GOGLA

The Voice of the Off-Grid Solar Energy Industry

Powering Opportunity in South Asia

From Work to Well-being, the Important Role of Small Scale Solar

altai consulting

UKaid from the British people

About

GOGLA
GOGLA is the global association for the off-grid solar energy industry. Established in 2012, GOGLA now represents over 170 members as a neutral, independent, not-for-profit industry association. Its mission is to help its members build sustainable markets, delivering quality, affordable products and services to as many households, businesses and communities as possible across the developing world. The products and solutions that GOGLA members sell transform lives. They improve health and education, create jobs and income opportunities and help consumers save money.

To find out more, go to www.gogla.org

Altai Consulting
Altai Consulting provides strategy consulting & research services to private companies, governments and public institutions in developing countries. Our teams operate in over 50 developing countries in Africa, the Middle East and South Asia.

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UKaid
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Foreword

As the world is running out of time to reach the Sustainable Development Goals (SDGs), off-grid solar is emerging as a power tool for change. Through technology and business innovation, our industry is working hard to develop products and services that bring light and energy services to energy poor households. Every day we see the positive impact that solar home systems have, and the ways in which they are providing customers with new opportunities to generate income, unlock more working hours and create jobs.

This is the fourth report in the ground-breaking 'Powering Opportunity' series and the first to focus on South Asia. The findings confirm what more than 280 million people already know: off-grid solar powers opportunity.

As with results from East and West Africa, the insights shared here reaffirm our belief that off-grid solar is crucial for reaching Sustainable Development Goal 7 (SDG 7) - access to affordable, reliable, sustainable and modern energy for all by 2030. In South Asia, as well as providing first-time energy access to rural households, this report shows that solar home systems are also bringing significant benefits for those who already have grid access, with the technologies co-existing to provide reliable and consistent electricity supply.

For both on and off-grid customers, the solar home systems bring significant improvements in quality of life, with households reporting that their health improves, they feel safer and that their children have more time to study. While for enterprise, reliable solar light and power is leading to greater income and increased productivity. As the off-grid sector matures, it is also delivering a new suite of applications, not least solar water pumps and refrigerators that can support agriculture and business.

The roots of the off-grid solar sector in South Asia now provide strong foundations, however, it is important to recognize that the industry operates in challenging and dynamic environments. The full potential of off-grid solar can only be achieved with continued and collaborative action from all stakeholders across the public and private sector.

This report provides important new insights for decision-makers on the valuable of small scale solar, both on and off grid. It is why we are calling on policymakers, investors, and development partners across South Asia to help us build a vibrant, strong, sustainable off-grid solar sector.

When we act together, delivering clean energy for all is within our reach. Together we can go further, faster, to connect millions of people to sustainable, reliable energy access and the positive social, economic and environmental benefits that come with it.

Viraj Gada, South Asia Representative

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Acknowledgments

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Executive Summary

Tracking the impact of off-grid solar is an essential part of GOGLA's work to support the industry. This latest iteration of the 'Powering Opportunity' reports, 'Powering Opportunity South Asia: From Work to Well-being, the Important Role of Small Scale Solar,' offers insight, analysis and new data on the social and economic impact of off-grid solar in the region.

Supported by the UK Department for International Development (DFID), this report explores how solar home systems (SHS) enable households in South Asia to improve their quality of life, become more active members of the workforce, and boost their income. The research took place in India and Pakistan with customers of three leading Solar Home System (SHS) providers: EcoEnergy, Greenlight Planet and Simpa Networks. Researchers were able to collect and analyse data from 949 customers who purchased their SHS in the first half of 2019.

This study follows three previous regional reports published by GOGLA which focused on East and West Africa, 'Powering Opportunity: The Economic Impact of Off-Grid Solar' (2018), 'Powering Opportunity in East Africa: Proving Off-Grid Solar is a Power Tool for Change' (2019), and 'Powering Opportunity in West Africa: Improving Lives, Powering Livelihoods with Off-Grid Solar' (2019). This is the final regional study in this series. The series will be concluded in March 2020 with a global compilation report.

SHS improve reliability of access and bring clean energy into homes.

For the majority of customers in this study (61%) the SHS is a back-up to the grid, complementing grid power by increasing availability and reliability of supply. For 37% of customers, the SHS is their main source of light. For most of these customers, it is their first experience of access to clean, modern power. Although most households use their SHS as a secondary source of light, 88% of customers say they use it every day.

More work hours unlocked and jobs created.

By extending business opening hours or freeing up time for customers to take on more economic activity, the SHS helps them work more hours or even start new income-generating activities. 12% of households say they undertake more economic activity since purchasing the SHS, including 10% of households that use the SHS for business purposes. The additional work enabled is equal to creating 4 new full-time equivalent (FTE)[1] positions for every 100 SHS sold.

Customers generate more income.

In total, 11% of all households report an increase in their income as a result of the SHS. The average reported additional income is $66 per month or $792 per year; equivalent to 10% of their country's average national monthly income per household[2].

Significant improvement in quality of life.

An impressive 94% of households report an improvement in their quality of life as a result of using the SHS. Most customers say they feel safer and that children have more time to do their homework.

1 Unit of measurement of the workload of an employed person. It is calculated as the total hours worked divided by the legal maximum week full-time jobs within each economic territory (i.e. 1 FTE is equivalent to 1 full-time worker).

2 Based on gross national income (GNI), ratio of additional income/GNI calculated for each household using country data before computing the average. World Bank (2018), GNI per capita: India $2,020, Pakistan $1,580.

Introduction

Key Findings

94% of households report their quality of life has improved since purchasing the SHS

12% of households undertake more economic activities thanks to their SHS

66% of customers say children have more time to do their homework

11% of households generate additional income once they purchase an SHS

Households create an additional $66 per month on average

Among households generating income

90% of customers report they feel safer with off-grid solar

SHS help households to work more hours or start new activities. Overall, this additional work translates into 4 FTE jobs per 100 SHS sold

Introduction

1.1. Context and objective

There are just 10 years left to realise Sustainable Development Goal 7 (SDG7), access to affordable, reliable, sustainable and modern energy for all. According to the 'Tracking SDG7' report, the number of people without access to electricity fell to 840 million in 2017, yet meeting SDG7 remains a challenge[3]. South Asia has made huge progress in access to energy goals over the last 20 years. During that period the unserved population in Central and South Asia shrunk from over 600 million people to less than 200 million[4] with grid expansion in India being a key driver of electrification for the region over the last two years.

In 2017, access to electricity in India reached 93% of the population while it remained at around 70% in Pakistan. Yet these two countries still have a combined population of almost 150 million unserved people for whom off grid solar could provide life-changing benefits[5]. In addition, grid expansion does not necessarily mean that the connected population receives adequate power. Even in grid-connected homes and businesses, back-up solutions such as off-grid solar continue to have a role to play and a potential market to address[6].

The off-grid solar sector has expanded considerably over the last nine years. The compound annual growth rate between 2010 and 2017 was close to 60%[7]. Similarly, investment in the sector has grown considerably from 10 investors and $21 million USD in 2012, to 43 investors and over $350 million USD in 2018[8]. In South Asia, the state of the off-grid solar market varies considerably in each country. For example, in India growth has been driven primarily by the consistent popularity of solar lantern sales, whilst in neighbouring Bangladesh the bedrock of the market lies in Solar Home Systems (SHS) sold through the IDCOL programme[9]. Notably, in more recent years, sales of SHS have also strengthened in India and Pakistan as customers seek larger products and services.

While there has been some research in Bangladesh to understand the socio-economic impact of SHS, far less been undertaken in India and Pakistan. Moreover, the majority of research into both solar lanterns and SHS has been focused on Africa, rather than Asia. In light of this data gap, the United Kingdom's Department for International Development (DFID), GOGLA, the global association for the off-grid solar energy industry, and Altai Consulting, expanded their 'Powering Opportunity' research series, which collects evidence on the socio-economic impact of solar home systems.

This is the fourth report in the series and the first to focus on South Asia, more specifically India and Pakistan.

The first 'Powering Opportunity' report was published in 2018, based on data collected in East Africa in 2017/18, and examined the impact of SHS on mostly rural households. This initial study illustrated that SHS greatly improve the well-being of those who use them in their homes and businesses. A cornerstone of the research also showed that a significant number of households were able to undertake more economic activity and generate additional income as a direct result of using their SHS.

In 2019 two further reports were published; 'Powering Opportunity in East Africa: Proving Off-grid Solar is a Power Tool for Change' which studied how those impacts evolved over time, and 'Powering Opportunity in West Africa: Improving Lives, Powering Livelihoods with Off-Grid Solar'; which was the first geographical expansion of the research into the West Africa region.

The South Asia research follows the same methodology as the original East Africa and West Africa research. However, aside from commonly expected cultural, political and geographic differences between South Asia and the countries and regions covered by the previous research, there are two specific contextual differences that are important to note. First, is the high rate of electrification in South Asia, especially in India following the government's successful

3 IEA, IRENA, UNSD, World Bank, WHO (2019), Tracking SDG 7: The Energy Progress Report 2019.
4 IEA, IRENA, UNSD, World Bank, WHO (2019), Tracking SDG 7: The Energy Progress Report 2019.
5 IEA, IRENA, UNSD, World Bank, WHO (2019), Country Reports. For more information please see https://trackingsdg7.esmap.org/country/india and https://trackingsdg7.esmap.org/country/pakistan
6 Dalberg Advisors and Lighting Global (2018), The 2018 Off-Grid Solar Market Trends Report.
7 Dalberg Advisors and Lighting Global (2018), The 2018 Off-Grid Solar Market Trends Report.
8 GOGLA (2019), Investing in the Off-Grid Solar Sector: What You Need to Know.
9 For more information, please see http://idcol.org/home/solar

Introduction

Saubhagya scheme, connecting 25 million additional households. In Pakistan, while access to energy has not seen rapid progress in recent years, the World Bank estimates that around 70% of the population is connected[10], which is still significantly higher than most nations in Sub-Saharan Africa. Second, is that the South Asia research also includes customers of PAYGo SHS sold via Micro-Finance Institutions (MFIs) as well as PAYGo customers who bought their systems directly from a PAYGo company. Systems were bought directly from Simpa Energy and EcoEnergy (and by the companies participating in the East and West Africa Powering Opportunity research), while Greenlight Planet's products in this research are distributed by Bandhan Bank. This enabled the study to additionally collect impact data for the MFI business model.

On these two points, this research finds that, amongst both on and off-grid customers and regardless of purchase via MFI or directly from the PAYGo company, SHS are helping households improve their quality of life and livelihoods – with these differences having no statistically significant bearing on results.

1.2. Methodology and limitations

Three solar home system providers, operating in two countries joined the South Asia research effort: EcoEnergy (Pakistan), Greenlight Planet (India) and Simpa Networks (India). Most of the customers interviewed live in the states of Assam and Uttar Pradesh in India and in the Sindh province in Pakistan.

Scope of the research

Country

India  Pakistan 

Company

The SHS sold by the participating companies range from 4 Wp to 315 Wp[11]. The difference in size translates to a difference in the cost to the customer but also in the amount of power the user has access to. The table below provides the exact system sizes[12] and examples of typically included appliances.

System sizes

Size range	Common features and appliances	System size
3–10 Wp		4 Wp 6 Wp
11–20 Wp		12 Wp
50+ Wp		100 Wp 200 Wp 315 Wp 50 Wp

10 World Bank (2017), please see https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=PK
11 All products in this research are Lighting Global compliant.
12 System size categories in the table are based on GOGLA's segmentation. EcoEnergy distributes products manufactured by Greenlight Planet and BBOXX.

Introduction

SHS are first and foremost designed to meet household-level electricity access needs. Therefore, the research uses the household rather than the individual as the primary unit for impact measurement. However, for specific metrics, efforts have been made to understand the profile of individuals within the household, especially in terms of gender.

Data Collection

The target population for the research is customers that purchased a SHS from the participating companies in the two designated countries between January and June 2019.

Original fieldwork design

In the original research design, baseline interviews were to be conducted by the companies at the time of purchase or soon after. After three months, customers that were interviewed during the baseline were to be called back by an independent third-party company for a follow-up phone-based interview to assess the impact of the SHS on their household.

Fieldwork challenges

Baseline data collection

During the baseline data collection, it soon became clear that it was difficult to reach customers by phone, as respondents were often not available for an interview, because phones were switched off or because not all customers had a telephone. This meant that it would be difficult to recontact all of the same customers by phone to undertake the follow-up survey.

Follow-up data collection

In order to secure a strong sample size and draw robust conclusions, a decision was made to change the follow-up data collection method to face-to-face interviews instead of phone-based interviews. In Pakistan, we used a combination of face-to-face and phone-based interviews, although the majority of interviews were conducted face-to-face.

Although the change in methodology helped us in increasing the number of successful interviews, the fieldwork experienced further challenges, as all regions suffered from severe flooding, coupled with considerable civil unrest in Assam. This caused delays, and it was difficult to reach many of the customers we interviewed during the baseline. While the aim was to interview each customer twice, we had to abandon the original fieldwork design, and additionally conduct interviews with customers that we had not interviewed before, but who had also purchased their system between January and June 2019. This altered the final data set, but it did enable us to collect a significant 949 follow-up interviews.

Final data set

The change in methodology resulted in the creation of three separate datasets: Pre-purchase, Post-purchase and Full Pre-purchase and Post-purchase:

- Pre-purchase interviews (phone-based) for 894 customers conducted between February and May 2019.
- Post-purchase interviews (phone-based and face-to-face) for 949 customers conducted between September and December 2019. All customers purchased their system between January and June 2019.
- Full Pre-purchase and Post-purchase interviews (phone-based and face-to-face) are available for 123 customers.

Because we interviewed only 123 customers (of the in total 949 customers) twice, it means that comparison over time in the research is limited. Instead, this report primarily focusses on households' current situation based on Post-purchase data, whilst demographic data is drawn from the Pre-purchase data set. Analysis of the evolution of sources of light used, hours of light available or energy expenses is not included in this report. However, key elements such as current energy usage and economic opportunity, based on Post-purchase data, are included, as this is based on the customers' situation after the purchase of the SHS.

Three-data point rule

GOGLA respects a three-data point rule when using its member companies' data. Therefore, analyses presented in this document rely on data from at least three different companies. This allows for greater reliability in the results as it means that no data point presented includes data from customers of only one company. However, it also means that certain insights cannot be shared publicly, and analyses cannot be conducted

by country, company or system size. Unlike the Powering Opportunity East Africa reports, the South Asia publication does not contain analysis by system size to respect this rule. However, GOGLA and companies have agreed to the publication of case studies that provide company-level insights.

Definitions

Full-Time Equivalent (FTE): Unit of measurement of the workload of an employed person. It is calculated as the total hours worked divided by the legal maximum week full-time jobs within each economic territory[13] (i.e. 1 FTE is equivalent to 1 full-time worker).

Pay-As-You-Go (PAYGo): Refers to a business model that allows users to pay for their product via consumer financing over time. This includes rent-to-own, energy as a service and Micro-Finance Institutions (MFIs)[14]. A PAYGo company will typically offer a solar product for which a customer makes a down payment, followed by regular payments for a term ranging from 6 months to 8 years[15]. In most cases, the repayment period is close to 24 months.

Solar Home System (SHS): The SHS included in this study refer to kits of solar technologies that consist of a solar PV panel, battery pack and LED lights which provide light and power to a household or business. These products are sold in many countries that have large populations living off-grid. The size of SHS can vary, as can the appliances they are sold with, although all are sold as plug-and-play kits. SHS are often defined as 11Wp and larger, while systems between 3-10Wp are referred to as 'multi light and phone charging kits. In this report, the term 'SHS' refers to the whole range of systems included in the research ranging from 4-315Wp.

Limitations and risk mitigation

- The data collection was affected by flooding in all geographies, and by civil unrest in Assam, which may have influenced customer's personal (financial) situations, and their answers to certain interview questions. The data may also have been affected by seasonal factors such as the agricultural calendar, political events, currency variations[16], diesel price variations, or other external influences.
- Due to the multi-country aspect of the research, cultural understanding and interpretation of certain questions may have differed. To mitigate this effect, all translations were reviewed by local staff of the participating companies to ensure the questions would be understood by their customers.
- For many questions requiring customers to quantify their answer, ranges were provided. Metrics based on these ranges were computed by using the median value of each range, the upper limit of the bottom range and the lower limit of the top range. (For example: If the range is 'Between 10 and 20', the value will be 15 and if the range is 'More than 50', the value will be 50).
- Data on income and expenses is reported by customers. This includes overall household income and expenses, and income generated from additional economic activity.

13 Commission of the European Communities, International Monetary Funds, Organisation for Economic Co-operation and Development, United Nations and World Bank (1993), System of National Accounts.

14 GOGLA defines companies as PAYGo providers if they sell their solar products with a form of consumer financing. Companies often use rent-to-own and energy-as-a-service business models or partner with Micro-Finance Institutions. The technology that allows to remotely lock a system to ensure customers pay for their product is refered to as 'PAYGo technology'. However, a product can be sold on a PAYGo basis without the technology being included in the product.

15 Details provided in Methodology Annex.

16 Exchange rates used in this report: 1 INR= 0.014 USD and 1 PKR= 0.0064 USD. Exchange rates were obtained through Thomson Reuters on October 1st, 2019.

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The Solar Home System Customer

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The Solar Home System Customer

2.1. Customer profile

The data collection of this research led to the creation of two separate data sets with limited overlap: Pre-purchase and Post-purchase. A third data set, Full Pre-purchase and Post-purchase, includes customers who were interview twice. Socio-demographic data was mostly collected during the pre-purchase interviews. Income data was only collected during post-purchase interviews.

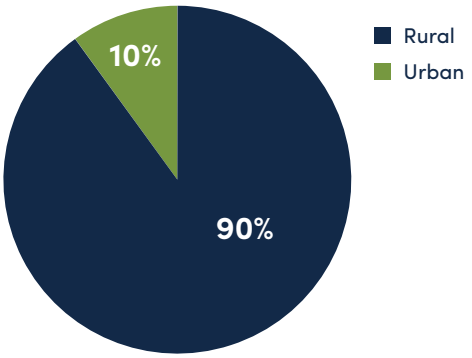
The table below provides an overview of the socio-demographic characteristics that define each of the three sub-samples of data. Depending on which phase of the report the interview took place, the socio-demographic data available differs.

This report focuses on impact and usage data collected in the Post-purchase interviews. Yet, it seems reasonable to assume that the Post-purchase sample is likely to share broad similarities with the Pre-purchase and Full Pre-purchase and Post-purchase samples. Pre-purchase data shows that a typical user household lives in a rural area and accommodates an average of seven members[20].

Type of location

90% of Pre-purchase interviewees live in rural areas. 10% are classified as urban or peri-urban households (Figure 1).

Figure 1: Type of location of Pre-purchase customers[21]



Household composition

The average household size among Pre-purchase interviewees is 6.9 members. 53% of household members, and therefore beneficiaries, are female (adult women and female children), and 42% are children.

Gender and age of the purchaser

81% of purchasers surveyed in the Pre-purchase interviews are men, with an average age of 32 years old.

	Pre-purchase sample[17]	Post-purchase sample	Full Pre-purchase and Post-purchase
Sample size	894	949	123
Gender of purchaser	81% male, 19% female	-	87% male, 13% female
Average age of purchaser	32	-	31
Household size	6.9	-	6.7
Type of location[18]	10% urban or peri-urban, 90% rural	-	3% urban or peri-urban, 97% rural
Median reported monthly income range[19]	-	140-160$	160-200$

17 Analysis of Pre-purchase data is unweighted.
18 Location types were defined by population. Urban designates a population above 5,000. Peri-urban a population between 2,000 and 5,000 and rural a population below 2,000. The definitions were defined in the same way for the entire Powering Opportunity Research across Africa and South Asia. These definitions were respected on a best effort basis.
19 Blank cells indicate unavailable data.
20 United Nations (2017), Household Size and Composition Around the World 2017. Average household size India: 4.8, Pakistan: 6.8
21 Analysis of Pre-purchase data is unweighted.

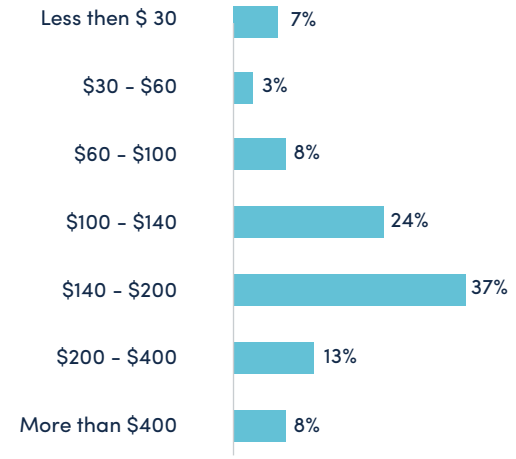
The Solar Home System Customer

Income-level

Data for income level was collected during the Post-purchase interviews. The median income range for customers is $140-$160 per month with a majority of customers reporting income between $120 and $200 per month (Figure 2).

Another notable characteristic of some of the customers' interviews in this research is that they are not directly customers of a PAYGo SHS provider. Rather, they are customers of an MFI with whom they may already have a successful loan repayment history.

Figure 2: Income distribution[22]



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22 Sample size excludes customers that refused to or were unable to answer.

Financial institutions and PAYGo in India

Bridging the energy access gap in low-income countries presents many challenges. Among these are poor infrastructure, limited investment capacity and a lack of awareness of the benefits of sustainable energy access. One of the most acute issues facing customers in low-income countries is the affordability of products and services. In the off-grid sector, one solution to increase affordability is through consumer financing. Consumer financing for energy access has been significantly boosted by the emergence of the PAYGo business model and technology[23] although as a financial model itself, it is not new.

In India, SELCO, a social energy enterprise based in Bangalore, partnered with Micro-Finance Institutions (MFIs) to distribute solar products in the 1990's. Since 2010, 17 rural banks have been financing SHS under a refinancing scheme from the Indian Ministry of New and Renewable Energy[24]. Financial institutions in India are generally familiar with distributed energy, but the PAYGo business model enables partnerships between companies and financial intuitions more easily to drive energy access. For example, Greenlight Planet has partnered with Bandhan Bank since 2014, which led to the distribution of over 300,000 products across Assam, Bihar, Jharkhand, Tripura, Uttar Pradesh and West Bengal.

MFIs and PAYGo providers target the same populations and similar loan sizes. For MFIs, PAYGo solar provides a new opportunity to attract or maintain customers. This research shows that SHS sold through MFIs lead to similar results in terms of impact to SHS sold directly by providers. For PAYGo providers, working with MFIs means that they benefit from lower interest rates[25], an existing customer base and experience in recovering funds.

In India, more commercial banks have also started to enter the sector. Simpa Networks recently secured debt financing to on-lend to customers from Kotak Mahindra Bank. In addition, support to Simpa Networks from RBL Bank provided access to clean energy for over 8,000 households in Uttar Pradesh[26].

Many more of these initiatives will be needed if India is to finance its 2030 clean energy targets, with an estimated $315 billion in debt funding still needed[27].

23 GOGLA defines companies as PAYGo providers if they sell their solar products with a form of consumer financing. Companies often use rent-to-own and energy-as-a-service business models or partner with Micro-Finance Institutions. The technology that allows to remotely lock a system to ensure customers pay for their product is refered to as 'PAYGo technology'. However, a product can be sold on a PAYGo basis without the technology being included in the product.

24 Debajit (2013), Solar Energy Programs for Rural Electrification: Experiences and Lessons from South Asia. Energy for Sustainable Development.

25 CGAP (2017), Solar Energy: A New Frontier for Microfinance.

26 CGAP (2017), Solar Energy: A New Frontier for Microfinance.

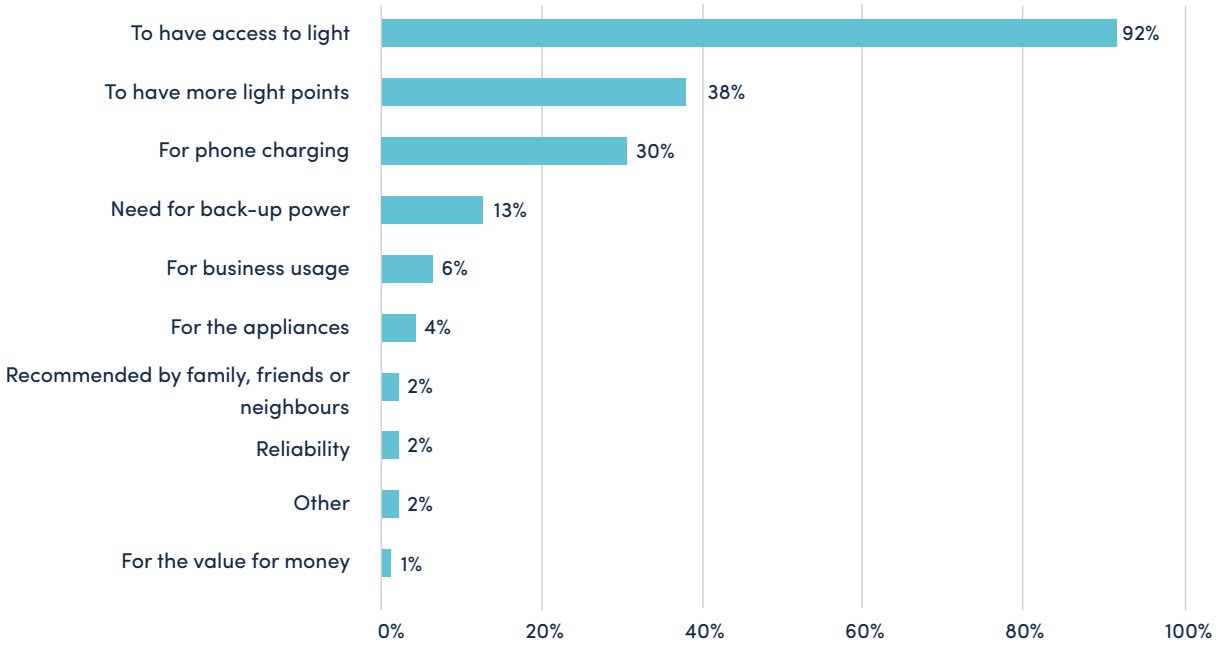
27 Climate Policy Initiative (2019), From Banks to Capital Markets: Alternative Investment Funds as a Potential Pathway for Refinancing Clean Energy Debt in India.

2.2. Customer experience

Reasons for purchasing the system

The most common reason to buy a SHS is to have access to light, with 92% of households saying this was the main purpose of their purchase (Figure 3). Other common decision factors include having more light (38%) and phone charging capacity (30%). Having the SHS as a back-up source of energy was also mentioned by 13% of households.

Figure 3: Reasons to purchase the SHS[28] N=949



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28 Responses were not prompted, and customers could provide multiple answers.

The Solar Home System Customer

Value for money

Three to six months after purchasing the solar home system, most customers are 'satisfied' or 'very satisfied' with the products they have purchased. 90% of customers rate the value for money of their product as either 'good' or 'very good' (Figure 4).

Likelihood to recommend

The results of the likelihood to recommend the SHS to family, friends or neighbours question are equally encouraging. Some 95% of households say they are either 'likely' or 'very likely' to recommend their product (Figure 5). Levels of satisfaction as measured through value for money perception and likelihood to recommend are high regardless of distribution, be it through a PAYGo provider or an MFI.

Figure 4: Value for money

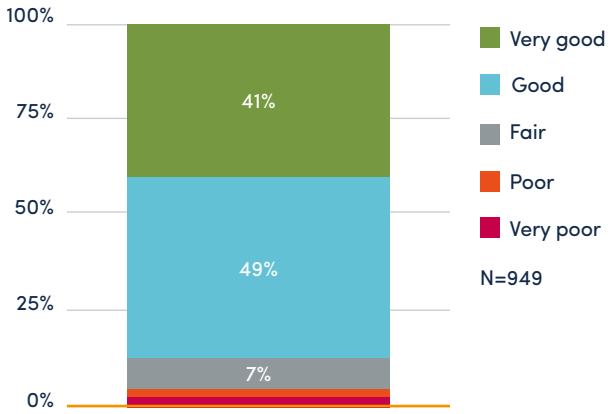
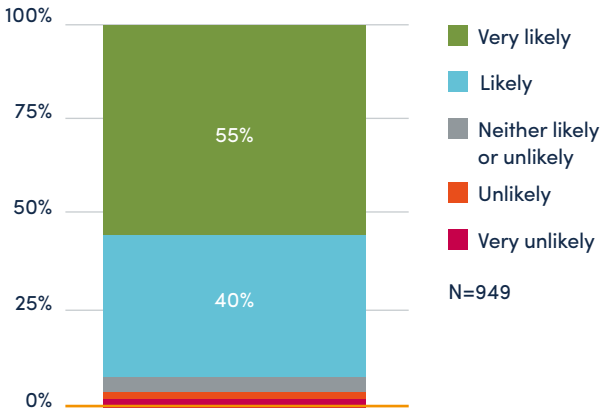


Figure 5: Likelihood to recommend




FROZ
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The Power Of Off-Grid Solar

The Power Of Off-Grid Solar

3.1. Improved access to light

Sources of light

More than half of customers (61%) report the grid as a main source of light, while 37% say they use the SHS as their main source (Figure 6). This shows that in South Asia, SHS are most commonly used as a back-up, or as an addition to the grid, with 62% of customers using it as a secondary source of light. This is underlined by 88% of customers who use their SHS every day, and another 10% who use it four to six days a week (Figure 7).

Beyond the grid and SHS, customers continue to use several other sources of light, which indicates the importance of a secure energy supply. These are almost all secondary or tertiary sources of light. The most commonly used are candles (21%), torches (14%) and kerosene (10%) (Figure 8).

Figure 6: Current sources of light

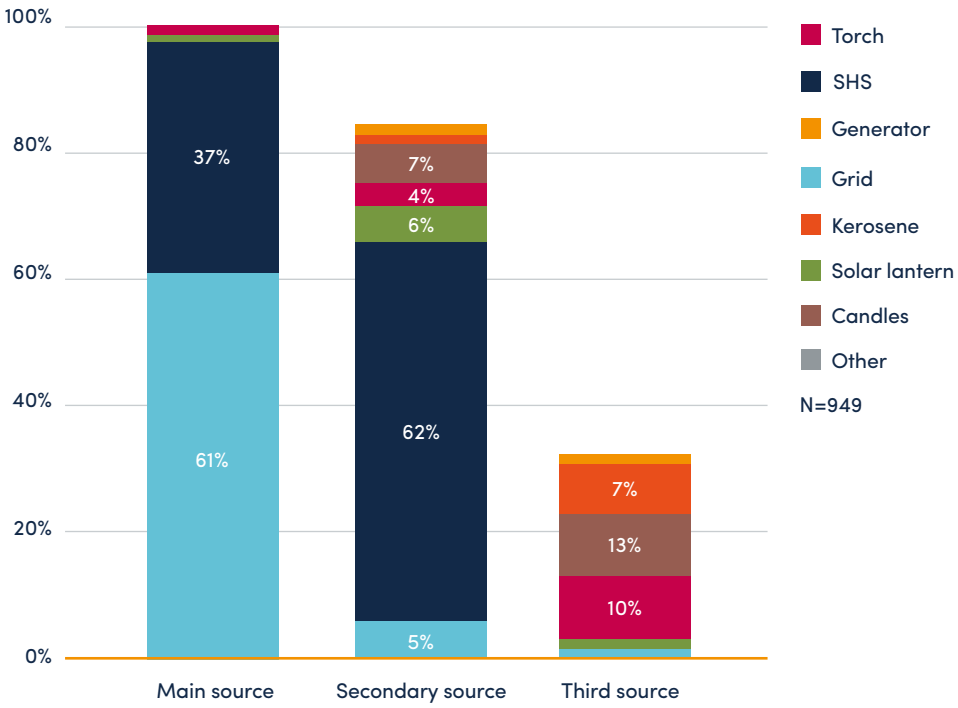
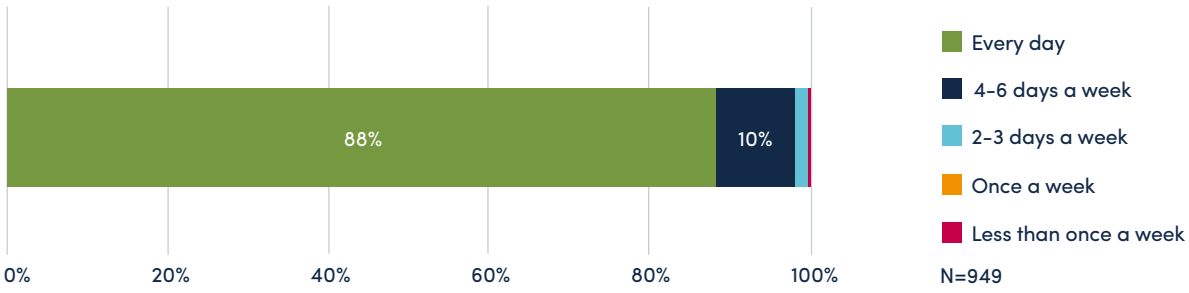


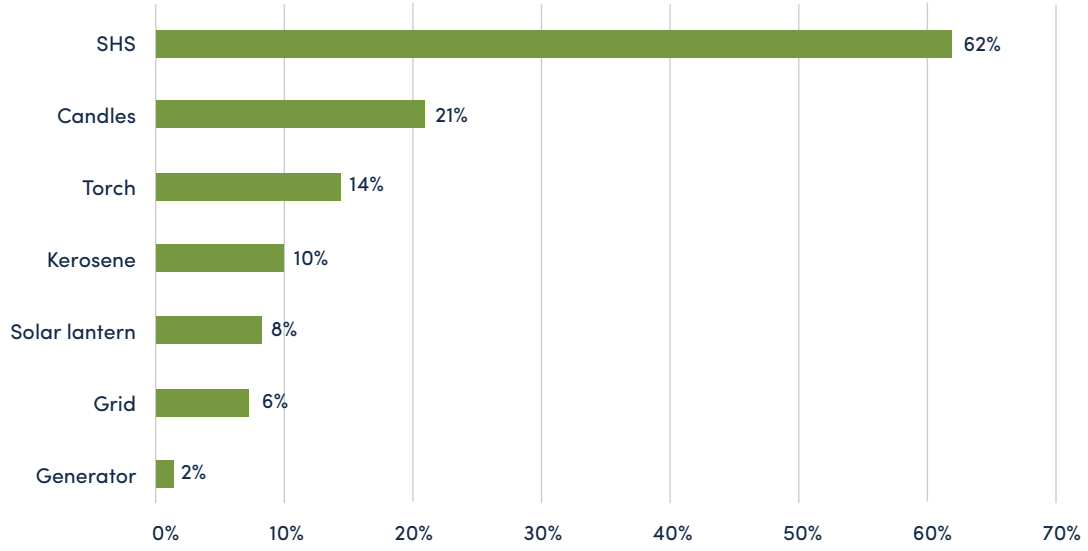
Figure 7: Frequency of use of the SHS



The Power Of Off-Grid Solar

Figure 8: Secondary sources (% of mentions secondary or third)

N=755



EcoEnergy provides access to clean, sustainable lighting

Muhammad Ashraf lives with his family in Wasi Adil Mori Talhar, in the province of Sindh, Pakistan. He decided to buy a SHS to have access to more light. Before Mr. Ashraf started using the SHS, he and his family used two candles per day to light their home at night, which would typically cost 40 PKR (0.25 USD), and usually only lasted for the family's dinner time.

"With the SHS we can light our home during the evening. It makes it easier for us to cook food, and we can now sit together and talk after dark, which was not possible before. My son and daughter are able to study at night as well, which helps them in school. The fact that we can pay in instalments is important to us. We would not be able to pay for the system otherwise."

The Power Of Off-Grid Solar

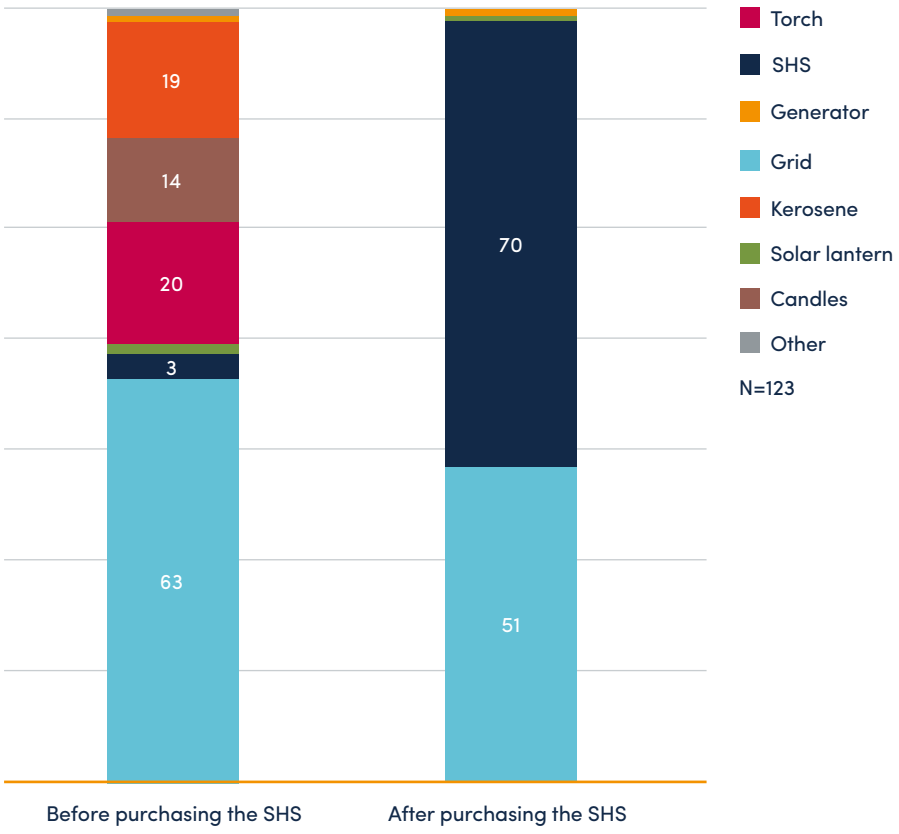
Overall, 89% of customers use more than one source of light. Among them, the main reasons mentioned are already having a grid connection (61%) and finding other sources[29] more convenient (19%). The 'Other' category includes customers experiencing issues with their SHS and customers that feel other sources are cheaper than the SHS (Figure 10).

Sources of light evolution

Among the 123 customers for which both Pre-purchase and Post-purchase data is available, the SHS has now become the main source of light for 70 households (57%), with 51 (43%) using the grid as their main source. As 63 (51%) of those households in the baseline reported access to grid electricity, this suggests that, after purchasing the SHS, some households switch to using the SHS as their primary source of light rather than the grid.

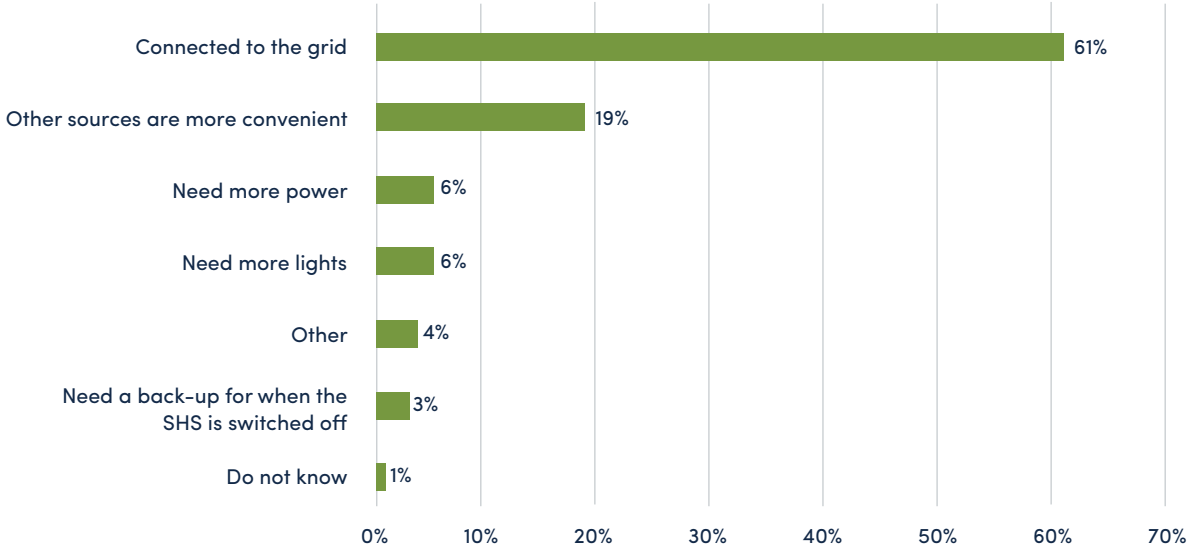
Before purchasing the SHS, households that were not connected to the grid mainly used torches, kerosene or candles (Figure 9).

Figure 9: Evolution main sources of light (in absolute terms)



29 May refer to the grid.

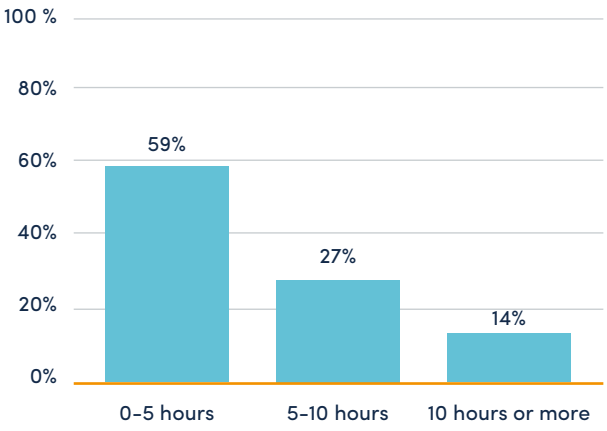
Figure 10: Reasons customer have more than one source of light N=755



Hours of light

On average, customers report using five hours of light per day. This is true regardless of whether the grid or the SHS is used as the main source of light. Most customers (59%) use less than five hours of light per day from all their lighting sources, primarily in the evening hours (Figure 11).

Figure 11: Hours of light N=949



3.2. Appliances

While lighting is the central feature of these systems, they also provide other services. Households can access a variety of appliances with their SHS depending on the power capacity and size, such as phone charging but also TVs and radios.

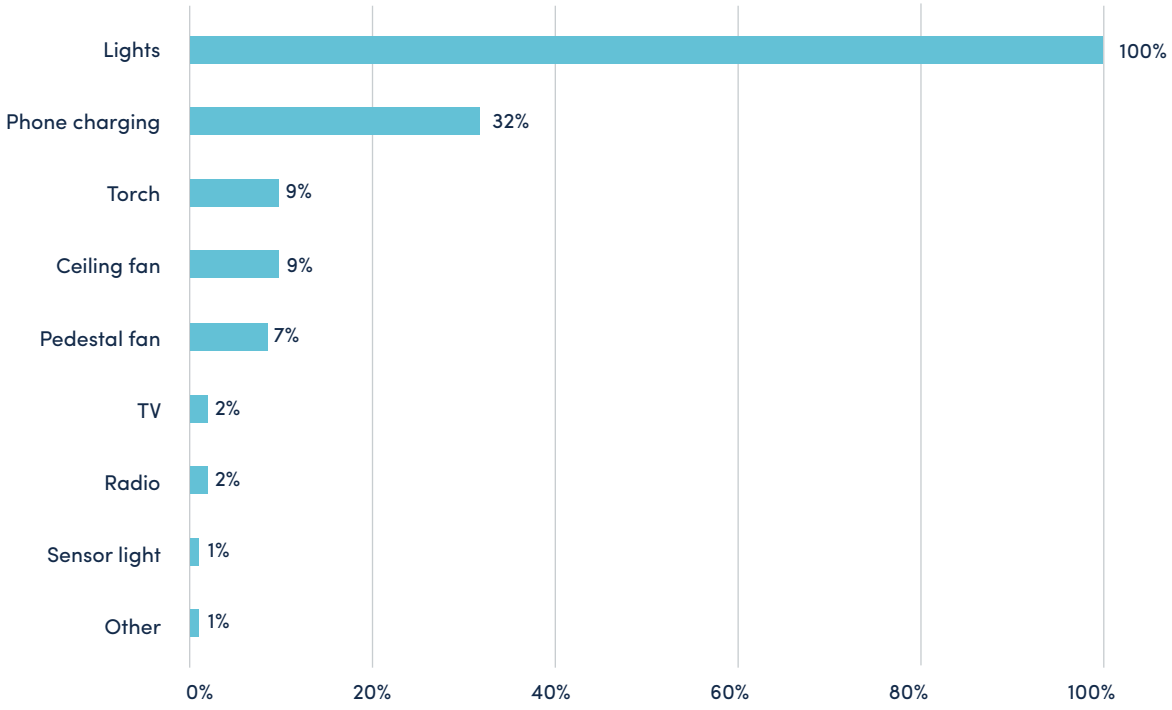
Appliances used

Beyond lighting, the most used appliances and applications are phone charging (32%) and fans which are mentioned by 16% of customers, including ceiling fans (9%) and pedestal fans (7%) (Figure 12).

Access to mobile phone charging capacity has had a significant effect on mobile phone usage, with 30% of customers reporting they use their phone more since purchasing the SHS. This improved connectivity can lead customers to improve their economic activity (see section 4. Economic Opportunity) and bring highly valuable social benefits, such as improving cohesion within dispersed families and improving users' sense of inclusion[31].

Figure 12: Appliances used[30]

N=755



30 Customers could provide multiple answers.

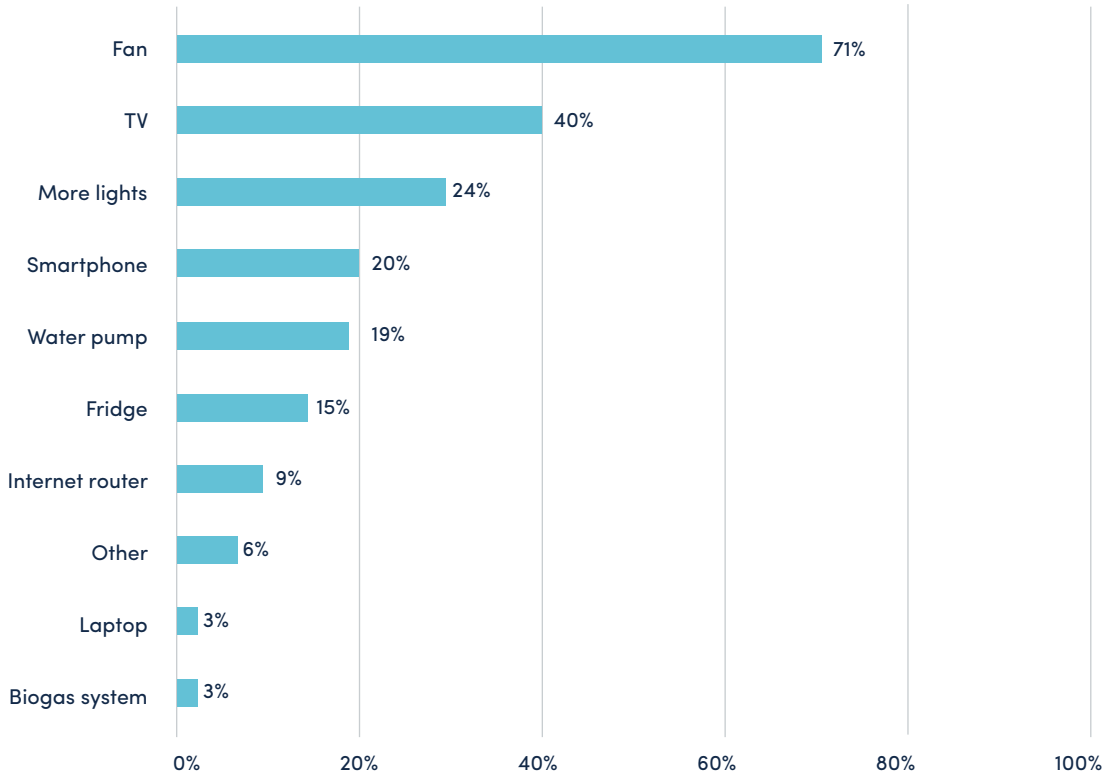
31 See GSMA (2006), The Economic and Social Benefits of Mobile Services in Bangladesh and Goodman (2005), Linking Mobile Phone Ownership and Use to Social Capital in Rural South Africa and Tanzania.

The Power Of Off-Grid Solar

Appliances wanted

Almost half (45%) of customers would be interested in using more appliances with their SHS (Figure 13). The most sought-after appliances are fans (71%), TVs (40%) and additional lights (24%). Interestingly, the list includes appliances that can be purchased for productive domestic use such as water pumps (19%) and fridges (15%), as well as devices not so commonly associated with off-grid solar providers such as smartphones (20%), internet routers (9%) and laptops (3%).

Figure 13: Additional appliances wanted[32] N=414



32 Customers could provide multiple answers. The 'Other' category includes a broad variety of items including irons, air conditioners and washing machines.

Economic Opportunities

Economic Opportunities

In addition to access to light and appliances, SHS can help households unlock economic opportunities and increase their income. Although not all households experience this, it can have a significant impact for those that do.

This section spotlights the key focus of this research: overall economic impact figures that are derived from either using the SHS in a business or being able to increase work hours with the extra time unlocked by the SHS.

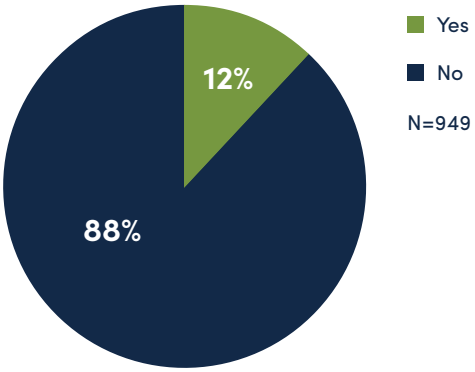
It is structured around three key impact measures:

- **Section 1: Undertaking more economic activities**, the share of households who report that the SHS has helped them undertake additional economic activity.
- **Section 2: Income generation**, customers who report generating additional income from new or extended economic activity.
- **Section 3: Job creation**, FTE employment created through new or extended economic activity.

4.1. Undertaking more economic activities

12% of SHS customers report undertaking additional economic activity (Figure 14). Economic activity includes customers using their SHS in a business, as well as customers that are able to work more hours thanks to the SHS[33].

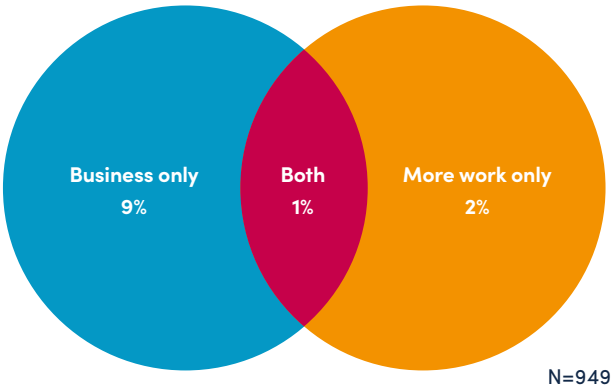
Figure 14: Share of households undertaking additional economic activity



Among the 12% of households able to take on more economic activity:

- 2% unlocked additional working hours thanks to the SHS
- 9% use the SHS to support a business
- 1% undertake both activities (effectively working additional hours and using the SHS in a business) (Figure 15).

Figure 15: Type of additional economic activity undertaken



Focus on business use of the SHS

10%[34] of households use the SHS in a business. Of these businesses, 82% were already operating before the purchase of the SHS with 18% of businesses being new ventures, starting after the SHS purchase.

The most common types of businesses operating with the SHS are small commerce, shops or stalls (50%), followed by small home businesses (26%) (Figure 16). The latter includes a variety of activities that are conducted from the home without a fixed location or space for operation, and may not be conducted on a regular basis. These activities include knitting, handicrafts and selling confectionary, fruit and vegetables or sweets and snacks.

In businesses, the SHS is primarily used for lighting the business indoors (94%). Other uses include outdoor lighting (45%) and phone charging for a fee (11%). Some customers also mention charging their own phone, which enables them to be more contactable to seize opportunities such as orders or requests for services (10%) (Figure 17).

33 To avoid double counting, the survey was designed so that customers reporting using their SHS for business could not report both impacts if all additional work hours were in the business using the SHS.

34 9% of households use the SHS for business purposes only, and 1% for both business and unlocking more hours of productive activity.

Economic Opportunities

Figure 16: Types of businesses the SHS are used in

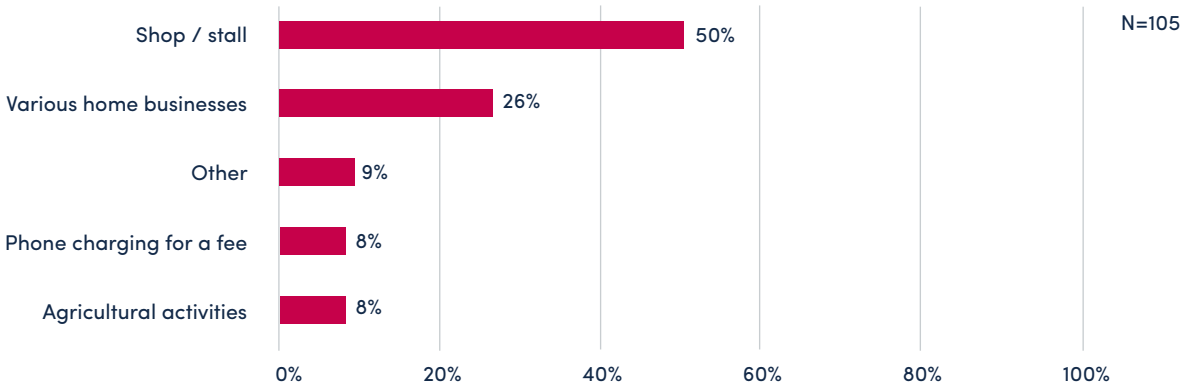
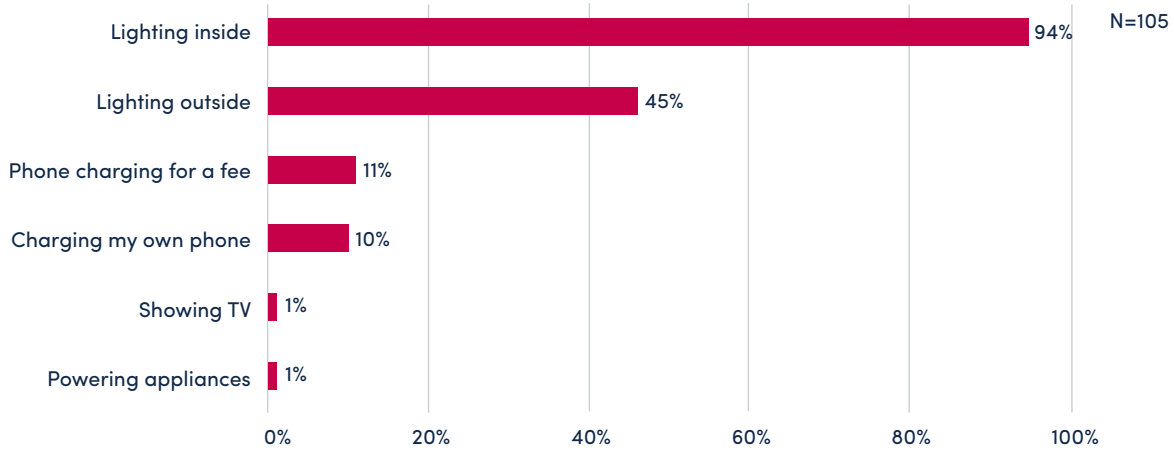


Figure 17: Use of the SHS for business[35]



Businesses do not necessarily use their SHS during all operating hours. 16% of customers use their SHS only part of the time the business is open, 38% use it during all opening hours and almost half (46%) use it beyond opening hours. This is often explained by businesses using the light for security. Overall, the surveyed businesses open 28 hours a week and the SHS is used in for business purposes for 21 hours a week.

35 Customers could provide multiple answers.

The need for reliable electricity access in Pakistan

Pakistan has made huge progress in terms of electrification during the last few decades. Over 90 million people were connected to the grid between 1990 and 2010. Yet, since 2010, the country has expanded access by less than one percentage point per year[36], and in 2017 it was estimated that 70.8% of the population had access to electricity[37].

According to a 2018 study by the World Bank[38], Pakistan may be losing up to $4.5 billion or 1.7% of its GDP due to lack of electrification and poor reliability of grid connection. This estimate is conservative, based on the official statistic of 5 million people off-grid in Pakistan, while 2017 census data indicates an off-grid population closer to 50 million people. The research finds that connecting 5 million people to the grid would generate an additional $565 million a year in income, while fixing reliability issues would generate another $3.9 billion per year.

Renewable energy, including off-grid solutions could play a key role in accelerating the population's access to energy as Pakistan has a high renewable energy potential, including for solar power[39]. In an effort to help seize this potential, the World Bank has committed $100 million to develop 400MW of new solar projects and provide off-grid companies with grants to supply 200,000 SHS in Sindh[40].

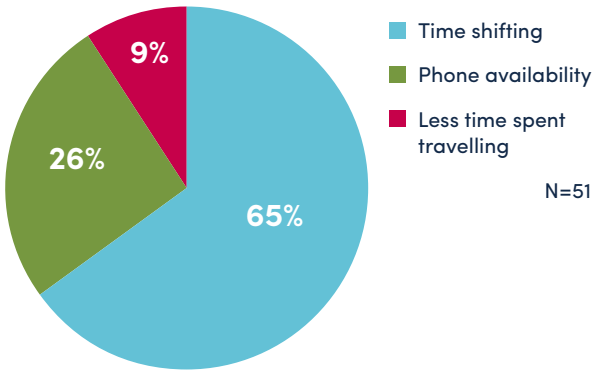
Focus on more work hours unlocked by the SHS

The SHS can also enable household members to spend more time at work. Access to light at home means customers can reorganise their activities during the day to increase the time they can spend working. Purchasing a SHS can eliminate the need to regularly travel to purchase light sources such as kerosene, or to charge a mobile phone, effectively freeing up time for work. Improved connectivity also means people are easier to reach, enabling them to capitalise on more opportunities[41].

At least one member is able to work more in 3% of households. In most of these households, more than one person is able to work longer which means the overall impact is broader in terms of productive activity (see sub-section 3. Job Creation).

Among households in which members work more hours, most (65%) say they are able to do so because they can reorganise their activities in the evening to increase their time at work. 26% report being able to work more as their mobile phone is charged more often, increasing their ability to seize opportunities. Finally, 9% report having more time to work as they spend less time travelling to purchase light sources or charge their phones (Figure 18).

Figure 18: Ways the SHS enables households to work more hours

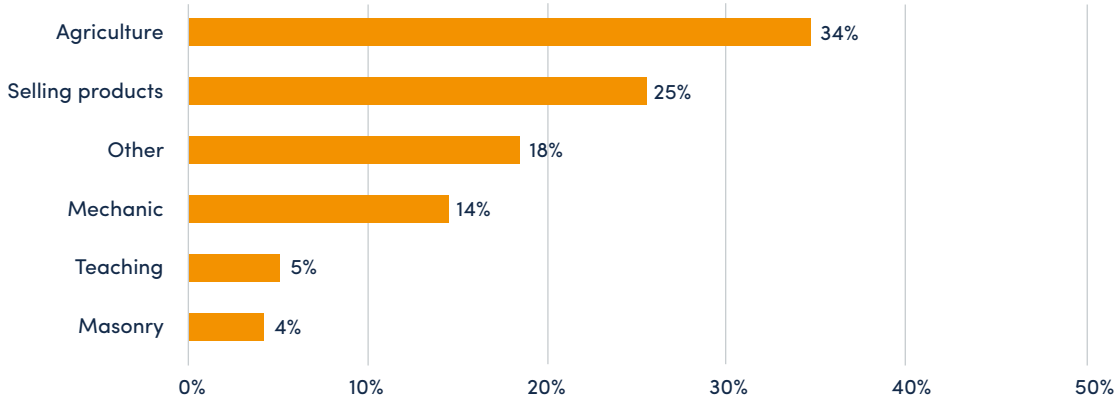


The main types of work undertaken are agriculture (34%) and selling products (25%). 'Other' includes civil servants, MFI employees and employees in small businesses (Figure 19).

36 IEA, IRENA, UNSD, World Bank, WHO (2019), Tracking SDG 7: The Energy Progress Report 2019.
37 World Bank (2017), please see https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=PK
38 World Bank (2018), Electrification and Household Welfare: Evidence from Pakistan.
39 Irfan et al. (2019), Solar Energy Development in Pakistan: Barriers and Policy Recommendations.
40 World Bank (2019), Sindh Solar Energy Project: Procurement Plan.
41 See Bloomberg (2018), Powering Last Mile Connectivity and GSMA (2006), The Economic and Social Benefits of Mobile Services in Bangladesh.

Economic Opportunities

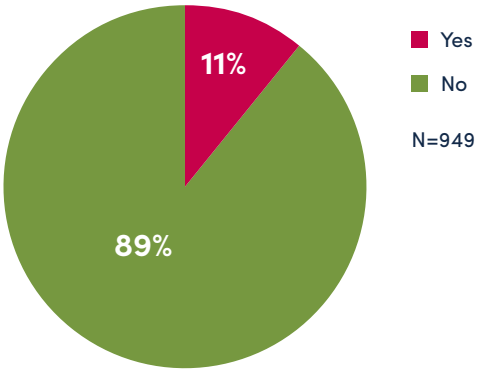
Figure 19: Types of activities conducted during additional work hours N=51



4.2. Income generation

89% of the 12% of households undertaking additional economic activity report this activity has led to an increase in income[42]. In total, they represent 11% of all households (Figure 20).

Figure 20: Share of households generating more income thanks to the SHS

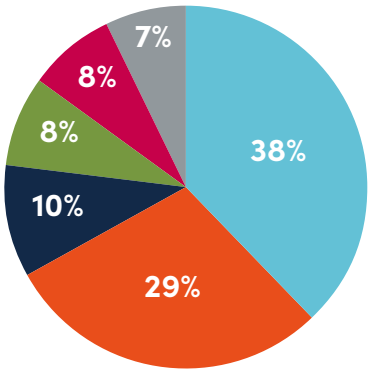


These households generate an average additional income of $66 per month since purchasing the SHS, or $792 a year. This is equivalent to 10% of the average household monthly income in their country[43]. Given that most customers report monthly incomes between $120 and $200, the new income generated is a significant addition to their finances.

Focus on business use of the SHS

82% of the surveyed business were operational before the SHS was purchased. Among them, 93% have been able to improve their income through the usage of the SHS. This is mostly enabled through the extension of opening hours (38%) or increased productivity (29%) (Figure 21).

Figure 21: Ways the SHS improves the income of pre-existing businesses



- Extended opening hours
- Increased productivity
- Running an additional business
- Missing fewer opportunities
- Attracting more customers
- Better customer experience

N=80

Overall, businesses using the SHS generate an average additional income of $65 per month. In particular, shops using the SHS generate an average additional income of $55 per month.

42 This sub-section on income generation analyses the data of households that report additional economic activity. In the study, this represents a sample size of 132. Analysis of this data allows the research to generate valuable insights but the statistical significance of this data beyond the sample is limited.

43 Based on gross national income (GNI), ratio of additional income/GNI calculated for each household using country data before computing the average. World Bank (2018), GNI per capita: India $2,020, Pakistan $1,580.

Focus on more work hours unlocked by the SHS

Among the 3% of households that report working additional hours since purchasing the SHS, two-thirds report being able to generate additional income. Overall, 2% of customers generate additional income by working more hours. Those that do not may experience other benefits, such as increased produce from farming or in-kind rewards, rather than cash.

Greenlight Planet SHS empower entrepreneurs

Shikha Dutt lives in Howli, in the state of Assam, India. She started a sewing business to improve her family's financial situation.

"Starting a business can be very challenging. Sometimes there is a lot of work, while at other times there is very little. This is why it is important to be able to work when I have customers. However, in Howli, electricity is not always available, which makes it difficult to sew especially in the evening. Before I started using the SHS, I would sometimes injure myself on the needle while sewing because I couldn't see properly."

The SHS improved the lighting conditions and availability in her business which enables Shikha to work also after dark. With her improved access to light, she hopes to grow her business in the future.

"It is great that the system is charged by sunlight during the day. The quality of the light is good, it lasts long enough in the evening, and our electricity bill has reduced. My dream is to have ten, twelve sewing machines, employ other people and to start a tailoring school. This would be a huge success for me."

4.3 Job creation

To further understand the relationship between economic activity and time spent working, the research sought to understand who in the household that reported the impact (12%) is benefiting from this increased activity. The study shows that in many cases (21%), more than one household member undertakes more economic activity, translating into a new job or more work hours[44].

To effectively demonstrate the impact of this increase in economic activity, this research uses a calculation of FTEs, based on the number of extra hours worked thanks to the SHS[45]. This FTE calculation includes the additional time spent working via all of the mechanisms highlighted earlier in this research: more time working due to extended business hours and more time spent working due to increased hours of light, less time spent travelling and better connectivity. The term 'job creation' refers to the creation of FTEs. The vast majority of FTEs in this research are enabled through additional work hours unlocked, rather than through entirely new employment opportunities.

44 This sub-section on job creation analyses the data of households that report additional economic activity. In the study, this represents a sample size of 132. Analysis of this data allows the research to generate insights but the statistical significance of this data beyond the sample is limited.

45 Please see the Methodology Annex for more details.

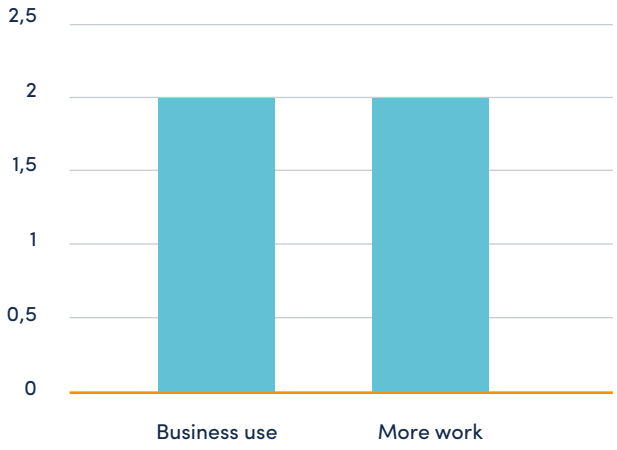
Economic Opportunities

Overall, the additional economic activity undertaken by household members in this research adds up to four FTEs created for each 100 SHS sold. Of these, two are created through business use of the SHS and two through additional work hours (Figure 22). 22% of these jobs are undertaken by women.

While this extra activity is very significant in demonstrating the opportunities created by the simple addition of light and power into a home or business, it should be noted that new jobs or work hours created due to the SHS are likely to be informal e.g. where additional hours are spent working in a small shop, or a household member is able to take on more part-time work, and may not be as secure as more formal activities. However, improving the lives of those in the informal workforce is still an important part of improving welfare for those in less secure employment especially in India and Pakistan, where the informal economy is still very large.

Of the 9% of households using the SHS in business, 12% said they were able to hire new employees since their purchase. On average these businesses hired 1.8 people each, about a third of whom being women.

Figure 22: FTEs created for 100 SHS sold by type of economic activity undertaken



Empowering women through off-grid solar

The research shows that almost a quarter of FTEs created through SHS ownership are undertaken by women, in line with female labour force participation in India and Pakistan[46]. However, off-grid solar can also provide employment opportunities for women through involvement in the supply chain, which is likely to be the most efficient way to affect gender norms[47].

Decentralised energy systems and off-grid solutions are in fact providing entrepreneurship opportunities for rural women who can be trained as solar engineers and subsequently improve their livelihood and role in society. One such success story is the Barefoot College's Solar Grannies initiative, which trained elderly rural women to become solar engineers, improving their self-sufficiency and boosting their self-esteem while bringing lighting to their respective villages[48]. Another example is GOGLA member and IFC Lighting Asia associate Frontier Markets, which has grown a network of around 3,000 women (Solar Sahelis) who are trained both technically for repairs and in sales and marketing of solar solutions, clean cookstoves and appliances[49].

46 World Bank Data (2019), please see https://data.worldbank.org/indicator/SL.TLF.TOTL.FE.ZS?locations=PK-IN
47 University of Oslo, TERI, Seacrester Consulting and Dunamai Energy (2019), Women's Empowerment and Electricity Access: How do Grid and Off-Grid Systems Enhance or Restrict Gender Equality?
48 For more information, please see https://www.barefootcollege.org/solution/solar/
49 For more information, please see https://frontiermkts.com/our-approach/solar-saheli/

Impact on Quality of Life

Impact on Quality of Life

While not all users benefit economically from their system, the SHS itself does a lot more to improve households' quality of life. Access to lighting, mobile phone charging and appliances offer many immediate benefits, and allows customers to feel safer, healthier and better connected.

Overall, 94% of households say the SHS helped improve their quality of life. Among them, 90% report feeling safer. Other common benefits include children having more time to do their homework (66%), having more light (57%) or having a phone that is always charged (56%). The benefits are similar for all customers regardless of whether the distributor is a PAYGo provider or an MFI.

Among the 6% of households that do not report a quality of life improvement, the main reasons cited are that they find the SHS expensive or that they are unable to use it for business purposes.

In addition to quality of life, 25% of households report they have more money available since buying the SHS. This additional money is mostly spent on household equipment (22%), food (14%), clothes (14%) or labelled as savings (14%).

Simpa Networks SHS improve quality of life

Sabitri Lenka lives in Bhagabatipur in the state of Odisha, India. Her house is not connected to the grid, so she and her husband decided to buy a SHS. Sabitri says the lighting makes her feel safer and allows her children to study at night.

"Our house is completely off-grid as we cannot have electricity poles in this area because of dangerous elephants. We used to be in the dark at night, but not anymore since we started using the SHS. My children are able to study after sunset and the light makes it safer to step out of the house in the evening. The fan is also great, as it helps us sleep and cook more comfortably."

Impact on Quality of Life

Figure 23: Reasons for quality of life improvement N=818

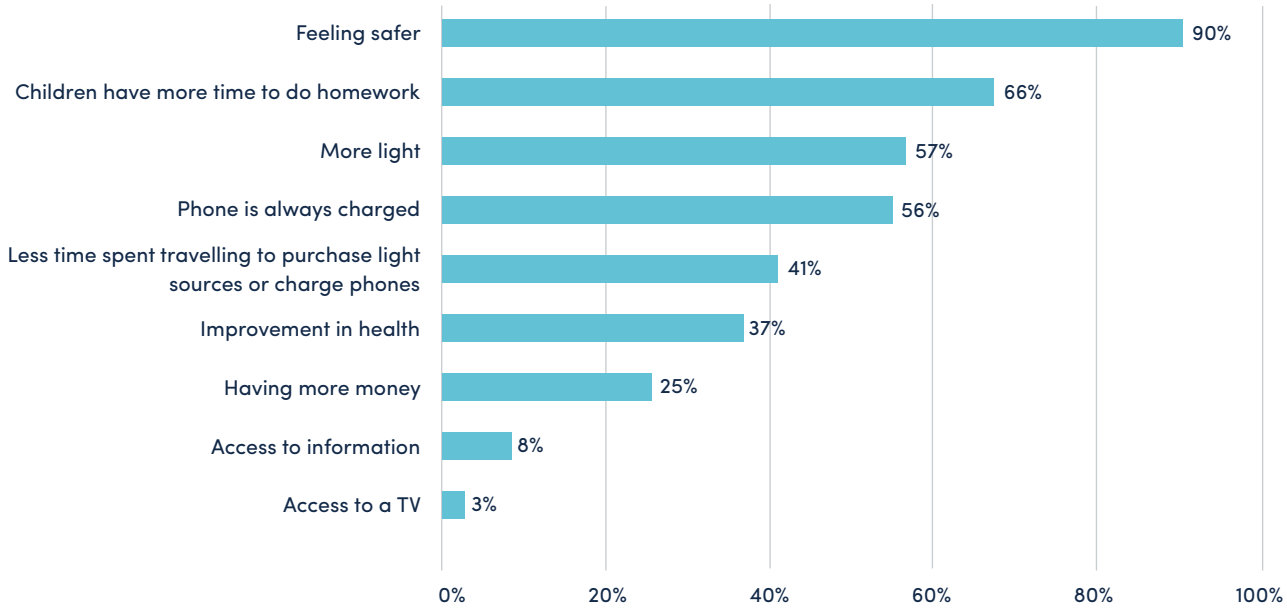
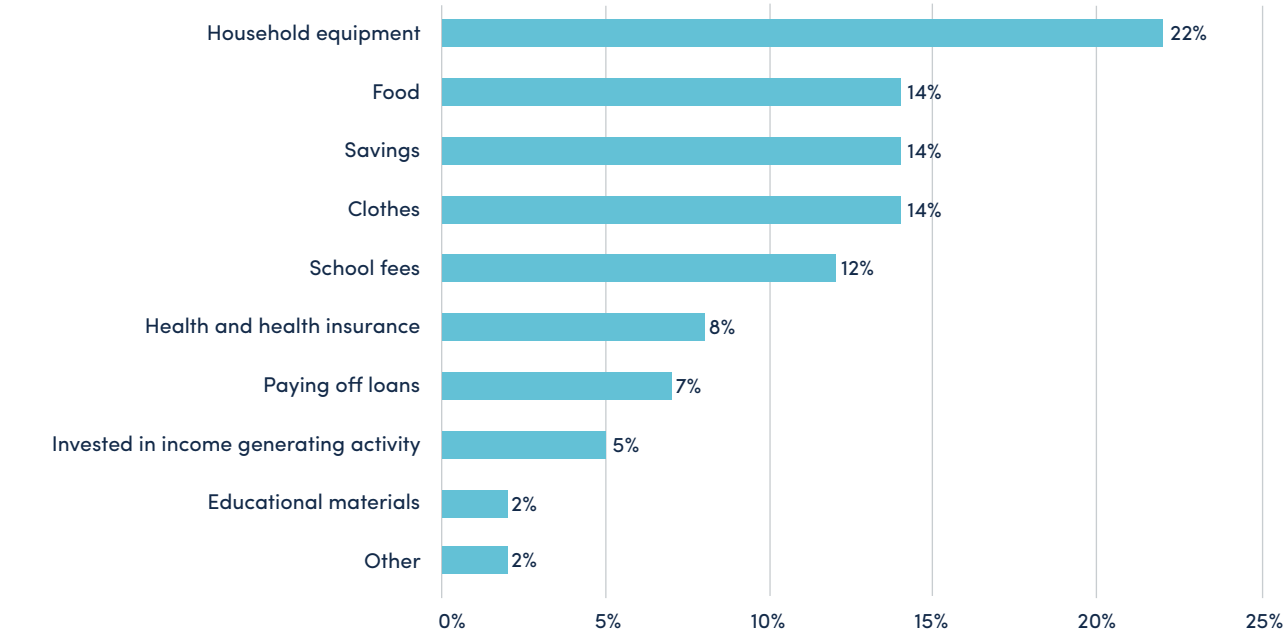


Figure 24: Main area of expenditure mentioned by households reporting additional money available since purchasing the SHS N=309



Conclusion

It is GOGLA's intention that the 'Powering Opportunity' series helps investors, decision-makers and those looking to support the industry, to better understand the positive impacts of off-grid solar and how it can be harnessed as a power tool for change.

Since the first publication in the 'Powering Opportunity' series, the research and data provides clear evidence that the SHS improves users' quality of life. This latest instalment expands on these findings, confirming the economic and social benefits experienced by SHS users in low and middle-income households in India and Pakistan.

Even though a majority of households in the South Asia study already had some form of access to the grid (61%), the research finds that SHS still has an important role to play, with systems being used daily by the majority of customers interviewed, and positive impacts being reported equally. This highlights that SHS provide a reliable complement to grid electricity supply, as well as being effective in its ability to reach those that are still unconnected.

In terms of well-being and security, the SHS has high rates of approval from customers. Almost all customers (95%) would recommend their product to a friend or relative and say their quality of life has improved (94%). Households report they feel safer (90%) and that children have more time to do their homework (66%). Notably, both customers who purchased their SHS from a provider and from an MFI report similar levels of satisfaction and report similar impacts.

A cornerstone of this study is the financial benefits the SHS delivers, as it enables households to undertake more economic activity. Overall, 12% of households report additional economic activity. Most of this economic activity is reported through business usage of the SHS (10%), while other households report members are able to work more hours, mostly in agriculture or sales. Additional time for work is mostly enabled by time-shifting or the ability to reorganise activities, especially in the evening, to effectively spend more time at work. To more clearly quantify this impact, the research in this report assessed this extra economic activity in terms of FTEs created by the additional hours spent working. Overall this additional activity generates 4 FTEs per 100 SHS sold.

For 11% of households, the SHS has enabled them to generate additional income. On average, this income adds up to $66 per month or $792 per year, representing 10% of the average household income of their country.

The findings in this report show that, whether or not customers are connected to the grid, SHS have strong potential to enhance quality of life and livelihoods.

Right now, in India and Pakistan, off-grid solar is providing households with new opportunities to create social and economic change for families, homes and businesses. Yet, in order to expand these opportunities, robust research to support the future of the off-grid sector is required.

Additional research could further support this effort:

- In line with recent grid expansion in India, how can SHS be integrated to the grid to improve energy supply and increase impact on lives and livelihoods?
- In countries with high energy access rates and where the unserved are increasingly hard to reach, to what extent and how can off-grid solar fill the remaining access gap? What policy and investment would be needed?
- What are the impacts of other small-scale solar products in South Asia, such as solar water pumps, fans and refrigerators?
- What policy and investment actions are needed to drive energy access and reliability of supply in South Asia via small scale solar?

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Annex

Annex

Product Annex

BBOXX - Home System – 50 Wp

Greenlight Planet – Sun King Home 40Z – 4 Wp

Greenlight Planet - Sun King Home 60 – 6 Wp

Greenlight Planet – Sun King Home 120 – 12 Wp

Simpa Networks - Spark Pro Breeze Hybrid - 100 Wp

Simpa Networks - Solar Combo 1520 - 200 Wp

Simpa Networks - Sunverter 1530 - 300 Wp

Annex

Methodology Annex

Pre-purchase data collection

Baseline data was collected by participating companies themselves using a questionnaire designed by Altai Consulting and after receiving training from Altai Consulting. This approach enabled the study to leverage points of contact between the company and customers while minimising the impact on operations. The survey was conducted at the moment of purchase or soon after. This avoided relying on customers' memories for information about their prior situation. The final pre-purchase sample size was 894.

Post-purchase data collection

Data collection was conducted by third-party companies Market Cube in India and IPSOS in Pakistan. The questionnaire and training for the data collection were provided by Altai Consulting.

Monitoring was continuously conducted by both Altai Consulting and the third-party companies to address all potential issues. Any irregularities or inconsistencies in interviews led to their dismissal.

Due to challenges in Pre-purchase data collection and difficulties in reaching customers by phone, the Post-purchase data collection was conducted through a mix of face-to-face and phone-based interviews to enable to reach a maximum number of customers over the project timeframe. Additionally, the number of complete Pre-purchase interviews was too low to rely only on those customers as interviewees for the Post-purchase data collection. Therefore, third parties were provided with phone numbers of other customers having purchased their SHS during the same time period.

The final post-purchase sample is composed of 949 interviews, including 123 for which both Pre-purchase and Post-purchase interviews are available.

Incomplete data

For the Pre-purchase data collection, flexibility was given to the participating companies as to how to collect the data. Some data was gathered from data previously collected by the company rather than asked to customers and, in some cases, questions were excluded all together because companies feared they might be perceived as too intrusive. This is reflected in smaller sample sizes for certain analyses.

Data cleaning

To ensure the robustness of the data, additional cleaning and recoding was conducted by Altai Consulting.

This was particularly the case for questions where 'Other, please specify' was a possible answer as this enabled to create new codes when a specific answer was given by a sufficient number of respondents.

Recoding was also used to eliminate inconsistencies when they could be verified with Sagaci Research.

Weighting

For this research, the target population is defined as new customers joining participating companies' customers bases in the country of study between January and June 2019.

The total number of new buyers of SHS during the period of interest were provided for all companies in all participating countries. This stratified information (by countries and by companies) on the target population, under the assumption that the convenience sampling could be considered as a clear random sampling, allowed to produce estimates with statistical precision and develop a weighting methodology to address the unequal selection of respondents.

For the aggregate data, weighting has been used to balance the quota effect and adjust the data collected to better represent the population from which the sample was drawn. Every interviewee was assigned a weighting factor by which the corresponding data was multiplied. The factor is determined by the number of occurrences in the target population divided by the number of occurrences in the sample:

$$\textbf{Weighting factor} = \frac{\text{Number of occurences in population}}{\text{Number of occurences in sample}}$$

Annex

Margin of error
The sample size provides a margin of error of 4.3% at 95% confidence level.

Analysis
Methodological rules were defined for certain analyses.

Full-Time Equivalents (FTEs)
FTE jobs were calculated relatively to the legal working week of 48 hours in India and Pakistan.

Customers reporting an existing business were asked to report the increased number of opening hours per week. The number of hours was attributed to only one household member and compared to a full week as described above.

Customers reporting a new business were asked how many household members worked in the business and how many hours they worked in the business. FTEs were calculated for each individual and summed at the household level.

Customers reporting new jobs or additional time at work were asked how many household members worked in the business and how many hours they worked in the business. FTEs were calculated for each individual and summed at the household level.

Although several businesses reporting gaining new employees, this data was not used within the FTE job calculation as data was not obtained on the number of additional hours worked by these employees.

Eliminating outliers
- **Income generation:** to eliminate extreme values from average calculations a minimum ($0.5) and maximum ($400) amount were defined.
- **Full-Time Equivalents:** to eliminate extreme values in the number of working hours, a maximum of 12 hours a day was considered for businesses and the legal working week for each country was defined as the upper limit for additional time spent working (see above).

Three-data point rule
This rule followed by GOGLA dictates that data can only be published if at least three separate companies have reported data for any single data point. When there are less than three responses, no results are shown. This protects the proprietary interests of the companies who have supplied data in support of this report and reduces the influence of any one company's data.

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Arthur van Schendelstraat 500A
3511 MH Utrecht
The Netherlands

info@gogla.org
+31 304 100 914

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