed that all household members used the solar home system. They are generally well educated, with 85 per cent of customers having someone in the household who had attained tertiary level education (polytechnic or university), consistent with the earlier finding that Lumos customers tend to be better off than average. The average household size is four members and most respondents have a bank account.

42%

of customers joined Lumos because they were seeking a better alternative to grid or generators.

3 The Poverty Probability Index (PPI®) is a poverty measurement tool asking survey respondents questions about their household's characteristics. Based on these responses across the customer sample, the likelihood that proportions of Lumos customer households live below different income levels per day can be estimated. The PPI uses Purchasing Power Parity and therefore is not comparable to local currency expenditure, consumption, or income data.

4 <https://www.povertyindex.org/country/nigeria>

5 For a comparison of the PPI and other customer indicators across a sample of 49 off-grid energy companies benchmarked by 60 Decibels, see *Why Off-Grid Energy Matters* (2020). <https://60decibels.com/energy-report>

As part of our survey, we developed a question on adoption personas. This question helps us understand where Lumos customers sit, or believe they sit, in the market in terms of their likelihood to adopt new products or services.⁶ This is most often shaped by education, risk appetite, income level, and personality, as well as access.

Adoption persona data can provide insight on who is being served, and how best to target different customers. As shown in Figure 4, 50 per cent of Lumos customers interviewed are categorised as ‘innovators’ or ‘early adopters’ meaning they are most likely to try new products before the general market. Home users are more likely to be early adopters while business users classified themselves more often as “early majority”.⁷

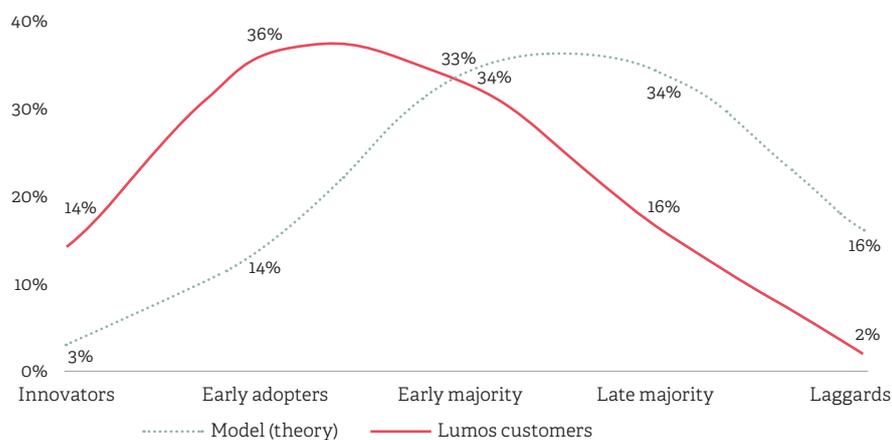


Figure 4: Adoption personas of Lumos customers

Customer profile

Meet Elizabeth O., a Lumos solar home system customer from the South South zone in Nigeria. Elizabeth and her family are connected to the grid but experience power outages at least once a week. The family was using a generator before they purchased the Lumos solar home system. Elizabeth’s energy costs were 875 Naira per week on electricity bills and 1200 Naira on fuel costs for her generator, totalling around \$5.70 each week.

Elizabeth learned about Lumos from her friend. She sees herself as an early adopter and was motivated to buy the solar home system so that she could have lighting, especially in the morning as she and her children prepare to go to work and school. She chose Lumos specifically because it is what her friend was using, and she wanted to use the same.

The Lumos solar home system was Elizabeth’s first purchase of a product through instalment repayments and she paid for the deposit from her savings and income. Elizabeth urges Lumos to create more awareness since a lot of people do not know about the benefits of the product.



The generator noise is unbearable and I need a stable light. That was why I purchased the solar home system.

Lumos customer

⁶ The theory comes from the Diffusion of Innovations by Everett Rogers (1962).

⁷ More insights and analysis are available in this NextBillion article: *From Early Adopters to Tech Laggards: Understanding Off-Grid Energy Customers*

2.3 Impact on quality of life and reliance on the product

Our study finds statistical and anecdotal evidence that Lumos contributes to quality of life improvements for families and businesses. 88 per cent of all customers say their quality of life has improved because of the solar home system, with 48 per cent of customers saying it has 'very much improved'. The main drivers for this, in customers' own words, were improved reliability of lighting and energy (35 per cent) and better quality of service for lighting and phone charging (29 per cent). 24 per cent talked about having lower stress levels and greater emotional well-being as a result of the solar home system, and 15 per cent mentioned financial savings.

57 per cent of customers indicated that they could not easily find a good alternative to the Lumos solar home system. 99 per cent of grid users had experienced power outages, on 3.2 days a week on average. This demonstrates the importance of having a reliable source of energy from the solar home system. 96 per cent of customers with a generator were fuelling it with petrol, while 4 per cent were using diesel.

Even though 85 per cent of Lumos customers were using other sources of light post-purchase, 95 per cent of all customers reported being reliant on their Lumos solar home system, with 55 per cent saying they 'absolutely rely' on it.

Perhaps unsurprisingly, we saw that a higher proportion of off-grid customers absolutely relied on their home system compared to those with grid access (76 per cent vs. 51 per cent) (Figure 5). This likely contributed to a slightly higher percentage of off-grid families saying their quality of life had improved (91 per cent vs. 86 per cent of on-grid) as shown in Figure 6.



I'm enjoying it. There is no noise from the generator. Before, if there was no light, I would have had to put on the generator, but now I don't need to. As a result, the noise pollution has stopped and there is always light in my house.

Lumos customer

88%

of all customers say their quality of life has improved because of the solar home system.

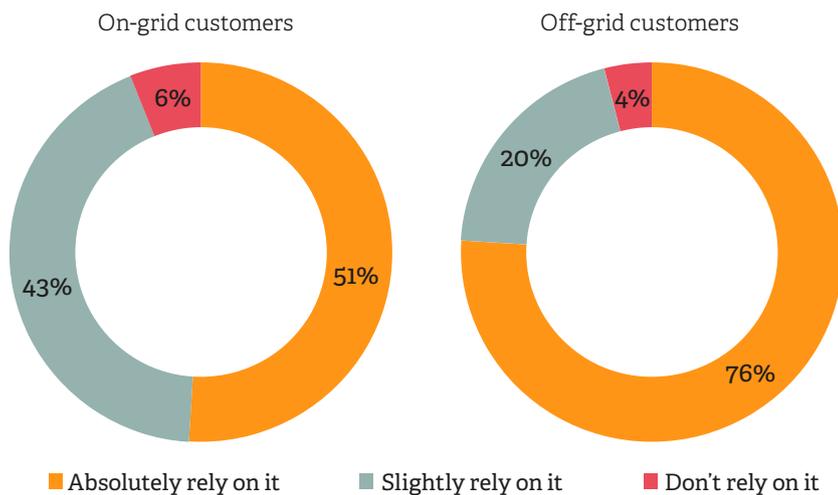


Figure 5: Reliance on Lumos' solar home system

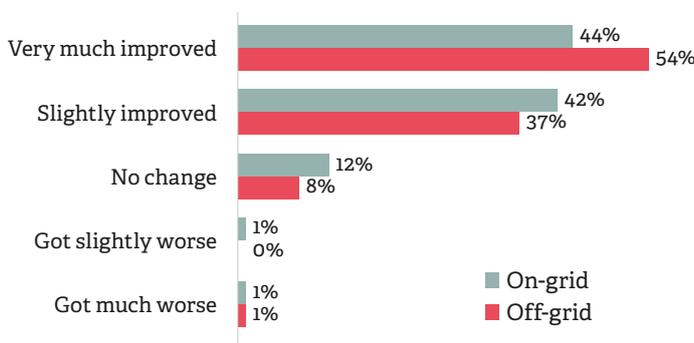


Figure 6: Perceived quality of life change by on-grid vs. off-grid customers

As shown in Figure 7, as customers increased their reliance on solar home systems between the initial and follow-up surveys, generator usage declined from 69 per cent to 58 per cent, and grid usage also decreased from 78 per cent to 66 per cent of households.

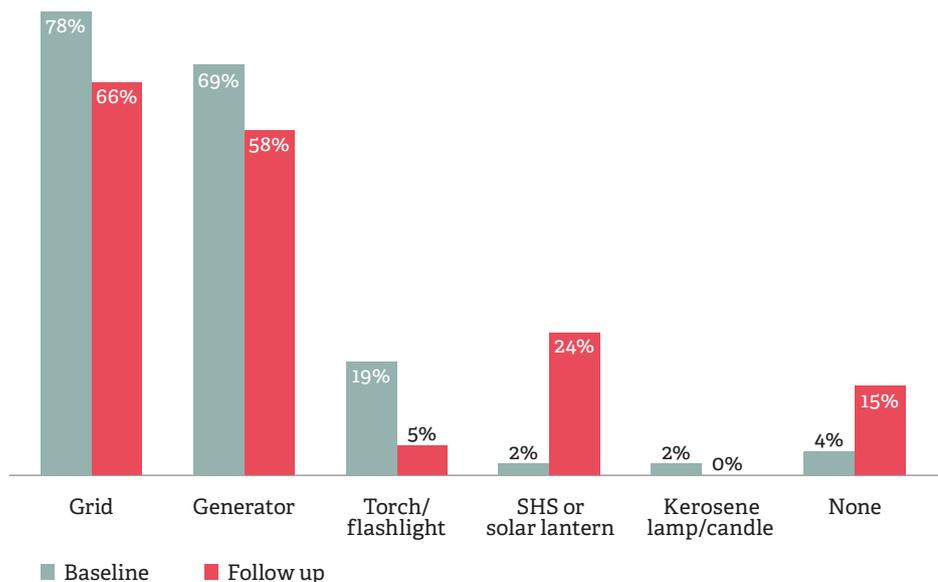


Figure 7: Alternative sources of light used by Lumos customers

2.4 Productive use of energy

There is much discussion in the sector on the potential of energy access to enable productivity. This provides opportunities for families and small businesses to generate income from their power and may contribute to poverty reduction strategies. Strikingly, 80 per cent of customers using their Lumos systems for income-generating activities report to have seen an increase in their income as a result of using the system.

At present, most Lumos customers use their solar energy system at home, while 16 per cent of customers use their solar home system at their place of work. Most of these users ran a shop (60 per cent) and a quarter had a barber shop or salon. These businesses were normally small enterprises with just two employees on average. Two-thirds were using a generator to power their business and were spending 42 per cent more than home-use customers on energy access, before using the Lumos system. 8 per cent of business customers represent new businesses that customers report they started because of their solar home system purchase.

For 96 per cent of these productive use customers, the business they were using their home system in was their main source of income when we followed up with them six months after purchase. This was an increase from 87 per cent at baseline, suggesting that this investment and/or the corresponding benefits had led to the businesses being the most important source of income for even more customers.

Additionally, during follow-up surveys, 77 per cent of business users said their enterprise had evolved as a result of having the Lumos system in their work place, with 14 per cent saying their opening hours had increased. More than one-third said that the solar product had positively affected their lives outside of their business too, with many purchasing a second Lumos product for their homes.



I am no more in the dark – there's more time to read, listen to news and other things. My children now have light to do their homework.

Lumos customer

8%

of business customers represent new businesses that customers report they started because of their solar home system purchase

2.5 Access to credit and affordability

Financing mechanisms such as Lumos's lease-to-own model make modern energy access more affordable to families. But, like any credit system, there sometimes can be unintended consequences. Even if customer repayment rates are high, there may be customers who find it difficult to make repayments.

For a closer look into affordability issues, it is helpful to get a sense of the typical costs to customers from using Lumos solar home systems. New customers typically pay a one-time commitment fee of approximately \$45 and after this they pay about \$15 per month for service. Discounts are offered on longer term pre-payments, and payments are not tied to usage or consumption. After five years a customer owns the system, which is then opened up for the customer's continuous use.

Our study explored customer perspectives on affordability further. We found that 41 per cent of customers said their solar product repayments were a burden, with 10 per cent of all customers saying they were a 'heavy burden'. Only 1 per cent of customers were taking out another loan to help with their repayments, but 45 per cent used their savings to make the payments. While this is not necessarily a negative outcome – indeed, it may represent families seeing their home system as an investment worth making – reduced savings may affect resilience to shocks.

Exploring what 'burden' may mean to people, we found that 16 per cent of customers sometimes have to cut back consumption to make their instalment payment, with 3 per cent saying they regularly had to. While these are relatively low proportions, this may merit consideration when reviewing affordability and access issues.

Lumos is addressing some of these challenges through efforts to improve its marketing to help ensure it reaches the right customers who are able to afford its products. When new customers are registered, the sales team records what appliances customers have and want to help ensure a strong customer-product fit. Sales staff are also motivated to bring in customers who will be able to afford to make repayments, as this is linked with pay incentives. Lumos is also widening its choice of products so that its offerings better fit with different customer requirements.

2.6 Satisfaction, challenges, and scalability

High customer satisfaction is particularly important in markets where the predominant sales channel is through word-of-mouth. Overall, Lumos customers were satisfied and experiencing positive impacts in their life as a result of their new energy source. 63 per cent of customers believe Lumos is 'very good' or 'good' value for money.

Using the Net Promoter Score® (NPS) – a measure used globally to assess customer satisfaction and loyalty – we found that Lumos scored a 'fair' 18. There was a significant difference between the satisfaction of home users and of business users, who are less likely to be Detractors (11 per cent vs. 22 per cent of home users). This means the NPS for business users is 36 compared to 16 for home users. Off-grid customers also had higher NPS scores, with an average of 21 compared to 16 for on-grid customers.

In order to get a good sense of what drove the satisfaction scores, we asked customers for the reasons behind their ratings. Promoters loved the improved quality of lighting and energy supply in their home, the accessibility the solar energy provided, and the financial savings they experienced. The Detractors talked about the expense of the payment plan, challenges with using their product, and were not very happy with the customer service they received.



Whenever electricity goes off, I turn to solar power. Many times, when I don't have money for fuel, I bank on my solar to power my shop.

Lumos customer

The Net Promoter Score® is calculated by asking customers to answer this question: *On a scale of 0 to 10, how likely are you to recommend the Lumos solar home system to a friend or family member, where 0 is least likely and 10 is most likely?* Customers rating 0-6 are 'Detractors', 7-8 'Passives', 9-10 'Promoters'. The NPS is calculated by subtracting the percentage of Detractors from the percentage of Promoters. The score can be anything from -100 to 100 with 100 being the highest. Global averages sit around 45.

59 per cent of customers gave a high score for how well they thought the expectations they had at time of purchasing the system had been met. Even so, many customers were unaware of certain aspects of Lumos' products or services. 25 per cent of customers said they felt they had been given some false expectations by sales agents on issues including what appliances are compatible with the system, battery power, and repayment terms. This could erode trust and have an impact on sales through word-of-mouth.

When customers were invited to share how Lumos could improve their product or service, 66 per cent asked for a larger system with more power and battery capacity, 23 per cent were hoping for different pricing options (mentioning the monthly subscription cost being inflexible to their needs), and 19 per cent wanted lower prices.

According to research by customer development platform Survey.io, involving hundreds of companies, if more than 40 per cent of users report they would be 'very disappointed' to no longer use a company's product, there is a much higher chance that sustainable customer acquisition channels can be built. We used this 'must-have' question in the survey and found that 92 per cent of Lumos customers would be disappointed if they were no longer able to use their home system, suggesting strong potential scalability.

Comparing the Lumos user experience across female and male customers yields some interesting differences (Figure 8). Male adults in the household most commonly made the decision to purchase the Lumos home system (76 per cent), with a higher proportion of male customers reporting to 'absolutely rely' on the system compared with female customers (58 per cent vs. 44 per cent). Relatedly, male customers had a much higher NPS than female customers (24 compared to 3) and are more likely to report their quality of life has 'very much improved' (53 per cent) compared to women (32 per cent). Male customers are also slightly more likely than females to report positive value for money from the product (64 per cent vs. 60 per cent).

The findings suggest that products may be best designed to meet the needs of male users – currently the main customer base – and there may be room to improve the gender inclusivity in the design and delivery of products and services to build demand and satisfaction among the female customer base.

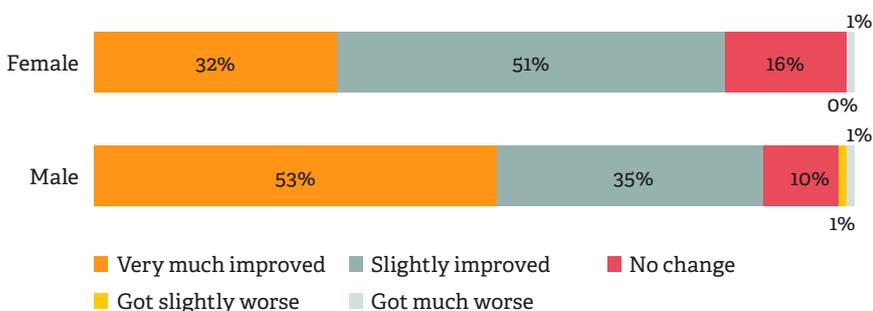


Figure 8: Quality of life change because of the Lumos solar home system

» Lumos is very good and I am glad to introduce it to people.

Lumos customer

92%

of Lumos customers would be disappointed if they were no longer able to use their solar home system.



03

Looking forward

Lumos' model has introduced an innovation in energy that has allowed a previously underserved population in Nigeria to access safe, bright, reliable, renewable power. The benefits of this are widespread, from increasing the earnings of small businesses to higher levels of happiness in the home.

Based on the information gathered in this study, some potential recommendations for Lumos include:

- Considering if there are financing strategies to make products more accessible to lower-income families, while considering potential trade-offs between product affordability and financial sustainability.
- Providing customers with clearer guidance on what service they should expect to get when they face a challenge, including who to contact and how, when they have a question or issue.
- Further exploring the reasons behind some of the challenges experienced by customers to understand whether they are due to technical issues, misuse, or mismatched expectations, so that they can be addressed accordingly.

The Lumos team has already taken some actions in response to customer feedback from this study and other channels. This includes expanding their product offering with higher and lower capacity products that provide a wider range of options to improve customer-product fit.

Lumos has also made significant investments in strengthening its product reliability and customer service, including enhancements in call centre technology. These improvements, when matched with Lumos's ability to access, in real time, the performance data of the system and provide solutions and upgrades over-the-air, have resulted in almost 85 per cent of customer issues being addressed by the call centre immediately and without the need for Lumos's technicians to make a site visit.

Overall, the results of this study show that Lumos is providing a product and service that has real value for families living with limited access to modern electricity. It could be interesting for future research to compare Lumos's experience in Nigeria against Cote D'Ivoire, where Lumos serves a more rural, off-grid customer base. We look forward to seeing Lumos' business continue to grow in Nigeria, Cote d'Ivoire and other countries to serve even more with their innovative, distributed power.



Lumos' model has introduced an innovation in energy that has allowed a previously underserved population in Nigeria to access safe, reliable and renewable power.

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▶ **CDC Group:**

Julia Tobias

jtobias@cdcgroup.com

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