

# Afghanistan Household & Enterprise Energy Diaries

## Final Report



## Acknowledgements

Samuel Hall is grateful for the support of all involved in the Afghanistan Energy Household and Enterprise Diaries Study. Special thanks to the World Bank Energy team: Fanny Missfeldt-Ringius, Peg Wilson, Niki Angelou, Abdul Quaraishi, Efre Ferrari and their support staff. The World Bank Afghanistan Energy team worked closely with Samuel Hall on collaborative data analysis and writing, as well as providing guidance and critical feedback. Samuel Hall is also grateful to the Afghanistan Energy Study Committee (AESC), who engaged with the research and provided feedback at all AESC meetings. This includes the cooperation of Afghanistan government, including the Ministry of Energy and Water (MEW), and the electricity utility provider Da Afghanistan Breshna Sherkat (DABS). It is hoped that the research provides policymakers and those in the energy sector with rigorous information from the household and enterprise level. The team gives thanks to everyone who offered their time and knowledge, as key informants in interviews and through informal sharing of perspectives and information.

The Samuel Hall research team would also like to give sincere thanks to the 11 call centre enumerators, who worked every day for a year calling research participants and conducting diary surveys over the phone, and to the call center management for their professional work. Thanks are extended to the 30 Community Focal Points who ensured smooth data collection in their home communities. Thanks also to the 82 enumerators who conducted data collection during the baseline phase, which laid the groundwork for the longitudinal study and provided a wealth of data and information in its own right. This was coordinated by Samuel Hall's two field coordinators, working through some of the most challenging research conditions globally. And to the wider team at Samuel Hall, without whom this research would not have been possible. Samuel Hall would like to express gratitude to the academic research partners for the study at the *Centre d'Études et de Recherches sur le Développement International* (CERDI).

Final thanks go to the 3,256 research participants. Participants gave their time, invited Samuel Hall into their homes, businesses and institutions, and allowed us all a glimpse into their lives as it relates to energy - to help build an understanding of energy patterns across the country of Afghanistan.

**Samuel Hall** conducted the Afghanistan Household and Enterprise Diaries Study, which is one component of the Afghanistan Energy Study, supported by the World Bank. Samuel Hall is a social enterprise that conducts research in countries affected by issues of migration and displacement, with a mandate to produce research that delivers a contribution to knowledge with an impact on policies, programmes and people. We specialise in socio-economic surveys, private and public sector studies, and impact assessments for a range of humanitarian and development actors. Samuel Hall has offices in Afghanistan and Kenya, and is registered in Somalia, Germany, and the United Arab Emirates. For more information, see: [www.samuelhall.org](http://www.samuelhall.org)

## Table of Contents

|  |     |
|--|-----|
| Acknowledgements.....  | 2   |
| Executive Summary.....   | 4   |
| 1) Introduction – Household and Enterprise Energy in Afghanistan .....                       | 6   |
| 2) Who is using energy? Sample Characteristics.....  | 8   |
| A. Household demographics .....  | 8   |
| B. Composition of businesses and community institutions .....                                | 10  |
| C. Livelihoods and income .....  | 17  |
| D. Assets and tools .....  | 23  |
| 3) Access to Electricity for Households, Businesses and Community Institutions.....          | 30  |
| A. Overview of access to electricity .....   | 31  |
| B. Grid-connected households, businesses and community institutions .....                    | 39  |
| C. Off-grid electricity solutions .....  | 58  |
| D. Other off-grid solutions: Generators, rechargeable batteries, mini-grid, pico-hydro ..... | 77  |
| 4) Aspirations for better energy, and willingness to pay .....                               | 83  |
| A. Aspirations .....   | 83  |
| B. Expected cost of, and willingness to pay for, grid electricity.....                       | 88  |
| 5) Cooking and heating .....   | 98  |
| A. Cooking solutions.....  | 98  |
| B. Heating solutions .....   | 100 |
| C. Cooking and heating fuel collection and expenditure .....                                 | 104 |
| D. Health and Safety.....  | 108 |
| 6) Concluding remarks .....  | 111 |

## Executive Summary

The Household and Enterprise Diary endeavor is part of the World Bank's Afghanistan Energy Study. The aim of the project is to collect data on energy patterns at the household and business/community institution level in different Afghan contexts. This includes information on sources of energy and electricity, fuel types, heating, cooking and lighting practices as well as willingness, and ability, to pay for better provision of energy. For the baseline phase of the 18 month-long study, Samuel Hall conducted over 3,000 household surveys, 250 business enterprise and community institution surveys as well as 30 focus group discussions across 30 communities in six provinces. The baseline phase was followed by monthly Diary Phone Surveys and Seasonal Case Studies over the course of one year. The longitudinal study was designed to capture household, energy and electricity patterns that vary through the year and across the different seasons. The research covers household income; household spending; electricity usage; and energy usage, including fuel for cooking and for heating during the colder months. The research participant locations formed a diverse range of communities in terms of histories, cultures, energy solutions, challenges and opportunities.

After the fall of the Taliban in 2001, only a small minority of the population of Afghanistan had access to electricity.<sup>1</sup> This has shifted dramatically in under two decades: almost the entire population now have access to some form of electricity, driven by the off-grid boom in solar home systems as well as increasing grid electricity supply.

Grid electricity, provided by Da Breshna Sherkat (DABS) is considered the gold standard of electricity provision, able to power a range of appliances at a cheaper cost than generators. Coverage is expanding: approximately a third of interviewees had access to the grid, and the number of grid-connected households grew throughout the year that this study was conducted. However, it is much more common in urban areas, with grid growth not penetrating more difficult-to-reach, remote, rural communities. Despite the multiple benefits of grid, it is not without issues. The performance of the grid varies at different times of the year and in the different sample provinces. Many complained about price, voltage fluctuations, and outages. At the same time, results of the study indicate that grid is not overpriced – the share of grid expenditure compared to reported income remains relatively modest.

Approximately two thirds of the households interviewed for this study possess a solar device. Boosted by programmes distributing solar sets, but also commonly bought privately in bazaars in district and provincial centres, solar is used for lighting, mobile phone charging, and, increasingly, powering televisions. There has been a remarkable rise of solar in Afghanistan, with even the poorest households in the sample possessing a cheap solar panel and battery set. Solar solutions do come with a range of issues. The cheap solar home systems are becoming synonymous with low quality electricity. The capacity for powering appliances is highly seasonal – in the winter, lights might only be able to be used for a few hours each day, if at all. The overwhelming majority of off-grid users of solar expect to be connected to the grid in the near future. This shapes aspirations for improved electricity as well as the demand for solar solutions of high quality (and consequent higher purchase cost).

---

<sup>1</sup> World Bank Group estimates that in 2005, the 23% of the population who did have access to electricity in Afghanistan were located almost entirely in urban areas.

Other electricity sources are almost negligible. Generators are only used by some 4% of the surveyed households, often as a backup for the grid. Rechargeable batteries and pico-hydro mini-grids do not appear to be common in the communities that were surveyed. Over the course of the year during which this study was conducted, a number of households got connected to the grid and abandoned these other sources of electricity. Businesses and community institutions tend to display a different energy mix: generator use is more common, particularly for energy-intensive trades such as metalworking and carpentry and particularly in locations where the grid is deemed unreliable (Kabul).

Heating and cooking are central in Afghan household and enterprise energy patterns. Electrical heating and cooking are not widespread. Instead, wood and solid fuels power a variety of heaters and stoves (including *bukhari* space heaters, *sandali*, and *tabakhana*, etc.). Heating by definition was seasonal, but identified patterns included the bulk purchase of wood for winter by many households. This purchase supplements gathered solid fuels including wood, animal dung, thorns and brush. These solid fuel sources also constituted mixed fuel sources used for cooking. The diary phase illustrated a prominent rise in the use of LPG stoves, with positive externalities in terms of health and well-being particularly for the female members of the household. Further research is needed to ascertain the pathways through which this beneficial conversion happens and ways to foster it, be it via distribution, outreach or price subsidies.

Finally, the research set out to understand what was the willingness to pay of off-grid Afghan households and businesses for a grid connection, and that of all respondents for different types of solar solutions. It emerges that overall, the willingness to pay for a grid connection appears rather high. Demand is found to be rather inelastic, barely dropping with rising proposed prices of connection. This indicates that it would not be necessary today to provide financial incentives / contributions to help the majority of off-grid households bear the financial burden of the grid connection. At the same time, most respondents underestimated the cost of wiring, as well as the “running cost” of grid electricity usage. The willingness to pay for a grid connection is also high among off-grid businesses and community institutions, though not as high as that of households. This might reflect both the higher cost, and the fact that certain businesses (roadside shops) and institutions (rural schools) simply do not, in their current form, require electricity to function. The willingness to pay for solar solutions is much lower, arguably due to the fact that many shun an investment in solar when they are expecting to obtain a grid connection in the near future.

Figure 1 Grid electricity lines in Kabul



## 1) Introduction – Household and Enterprise Energy in Afghanistan

Energy at the household, small business and community institution level is a central pillar in building sustainable development and access to better livelihoods for the citizens of Afghanistan. Rapid expansion of grid and off-grid electrification is occurring across the country, facilitated by a range of national and international actors. Grid expansion continues at an uneven pace with Afghan households, especially in urban areas, being progressively connected to grid electricity. Ongoing renewable energy projects range in scale from the micro-household level to large multi-megawatt solar-plant and hydro-electricity projects. Households and small businesses are continually creating their own energy solutions, often innovative, and the proliferation of solar panels on rooftops across the country are a visible mark of a rapidly changing sector.

Despite the gains in electricity access, major challenges in the provision of sustainable energy remain in Afghanistan, a country estimated to have some of the lowest electricity usage rates in the world. Diverse difficult-to-access terrain and areas affected by conflict or controlled by non-government actors are some of the structural barriers that make investment, expansion, operations and maintenance of the electricity grid challenging. The national grid is not a unified system and instead operates as nine asynchronous “islands” each being fed by different power systems, leading to many inefficiencies in electrical power distributions. There are also immense gaps between the potential for renewables in possible wind and solar production and utilisation and production from these energy sources. All these challenges in the energy sector in Afghanistan place constraints on business capacity and industrial production, and lead to suboptimal energy usage at the household level.

Notwithstanding these challenges, the energy sector continues to transition and change to meet increasing supply. Afghanistan lies between Central Asian states with vast gas reserves and increasing levels of hydro-electric production and South Asian states such as Pakistan who are experiencing burgeoning demand. There is also a pipeline of projects for enlarging Afghanistan’s indigenous electricity generation through hydro-power and renewable production facilities across the country, with transmission and distribution infrastructure to match. The CASA-1000 project, a regional electricity transmission infrastructure project between the Kyrgyz Republic, Tajikistan, Afghanistan and Pakistan, is one prominent example. Off-grid and other renewable solutions are being driven by multiple initiatives, including the Bamiyan Renewable Energy Program, 5.5MW solar complex being constructed in Daikundi and the 2MW Kandahar solar power plant. There have also been renewable projects at the household and community level, including during the National Solidarity Program (NSP). These boosts in supply and capacity enhancement have contributed to the expansion in grid electrification and the remarkable rise in access to electricity of some-kind.

Heating and cooking comprise major parts of Afghanistan’s energy needs. Traditional biomass fuels including wood and other plant-based materials such thorns, brush and bushes as well as animal dung continue to be important in many areas of Afghanistan for both cooking and heating, with considerable negative externalities both in terms of health and time use.

Actors working in the energy and electricity sector that shape household and enterprise energy patterns include the Afghanistan government - the Ministry of Energy and Water (MEW) along with *Da Breshna Sherkat (DABS)*, the major energy utility provider managing and operating the commercial electric power generation, importation, transmission and distribution. They are supported by international partners, including the World Bank, Asian Development Bank and international donors such as USAID. Other actors include the private sector, which engages in construction and different facets of the renewables sector, as well as non-government organisations (NGOs). These actors are dealing with protracted challenges in the provision of enhanced energy solutions, but also opportunities in the energy transitions occurring in Afghanistan, tackling gaps as demand for safe, affordable and reliable energy continues to increase across the country.

Today, the Government of Afghanistan, donors, private sector actors and civil society organizations require access to quality information and data about the current energy landscape in Afghanistan, in order to better tailor responses to the country’s growing energy needs.

This research sets out to fill some of the existing information gaps. The Afghanistan Household and Enterprise Energy Diaries Study is a longitudinal research project on energy and electricity patterns, which represents Activity 3 of the Afghanistan Energy Study (AES), supported by the World Bank and managed by the AES Committee. The AES aims to develop a holistic understanding of the gaps and prospects in the energy sector through a series of complementary assessments and surveys, with the goal of informing future investment, build capacity at relevant line ministries and contribute to knowledge sharing in a number of key energy areas.

This research combines an in-depth Baseline Survey with a year-long panel data collection exercise through a dedicated call centre, triangulated through qualitative research that provides context to the numbers and also a platform for Afghan voices on their interactions with energy.

Topics covered include information on sources of energy and electricity, fuel sources, heating, cooking and lighting as well as willingness, and ability, to pay for better provision of energy.

*Figure 2 A research participant stands with his solitary solar panel. It charges a battery which powers light-bulbs and mobile phone charging. Talkahki, Samangan*

Knowing what is in use at the moment, challenges in energy provision, household aspirations *and* the multiple intersections with health, education and gender are all crucial in being able to understand the energy landscape and to scale up the provision of energy solutions. This study represents part of a unique investigation into household and enterprise energy in Afghanistan, and the crucial role energy plays in Afghans’ everyday lives.

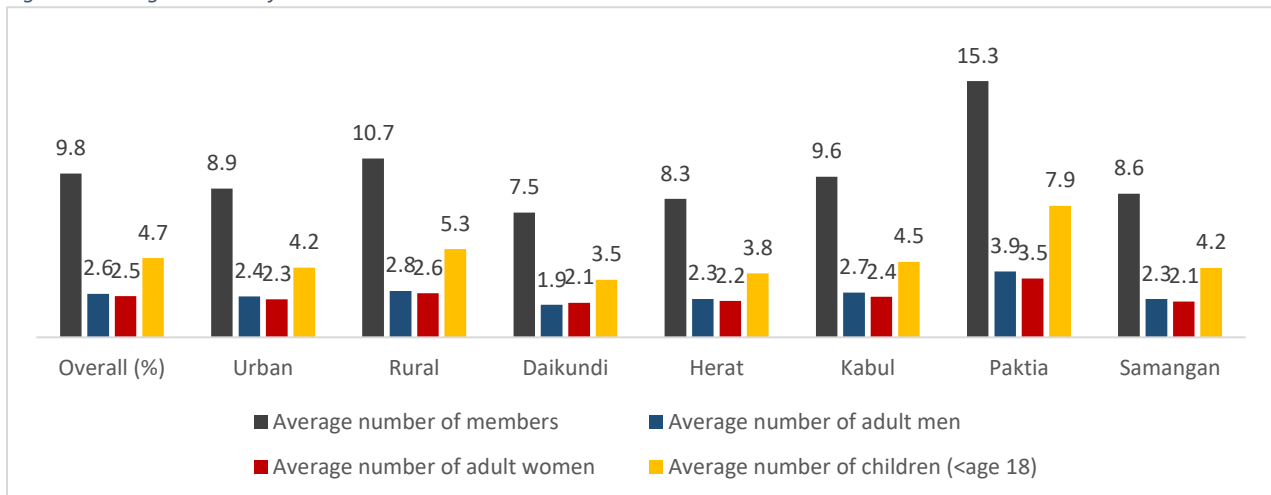


## 2) Who is using energy? Sample Characteristics

3,061 households and 253 businesses and community institutions across thirty locations in five provinces took part in the study. The five provinces, Kabul, Herat, Samangan, Paktia and Daikundi were chosen to meet different energy pattern categories.<sup>2</sup> In each province, six communities (three urban, three rural) were sampled; and within each of these communities a minimum of 100 households were randomly selected to take part in the research.<sup>3</sup> In addition, 179 businesses and 74 community institutions were covered by the study. These research participants covered a broad span of characteristics and experiences: from remote, agrarian Daikundi villages in the Central Highlands where houses are set far from each-other and solar panels power a few lightbulbs, mobile phone charging and perhaps a television; to urban neighbourhoods in Kabul, where densely built complexes house daily-wage labourers, metalworkers, or professionals using grid electricity.

### A. Household demographics

Figure 3 Average number of household members



Across the study sample, Afghans usually live with their immediate and often extended families including in-laws and grandparents. Mixed living situations, with individuals living with non-family members or living by themselves are rare, especially in rural areas. It is also rare for a household to consist of fewer than four people.

Major differences in household literacy rate between urban and rural households were not apparent across the sample. Provincial differences are more pronounced: Kabul had a much higher rate of at least one man being literate in the household than other provinces. Female literacy in the Paktia sample was very low – only 17.6% of households had at least one literate woman in the household, compared to over half of households in Daikundi and Herat, and just under half of households in Kabul (Figure 4).

<sup>2</sup> The five energy profile categories consisted of: 1. *Highest* – Kabul; 2. *Expected to grow* – Samangan; 3. *Connection to the grid possible* – Paktia; 4. *Connected to Iran* – Herat; 5. *Off-grid solutions* - Daikundi

<sup>3</sup> A detailed outline of the sampling and of the communities can be found in Annex 3: Methodology and Fieldwork



Figure 4 Literacy

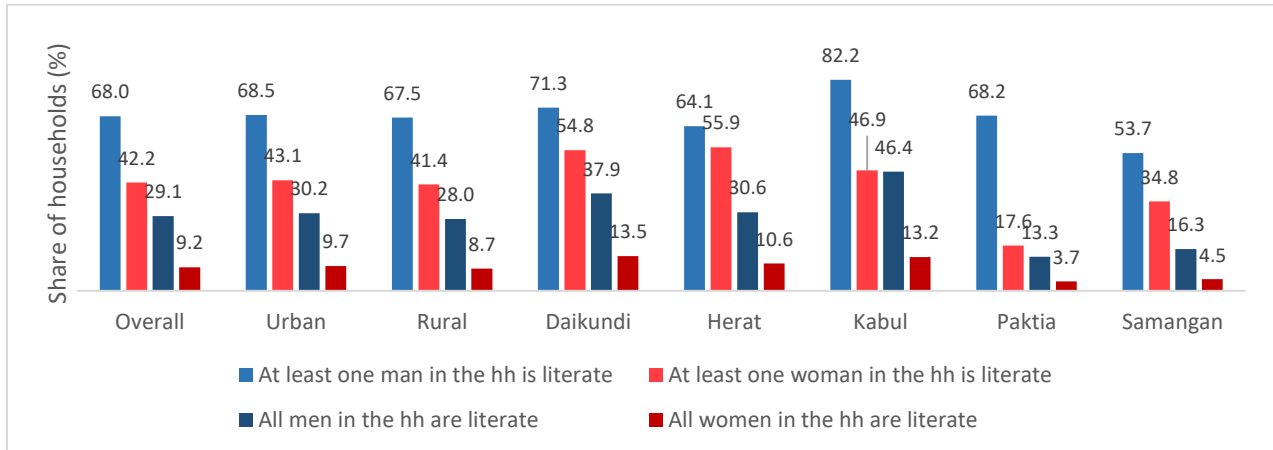


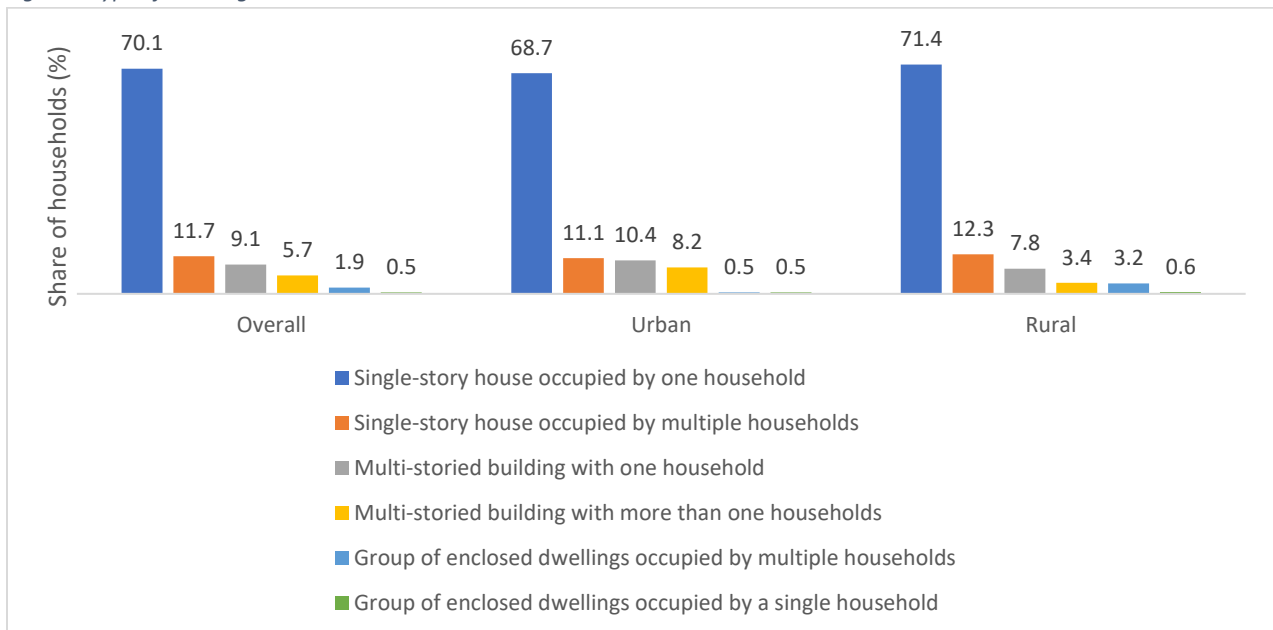
Figure 5 Dwelling in Charkh, Daikundi



The most common type of dwellings is single-story houses occupied by only one household (whose prevalence ranges from 53% in Herat to over 80% in Paktia and Samangan), followed by shared single-story houses (12% overall) and shared multi-story buildings (9% overall). The first two (single-story houses) are commonly constructed of mud bricks, while the latter (multi-story buildings) is made of brick / stone. The most common material for the roof (70%) is wood (Figure 6).

The vast majority of respondents (94%) owns their dwelling and thus does not have to cover rental costs.

Figure 6 Type of dwelling



A plurality (over a third in rural contexts, one in five in urban ones) of respondent draws water from a well, usually through a hand pump. Electric water pumps are common only in Herat (27%), while the share of respondents whose main source of water is a river is highest in Samangan (44%).

*Figure 7 Panorama of the river running through Talkhaki, Samangan, with a canal running alongside. Grid electricity poles without power lines can be seen on the far bank.*



## B. Composition of businesses and community institutions

Businesses and Community Institutions are the major consumers of electricity in Afghanistan. The research study focussed on small-to-medium sized business enterprises (SMEs)<sup>4</sup>, as well as community institutions of varying sizes – government, public or civic organisations such as schools, mosques and clinics – in the communities where the household component was conducted. This is where people work, shop, learn, seek medical support and pray. A wide range of businesses and community institutions with distinct energy usage patterns were surveyed across all five provinces in purposive selections. While some rural communities in the sample (such as Ghaf in Daikundi and Nargese in Paktia), were almost entirely agrarian and only had a few small retail shops; many communities had a broad span of home-enterprises, mobile-vending and more traditional businesses that engaged with energy in disparate and sometimes novel ways.<sup>5</sup>

*Nota bene: Unlike the households within the communities, the sampling of the enterprises and community institutions was not random. Indeed, many communities did not have more than a small number of businesses within the boundaries of their community, often shopping in their respective district or provincial centre bazaars (including for energy-related products such as gas, wood, electrical appliances and solar home system parts). This means that the energy patterns of the enterprises within the study are not representative. Instead, they are a snapshot of how SMEs and local community institutions - that households frequent for commerce, education, health and religion - use different types of energy.*

<sup>4</sup> Large industrial sites were not included in the sampling, although a small number of factories were.

<sup>5</sup> Examples include an embroiderer in Daikundi who used a solar home system to power her sewing machine. A barber in Shewaki, Kabul Province used a large [wooden boiling system](#) to provide hot showers and baths to patrons for a fee.

Figure 8 A water pumping business using new solar panels, Dasht-e-Barchi, Kabul



The business and community institution respondents were almost exclusively male and were comprised of business owners / employees, medical staff and teachers, wakils and administrators. This sample was largely (76%) literate. Interviewed business and institution establishments vary considerably in size. The average number of employees at businesses was 3.5, excluding two businesses with large numbers of employees. The average community institution had 20 employees. The lower average for businesses can be attributed to the many small retail and trades shops.

All interviewed establishments save nine (mostly schools) are active year-round, usually for eight hours or more. Most of the interviewed businesses and institutions occupy a single story-building by themselves. One community institution in four occupies a building with several stories.

Community institutions have occupied their building for 15 years on average, while businesses usually only moved in over the course of the past five years. Size of the space occupied varies widely, but revolves around a median of 6m by 4m for businesses and 40m by 25m for community institutions. Businesses commonly rent their space (54%), while most institutions occupy publicly administered property (67%). The building materials reflect those of residential buildings.

#### Formality

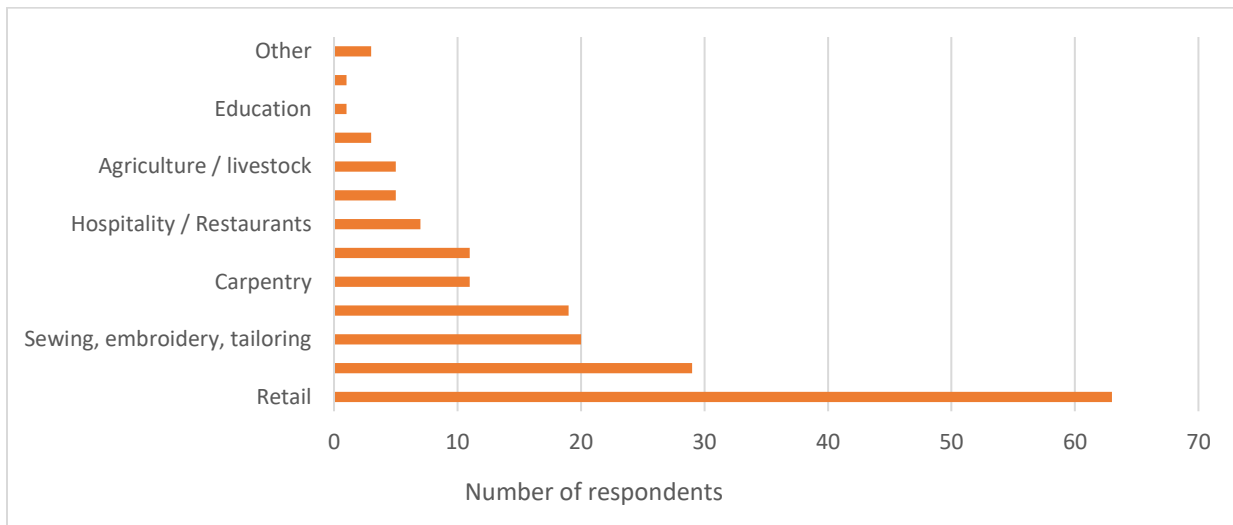
The Afghan economy is a complex system that consists of formal (private and public), informal but legitimate, illicit (opium production and smuggling), and aid-dependent (mostly service) sectors. While the international community and the Afghan government declared that they would rebuild the Afghan economy based on a free-market ideology in which a competitive private sector would be the engine of sustainable growth, unregulated activities dominate the Afghan economy. It is estimated that the formal economic activities account for only a 10-12 percent of its GDP. In this context, the state fails to be able to generate tax revenues (which further erodes its already weak legitimacy). There are two reasons why licit firms prefer informality: firms may not register because they perceive that the costs of registration (paying taxes, registration fees, etc.) outweigh its benefits. Furthermore, entrepreneurs may lack the information regarding their obligations with respect to registration. Over half (53%) of the interviewed businesses in the sample covered by this study are informal.

**Businesses** were small-to-medium sized enterprises and operated for profit. The majority of businesses in the sample were designated as shops. Given that the SMEs were close-to-evenly spread across the 30 communities sampled, including rural villages, shops were much more common than factories or larger industrial businesses. The sample included 123 shops, selling goods and services (for instance, groceries), as well as workshops for manufacturing and repair.

Figure 9 Shops lining the street in Karte Naw, Kabul



Figure 10 Business sectors



**Retail** - The highest number of businesses within the research sample were in the retail sector. This category was mostly comprised of grocery stores, with almost all the communities, including rural villages, having grocery stores of varying size selling basic foodstuffs and everyday goods. Nine retail businesses were filling stations for motor vehicles. The minority were specialty retail stores, including a store for electrical and construction tools; a sweetshop; an auto parts sales store; pharmacies and an ice-cream vendor in Daikundi.

A small goods shopkeeper in rural Samangan is emblematic of many of the businesses within the sample, supplying goods within their village communities:

*I am a shopkeeper. I have two shops here; I manage the one and the other is managed by my son. Everything can be found in our shop; such as dry tea, sugar, sweets, bicycle tires and motorcycle tires, petrol and diesel, air pumps and many other things. I go to Mazar-e-Sharif<sup>6</sup> every week to buy goods and supplies for the shop.*

General goods shopkeeper, Lab-e-Aab in rural Samangan

### **Tailoring and embroidery -**

Tailoring is the top profession of employment for Afghan women and the fourth-ranked for Afghan men. Work is subject to seasonality, with busy periods for instance around Eid. Electricity is a key with sewing machines reliant on energy to function productively.

Embroidery is an important sector that provides home-based income earning opportunities for women as well as traditional work for men. The largest threat to growth in the embroidery business is automation. Many young entrepreneurs however are seeking to emulate the competition through the use of machines. This requires both capital and a stable source of electricity.

Figure 11 One of the few home-based activities open to women



**Carpentry** - Clustered in dedicated neighbourhoods, carpenters tend to specialise in the fabrication of particular items such as doors, window frames or furniture. The business is seasonal, with demand decreasing in the colder months. Traditional masters who still carve intricate patterns by hand find it increasingly difficult to compete with machine-made products. Like their embroiderer-peers, many carpenters aspire to making the shift to machine carpentry – shaping their demand and aspirations for different electrical solutions.

Figure 12 Reliant on machinery: carpentry in Samangan



*I am a carpenter; I usually use electric machines in my workshop. I am head of the workshop; we make windows, doors and cabinets. I use generator as energy source to my works. We import wood from Mazar-e-Sharif to make windows, doors and other things. I have 8 workers in my workshop including one of my sons; he goes to school as well.*

Carpenter, Lab-e-Aab in rural Samangan.

<sup>6</sup> The major city in the north of Afghanistan, in Balkh Province



**Metal works** - Afghan metal workers share a number of traits with their carpenter peers. They fabricate doors, windows and bars from metal. The challenges most frequently voiced by metal workers in terms of their overall business are the need for large spaces, which translates to high rents, and high electricity reliance and demands, and therefore costs. Those unable to afford modern machines face pressure from competitors who work more efficiently.

*Figure 13 Metalwork business, Herat*



**Mechanic services, mobile phone repair** - While the sector is enjoying solid growth, car mechanics face limitations in terms of space and infrastructure (reliant on working electricity and water supply). The repairing of mobile phones is a relatively recent profession, well on the rise.

**Hospitality and restaurants** – This category in the sample included four hotels, two restaurants and a café. By definition, energy for cooking is central to organisations in the sector.



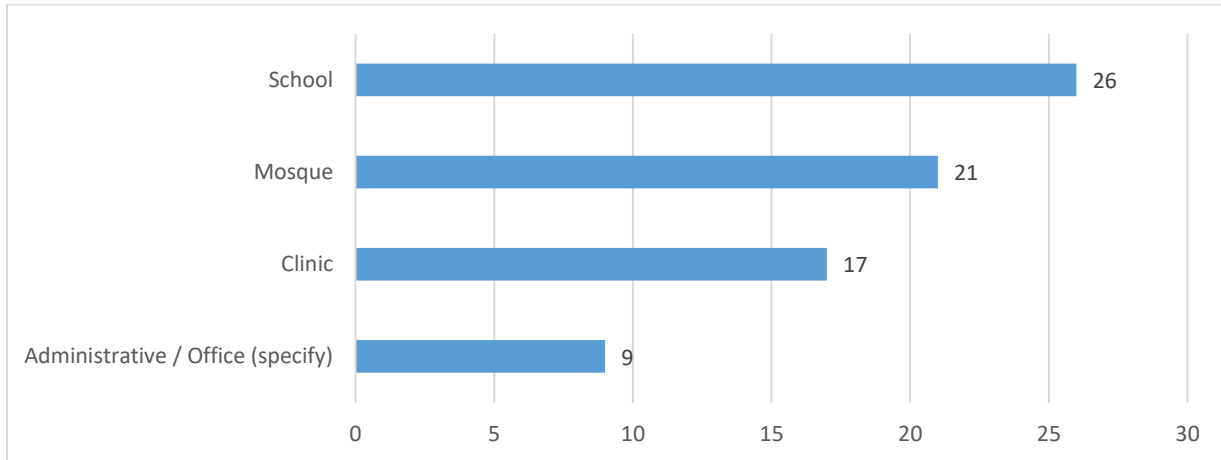
*Figure 14 Up-and-coming: Electronics*

**Administration/Services** – The Administration and/or Services sector responses included two baths (one of which was also a hairdresser); five photography-photocopying-printing shops; and two cleaning shops, both of which cleaned cars and one of which also cleaned carpets.

**Other** - The three businesses that responded in the “Other” category were gyms / sports complexes.

**Community institutions** were defined by their status as service providers but not for profit. The research sample was comprised almost entirely of schools, mosques, clinics and government offices (Figure 15). The government offices consisted of directorates of various government ministries (including education, public works and the municipality).

Figure 15 Types of community institutions



**Schools** - There have been concerted efforts to increase the number of schools across Afghanistan. While most communities within the sample had at least a primary school within walking distance, some communities had high schools located only in nearby communities that required a commute. Schools varied in size - two of the schools in rural Paktia had only nine employees each, while two of the schools in urban Herat had well over 50 employees.

The energy supplies to a school vary greatly. Some schools reported no electricity at all, consisting of simply a room, and perhaps a *bukhari* to keep the classroom warm during winter. Other schools have grid electricity and computer labs. More common are schools with electricity for basic lighting. Schools in Afghanistan usually operate in a split-day format. Students will attend either a morning or afternoon session for four hours, and often-times, teachers will do the same.<sup>7</sup>



Figure 16 A grid connected high school drawn by a child in the Seasonal Case Study Child Energy Visualisations

<sup>7</sup> This means that many teachers are involved in other income earning work in the other part of their day: In the seasonal case study household in Khwaja Chast, Daikundi, the head of the household worked in his agricultural fields in the morning before teaching in the afternoons.

*Figure 17 Women walk past an ambulance with a grid electricity box on the pavement behind, Herat*

**Clinics** - As with schools, clinics also vary in size – with different numbers of medical and support staff dependent on whether the institution is servicing a small village or more densely populated urban area. Clinics use electricity for lighting but may also use electronic medical instruments and computers. Clinics may also use electricity for refrigeration of some medicines and vaccines.



*Figure 18 A mosque in a neighbourhood on the outskirts of Kabul, with the muezzin's loudspeaker rising up*



**Mosques** - Mosques are all-important religious institutions across Afghanistan. Friday prayers often see most of a rural village attend the mosque, also frequented on other days. They will have a small number of religious leaders, a Mullah or Imam. Mosques will usually use electricity for lighting, but may also have electric loudspeakers for preaching and the muezzin's call to prayer.



## C. Livelihoods and income

### a) Households

Households draw their livelihoods and incomes from different sources, naturally somewhat dependent on whether they are located in urban or rural areas. Both contexts have sets of households whose work has high levels of precarity - daily wage laborers in urban areas and poorer subsistence farmers and livestock herders in rural ones. Both urban and rural areas also have workers who have more stability, including professionals, tradespeople and shopkeepers, along with those with larger farms and agricultural gardens.

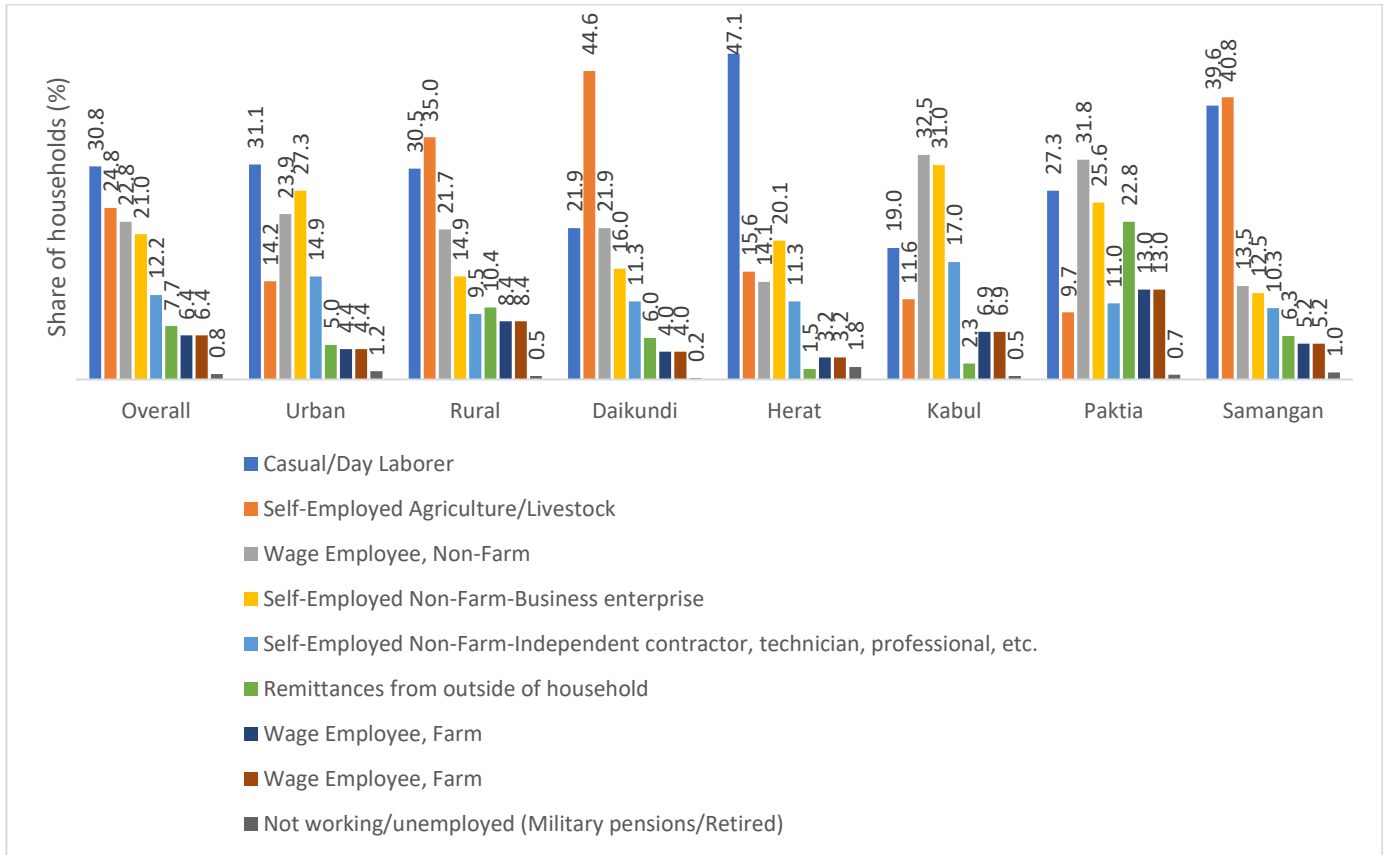
Figure 19 Labouring in rural Daikundi; and Figure 20 Labouring in urban Karte Naw, Kabul



*Sometimes when we gain more than we need from the fields, we sell it in the market. My daughters-in-law and I milk the cows at home and also make yogurt. Then the men take [the milk and yogurt] to the market to sell them.*

Female, Mondokhail, rural Paktia

Figure 21 Share of households by occupation of people contributing to household income



A broad range of occupation sectors was highlighted in the household respondent sample. Work in agriculture and forestry along with construction predominated with a combined 61.5% of interviewee households indicating they worked in these sectors (Figure 21). As to be expected, agriculture was much higher in the rural category sample. Retail and motor repair was the third largest selection category (both mostly occupying shop-spaces in both urban and rural areas).

Figure 22 Dwelling of Seasonal Case Study respondent, Chawgai, Samangan



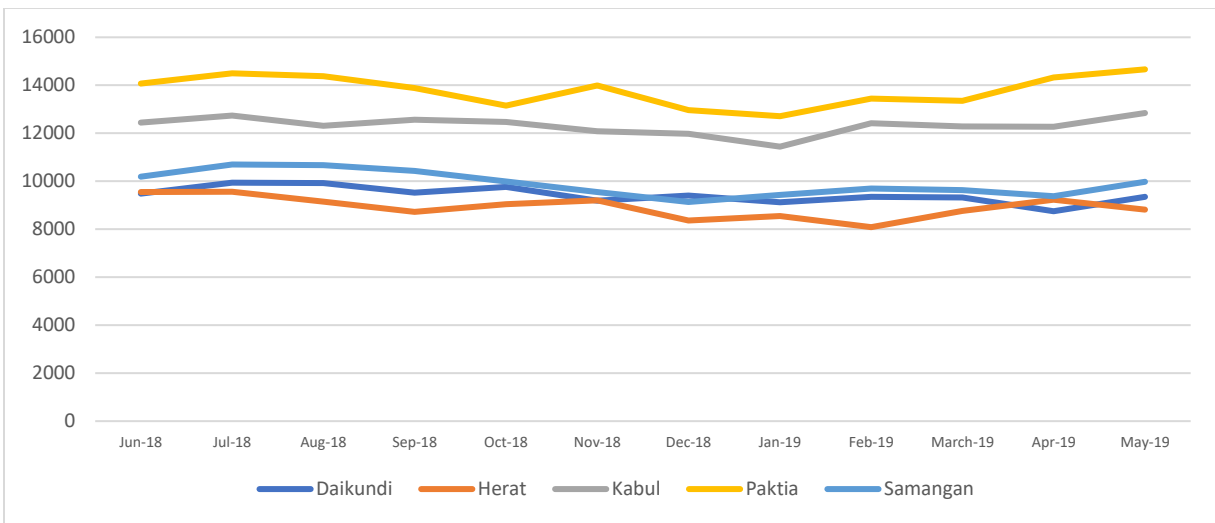
*I am a farmer and I have 12 sheep and 5 acres of land. I have a lot of almond trees in the fields and I cultivate wheat, potatoes and other vegetables. I gained almost 21 kgs of almond this year.*

Farmer, Chawgai, Samangan

16% of respondent households operate a business from home. By far the most common type of home-based non-agricultural income earning activity is tailoring (8.6% of respondents), often carried out by women. Embroidery is also common, at 3.3% of overall respondents (including 6.2% in Herat).

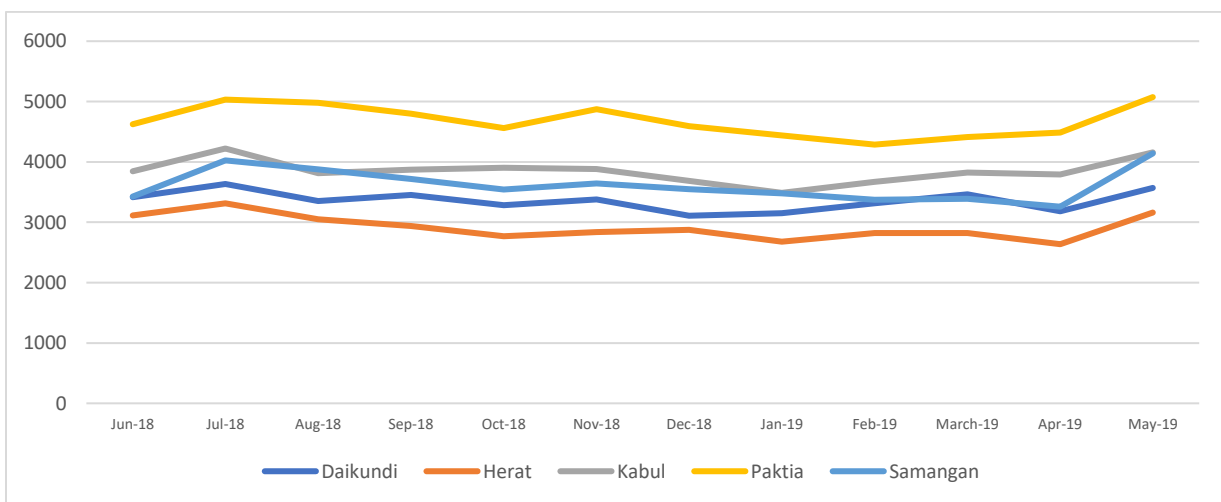
The monthly reported average income is per household (Figure 23). Paktia reported higher average income amounts, with one possible explanation linked to the sampled household sizes in the province being noticeably larger than others, with a reported average of 15.3 members – compared to an average of 7.5 members in Daikundi and 8.3 members in Herat (Figure 3). Interviewee households in Kabul also reported higher monthly incomes per household compared to Herat, Daikundi and Samangan, matching its status as one of the higher income-generating provinces in Afghanistan.

Figure 23 Reported average monthly income



Reported income trends (Figure 24) are mirrored by those in spending:

Figure 24 Reported average weekly spending



Self-reported income and self-reported spending depicts a slight decrease in household incomes in the colder, winter months. Seasonal variation in income has ramifications for willingness (and ability) to pay for enhanced electricity solutions, asset ownership, payment of grid billing cycles and energy use.

Figure 25 Winter fields in Qarabagh district, Kabul



*There cannot be any economic activity when the weather is cold. Agriculture is not possible when the ground is covered in snow.*

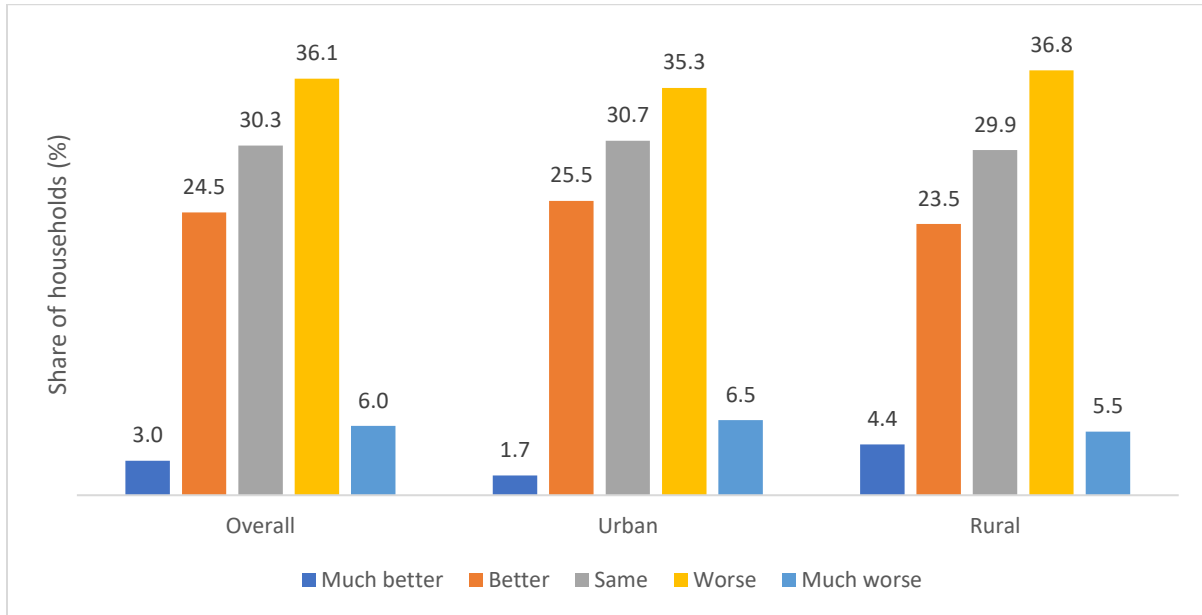
Farmer, Mondokhail, Paktia

#### **Coping during the colder months**

One reason why the winter dip in income is not more pronounced is a diversification of income strategy employed by households across Afghanistan. This is exemplified in the qualitative deep dives during the seasonal case studies. In the urban household in Dasht-e-Barchi, Kabul, the winter-unemployed head of household (a daily wage laborer) helps out with a group at a friend's shop for a stipend. In Langar, the rural north of Kabul province, the household receives remittances from abroad and sell their land in times of cash shortage. Similarly in Mondokhail, rural Paktia, one child works for the military, another was working in Dubai and sending home remittances. In the Community Profiling stage, one community in Daikundi reported that many of the men travel to work in the Dar-e-Soof coal mine in Samangan, one of the largest in Afghanistan, over the winter months when their farms were under snow. Another reason why, despite qualitative findings pointing to strong seasonality, spending does not drop much might be the widely available coping mechanism of debt: Indeed, some 80% of interviewed households have access to credit and loans, usually from friends / relatives (67.4%) but also shops (36.9%).

The precarious livelihoods of the sample, and general absence of sustainable income-generating activities, are reflected in a general mood of pessimism: over four respondents in ten note that their economic situation compared to one year ago was worse, or much worse (Figure 26).

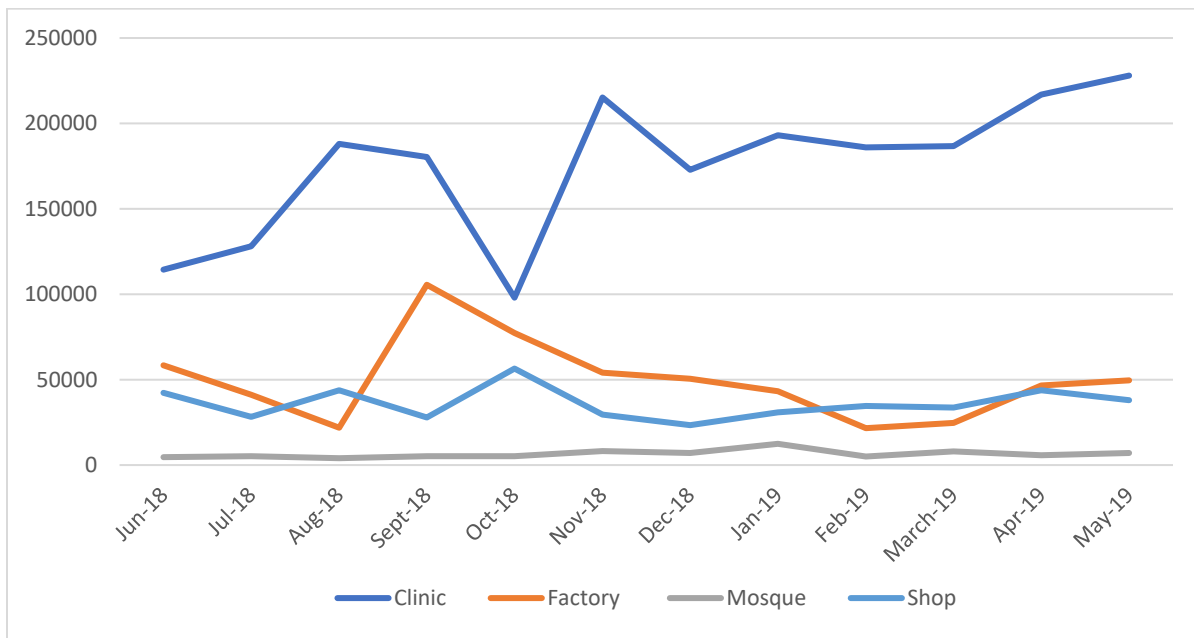
Figure 26 Households' economic situation compared to one year ago



*b) Businesses and institutions*

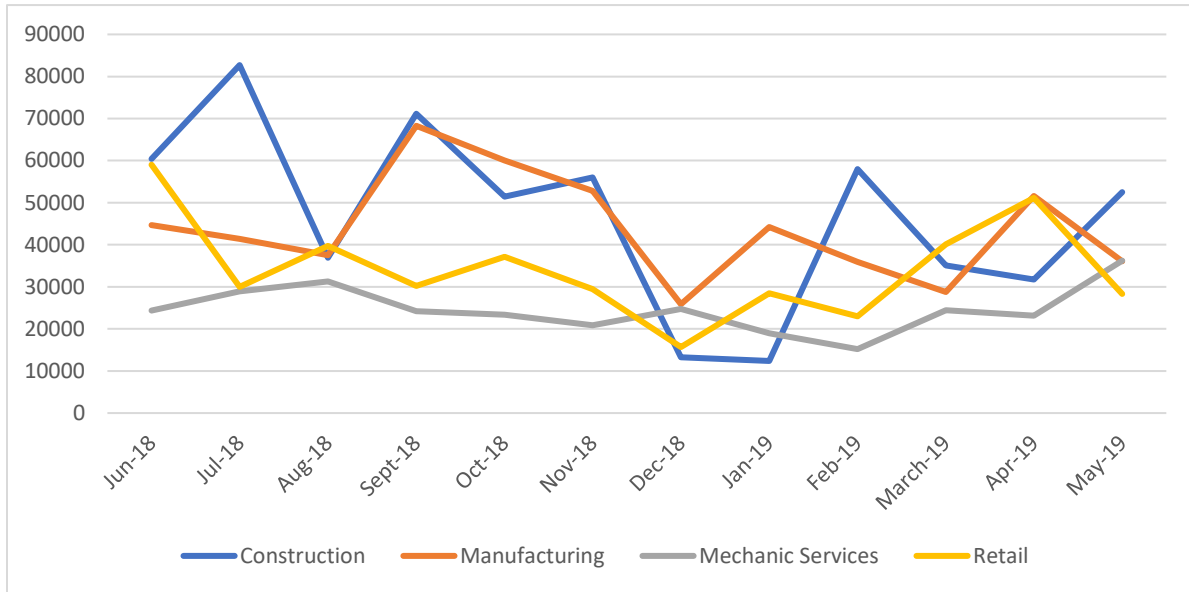
Business / Institution's income over time display modest seasonal variation (Figure 27), no doubt due to the fact that most of the surveyed entities are not active in the agricultural sector.

Figure 27 Business / community institution Income over time



A deep-dive into the income of the types of small-to-medium enterprises (SMEs) that constitute the bulk of the business sample **does however show a predictable dip in income in the coldest months** in the construction sector as well as retail and manufacturing (Figure 28). Mechanics appear to operate relatively independently of seasonal fluctuations.

Figure 28 Income over time - most common businesses

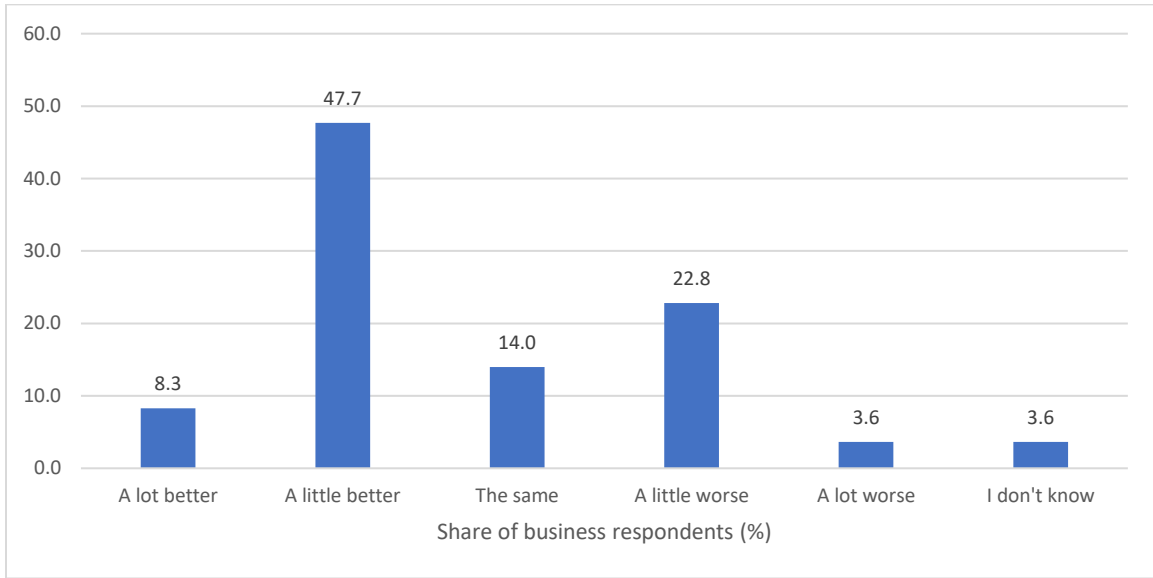


*I have a motorcycle repairing shop. When I set up my business, I took a loan and bought a booth. This booth is mine, but I still have to pay the municipality 6,000 AFN per year. My income is not bad, I can make 1,000 AFN each day. My apprentice makes 6,000 AFN.*

Mechanic, Sang-e-Moom, Daikundi

In terms of prospects for the near term, business and community institution respondents are fairly optimistic, with some 60% overall stating that they expected the future of their business / institution to be better, or much better, than is currently the case (Figure 29).

Figure 29 Prospects: How will the business do two years from now?



#### D. Assets and tools

**Household asset ownership** varies depending on (and thus can serve as a proxy for) socio-economic status and type of environment (Figure 31). Some assets however are ubiquitous: all of the interviewed households have at least one cell phone in the family, and over 80% own a stove. Irons and sewing machines are very common.<sup>8</sup>

*We have four mobiles in our house. One of them is a smart phone and the other three are simple mobiles. The smart phone is with my son and he uses the internet on it. Sometimes we use it too, to call our relatives who are abroad.*

Seasonal Case Study Participant, Kata Bolandi, Dasht-e-Barchi, Kabul

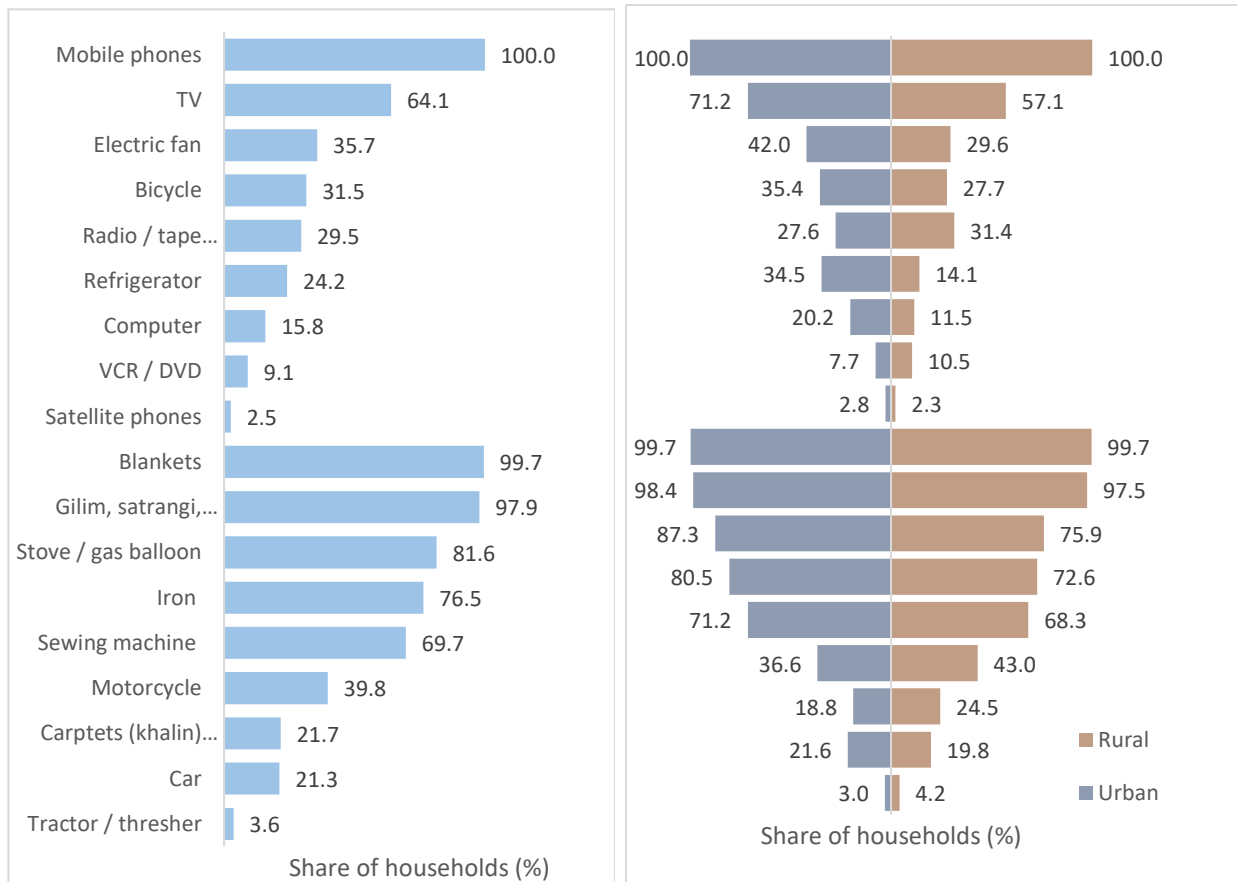
<sup>8</sup> Both are commonly operated without electricity.

Figure 30 A labourer leaps up a wood pile to grab his mobile phone, charging on a solar panel set. Kabul



The second most common electrical appliance is television (64%), followed by electrical fans (36%). About 29% of households own a radio or tape recorder, and 24% own a refrigerator. Urban households are more likely to own more electrical appliances than rural households. The largest gap is reported for refrigerators; over 1 in 3 urban households own a refrigerator, against only 14% of rural households (Figure 31).

Figure 31 Share of households by appliances owned





Ownership of electrical appliances increased steadily across the longitudinal data collection year (Figure 32). Ownership of television showed the fastest growth (from 66.8% of total respondents in June 2018 to 76.1% in May 2019), followed by electric fans reaching over 45% by the end of the period. Refrigerators – a higher load appliance - also showed steady growth, reaching 29.5%.

Figure 32 Ownership of electrical appliances over time (overall)

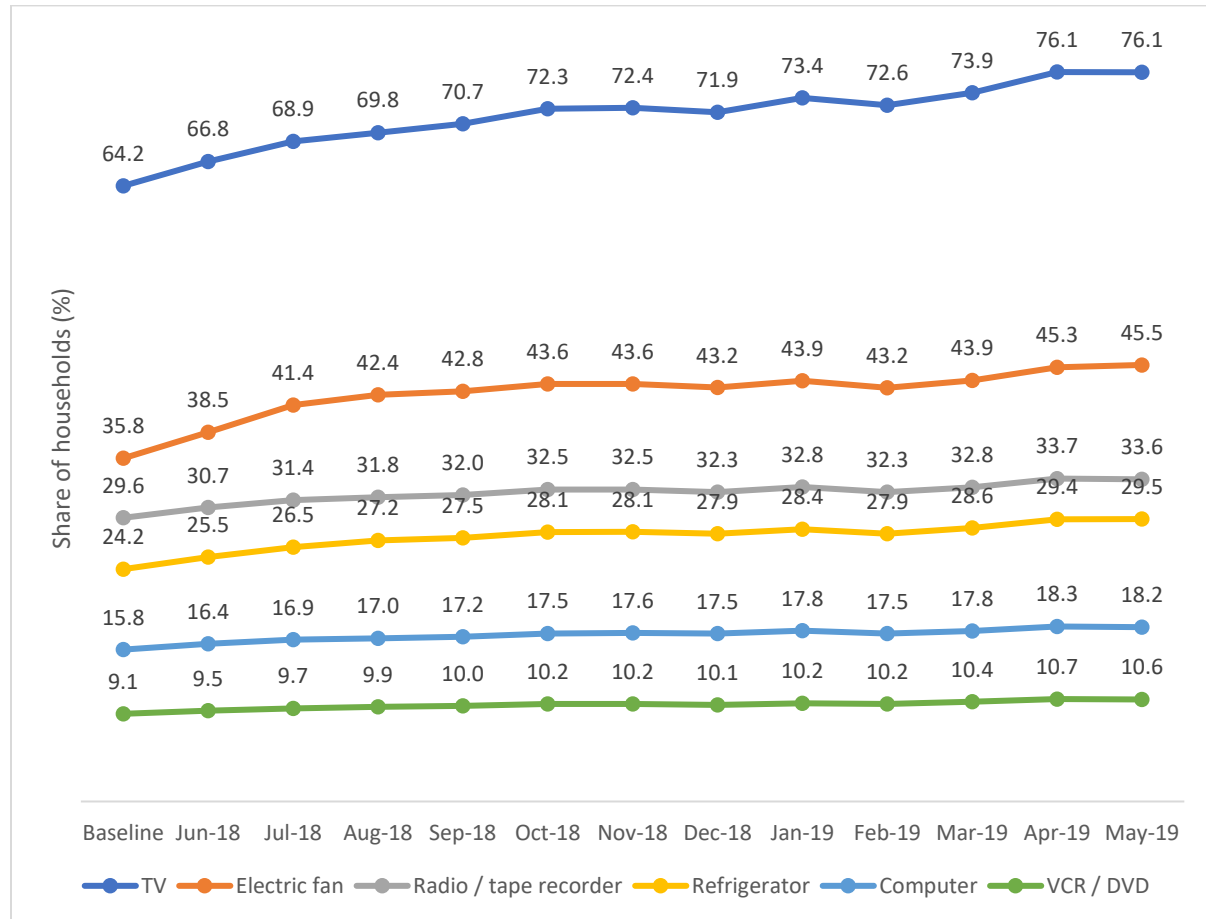


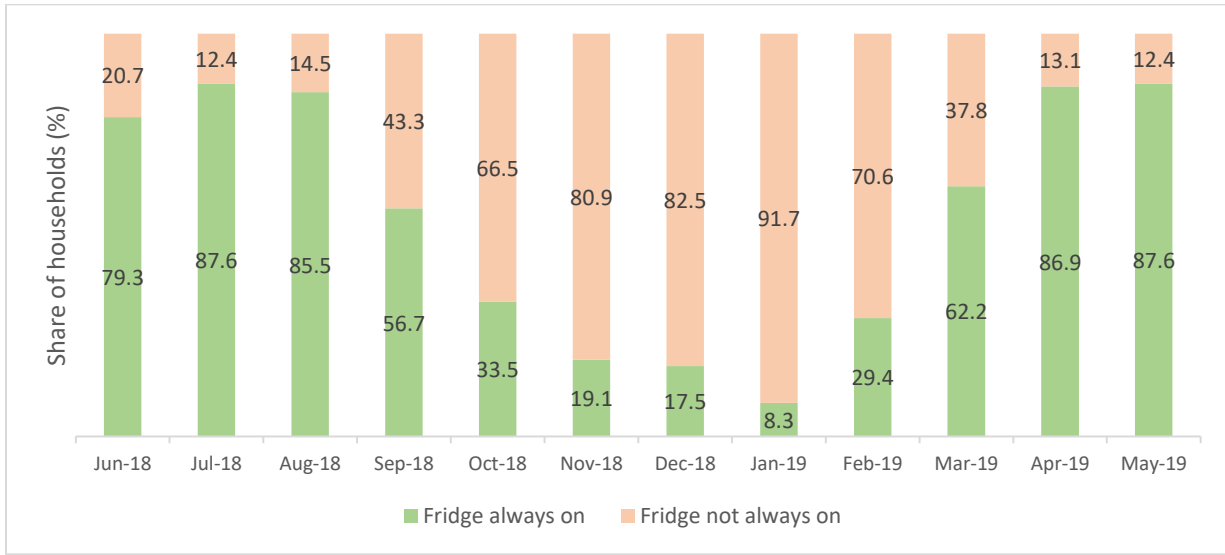
Figure 33 Most useful in the summer.



The use of a television and radio/tape recorder is fairly stable around the year, at approximately 4 hours per day and 3 hours per day respectively. Unsurprisingly, the use of electric fans is seasonal. Households use them during the hotter times of the year (mainly from May to August), for up to 9 hours per day on average.

The use of refrigerators is also seasonal. The majority of households unplug their fridge from October to February, where perishables can be stored in the cold weather without risk of being spoiled (Figure 34).

Figure 34 Seasonal use of refrigerators



### Soap dramas, religious shows and news – Television in Afghanistan

Along with mobile phones, televisions are transforming how households and communities in Afghanistan receive information. The level of television ownership is both demonstrative of the expansion of electricity access in Afghanistan in general, and of television as a major use of electricity at the household level.

Television featured prominently in qualitative research discussions on how households use - or would like to use - electricity. The television was switched on at an average of four hours per day, with most members of the house; male, female, and children, watching television shows of some kind throughout the day.<sup>9</sup>

Figure 35 Children watching a nature show, Jebrael, Herat



Information and learning on Afghanistan and the wider world was a common positive theme highlighted by many research participants when discussing television. More ambivalent was the ability to keep children entertained inside the home, seen as a benefit to parents who wanted to limit their children's time outside. Some scepticism was also voiced: *"My kids usually watch dramas and entertainment programs and my husband mostly watches the news. (...) but I think it's all lies. Nothing on the news is true."*

Television as an agent of social change and its impact on various social, economic and political processes continues to be a topic of research.<sup>10</sup> While there was much discussion in the qualitative

research about the advantages televisions have for families, the high numbers cited in the sample and increase over the panel data year show that television is most certainly a major appliance in the consumption of electricity across Afghanistan.

*I cannot say changes in energy aren't without impact, because when there wasn't electricity, we did not have any cellphones or televisions. We only heard that someone is our President, but when we got access to electricity, that was the time when we saw the face of the President. Through television, we got information about the culture of other countries, we saw news from around the world and our own country.*

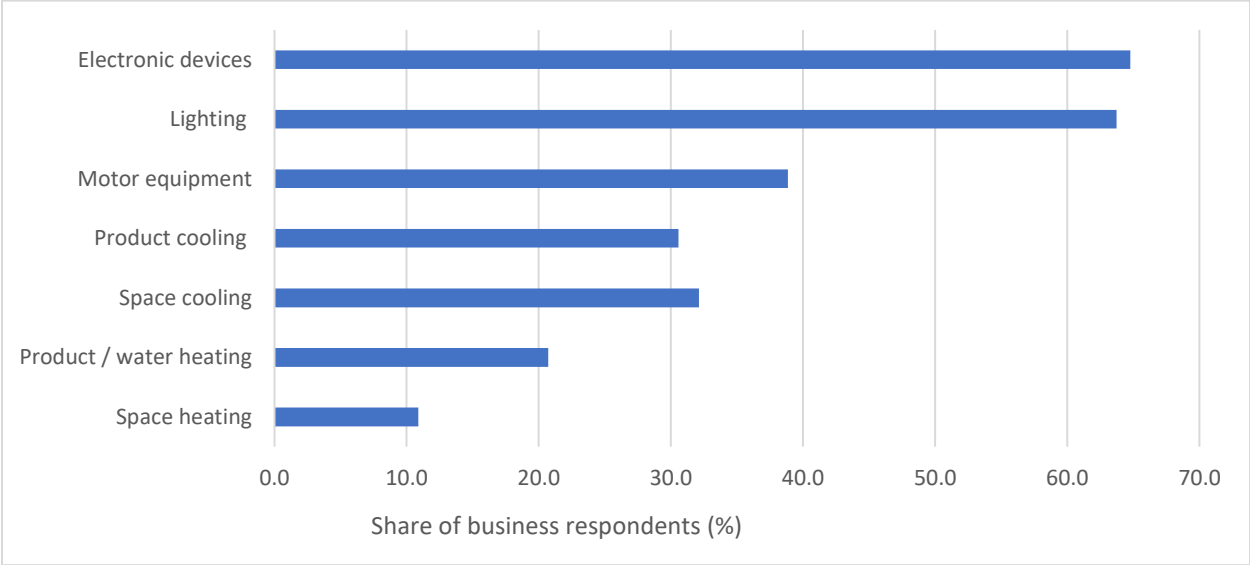
Female in Langar, Kabul Province

<sup>9</sup> This appears slightly incongruous with the many complaints about high electricity costs, especially for grid. This might align however with a DABS Key Informant Interview, where DABS officials opined that information campaigns for households were urgently needed on electricity consumption. The high number of television hours certainly demonstrated the high priority many Afghan families placed on watching television

<sup>10</sup> See for example, Johnson, K (2001), Media and social change: the modernizing influences of television in rural India from almost two decades ago, to the more recent La Ferrara, E (2016), Mass Media and Social Change: Can we Use Television to Fight Poverty?

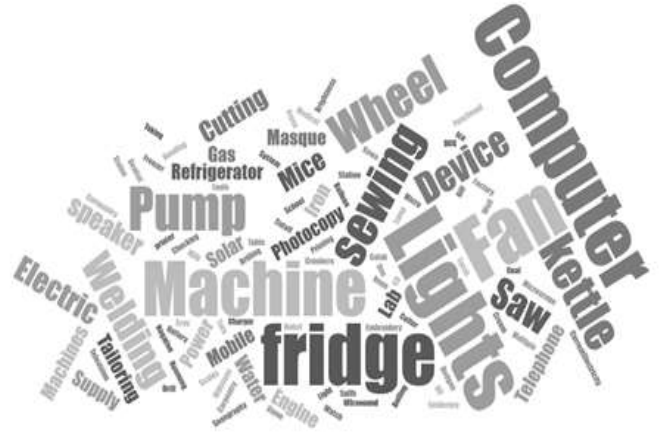
The wide range of **enterprises** and their multitude of varying tools; from ice-cream making machines, lathes, computers, to chicken coop equipment, provided an impression of the drivers of the Afghan economy. In terms of electricity usage, small businesses are not that different from households in that they need electricity mainly for lighting and to charge their phones. The most important uses of electricity according to business and community institution respondents are electronic devices, followed by lighting.

Figure 36 Business use of electricity



Tool usage is dependent on electricity supply. Contrasts in focus group discussions with businesses could be seen between communities with grid electricity and off-grid communities. Storekeepers in rural Samangan communities without grid access had aspirations to be able to cool and store more perishables – at the time not being able to stock dairy and other fresh produce because of the lack of higher capacity electricity for proper refrigerators. Many of the businesses in the same focus group discussion spoke of a desire for fans to cool their workspaces in the hotter summer months. Conversely, in Khair Khana in Kabul, where there is grid coverage, refrigerators are commonly used by shops. Here the most common concern are outages which could lead to produce spoiling.

Figure 37 Sewing machines in a tailor's shop, tools used by businesses



Different levels of tool usage and asset ownership were highly dependent on the energy solutions the businesses, community institutions and households in the sample employed. Ubiquitous items such as mobile phones could be charged using off-grid solar or lower capacity electrical solutions. Higher load tools such as welding machines, and appliances such as refrigerators, were much more dependent on accessing grid electricity or generators.

Figure 38 Street scene in Paktia



### 3) Access to Electricity for Households, Businesses and Community Institutions

Electricity is the major component of household and enterprise energy usage in Afghanistan and shapes the lives and livelihoods of people across the country. As the following chapter lays out, electricity is not only in a state- or more aptly, in states - of transition in Afghanistan, but also a factor in the lived experience of people (such in their entertainment and communications, in their ability to store food or keep cool in summer), which varies widely across households and communities. This variation is apparent even with households who have the same source of electricity: the experience of grid electricity heavily depends on where a household may be, with outage problems in Kabul being much more pronounced than Samangan. Off-grid solutions, solar being the most utilised by far, are changing how families light their homes and communicate with each-other and the world outside their villages or neighbourhoods. Afghanistan has seen a remarkable rate of electrification to at least some form of electricity.<sup>11</sup> This story, driven by the “solar miracle”, is explored further here, along with the nuances underlying the trend including the quality of electricity and its intersections with health, education and business usage.

*Figure 39 Grid transmission pylons on the right march from Central Asia to Kabul, through Samangan*




---

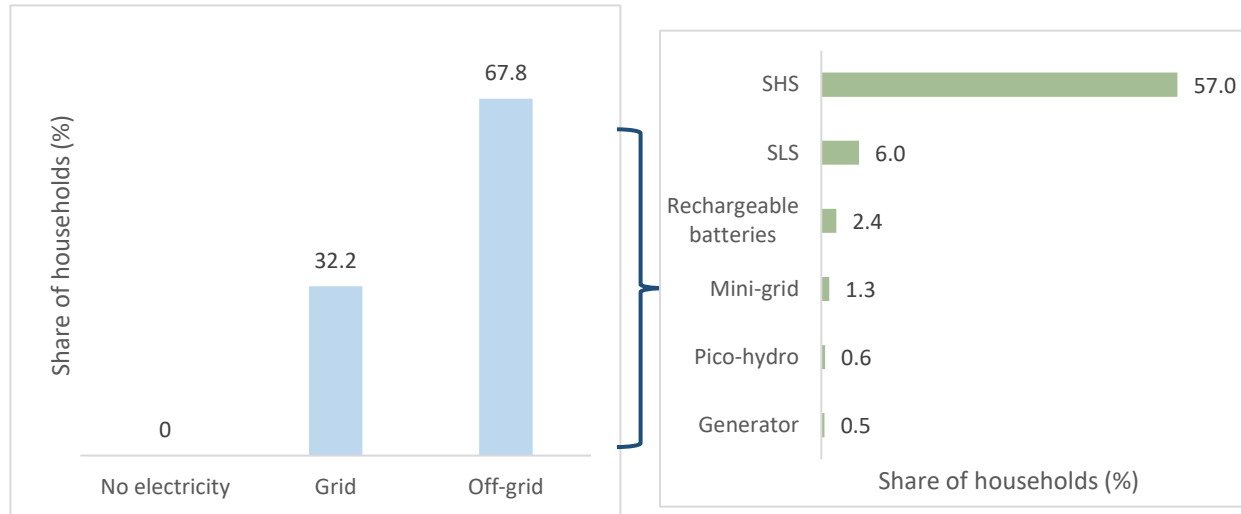
<sup>11</sup> World Bank data calculated the population access to electricity rate in Afghanistan at 42.4% in 2007. Sustainable Energy for All (SEforALL) and World Bank data sources had the population access to electricity rate at close to zero percent in 2000, rising to 42.4% in 2007 and again 97.6% in 2016. The latest rate from 2016 closely mirrors the results from the Household Energy Diaries.

## A. Overview of access to electricity

- **Households**

Approximately one in three households in the sample had access to the grid, while the rest used off-grid solutions – predominantly solar. No household in the sample reported a lack of electricity. Solar home systems (SHS) are the most common off-grid solution by far. About 57% of households use SHS as a primary source of electricity, while only 7.6% use a solar lighting system (SLS) (Figure 40). The share of households using other off-grid technologies such as generators, rechargeable batteries or pico-hydro is very small.

Figure 40 Share of households by primary source of electricity



Virtually all households connected to the grid use it as their primary source of electricity. The same holds for households connected to a mini-grid. However, off-grid stand-alone systems may also be used as secondary or back-up sources. About 14% of interviewed households use an off-grid solution as secondary source (Figure 41). The large majority of households with solar devices use them as primary source, but rechargeable batteries, pico-hydro and even more generators are mainly used as secondary sources (Figure 41).



Figure 41 Share of households by primary and secondary sources of electricity

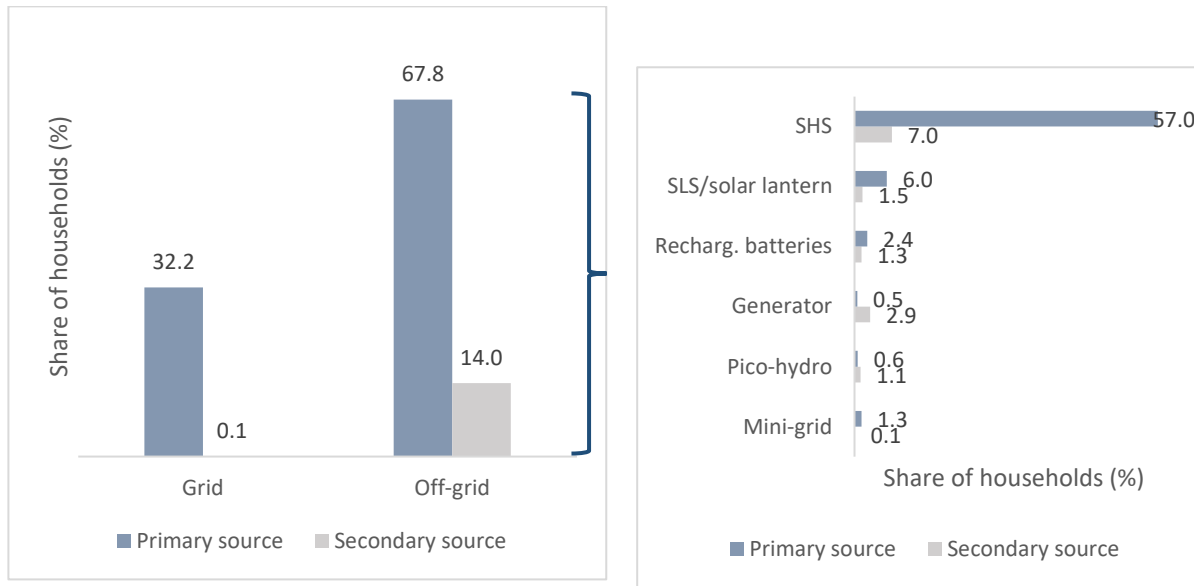


Figure 42 Bent poles or straight poles, grid is in high demand. Chawghai, Samangan.



Grid electricity was generally considered by respondents to be the best electrical solution available. While interviewee households did have a range of complaints in regards to their grid electricity, many respondents with solar were eager to connect to the grid with the expectation it would perform better for their electricity needs.

*We want to have access to national grid power that we could use appliances like an iron, refrigerator, fan, washing machine. We can't use any of them currently due to insufficient energy.*

Male, Khwaja Chasht, Daikundi

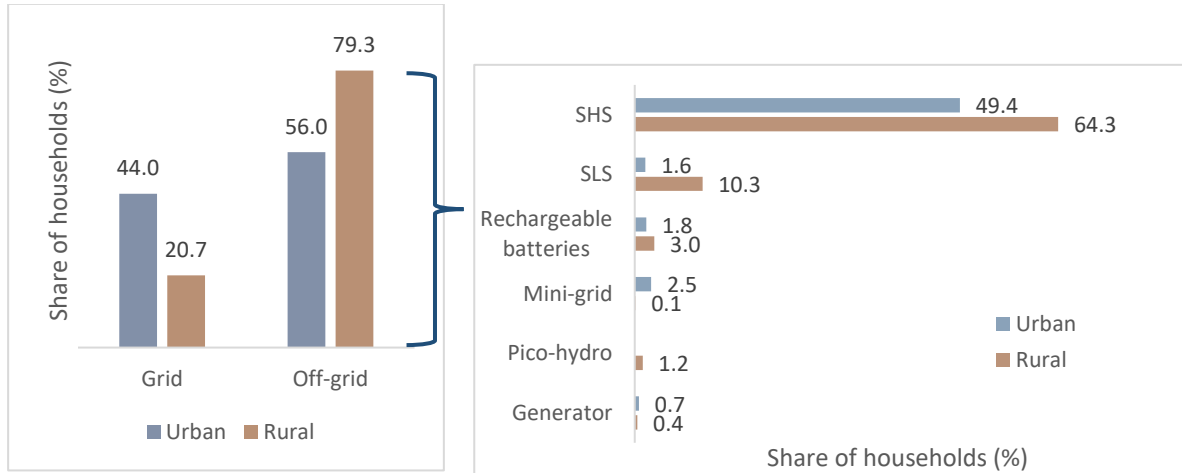
*We don't have any cooling systems like fans or a refrigerator because we don't have sufficient energy for this purpose. If we get connected to grid power, we will definitely use these appliances.*

Male, Mondokhail Paktia



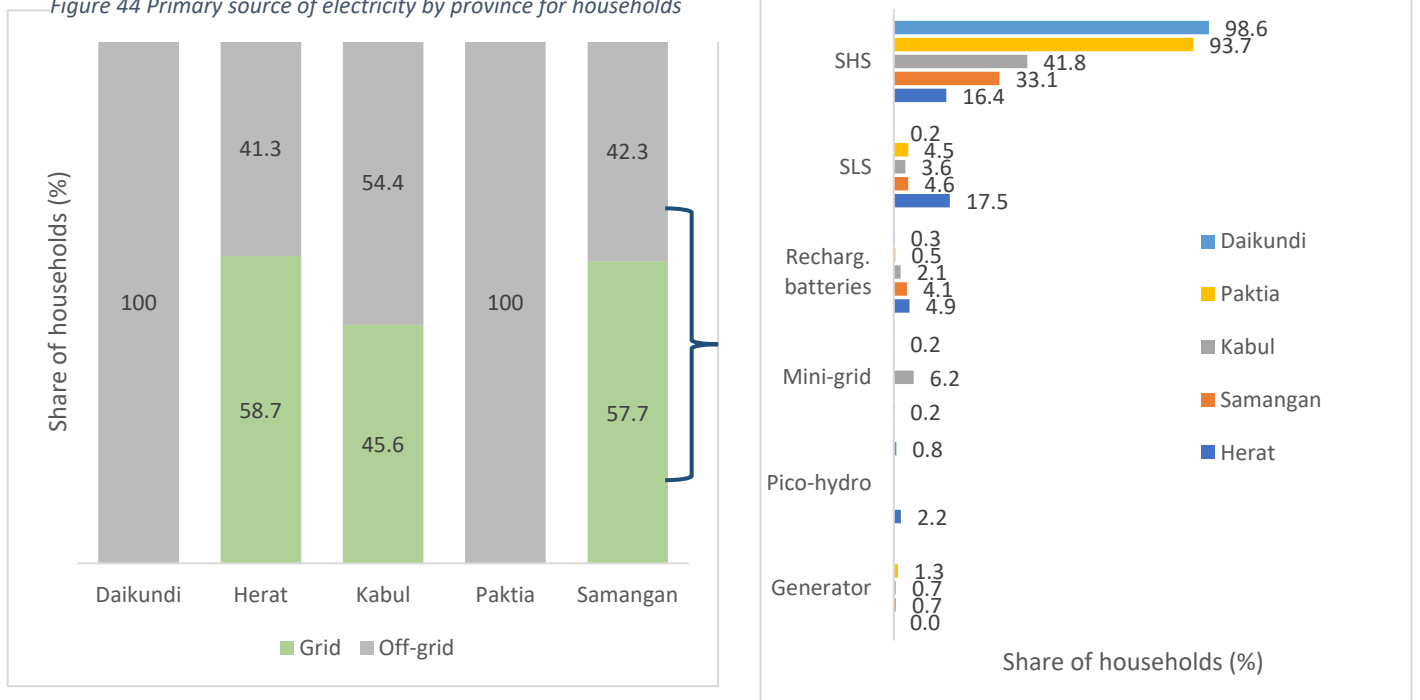
The grid is the primary source of electricity for 32% of respondents (44% of urban households and 21% of rural households). The remaining 56% of the urban households and 79% of rural households have access to off-grid electricity, mainly Solar Housing Systems (SHS) (Figure 43).

Figure 43 Share of households by primary source of electricity



There is no electricity grid in the sampled households in Daiikundi and Paktia (Figure 44). Overall penetration of grid in these two provinces as a whole remains low with grid electricity being supplied to a small number of businesses and community institutions. Grid electrification of households surveyed in the Energy Diaries study in Herat reaches 58.7%, in Samangan 57.7% and in Kabul 45.6%. In Daiikundi, almost all households (99%) use SHS as primary electricity source. In Paktia, the share of households using solar reaches 94% (Figure 44).

Figure 44 Primary source of electricity by province for households



On the surface, the richer a household, the more likely to have access to the grid.

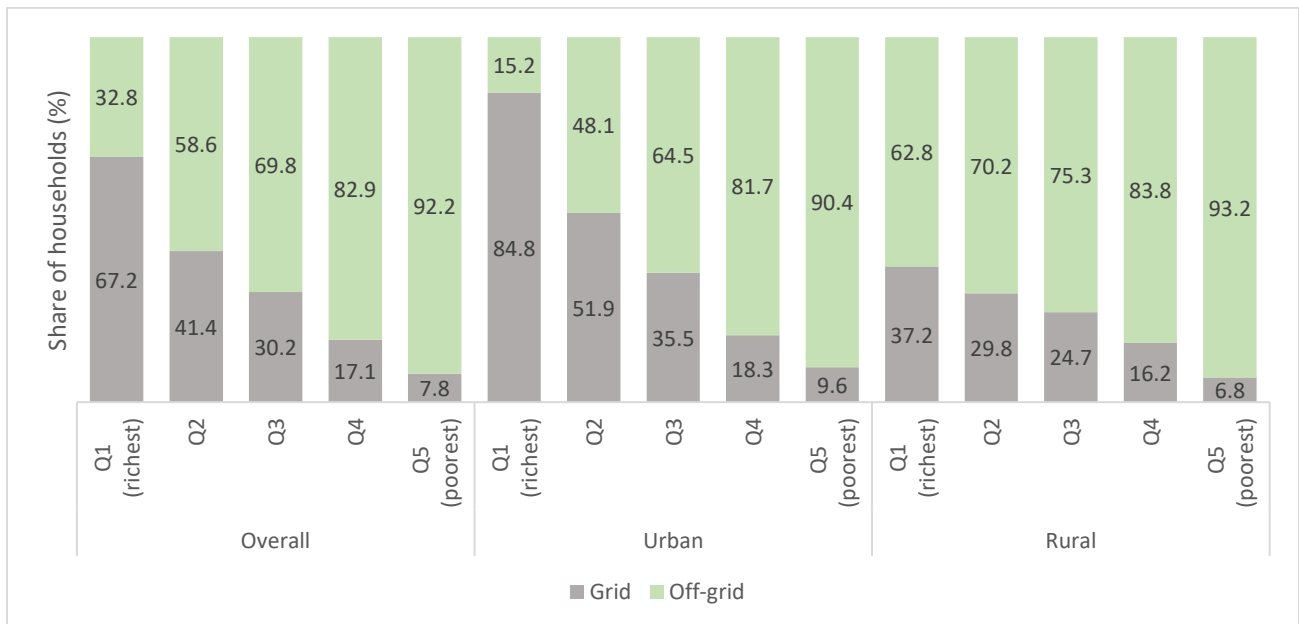
**Caveat: Asset-based wealth metrics and the grid**

The wealth quintiles developed for this study are based on a wealth index developed by the World Bank in the context of the 2016-2017 Afghan Living Conditions Survey. This index is built from a battery of indicators including ownership of an array of productive and durable assets. In order to be able in the future to project the results of our diary study from the five provinces under study to other contexts in Afghanistan, Samuel Hall and the World Bank Afghanistan Energy Team reproduced the set of asset ownership questions in the Energy Diaries Study Baseline component. The World Bank then ran province-by-province regressions of its wealth index against ownership of these assets and provided Samuel Hall with the model parameters. This allowed the research team to predict the wealth index scores of each of our respondents and rank them into five quintiles—the first estimated to be the wealthiest 20%, the fifth, the poorest 20%.

That said, the index was not originally intended to compare wealth in the context of a connection to the grid or lack thereof. Indeed, in some provinces, the weight of a high consumption asset exclusively associated with grid connected households, for example, a refrigerator, predominated. The high weight assigned these assets precludes, in some provinces, households not connected to the grid from belonging to any but the lower two or three quintiles. As such, the wealth quintile is not an appropriate measure by which to compare *a posteriori* grid connected households to those not connected.

As such, over 2 in 3 households of the richest quintile have access to the grid, compared to only 8% of the poorest households. The gap is larger in urban areas than in rural areas (Figure 45).

Figure 45 Share of households by primary electricity source, by wealth quintile



Following households over the course of a whole year, this study witnessed the grid electrification of Afghanistan first-hand. Two out of the thirty total sampled communities reported that grid electricity became available in their areas over the course of the longitudinal study. Kata Bolandi (in Dasht-e-Barchi in western Kabul city), and Deh Yahya in Deh Sabz District - both in Kabul Province - were connected to the grid in late 2018. Interviewee households in the two communities then started connecting to the grid, as captured in the monthly diary phone surveys. The share of grid-connected households increased to 36.3%, up from 32.2% in the baseline (Figure 46). The increase was reflected in both urban and rural areas, from 44.2% to 48.3% in urban areas and from 20.9% to 24.9% in rural areas. The total share of households using off-grid technologies reduced correspondingly.

Figure 46 Share of households by primary source of electricity over time

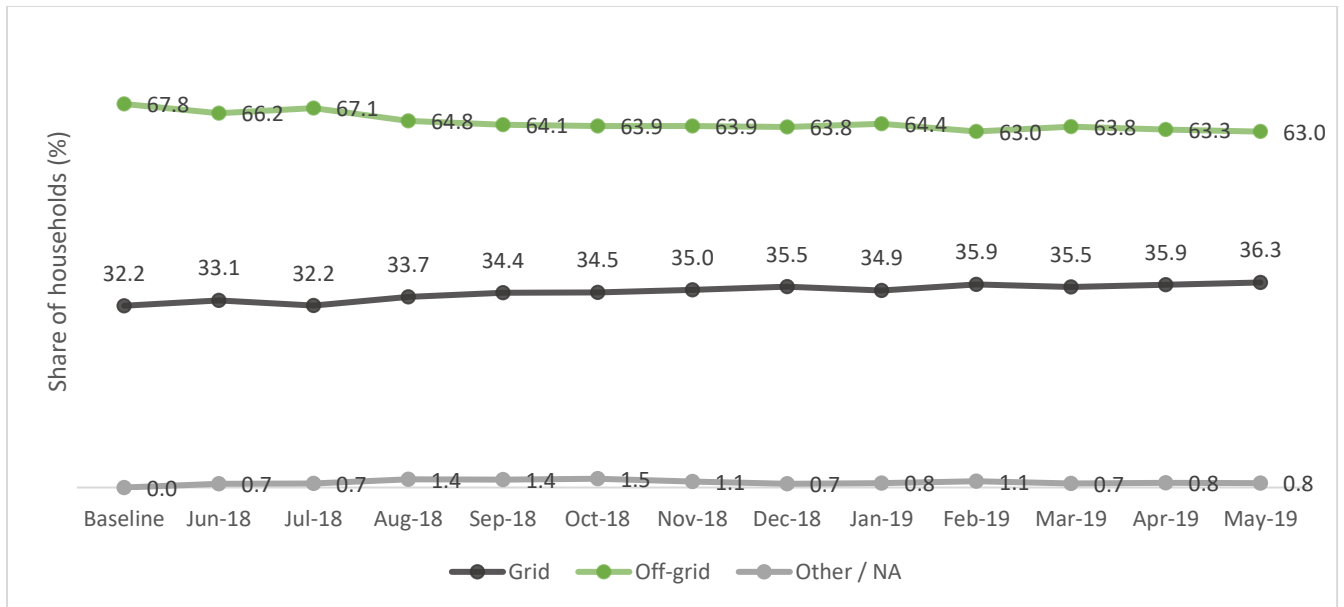


Figure 47 Newly connected grid lines across Kata Bolandi, Dasht-e-Barchi, in western Kabul. Many solar panels still on rooftops after the recent grid connection.



**Seasonal case study insights<sup>12</sup>:** The household in urban Kabul uses electricity more now that it is connected to the grid. As a backup, it keeps relying on a solar panel. Solar is mainly used for lighting and charging phones, while grid is also used for powering the television. Previously, when relying only on a mini-grid, electricity was only available for four hours every evening. Today, it is technically available around the clock, though in practice it often cuts out. Officials and local politicians are held responsible for power cuts.

<sup>12</sup> The Seasonal Case Studies component of the research was a qualitative deep-dive with 10 households (two in each of the five provinces), four times throughout the year corresponding to each season. The seasonal case studies ran concurrently with the panel call centre year. They are presented in full in an annex to this report.

### Comparisons to the Afghanistan Living Conditions Survey (ALCS)

Since 2003, the Afghanistan Central Statistical Office, with the support of donors, has been carrying out a comprehensive survey of the population at approximately 2-year intervals. The Afghanistan Living Conditions Survey (ALCS), formerly the National Risk and Vulnerability Assessment (NRVA) collects data from over 30,000 households regarding a number of issues related to age and gender, family size, housing, income and employment, asset ownership, and energy use and access. The survey undertaken under the Afghanistan Energy Study was intended to dig more deeply into the specifics of energy use and expenditure over an extended period of time. The sample was approximately one-tenth the size of the ALCS and for logistical and security reasons was confined to a more limited geographic area. Hence, the findings are not directly comparable with those of the ALCS.

Nevertheless, the findings of the most recent (2016-2017) national survey largely validate the results of the current survey. The table below summarizes the ALCS responses to the questions related to electricity access, including grid access and use of alternatives.

|                  | % population with access to Electricity from grid | % population with access to Electricity from generator (government, community, private) | % population with access to Electricity from renewables (solar, wind) | % population with access to Other (dynamo, battery) |
|------------------|---|---|---|---|
| National         | 30.9  | 2.1   | 59.8  | 18.3  |
| Urban            | 91.9  | 4.9   | 15.9  | 8.2   |
| Rural            | 11.9  | 1.2   | 73.4  | 21.5  |
| Poorest quintile | 10.6  | 0.2   | 69.1  | 21.7  |
| Quintile 2       | 13.5  | 0.5   | 74.5  | 22.0  |
| Quintile 3       | 22.7  | 1.4   | 69.7  | 20.8  |
| Quintile 4       | 38.6  | 2.3   | 56.9  | 16.4  |
| Richest quintile | 67.8  | 6.0   | 29.8  | 11.0  |

Overall, figures for access to the grid are similar under the two surveys. While there is some double counting in the figures

for access to other sources (respondents were allowed to mention more than one alternative), the national survey confirms the relatively low use of generators and the high reliance on solar and wind.

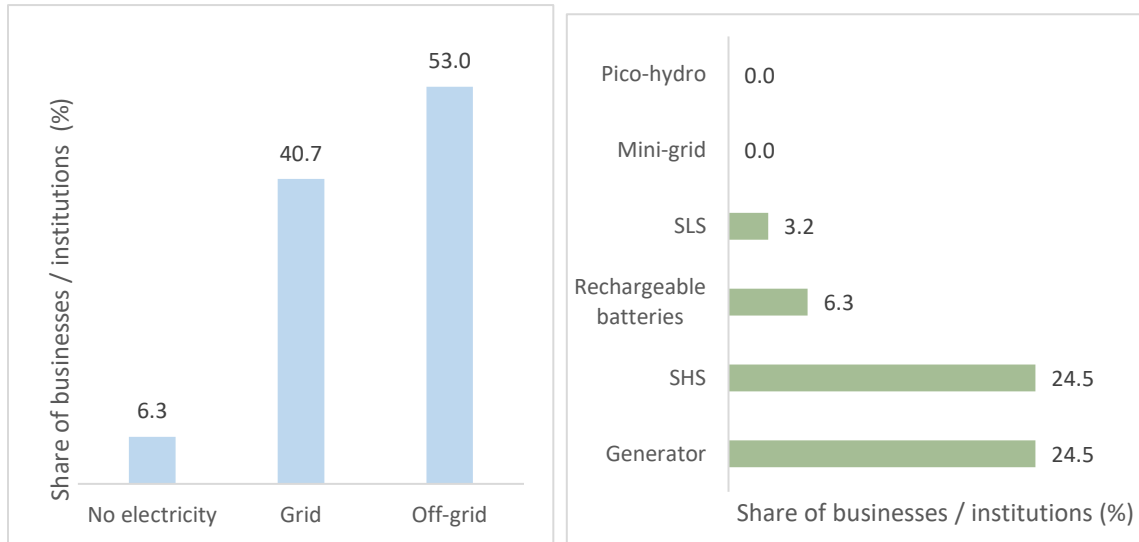
The ALCS also confirms the smaller survey's findings that access to some form of electricity is nearly universal. The table below summarizes the ALCS responses to questions related to the household's source of lighting. Electricity dwarfs all other alternatives. In addition, where qualitative responses were provided to "other" sources of lighting, battery powered lamps and torches were among the most common options noted.

|                  | % Population with access to Source of lighting: none or candle | % population with access to Source of lighting: electricity | % population with access to Source of lighting: gas | % population with access to Source of lighting: fuel | % population with access to Source of lighting: other |
|------------------|--|---|---|--|---|
| National         | 0.4  | 93.2  | 1.4   | 1.4  | 3.6   |
| Urban            | 0.2  | 98.7  | 0.7   | 0.0  | 0.4   |
| Rural            | 0.5  | 91.5  | 1.6   | 1.8  | 4.5   |
| Poorest quintile | 1.0  | 92.3  | 1.2   | 2.5  | 3.0   |
| Quintile 2       | 0.3  | 90.2  | 1.9   | 1.7  | 5.9   |
| Quintile 3       | 0.6  | 91.8  | 1.5   | 1.2  | 5.0   |
| Quintile 4       | 0.2  | 94.4  | 1.4   | 1.2  | 2.8   |
| Richest quintile | 0.1  | 97.3  | 0.9   | 0.4  | 1.2   |

- **Businesses and Community Institutions**

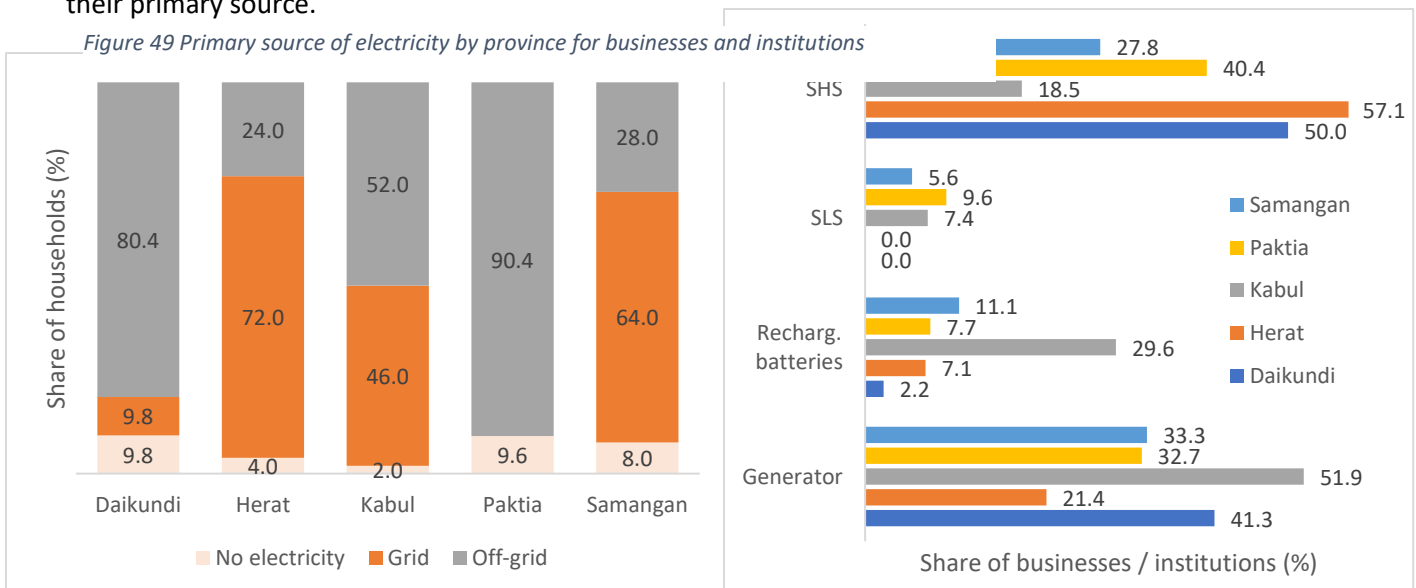
Electricity sources for businesses are closely linked to the type of work that business does. Higher electricity intensive work such as metalworking and carpentry will usually require grid electricity, or in the absence of grid (due to it not being connected in the area or due to outages), generators. Small retail shops however may only need solar electricity for lighting and for charging mobile phones. Some businesses use a mixture of different electrical sources.

Figure 48 Sources of electricity for surveyed businesses & institutions



Businesses electricity sources are characterised by a much higher level of generator usage compared to households. 40.7% of interviewed businesses and institutions have access to the grid, while the rest rely on off-grid solutions. Here the picture differs markedly from households: 28.5% of surveyed businesses and institutions have a generator as their primary source of electricity, while only 27.9% rely on solar as their primary source.

Figure 49 Primary source of electricity by province for businesses and institutions



Back-ups to the grid are also more common amongst businesses compared to households. While a household may be able to get by without their electrical appliances for periods of time, many businesses will lose productive hours and the use of tools. 6% of business and community institution respondents reported having no electricity whatsoever.

*For our power now, we pay between 200,000 and 300,000 AFN per month for city [grid] power, not including the generator costs (...) A transformer would improve the quality and the amount of power we have access to, but we cannot install it - even if we pay for it, the government will not allow it. We understand this, because the government manages power across the city and diverting more power to us would mean a loss for others elsewhere in the city. (...) We would like to use solar for our power but have a big problem on this front - we could not find a solar company that could install a system that was sufficient to power all our needs. We also cannot spend a significant amount of money on solar when it may simply incur more problems that lead to more costs.*

*Ghalib University respondent, Herat*

**Non-electrified businesses and community institutions**

A number of businesses and community institutions responded in the survey that they had no form of electricity whatsoever – neither grid, nor generator, nor solar. While still a relatively small number, this was a much higher percentage than households, who would at the very least own a cheap solar panel and battery set. The majority of institutions without any source of electricity were schools, mostly in rural areas.

*We have lighting in the shop, but not at my school. There is no energy at our school.*

Child in Sang-e-Moom, Daikundi, Seasonal Case Studies

Almost all of the remaining completely non-electrified enterprises were small retail businesses such as small vendors, selling food and everyday goods. One was a tailor, ostensibly using manually-powered tailoring machines, and the last was a cosmetics business.

*We don't use electricity for anything in the shop. We close our shop in the evenings because we don't have light in the shop. We have a refrigerator but is not connected to electricity - we put ice pieces inside the refrigerator to keep the drinks and water cool. We do use a sandali for warming in the winter.*

Small business owner, Talkhaki, Samangan

Figure 50 Weaving carpets without electricity in Samangan; and underneath, a rural mosque



## B. Grid-connected households, businesses and community institutions

The Afghan government and international partners have expended significant effort on expanding the supply of grid electricity in Afghanistan. Rates of grid electrification are rising overall, with increasing supply from both indigenous production and imports, as well as investments and construction in the distribution network.<sup>13</sup> The performance of grid electricity is a prevalent concern, with experiences varying across the provinces and respondent households and enterprises within the sample.

### a) Access to the grid and secondary electricity sources

#### • Households

The vast majority (90.1%) of grid-connected households used the grid as their only source of electricity. The share in rural areas is slightly lower, but still quite high at 87.2% (Figure 52). Due to the lower performance of the electricity supply in Kabul, only 77% of households use solely the grid for electricity (Figure 52).

Figure 51 Solar panels and grid-lines in Kata Bolandi, Kabul



Qualitative examples offer a comparison between Kabul province and Samangan province : In Yakatoot, Samangan, key informants in the community profiling phase indicated that households began to sell their solar home systems after being connected to the relatively reliable grid three years prior to study (in approximately 2015). In Kata Bolandi, Dasht-e-Barchi, in the west of the city of Kabul, the Seasonal Case Study household continued to use their solar device as a back-up to the grid, after connecting in 2018.

*It has been few months that we have had access to grid electricity... In the case of power cuts, we use our solar power and mobile phone lights... For example, we didn't have electricity last night. We used solar power.*

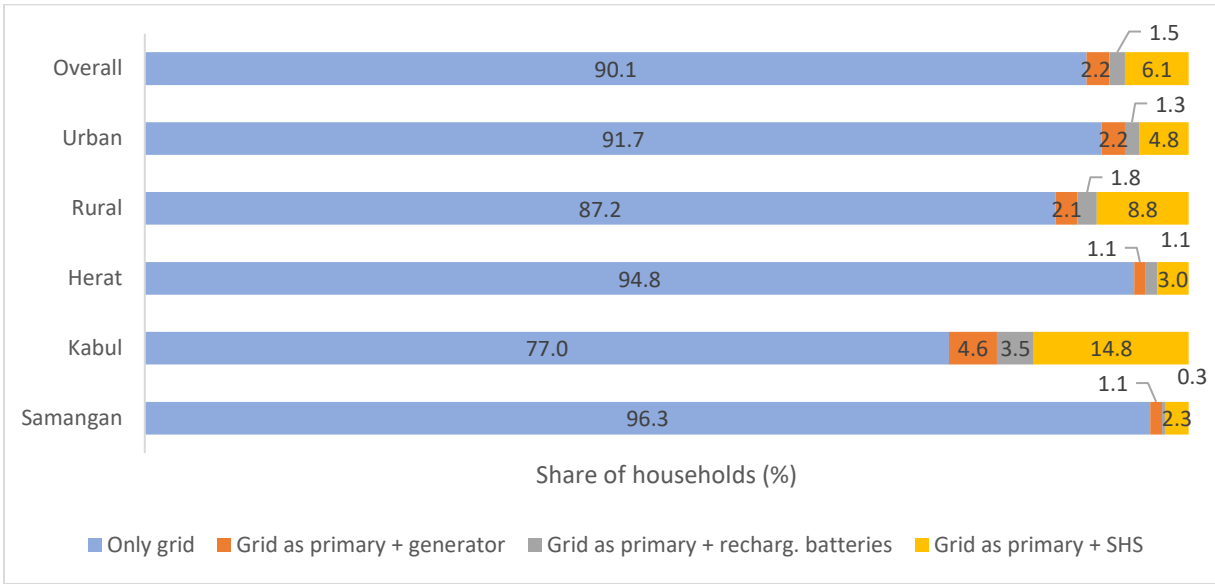
Female, Kata Bolandi, Dasht-e-Barchi, Kabul.

The most common secondary source in grid-connected households are SHS, reaching 6% of households overall – and close to 15% in Kabul. The second most common secondary source are generators with 2.2% of households (Figure 52).

<sup>13</sup> Indigenous electricity generation examples include the Afghan-India Friendship Dam (formerly called the Salma Dam) in Herat opened in 2016, the restart of one of four turbines at the Naghlu Hydropower Plant in 2018, the first phase of Kajaki Dam plant in Helmand and numerous other completed, ongoing and upcoming power generation projects. Increasing imports refers to multiple agreements the Afghan government and DABS have made, including between 2015 and 2019, with Central Asian Countries to boost electricity supplies.

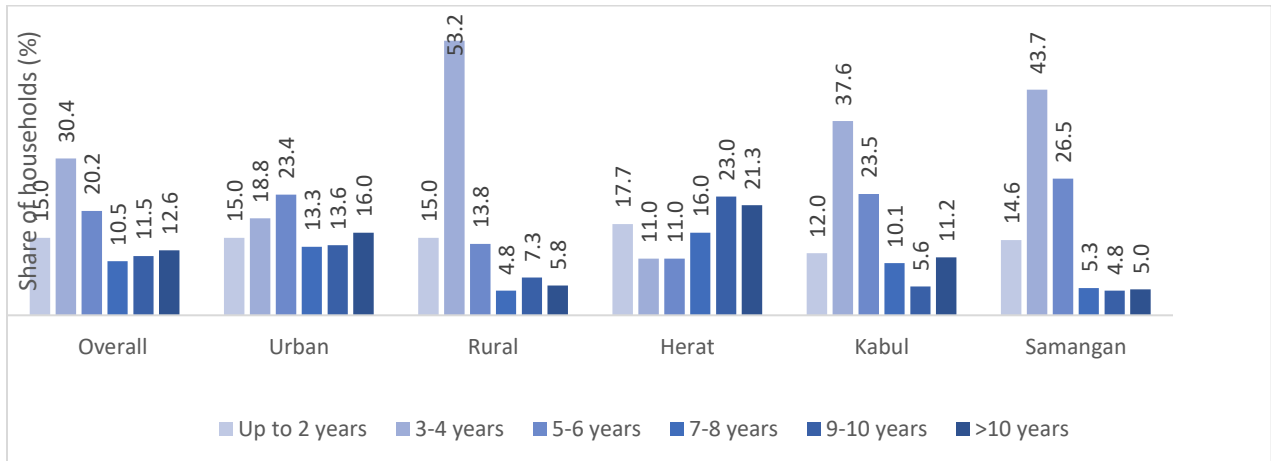


Figure 52 Share of grid-connected households by secondary electricity source (overall, urban/rural, by province)



Approximately 45% of interviewee households have been connected to the grid during the last 4 years, driven by recent grid electrification efforts (Figure 53). Herat has been electrified for the longest time, while electrification in Samangan is more recent. A grid electricity substation was opened near Gardez, the capital of Paktia in 2018.<sup>14</sup> However, no household respondents in the Paktia sample indicated across the longitudinal data collection that they had connected to the grid. Daikundi province has a small grid that supplies large commercial businesses such as hotels and government institution complexes as universities, but not households. As in Paktia, no household interviewees responded that they were connected to grid electricity.

Figure 53 Share of grid-connected households by number of years connected (overall, urban/rural, by province)



<sup>14</sup> DABS, 2018, [Opening Ceremony of 220 KV Power line and 220/20 KV of Gardez’s Substation](#), April 1, 2018



Figure 54 Transmission poles without grid-lines, near to the Gardez Substation in Paktia Province

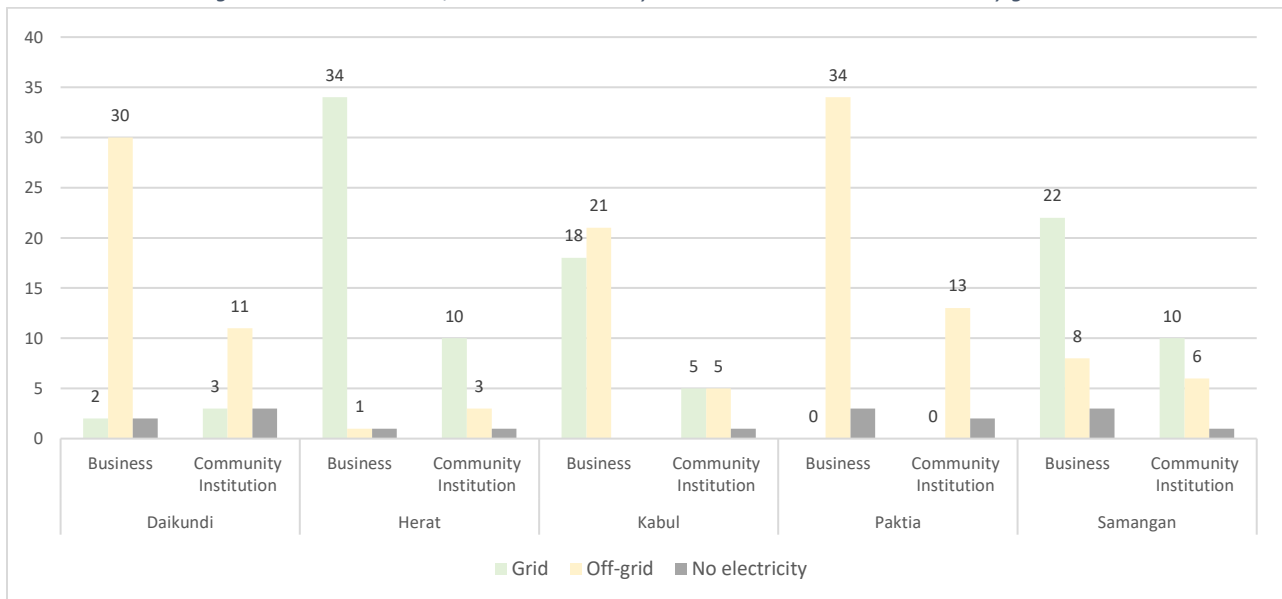


- **Businesses and community institutions**

Grid connection for businesses and community institutions, like for households, was almost entirely dependent on the community and provincial access to the grid. This means that businesses and community institutions in provinces such as Paktia must get by without connecting to the grid, turning to other electrical solutions to power their operations (Figure 55).

Five respondents (two businesses and three community institutions) reported they accessed grid electricity in Daikundi (Figure 55), a province where no households had indicated they used grid. DABS provides electricity to some larger businesses and community institutions in Nili, the provincial capital of Daikundi, through a diesel generator. This includes the five enterprises in the sample, all located proximate to Nili and who responded that they paid DABS for their electricity. DABS is also constructing further renewables electricity provision in Daikundi, including two hydroelectric dams and a 5.5MW solar project.

Figure 55 Is this business / institution currently connected to the national electricity grid?



### How do businesses get grid electricity?

This process, as regulated by the 2016 Electrical Energy Services Regulating Law, starts with the customer submitting an application to DABS. The application must include information on the property and on the type of activity requiring power. DABS sends inspectors to visit the site in order to verify the feasibility of the new connection and assess whether the power station has sufficient capacity. In the large majority of cases sufficient capacity is not available, and a new distribution transformer needs to be installed. Based on the results of the inspection, DABS approves the application and provides the customer with a list of the materials to be purchased, including the transformer. Once purchased, the materials are checked and approved by DABS. After they are approved, the customer's contractor can install the transformer. Alternatively, the connection works can be done by DABS. At this point the customer needs to buy and install a meter, and DABS visits the site to make a final inspection. The meter is locked, and the customer receives written permission to use electricity.

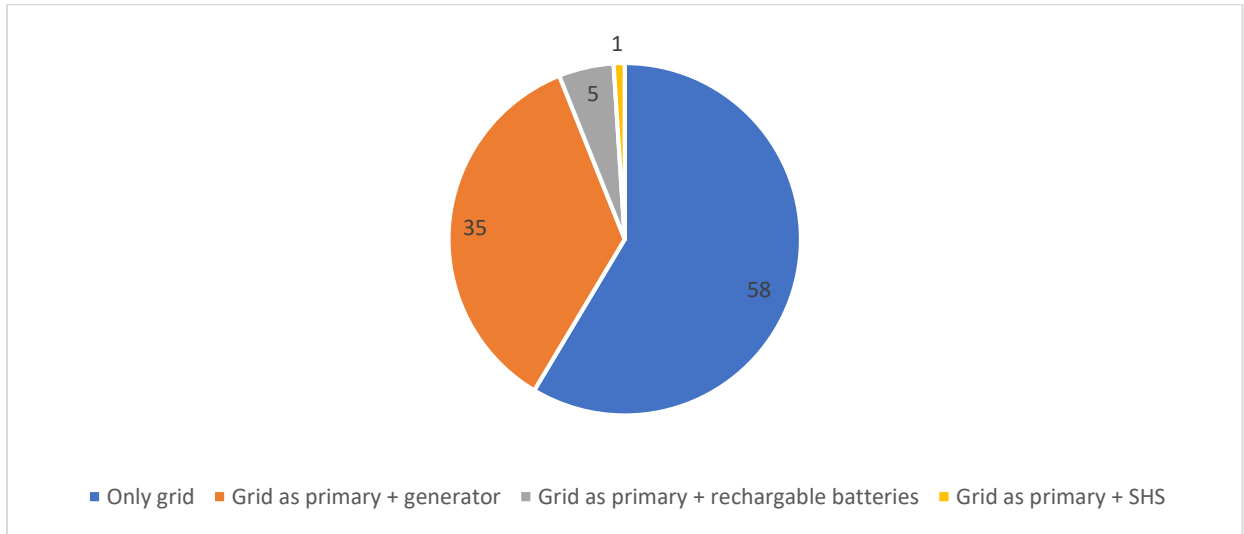
Source: 2017 Subnational Doing Business in Afghanistan Study, World Bank

*Figure 56 Sang-e-Moom, near Nili, Daikundi. Electricity lines stretch along the valley.*



58 businesses had grid as their only, and thus by definition main, source of electricity. There was one business who had access to the grid but did not use it as their main source of electricity - a miller in Yakatoot, Samangan, who had grid access, but who used a generator as their main source of electricity to power their millstone. A sizeable proportion (35%) of grid-connected businesses use a generator as a back-up (Figure 57).

Figure 57 Share of grid-connected business / community institution respondents by secondary source of electricity



b) Cost and usage<sup>15</sup>

- **Households**

About 85% of the grid-connected households in our sample have individual meters. Urban households are more likely to have shared meters. Shared meters are also more common in Herat (18%). Only a very small share of households (1.5%) have non-working meters.

Figure 58 Different sets of electricity meters administered by DABS



<sup>15</sup> The currency in Afghanistan is the Afghani. Within the report, *Afghanis*, *AFN*, and the shortened *Afs* are all used in reference to Afghanis. Equivalent estimates to US Dollars are provided at mid-2019 rates, US\$1 to AFN75-80 converted equivalence. One thing to note is the depreciation of the Afghani against the US Dollar and many other currencies over the decade prior to 2019 – meaning historical prices that may be quoted in the report may vary.

Grid electricity meters are read by DABS employees every two months, and then a bill is generated with the kW consumption amount and the associated tariff. The tariffs differ in every province, but the overall impression of research participants is that grid power is more affordable than many alternatives:

*At the time of mini-grid, the price was 45 to 50 AFN per kWh. But the grid is cheaper – up to 200 kWh, we pay 2-2.5 AFN. Above, up to 400, we pay 4 AFN. It goes up to 10 AFN per kWh.*

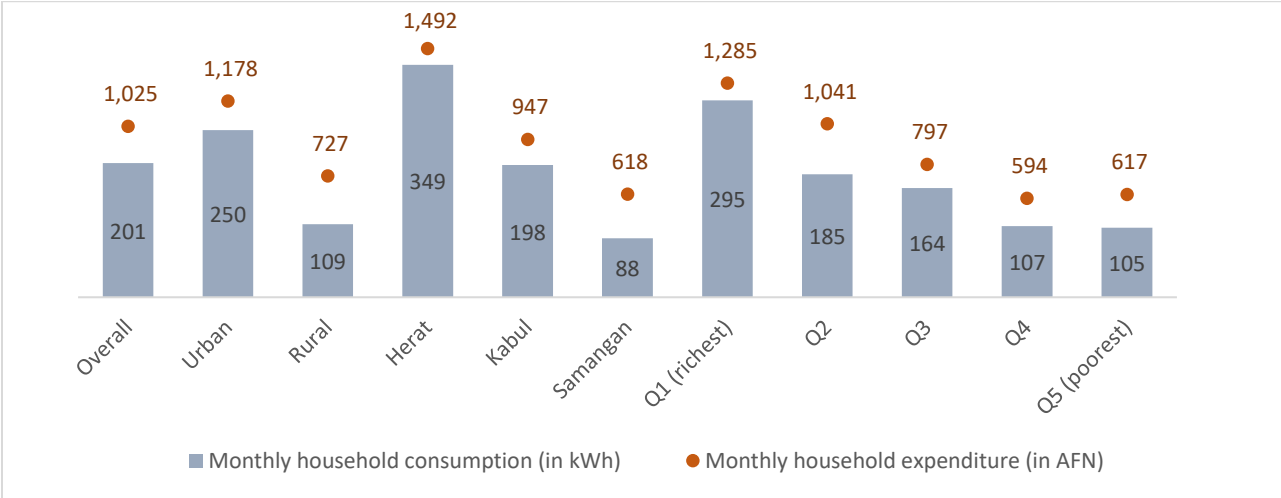
Male, Kata Bolandi, Dasht-e Barchi, Kabul

**Electricity Tariffs**

One source of difference between household expenditures on grid electricity is the regional differences in the end-user tariffs charged by DABS. For example, in Herat province, households pay a flat tariff of AFN 5 per kWh. In Samangan, by contrast, the household tariff is AFN 6.25 per kWh. Customers in Kabul pay an inverted block tariff. From 0 – 200 kWh per billing period (2 months), the tariff is only AFN 2.5 per kWh. It rises to AFN 3.75 per kWh for consumption between 201 and 400 kWh, and peaks at AFN 10 per kWh for consumption in excess of 2,000 kWh. The derivation of these tariffs and the reasons for the differences seems to have been lost in the past. DABS personnel have no clear explanation. Periodically cross-the-board percentage increases are implemented (although the last one was three years ago) but the fundamental structure does not appear to have changed significantly.

DABS, with the support of the Government, is working to modernize its tariff setting processes, with a view to having a new system in place by the end of the year. The inverted block tariffs in Kabul and some other jurisdictions will be eliminated and households will be charged a single rate for all power. Efforts will be made to eliminate inter-provincial differences except where these are clearly justified by costs. Tariffs will be adjusted at intervals not to exceed 18 months. Unfortunately, owing to the failure to make regular adjustments, DABS current tariffs are well below cost recovery and regular and substantial increases will be needed – in addition to concerted efforts to improve operating efficiency – in order to ensure the financial viability of the utility. As tariffs move towards cost recovery levels, it may be necessary for a time for the government to provide transparent transfer payments to DABS in order to smooth out the impacts on household expenditures.

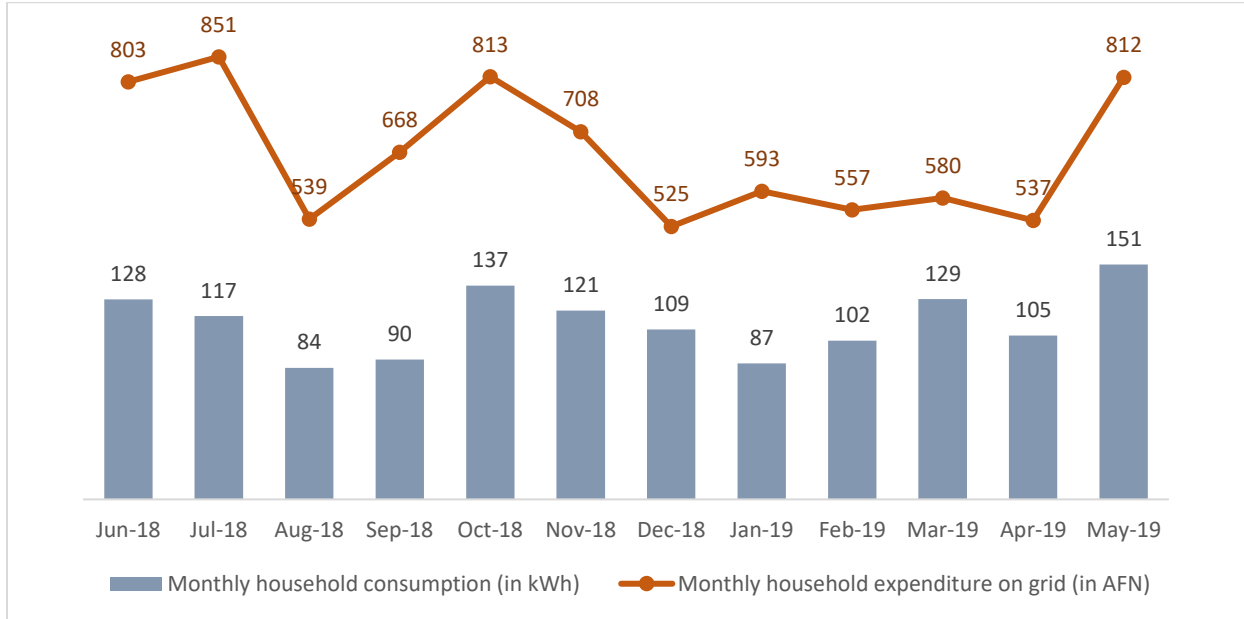
Figure 59 Reported monthly electricity consumption and expenditure of grid-connected households



Note: Q = quintile.

Electricity consumption and related expenditure varies across the year. **Households overall pay on average between AFN 525 (US\$6.70) and AFN 851 (US\$10.85) per month, for a consumption between 84 kWh and 151 kWh (Figure 60).**

Figure 60 Monthly household expenditure on, and consumption of, grid electricity over time (overall)



Urban households consume on average about 2.5 times as much electricity as rural households (250 kWh versus 109 kWh respectively). Also, the richest 20% of the households consume on average about 3 times as much electricity as the poorest 20%. There are also variations across provinces for grid electricity consumption. Households in Herat consume on average about 4 times as much electricity as households in Samangan.

*Nota bene: For a number of reasons, respondents were frequently unable to report exact usage and billing data. For the invoices, an added complication lies in the fact that amounts invoiced are often inaccurate.*

### The unit cost of energy

The chart to the right shows reported invoice amounts against reported usage over the previous month throughout the year. Many households report considerable invoices in the absence of any usage, perhaps reflecting fixed costs or passive power usage unacknowledged by the respondent. A linear regression shows fixed costs between 300 and over 1000 AFG, with the highest paid in Herat. Kabul respondents showed a higher marginal cost per kWh, though the overall cost remained below Herat's at all reported usage levels. If we assume fixed costs are nil, we find the following estimated cost per kWh:

- Herat: 5.01
- Kabul: 4.27
- Samangan: 5.5

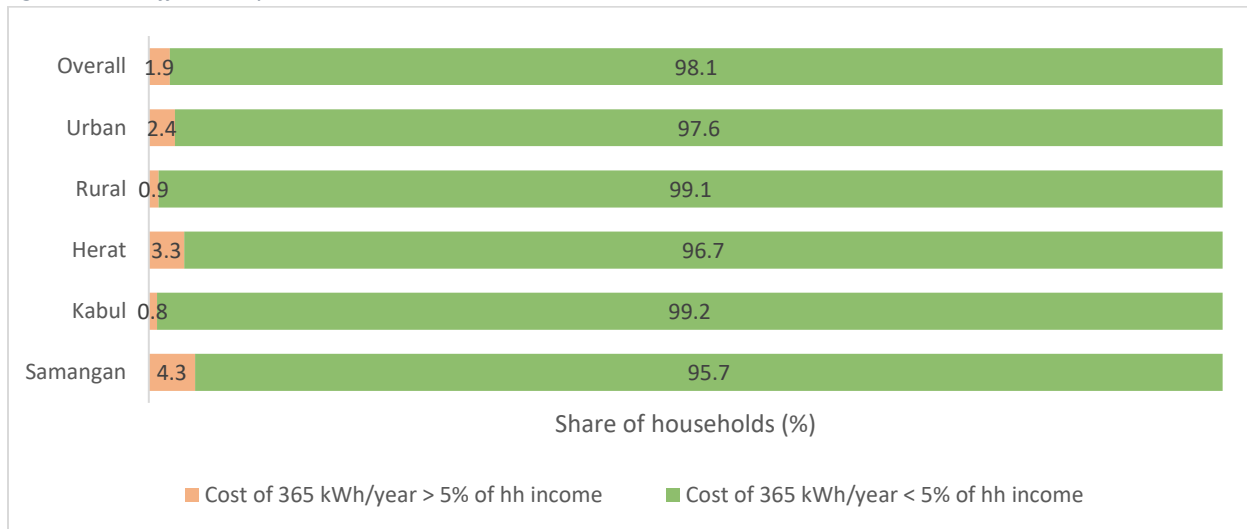


In line with World Bank Multi-Tier Framework standards, the **Affordability** of the electricity service can be determined by whether the cost of a standard consumption package of 30 kWh per month (corresponding to 365 kWh per year) exceeds 5% of a household's expenditure. The current cost of 365 kWh per year corresponds to AFN 1,440 in Herat, AFN 720 in Kabul and AFN 1,800 in Samangan<sup>16</sup> (corresponding to USD 18, USD 9 and USD 23 respectively).

Based on this standard, grid electricity in Afghanistan would appear to be eminently affordable. Overall, only 1.9% of grid-connected households cannot afford the standard package (Figure 61):

<sup>16</sup> The cost per kWh use is AFN 4 in Herat, AFN 2 in Kabul, and AFN 5 in Samangan.

Figure 61 Grid affordability



**Yet if the cost of energy compared to income appears low, this contrasts with both data from the quantitative survey as well as qualitative information from community profiling, focus group discussions and the seasonal case studies.** Half of the surveyed grid households responded that price was a serious issue with their grid electricity. While some interviewees in focus group discussions did agree that their energy was affordable, there were many complaints regarding the high cost of grid power - and it was often reported that households might use grid power only for lighting, or small activities like charging phones, due to the high cost of energy from the grid. In qualitative discussions, interviewees reported the challenges of high energy bills for grid power, though as with the responses to the quantitative survey, reported costs varied, as did attitudes toward how expensive power was.

*The problem is that it's very expensive now; before it was not that bad but now our bill is 1,200 AFN in a month. Our bill comes in every two months, my brother sends us money for it because my father is not able to pay that. (...) We manage because we are not very poor. But we still can't use the refrigerator and the washing machine.*

Women from Chawghai, Samangan

Figure 62 DABS invoice



Invoices are most commonly paid to DABS, either through a bank or trusted middlemen. It is not common for a household to pay the community or the landlord or a neighbour for the electricity supply.

14% of households reported meter reading as one of their main issues with their grid supply. In qualitative research, some grid users discussed frustration with billing, their consideration that DABS was not always considered a trusted intermediary, and that invoices were frequently inaccurate.



### Voices from Afghanistan: DABS invoices

*We have had grid power for a month and a half, and we have not received a bill yet. So, I honestly do not know what the cost will be. (...) One of my friends uses only one light and a refrigerator. His bill was 17,000 Afs. When we complained, people from DABS found that his bill was really only supposed to be 1,700 Afs -they just added a 0! If the people responsible make this kind of mistake, it will be difficult for people like us to pay their bills!*

*(...)*

*Our neighbours have washing machines, and they consume a lot of electricity. Their bill was 250 Afs. We do not have a washing machine, an electric iron or other big appliances. Still, our bill was 385 Afs. I went to talk to the person responsible, he came and read our bill and said we had been billed for 160 kWh when really, we had only used 124. He said we would be compensated with the next invoice. But I know the bill my neighbours received was very low, even though they consume a lot. I do not know how meter data collectors come up with these numbers.*

*Recent grid connected household, Dasht-e Barchi, Kabul*

### Businesses and community institutions

Getting connected to the grid is considerably more expensive for businesses than for households, both if the business needs to be connected to the more expensive 3-phase grid connection (at a cost of AFN 28,000 – 30,000 for connection, in contrast to the AFN3,500-6,000 for the 1-phase connection for households<sup>17</sup>), and due to higher tariff structures. Some of the respondents in the business and institution sample appear to be using single-phase connections with inferior performance:

*Our carpentry business highly depends on energy [-electricity]. All the machineries we have are run by it. We don't have a 3-phase energy connection to respond to our needs. Our neighbouring shops also don't help us they say the machines we have use a lot of energy. It's why we have to use a generator which really costs us a lot [300-350 AFN daily or 6000 AFN monthly in generator fuel]. When we asked the energy office to connect us to a 3-phase national grid connection, they asked us for between [AFN40,000 and 100,000]<sup>18</sup>, which we can't afford at all.*

*Carpentry business owner, Khair Khana, Kabul*

Across the total sample, one in ten businesses and institutions with grid electricity report using the same meter as others, with the number of other shared meter-users ranging from one to seven. Like households, businesses with grid electricity will pay DABS every two months through taking their bills to the bank or through M-PAISA (a mobile-phone based money transfer service).

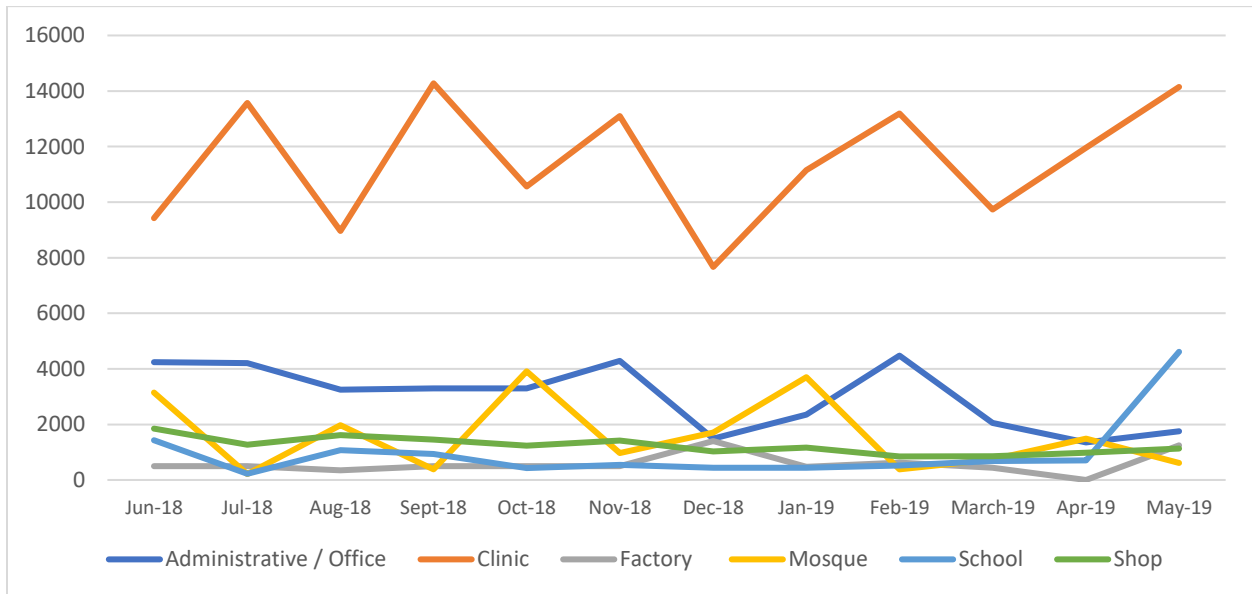
<sup>17</sup> Equivalent to US\$320-\$385 for the 3-phase business grid connection and US\$45-\$75 for households.

<sup>18</sup> Note that this amount is not in line with the quotes from DABS for 3-phase electricity at AFN28,000 to AFN30,000.

### Tariffs for business and institutions connected to the grid

Businesses pay a different, and higher, tariff than households. While household tariffs are tiered in some provinces, including in Kabul, commercial tariffs are usually the same regardless of consumption levels in the sample provinces where grid is available in Kabul, Herat and Samangan. In Kabul and Herat, shops, industries and machinery are charged a flat rate of AFN 12.5 per kWh (except for specifically registered industries charged at AFN 6.75); the Balkh-Samangan tariff structure has almost all non-residential users charged at AFN 16.88. Government offices in Kabul are charged AFN 13.75 per kWh (in Herat and Samangan, they are charged the same as commercial categories), while Holy Places are often charged at a lesser rate (AFN 5 per kWh in Herat, AFN 6.25 in Samangan and tiered in Kabul).<sup>19</sup>

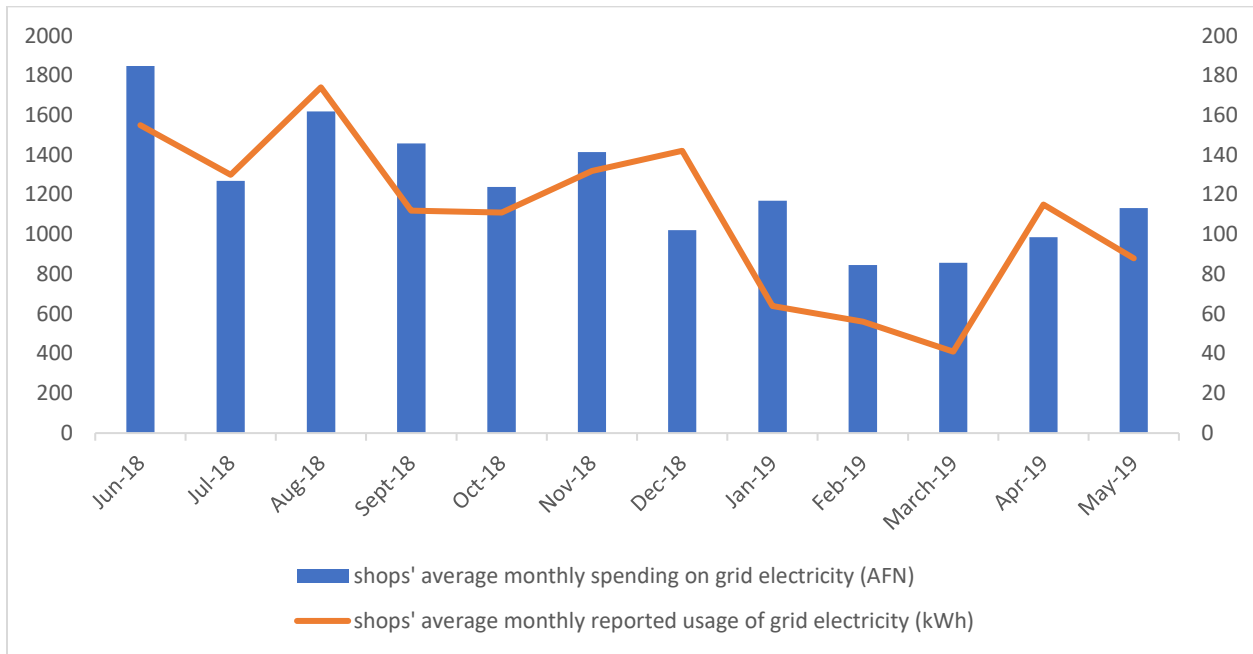
Figure 63 Reported monthly spending on grid electricity



Business and institution respondents were often unable to cite reliable data for their usage of electricity. The exception to this rule were shop-owners. For shops, a drop in use of, and spending on, grid electricity can be observed for the cooler months:

<sup>19</sup> Tariff structure summary provided by DABS, 2019

Figure 64 Shops' reported electricity use and spending



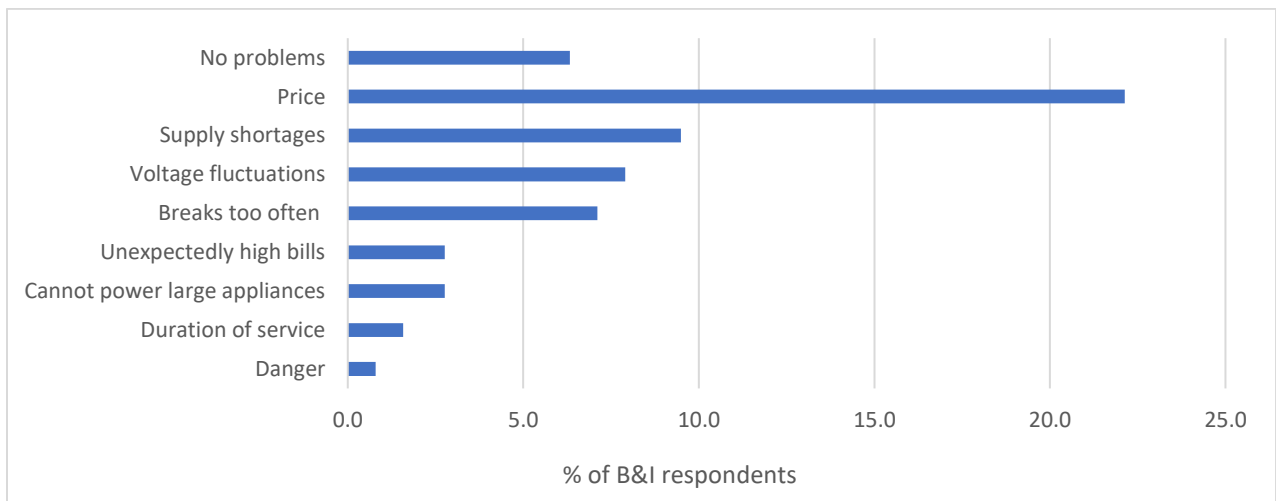
The interviewed business owners regularly spend a third of their monthly income on energy expenses.

*Monthly I allocate 35% of my income for the energy expenses. I make 1,000 AFN on good days, but 350 go right into my electricity bill! This is the only reason that I can't take my business ahead in a better and more advanced way.*

Owner of an internet café, Herat

The price of grid electricity is the most frequently cited problem that the interviewed business and institution respondents have with their energy solution:

Figure 65 Grid problems according to B&I respondents

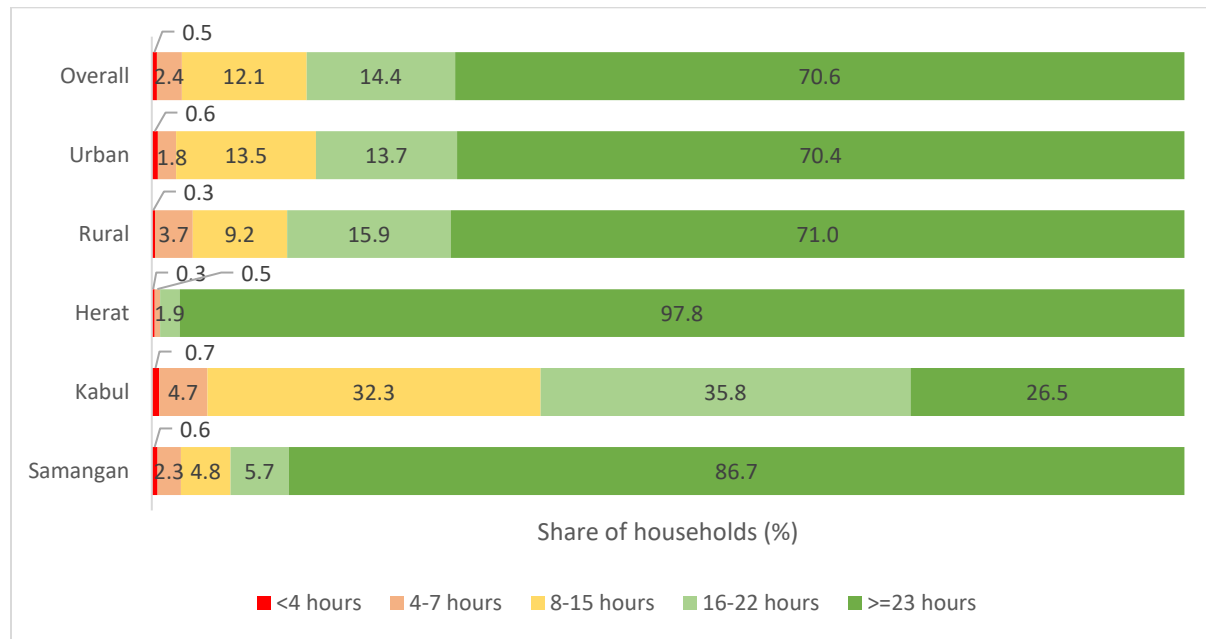


c) Grid performance

- Households

The **Availability** of supply refers to the amount of time during which electricity is available during a 24-hour day and in particular during the evening (from 6pm to 10pm). About 7 in 10 grid-connected households receive at least 23 hours of electricity per day. The situation is similar in urban and rural areas. However, in Kabul, only about 1 in 4 households receives at least 23 hours of electricity per day. Over a third of sampled grid-connected households in Kabul are electrified for less than 15 hours per day (Figure 66).

Figure 66 Share of grid-connected households based on Daily Availability (24-hour day)

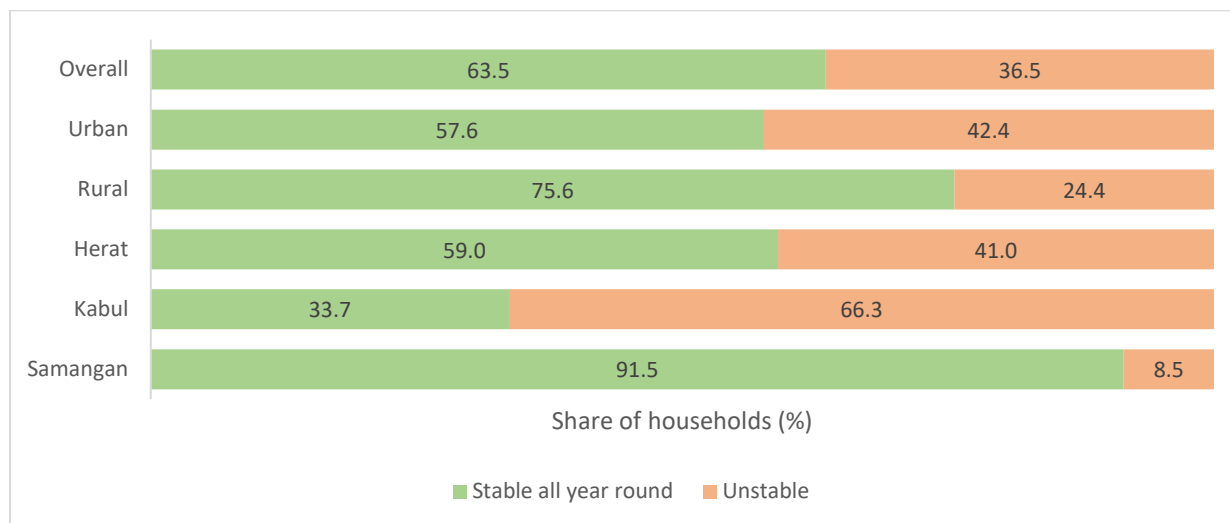


Electricity is available during the evening (from 6pm to 10pm) for over 9 in 10 households. However, households in Kabul are more likely to suffer from electricity shortages during this time period. The daily availability of grid can be seen in the juxtaposition between Herat (with almost all respondents reporting more than 23 hours of electricity per day) and Kabul (with only a quarter selecting 23 hours plus per day).

However, even if the grid performance is relatively good on an average day, **it suffers strong seasonal variations**. The performance of the electricity supply is stable across the year for about 2 in 3 grid-connected households. Urban households are less likely to experience available supply across the year than rural households (42% versus 24%). Electricity not being available across the year impacts 2 in 3 households in Kabul. In contrast, over 9 in 10 households in Samangan have similar electricity availability over the year.

Seasonality is a key aspect of energy consumption and affects usage patterns in multiple ways. Lighting needs change with differentials in daylight-hours (daylight hours increase approximately 1 hour each month over spring). Winter has a two-fold inverse effect on energy in provinces like Kabul - demand rises sharply while supply decreases (due to hydropower shortages for grid-supply).

Figure 67 Grid performance throughout the year



Jadi (January) and Dalwa (February) are the worst months in terms of electricity availability, impacting about one third of urban households and one fifth of rural households (Figure 67). Hot (March) and Qaws (April) are also problematic for households in Kabul.<sup>20</sup>

#### Voices from Afghan households

*Sometimes we wait for the grid to come back on all day long. During the winter, it often cuts out because of technical problems. During the day, in winter, we will often have only five or six hours of electricity.*

Karte Naw, Kabul

*The problem with the grid is that it is both expensive and weak. During the winter, there are many power outages. We need to turn on the generator for lighting, and use coal for heating, because the voltage is so low.*

Jebraeel, Herat

The **Reliability** of the electricity supply captures the frequency and duration of unscheduled (unexpected) outages. Reliability is adequate for about 3 in 4 households (which experience less than 4 disruptions per week of less than 2 hours). The situation is fairly similar across urban and rural areas. The province of Kabul is by far the most impacted by unreliable supply. Over half of the households in Kabul suffer from 4 to 14 disruption per week. These outages lasted an average of **9.1 hours per day** across the 279 households in Kabul who reported outages. In contrast, Herat has the most reliable electricity supply.

*“The energy shortage[s] cause us a lot of issues. Half a week we have no electricity and we are doing nothing.”*

- A small business owner in the 315 neighbourhood of Khair Khana, in urban Kabul.

<sup>20</sup> The Hijri Shamsi calendar months in common usage in Afghanistan were used in the surveys for ease-of-understanding by research participants. Equivalentents in the Gregorian calendar correspond to the largest cross-over in days for that month.

Power outages appear to follow some seasonality patterns. June and July 2018 appear to be the worst months, with over half of the households experiencing more than 4 outages per week on average, reportedly due to increased usage of electric devices during the hottest months. From October to December 2018, just under half of the households reported to experience more than 4 outages per week. More reliable months are April and May, and to a lesser extent August and September.

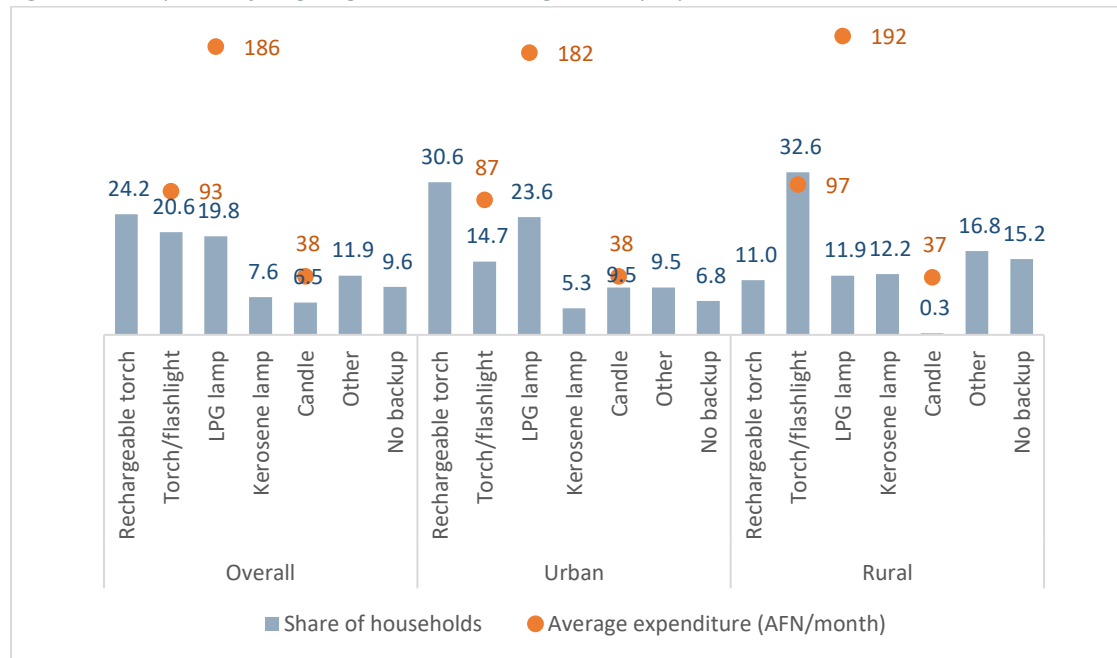
### When the lights go out

Close to 1 in 2 grid-connected households have torches or flashlights as backup sources for (Figure 69). Urban households are more likely to own rechargeable torches, while in rural areas they are more likely to own non-rechargeable torches. LPG lamps are used by 1 in 5 households, mainly in urban areas. Less than 1 in 10 households do not have a backup lighting source. The most expensive backup lighting source is the LPG lamp, at AFN 186 per month. The “other” category was mainly comprised of interviewees responding that they used their mobile phone as a back-up source of lighting (Figure 69).

Figure 68 Pointing out different types of back-up lighting options during the Baseline Survey, Samangan, 2018



Figure 69 backup source for lighting, and related average monthly expenditure

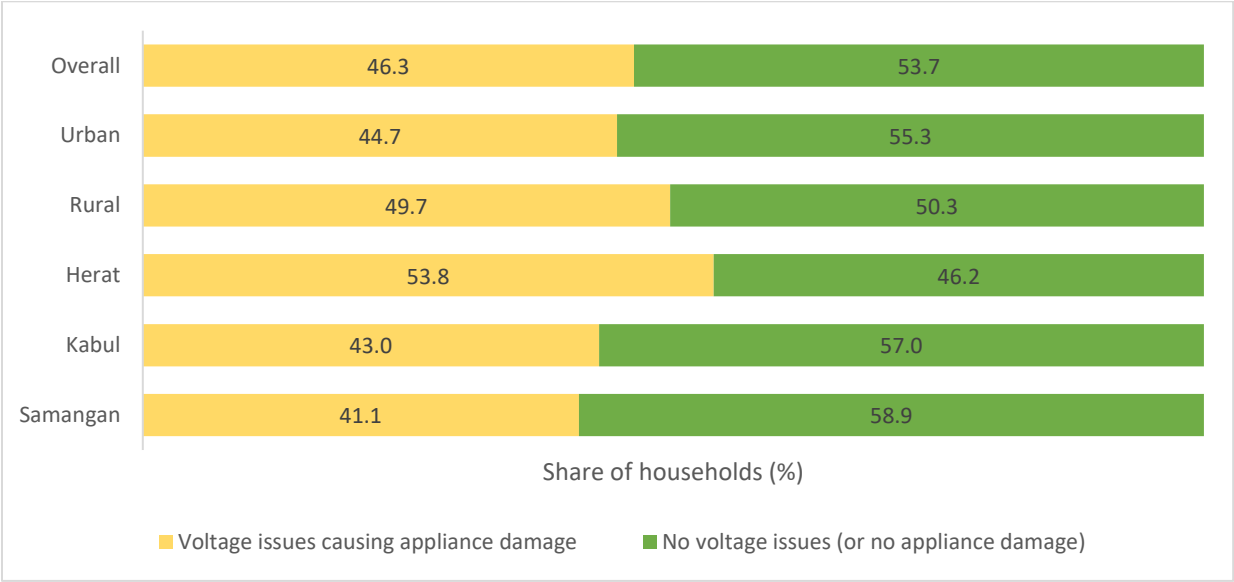


The **Quality** of the electricity supply refers to low or fluctuating voltage, often resulting in appliance damage. Quality is inadequate for about half of the households – overall over 46% of households suffered from voltage issues which resulted in the damage of appliances. Rural areas are more likely to experience voltage issues causing appliance damage. In contrast with *reliability*, households in Herat are more likely to suffer from voltage issues, with over half of respondents reporting appliance damage due to them (Figure 70). In Kabul, over 4 in 10 households have inadequate voltage (Figure 70).

*Our electricity disconnects many times in a day which can cause damage to our electronic devices. (...) Our main problem with electricity is... the lack of electricity! In winter, most of the days we won't have electricity because of technical problems. During the days in winter we will have only 5 to 6 hours electricity*

Female, Karte Naw, Kabul province

Figure 70 Share of households based on quality



Two research participants from the same community in Jebraeel, a township community on the outskirts of Herat city, showed the split on voltage issues.

*Sometimes when the power voltage is low we can't use any appliances. We decide to buy some appliances for baking sweets at home, but this voltage is not able to support those appliances.*

Female, Jebraeel, Herat



Figure 71 Television not being used in Kata Bolandi, Dasht-e-Barchi, Kabul



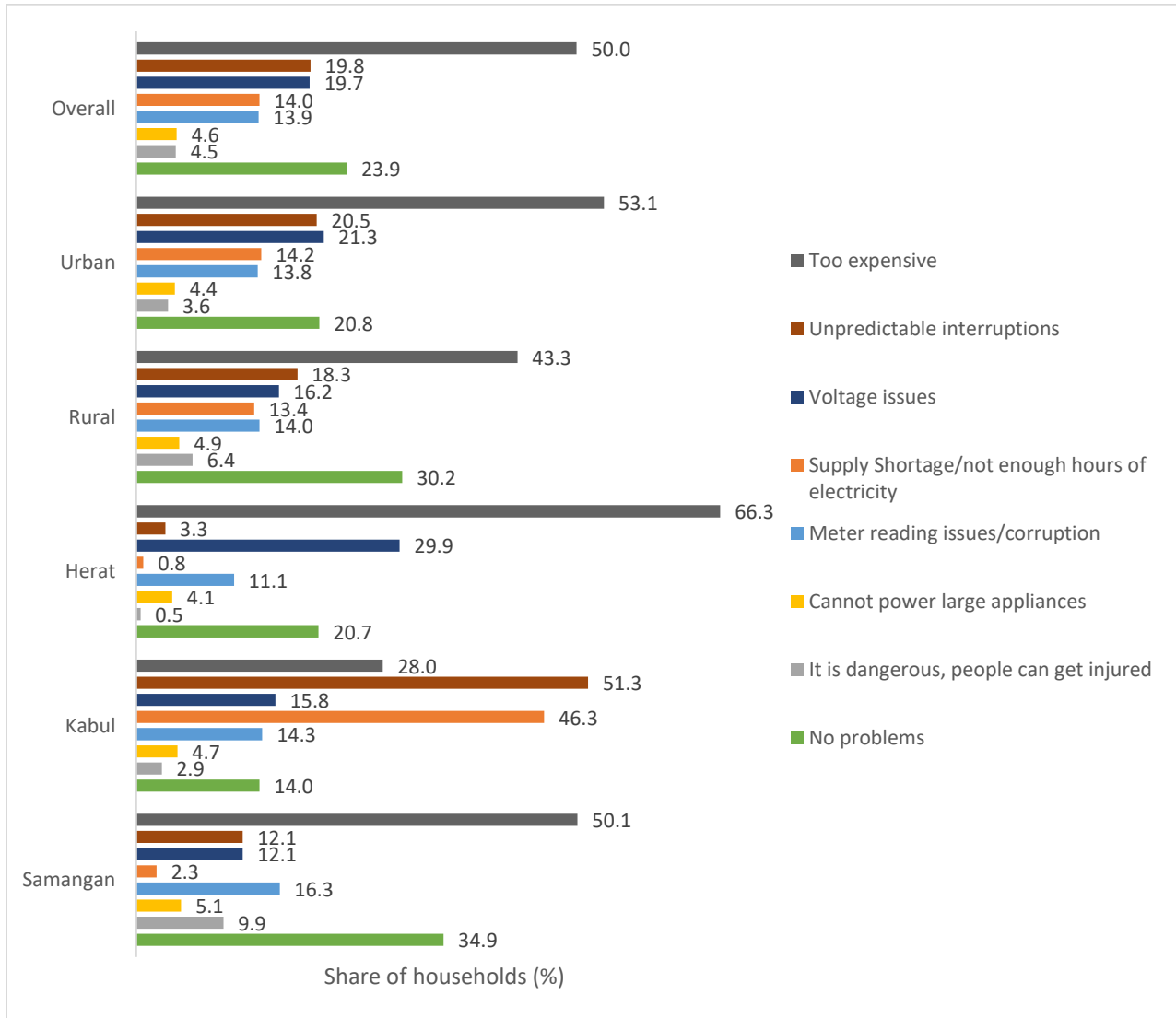
The **Safety** of the electricity supply refers to past accidents related to electricity (such as faulty internal wiring or incorrect use of appliances) over the last 12 months. Only a small share of households (1.4%) experienced past accidents due to electricity. Rural households are more likely to suffer from past accidents than urban households. This is reflected in the low share of grid-connected respondents who consider safety a major issue. In contrast, expensive electricity supply is a key issue for half of the grid-connected households. In Herat, the share rises to over 66% (Figure 72).

*Gas is expensive to use, but we can't use the electricity for all our needs. It's more comfortable to use than anything else, but it just costs too much.*

Female, Shaalbaafan, Herat province

About 1 in 5 households considers unpredictable interruptions and voltage issues to be important problems. In Kabul, about half of the households mentioned unpredictable outages and supply shortages as key disruptions. Meter reading issues are an issue for 14% of households (Figure 72).

Figure 72 Main issues related to grid electricity supply



- Businesses and Community Institutions**

60% of business / institution respondents noted that the grid fluctuations had caused damage to tools and appliances, an issue also noted by respondents in qualitative research for both households and businesses, who had lost appliances or were simply unable to power the appliances they needed.

*Power quality variance is a big problem for us - for example, we have a large elevator for use by patients which needs to fit beds for transfers (so not having enough power to power this or having patients stuck is a serious issue).*

Hospital General Manager, Herat City

Grid users often complain about the cost of the electricity, but there is recognition that the **grid is still more cost efficient than generators:**

*Our entire [business] activity depends on energy. If there is no energy, we cannot work at all. Previously per kilowatt, it cost us 6 or 6.5 AFN, but now it costs 12.5 or 13 AFN [for grid electricity bills]. Still, we are happy with [grid electricity] because if we use a generator it will cost us a lot more. For one dress, for which we gain 300 AFN, we would have had to have spent 100 AFN on [generator fuel costs].*

Tailor, Khair Khana, Kabul

Business owners frequently suffer from fluctuations in the performance of their grid electricity, particularly in Kabul. 80% of surveyed businesses and institutions note that their workplace had suffered from a lack of supply in electricity (143 of 178 businesses)– the same number would expect their sector to “grow a lot” if supply of electricity were to improve and become more affordable. Indeed, when business survey respondents were asked what prevents them from using more powered tools, the lack of supply (90 out of 178 businesses) and the cost of electricity (54 out of 178) were cited. This is a similar trend to those described in an informal business study in 2011, where *Harakat* found that “lack of financing (44 percent), low demand (37 percent) and lack of electricity (31 percent) were stated as the most important constraints to their business development.”<sup>21</sup> This was also echoed by a key informant interview with a senior adviser to the deputy minister of MEW, who spoke about the large energy needs of businesses.

#### **Outages – the loss of credibility, customers, and stock**

Outages were a major issue for businesses and institutions, especially the case in provinces such as Kabul which experienced more outages than Samangan and Herat.

*Energy impacts our work a lot. The electricity is cut off for longer periods of time, which leads to our work getting stuck, and results in us not meeting deadlines for customers. Due to this, we lose both our credibility and also the customers.*

Tailor, Khair Khana

*Suppose a customer comes and asks for an energy drink and it is warm - he will not buy that. On one side, we lose our customers. On the other side, a lot of other things that are used daily such as dairy become rotten. This means financial losses.*

General Store owner, Khair Khana

<sup>21</sup> Harakat, 2011, *Informality and Small Business Development in the City of Kabul*

### C. Off-grid electricity solutions

Those employing off-grid electricity systems comprised the majority in the sample in Afghanistan. Approximately two-thirds of interviewee households used off-grid solutions, almost entirely solar home systems at the household level. In many ways, this high level of solar penetration represented a *solar miracle* – with even some of the poorest households using a cheap solar panel and battery set for some light bulbs and mobile phone charging. Generators, pico-hydro and rechargeable batteries were rare in comparison.

Figure 73 Life "off-the-grid" in Daikundi, the central highlands of Afghanistan



#### a) Solar electricity

Before 2005, the majority of Afghans had never had any form of electricity, relying on oil lamps for lighting. For that year, the World Bank Group estimates that the number of Afghans with basic to electricity was only 23%<sup>22</sup> - mostly those living in the major urban areas of the country already connected to the grid. In under two decades, this has shifted dramatically, with World Bank calculations in 2017 with 97.7%<sup>23</sup> of the population having electricity access, corroborated by the research sample in the energy diaries where almost all surveyed households reported having access to some form of electricity. Along with increasing grid electricity, this appears driven in large part by the expansion in solar home systems. **Two-thirds of households in the research sample have access to solar electricity**, almost all as their primary source of electricity. This is one of the most important pieces of the Afghanistan Energy puzzle. Multiple factors explain this development. Donor-funded interventions, which in the past decade have distributed solar home systems in rural areas, probably played a role in demonstrating the effectiveness of the solar PV technology among rural communities. Solar home systems have sometimes been given, for instance, during the National Solidarity Program (NSP).

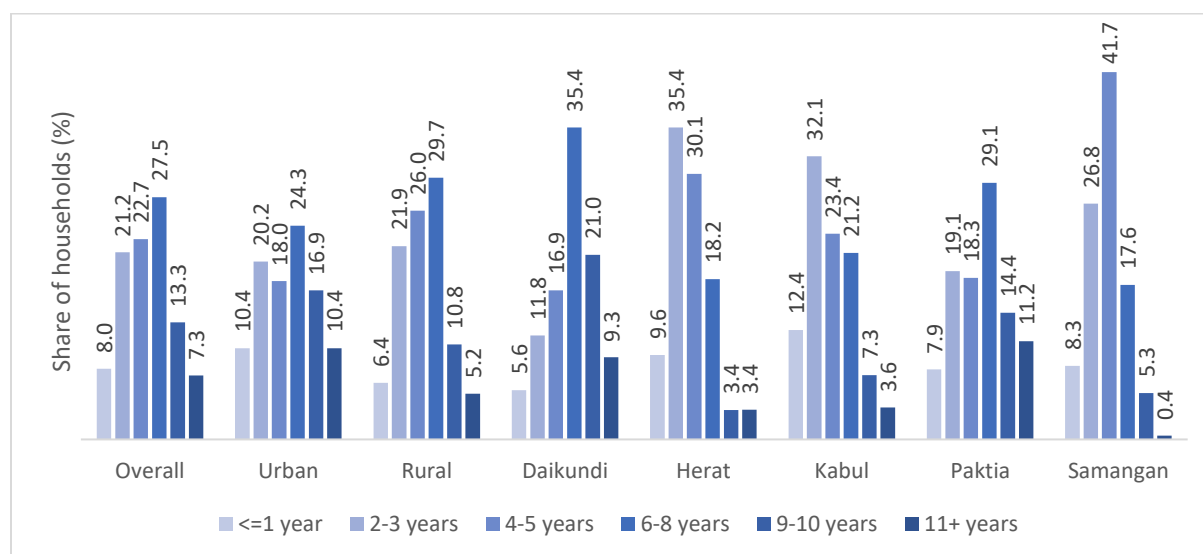
<sup>22</sup> NRVA- The National Risk and Vulnerability Assessment 2005: Afghanistan"; 2005; Kabul.

<sup>23</sup> [World Bank staff](#) estimates based on the NRVA 2007-2008, NRVA 2011-2012, ALCS 2013-2014 and

Notwithstanding government support, most of the households have purchased solar products themselves and it is remarkable that solar home systems have reached all the segments of the population, even the poorest ones.<sup>24</sup> Solar home systems or their replacement components are usually bought at the local district or provincial centre. Buyers can purchase cheap panels, batteries and wiring, set the system up themselves in their households, and then use the solar to power basic lighting, mobile phone charging and sometimes a television.

Access to off-grid solar solutions is a recent phenomenon with **over half of the surveyed households obtaining their main solar device at some point over the last 5 years**. This is even more true in rural areas. The majority of households in provinces without access to the grid (Daikundi and Paktia) got their solar system earlier in time. In Daikundi, about 2 in 3 households have owned their device for at least 6 years (Figure 74).

Figure 74 Number of years owning their main solar device (overall, urban/rural, by province)



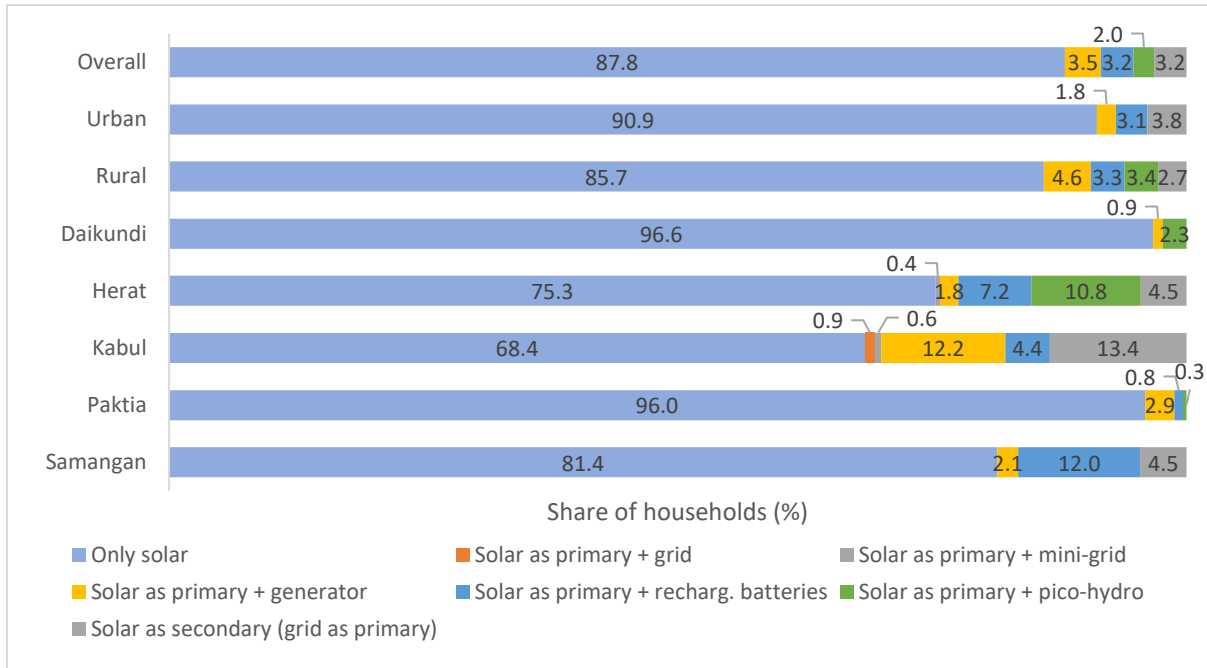
**Most respondent households with solar own a solar home system (89.1%).** Of the almost-two thirds of off-grid households with a solar device, the large majority have SHS as primary source of electricity (9 in 10 households), and only a few (the remaining 1 in 10 solar households) opt for the smaller solar lighting systems.

**The majority (86.5%) of interviewed households with off-grid solar own one solar device,** while 10.8% own two devices. The share is fairly similar in urban and rural areas. The likelihood of owning multiple solar devices increases with household’s income. The richest households are more than twice more likely to own multiple solar devices as the poorest households.

<sup>24</sup> - a striking difference compared to many other contexts, such as countries in Africa including Burundi and Kenya, where grid connection is still low but solar has not proliferated as widely as in Afghanistan.

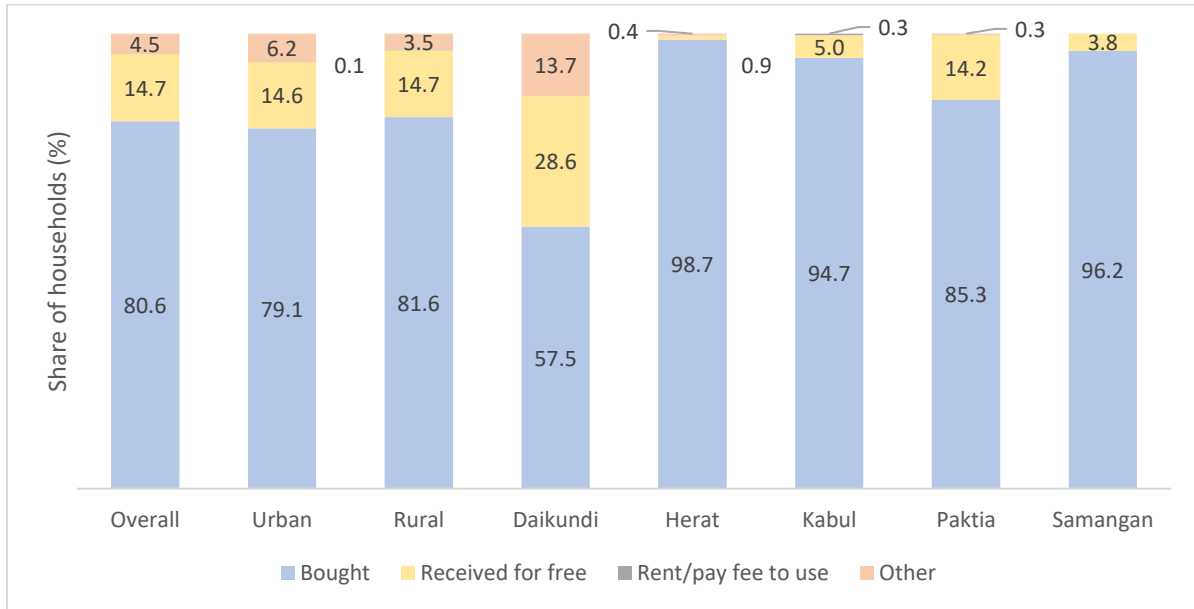
**Most (88%) off-grid solar households do not have a secondary source of electricity.** In grid-electrified provinces (such as Herat, Kabul and Samangan), the average share of off-grid solar households using solar as their only source of electricity is lower, but still quite high at 75%. The most common secondary source for off-grid solar households are generators (3.5% of households), and rechargeable batteries (3.2%).

Figure 75 Secondary electricity sources of off-grid solar households



**Most households have purchased their solar device.** About 8 in 10 households have purchased their main solar device, while 15% received it for free (Figure 76). The share is similar in urban and rural areas. Free devices are particularly common in Daikundi (29% of households) and Paktia (14%) – both provinces are without grid access (Box: Voices from Afghanistan: Acquisition and use of solar a solar device). Rentals or fee-to-use schemes are very rare; only 0.3% of solar households in Kabul (Figure 76).

Figure 76 Method of acquisition of main solar device





### Voices from Afghanistan: Acquisition and use of a solar device

An example of typical use of solar can be found in rural Paktia. The household profiled in the Seasonal Case Studies has two solar panels (100 and 180 ampere) purchased for 1,500 AFN (US\$20) and 3,600 AFN (US\$45) respectively. This setup is complemented with two batteries of 200 amperes. This is sufficient to power lights, but not a fan or, to the dismay of the interviewed female family member who works from home as a tailor, a sewing machine. The equipment is several years old and is beginning to struggle to maintain a stable voltage, which causes damage to the lights.

*We use solar energy only for lighting for two rooms because our solar energy is weak. We also use solar energy for charging phones. But we cannot use it for other machines to ease our daily works.*

Male, Rural Paktia

In rural Daikundi, the profiled household in the seasonal case studies received a solar panel from the Ministry of Rural Rehabilitation and Development.

*Our solar panel was provided to us. It has 75 volts, and is connected to a battery which has 100 amperes. It cost 6,000 AFN, and should be fine to function for four years. Installing a new solar home system would cost us 20,000 AFN, plus a battery for 6,000 AFN.*

Male, Rural Daikundi

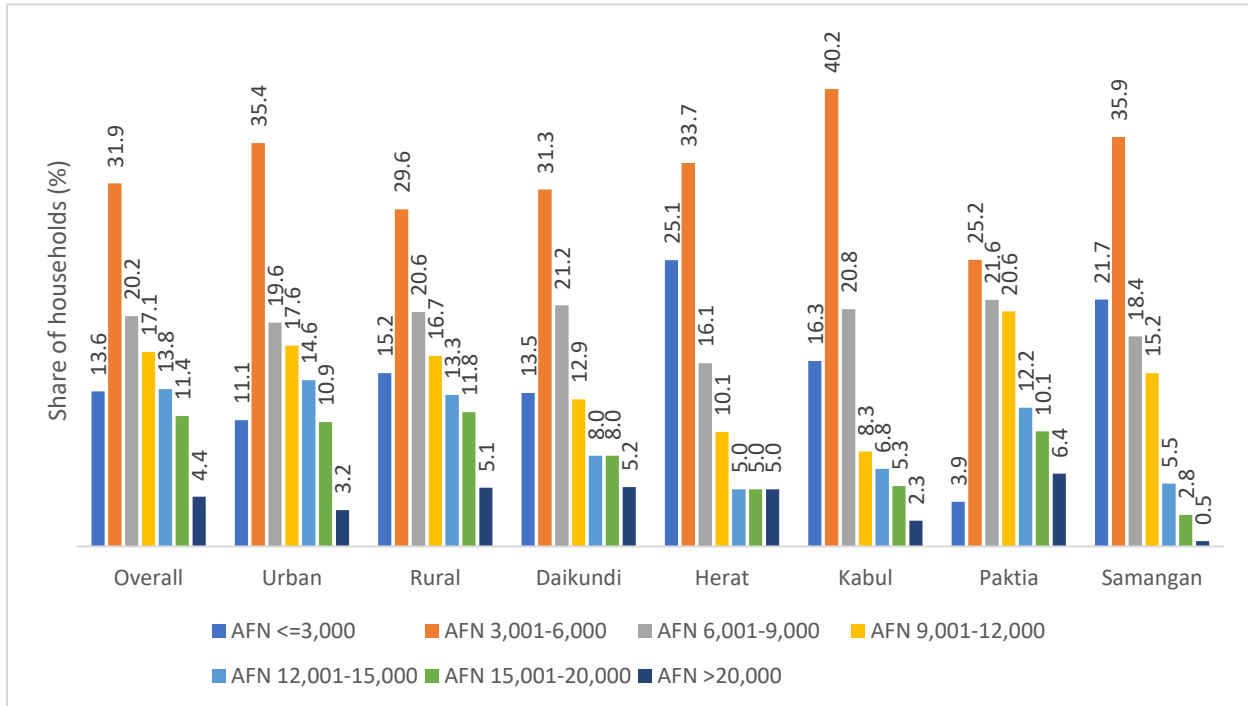
*Figure 77 A solar panel at the seasonal case study household in rural Daikundi*



*Nota bene: To read the entire Seasonal Case Studies, please refer to the relevant annex.*

**The price of purchasing solar varies depending on performance, but is becoming cheaper.** About 1 in 3 solar households paid between AFN 3,000 and AFN 6,000 for their solar solution (equivalent to US\$38-\$76) (Figure 78). Another third of the households paid between AFN 6,000 (US\$76) and AFN 12,000 (\$153). Lower cost solutions (up to AFN 3,000 / US\$38) are more common in Herat and Samangan, as well as among the 20% poorest households.

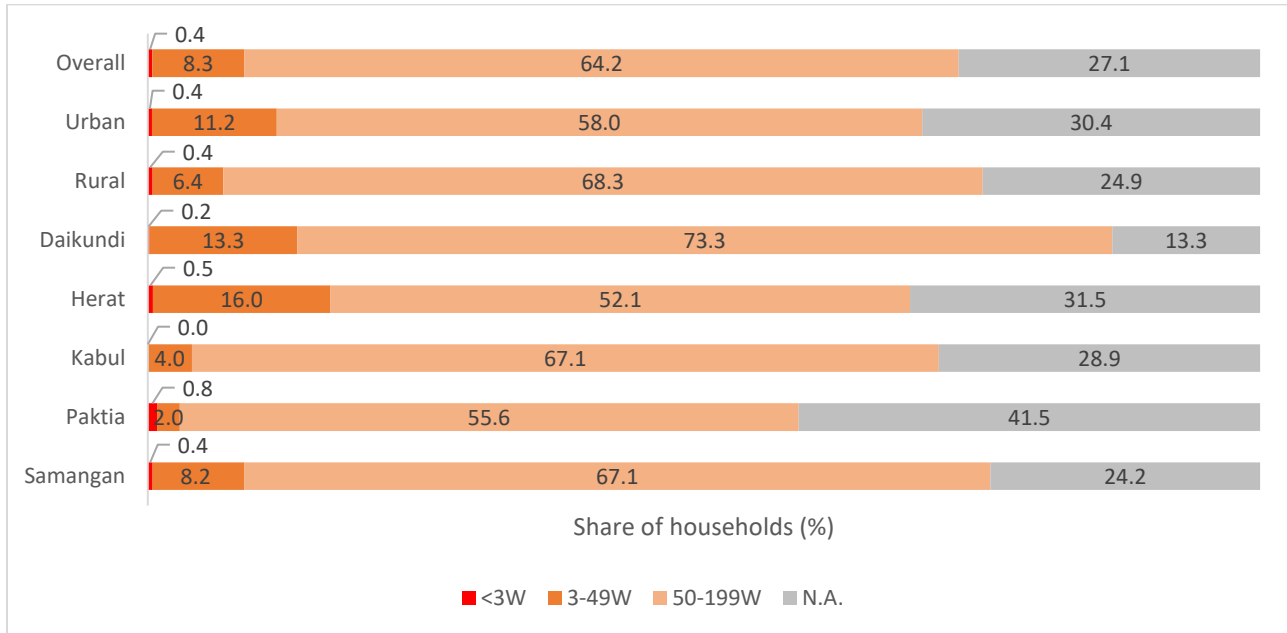
Figure 78 Price of purchase of main solar device



In terms of **power output**, about 2 in 3 off-grid solar households own a solar solution of 50 to 199 Watts capacity. Less than 9% own a lower capacity device.<sup>25</sup> Only 1 in 4 off-grid solar households own an inverter – this appears to be more common in rural (30%) than in urban areas (15%), and more common in Herat than in Kabul.

<sup>25</sup> Nota bene: Many respondents (27%) were not aware of the capacity of their main solar device.

Figure 79 Share of off-grid households based on Capacity of main solar device



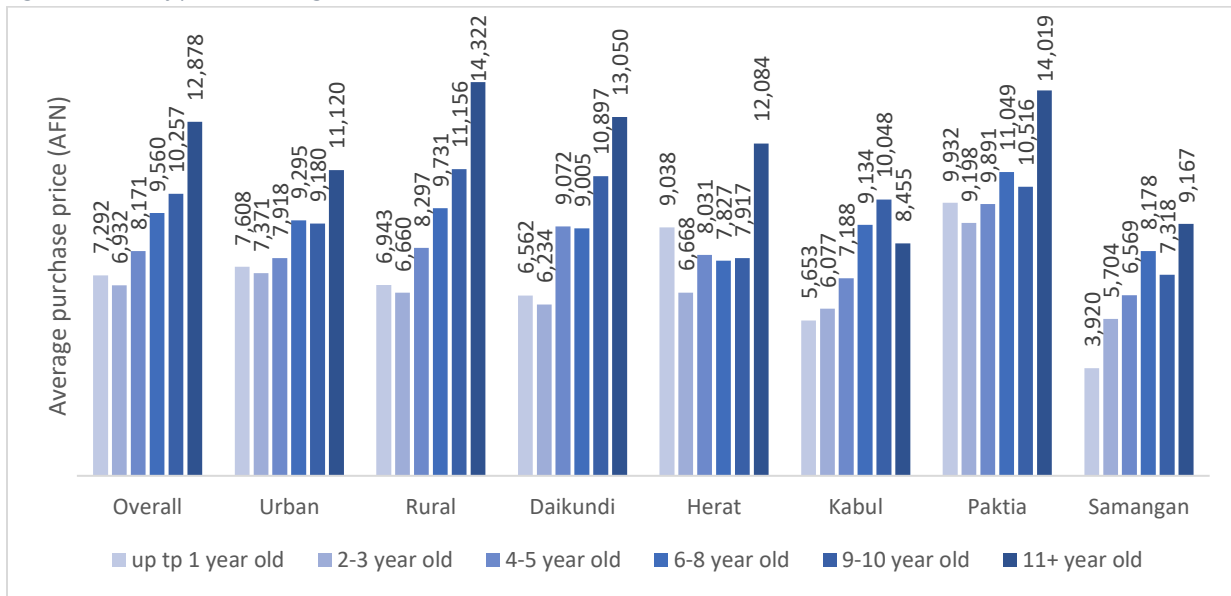
The average purchase price of solar solutions has decreased over time, with recent purchases reportedly far cheaper than older ones (Figure 80). New solar devices (up to 1-year old) were acquired at an average price of AFN 7,292 (approximately equivalent to US\$93). In comparison, the average price of devices bought 11 years ago or more was AFN 12,878 (US\$164). This price decrease may be even more pronounced when factoring in the currency depreciation of the Afghani over the past decade, with the purchasing power of Afghanis on the international market (where most of the solar home systems are initially purchased) being far less in 2019 than previously. The most likely explanation for this is marked decrease in the purchase price of a solar home system is the global fall in the cost of solar photovoltaics worldwide.

While not with specific data on Afghanistan, International Renewable Energy Agency (IRENA) documented a sharp decline of 47-78% in residential solar PV total system costs in a wide range of countries between 2010 and 2017.<sup>26</sup> In India, the total installed cost fell 54% between 2013 and 2017 alone.<sup>27</sup>

<sup>26</sup> IRENA, 2018, [Renewable Power Generation Costs in 2017](#), International Renewable Energy Agency, Abu Dhabi

<sup>27</sup> Ibid

Figure 80 Price of purchase vs age



*Nota bene: This decrease was exemplified by the household in Langar that took part in the Seasonal Case Studies. The first solar panel they purchased during the Karzai Government (before 2014) cost AFN 20,000 (US\$255 in today's currency terms, probably much more given the currency depreciation of the Afghani). The second solar panel they purchased in 2016 for AFN 6,000 (US\$76).<sup>28</sup>*

From June 2018 to May 2019, an average of 2.3% of off-grid solar households purchased a new solar system component (for instance a battery, a PV module, an inverter or replacement wiring) each month. The average cost of purchase of a new solar solution was AFN 4,551 (approximately equivalent to US\$60). The average battery capacity in that purchase was 90 ampere hours.<sup>29</sup> Purchasing of an additional panel to their existing system was a less popular option: 0.4% of off-grid solar households added one each a month, 4.3% yearly. The average monthly cost of maintenance and repair of the main solar device ranged from AFN 345 in June 2018 to AFN 52 in April 2019.<sup>30</sup>

Without exception, respondents **use** their solar device for lighting. For households, other popular uses include charging mobile phones (83%) and entertainment / watching TV (30%) (Figure 81). Businesses and institutions, to the extent that they use solar energy, often power their electronic devices in this fashion.

*Our resource for lighting is solar power. We have used this system for 10 years. We have received a panel for free almost 10 years ago, and we still use it today for lighting and charging mobiles. We bought another solar home system last year. And we are using the power of this system for lighting, charging mobiles and computers, and switching on the television.*

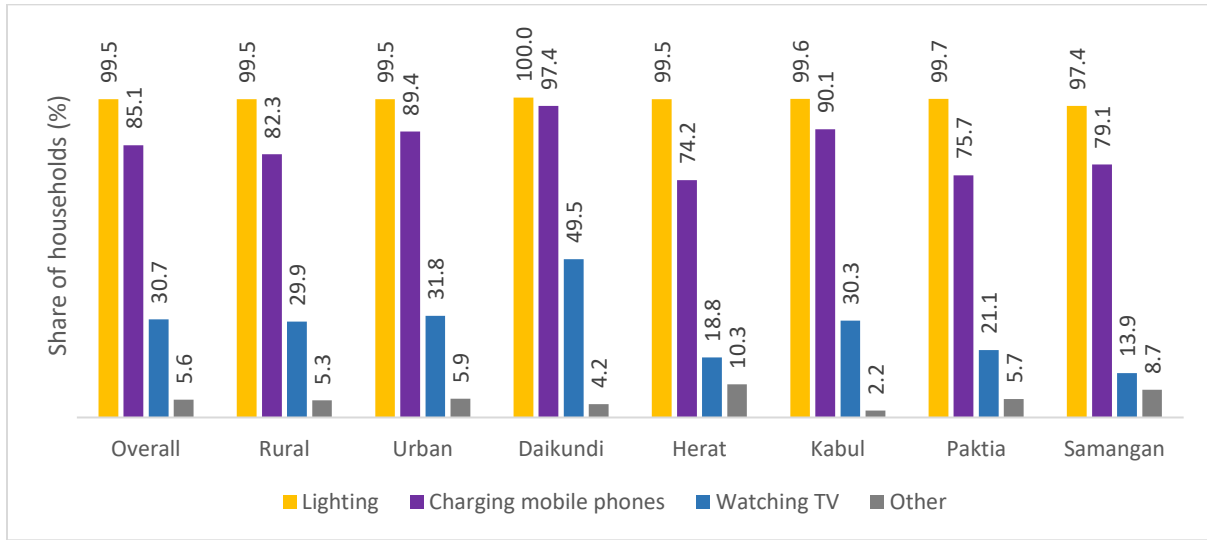
Female, Khwaja Chasht, Daikundi province

<sup>28</sup> Seasonal Case Studies, Langar, Kabul

<sup>29</sup> Data on price of purchase and capacity of the system were collected from November 2018 to May 2019.

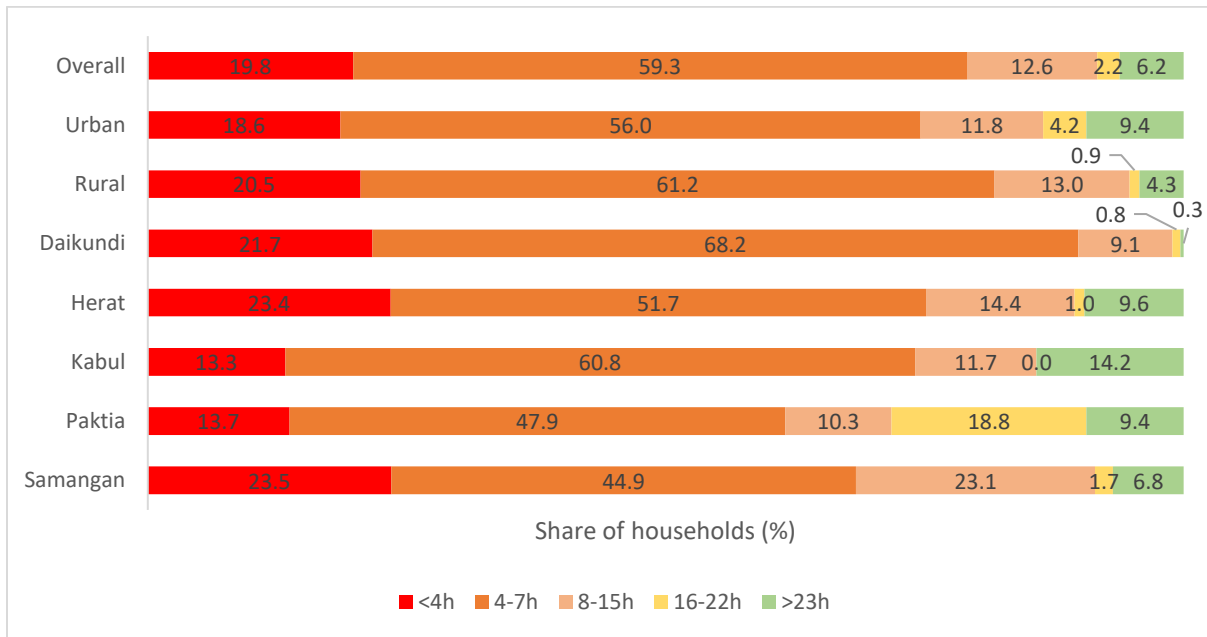
<sup>30</sup> The yearly average amounts to AFN 164.

Figure 81 Uses of solar



The majority of off-grid solar households (59%) have electricity between 4 and 7 hours per day. About 1 in 5 households has less than 4 hours per day (Figure 82). Only 8.4% have electricity for at least 16 hours per day.

Figure 82 Daily Availability (24-hour) of power from the main solar device



About 2 in 3 off-grid solar households have electricity during 4 hours in the evening (between 6pm and 10pm). Most of the remaining households have at least 3 hours.

Figure 83 Average hours of availability of power from main solar device over time

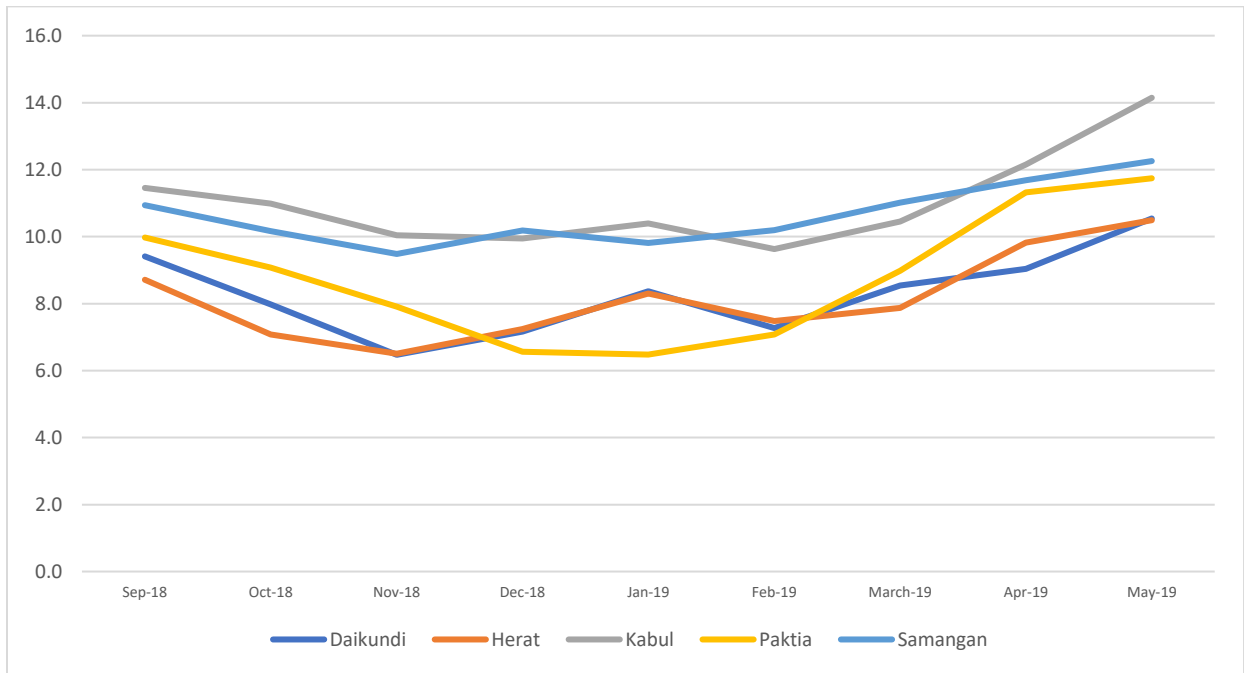


Figure 84 A dream of spring

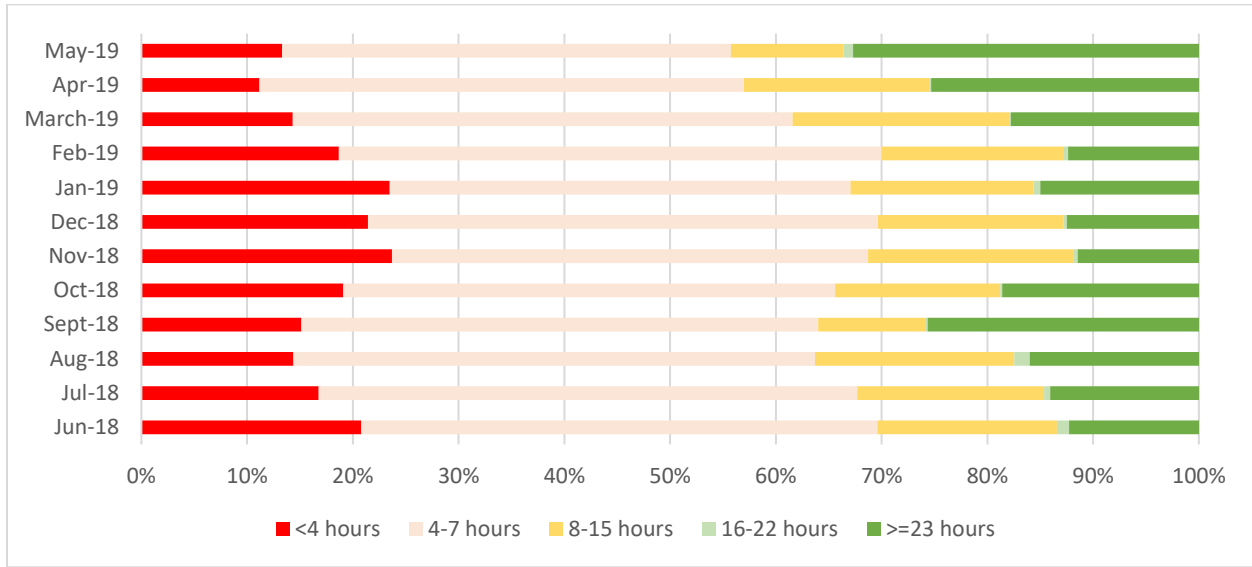
**The availability of solar drops in the colder months.** As early as the autumn, solar energy usage tends to drop (Figure 85). When it is cloudy, the solar panels cannot charge the batteries fully, and the use of appliances such as television but also telephones drops. The drop in supply comes at a time of increased demand, particularly for lighting. The sentiment that solar panels could barely charge batteries enough to keep lights on for a couple of hours, and nothing more, was a common complaint during qualitative discussions with off-grid households.



*In our village, everyone uses solar. But when the weather is cold and cloudy, solar does not charge. All of us have to live in darkness.*

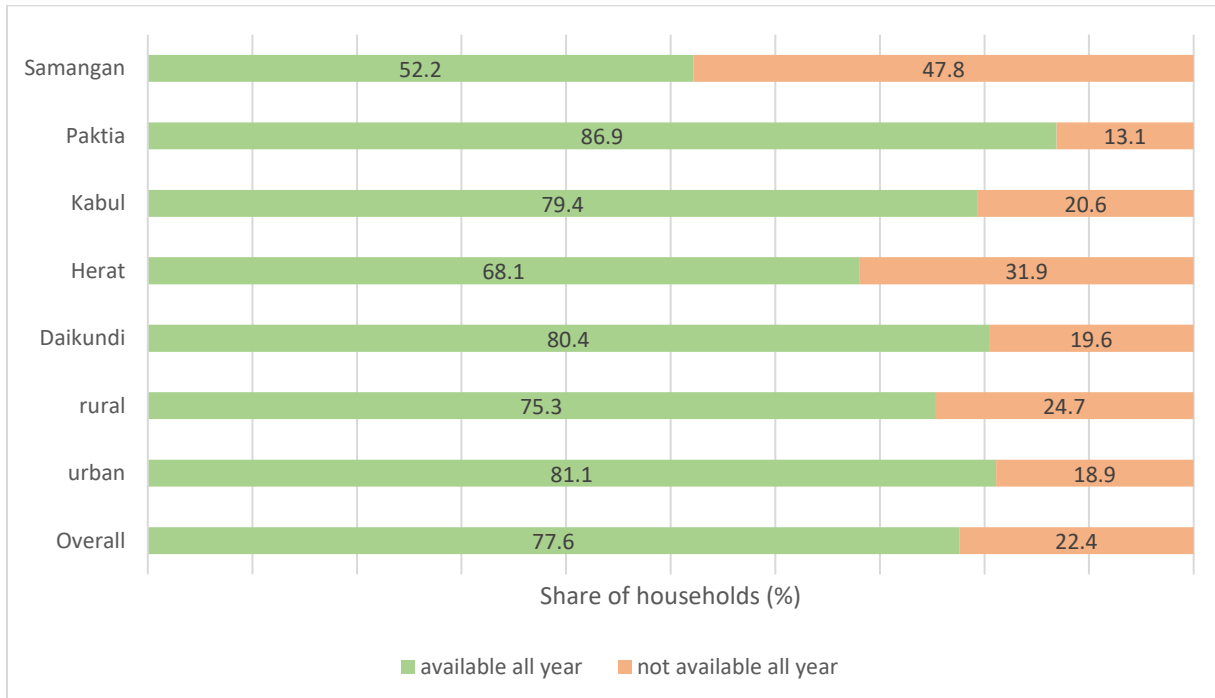
Male, Rural Herat

Figure 85 Hours of availability of service from main solar device over time.



Over 3 in 4 off-grid solar households reported stable performance of their solar solution around the year (Figure 86) – meaning despite the shorter duration of electricity that might be available, at least some supply was available for these households.

Figure 86 Availability of solar around the year





### When the solar-powered lights go out

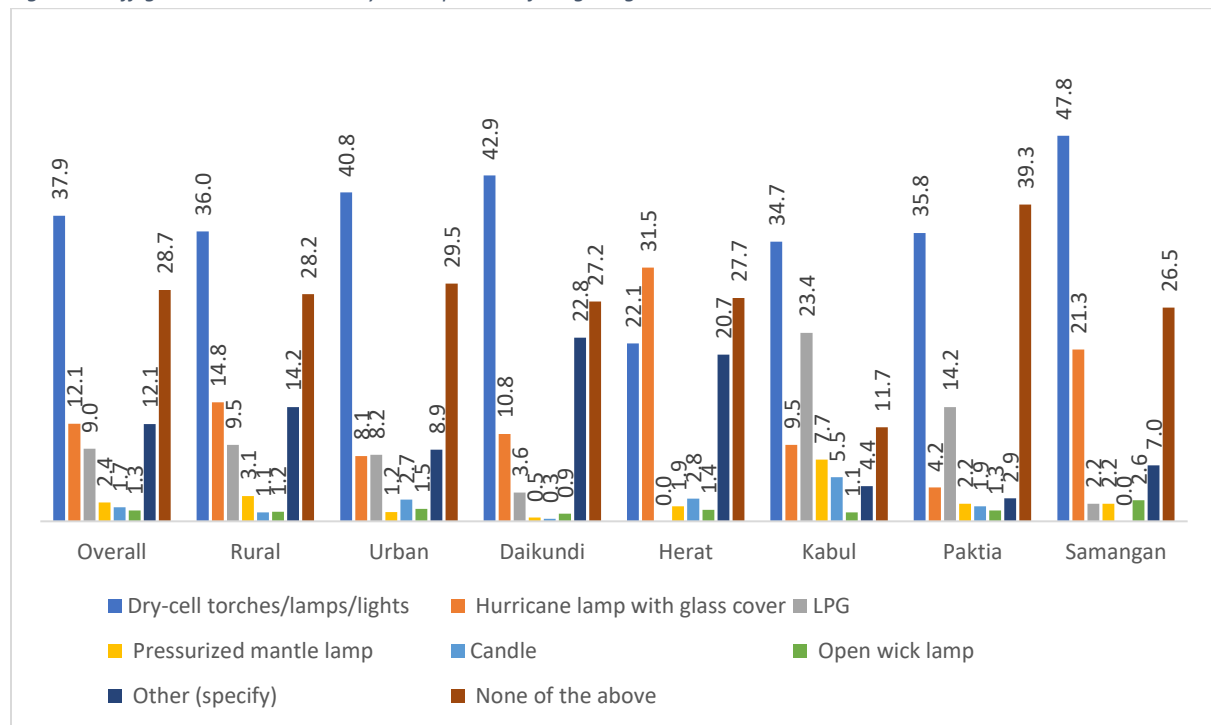
Back-up sources for solar powered lighting may be used for two major reasons – the first, when the battery does not get charged enough, especially during the winter months (when it is also darker for longer); the second, when the solar home system or lighting system is damaged or requires replacement. The most common backup source for lighting are dry-cell lights, with almost 4 in 10 off-grid solar households using them (Figure 88). The second most common source are hurricane lamps with glass cover (with 12% of households). In Herat though, hurricane lamps are the most common backup source with 31.5% of households.

Figure 87 Not always available?



LPG lamps are particularly popular in Kabul and among the richest 20% households, which are 4 times more likely to use them compared to the poorest quintile (20.8% versus 5.9%) (Figure 88).

Figure 88 Off-grid solar households by backup source for lighting



**About 70% of households reported to have received information and training on the main solar device.** Over 8 in 10 households in Kabul, Herat and Paktia had received information and training, while this was the case for 6 in 10 households in Daikundi and only 2 in 10 in Samangan. The richest 20% of the households were more likely to have received information and training than the poorest 20% of the households.

We have many problems with customers who don't know how to use solar - but we can send people to assist. We can teach people how to use their systems, and we give two to five days of training for those who purchase our packages as part of their cost of buying.

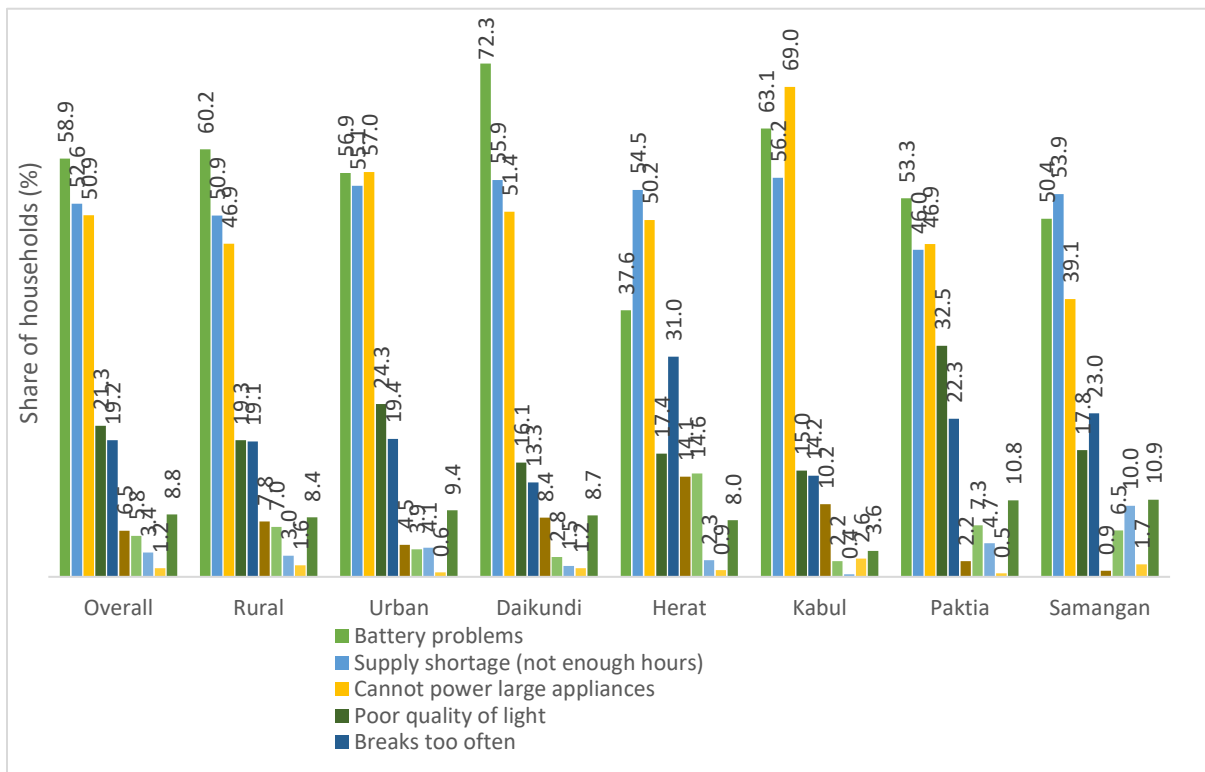
Sun Solar (solar retailers), Herat

Figure 89 Sub-optimally positioned solar panel in Talkhaki, Samangan



The most commonly mentioned issue with solar solutions is the battery, followed by poor system capacity resulting in supply shortages and inability to power large appliances. Over half of the households that use solar as primary source of electricity experienced these issues (Figure 90). Batteries are less of an issue in Herat compared to the other provinces. Poor quality and frequent breakdowns are impacting 1 in 5 households. Maintenance and spare parts availability do not appear to be widespread issues (Figure 90).

Figure 90 Main issues related to off-grid solar systems



*We don't have any appliance like a refrigerator to keep food fresh. The solar energy [that we have] cannot support such an appliance, and we are not connected to the grid to [be able to] use them.*

Female, Mondokhail, Paktia

Overall, much remains to be done to further improve the quality of the energy services provided to off-grid customers in the country. There have been no minimum standards guarantee for solar home systems in Afghanistan, meaning solar is often synonymous with low-quality electricity provision. It is also often considered expensive to maintain due to the low quality and short-lasting components. Solar devices are usually unable to power large appliances, such as refrigerators. Power is also less available in the colder months, meaning as demand increases for electricity with longer nights, the supply drops.

*We cannot use these appliances more because its winter and solar energy is weak as it's cloudy throughout the day, and our solar panel cannot charge the battery fully therefore we use these appliances less in winters.*

Male, Mondokhail, Paktia

Solar is thus not Afghans' first choice, but rather an interim solution while waiting for a grid connection, or a backup for unreliable grid provision.

*Figure 91 Second-hand solar panels on sale at an electronics store targeting customers from remote districts not yet connected to the grid. The bazaar in Aybak, Samangan*



Once a community has been connected to the grid, the demand for solar solutions, drops quickly:

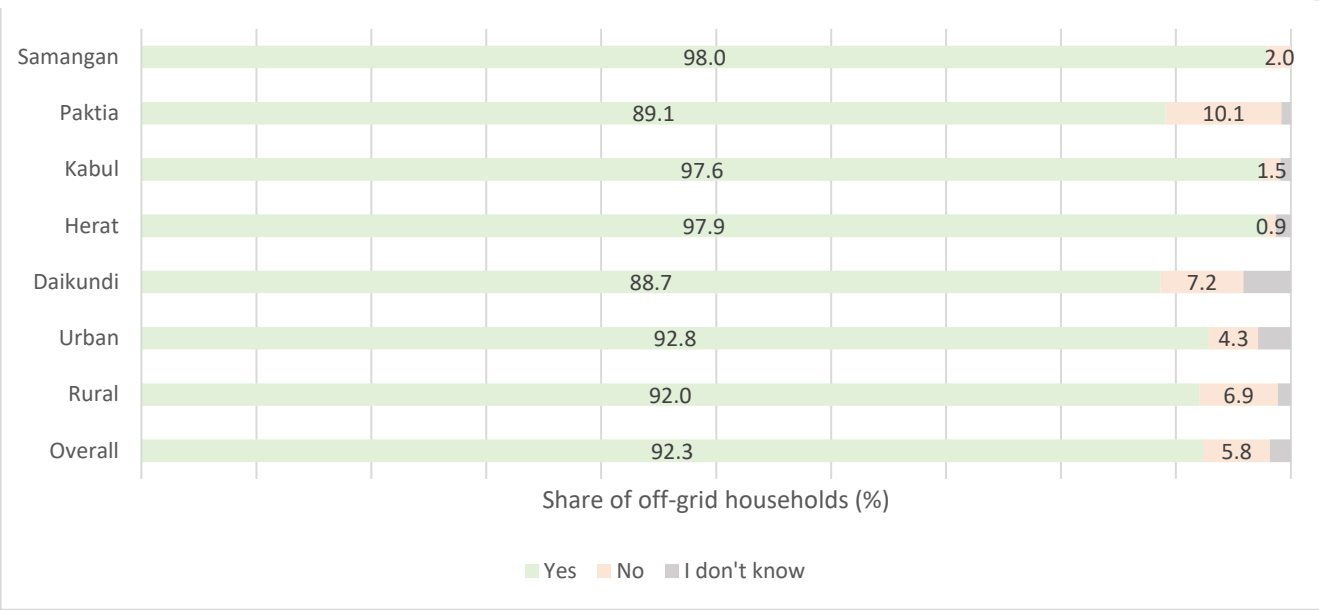
*Three years after we were connected to the grid, we had sold all our old stuff such as fuel lanterns, solar lanterns and solar home systems in the bazaar in Aybak.<sup>31</sup> Now all of us use grid power.*

Shura member, Yakatoot, Samangan

<sup>31</sup> Aybak is the provincial capital of Samangan

Indeed, **the vast majority of households does not expect to remain off-grid for long** (Figure 92). The expectation of imminent grid electricity connections amongst the majority of the sample population (92.3%) could potentially shape consumer energy preferences and demand. Many areas of Afghanistan are not expected to be connected to the grid expansion for years, and possibly decades. The gap between household expectations and this infrastructure reality may shape household and enterprise preferences and behaviour. If a household is in a community where there are no plans for grid expansion, but the household members think that there is, then this may mean they do not upgrade their solar home systems with more advanced parts.

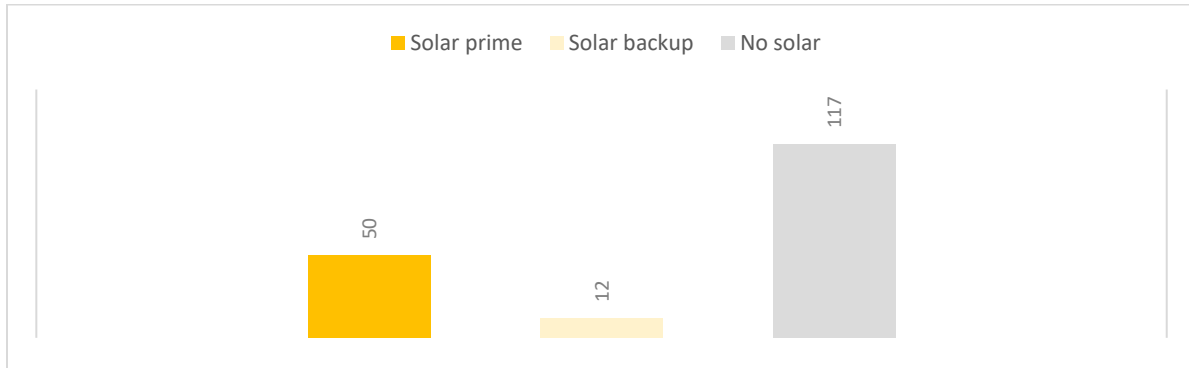
Figure 92 Share of off-grid households who expect to obtain a grid connection in the near future (the next 3 years)



- **Businesses and Community Institutions**

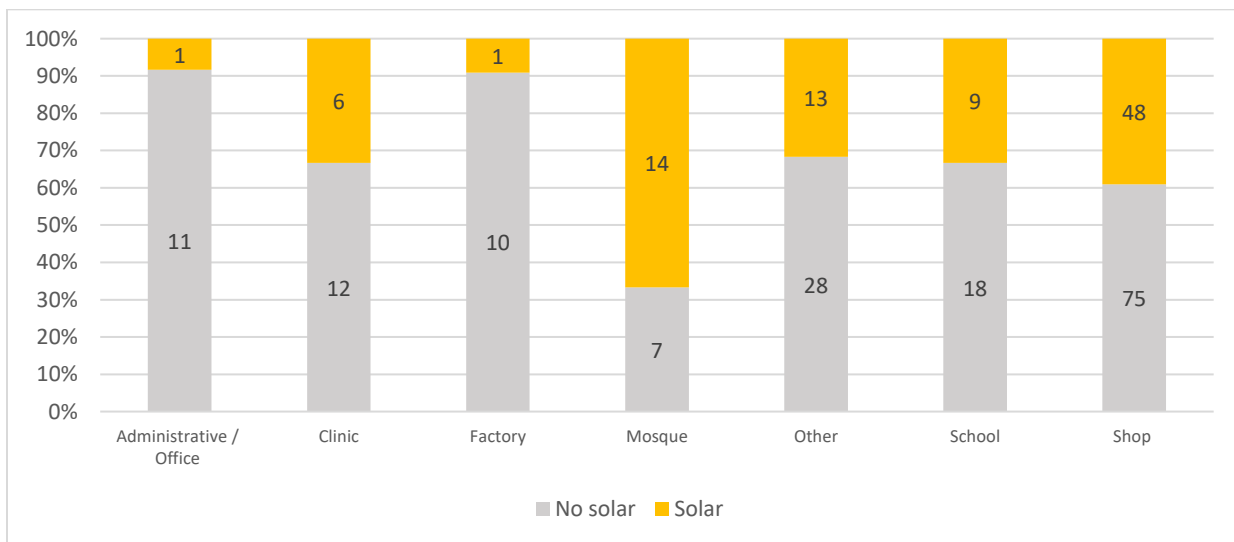
The trend observed for households towards solar in areas without grid does not appear to be occurring to the same extent with businesses. In areas without grid in the household sample, almost all households used solar and a very small proportion used a generator. Among the businesses, 50 out of the 179 said they used solar as their primary source of electricity (Figure 93) – one less in total than businesses that responded that they used generators as their prime solution (Figure 99).

Figure 93 Number of businesses with solar as prime, solar as back-up and with different electricity solutions



One major reason why solar penetration is not as high amongst businesses is that solar electricity is not able to power many electrical tools and appliances, with generators providing the extra capacity needed to do this. Along with the capacity comparisons for higher power consumption tools, the factor of seasonality is also pronounced. Households complain about not being able to watch television or use lights for longer periods of time in winter with the capacity of their solar panels. For a business needing to power tools and appliances as part of their operations, not being able to draw on sufficient electricity supply for many months of the year makes a generator (which can be used at any time), a preferable choice.

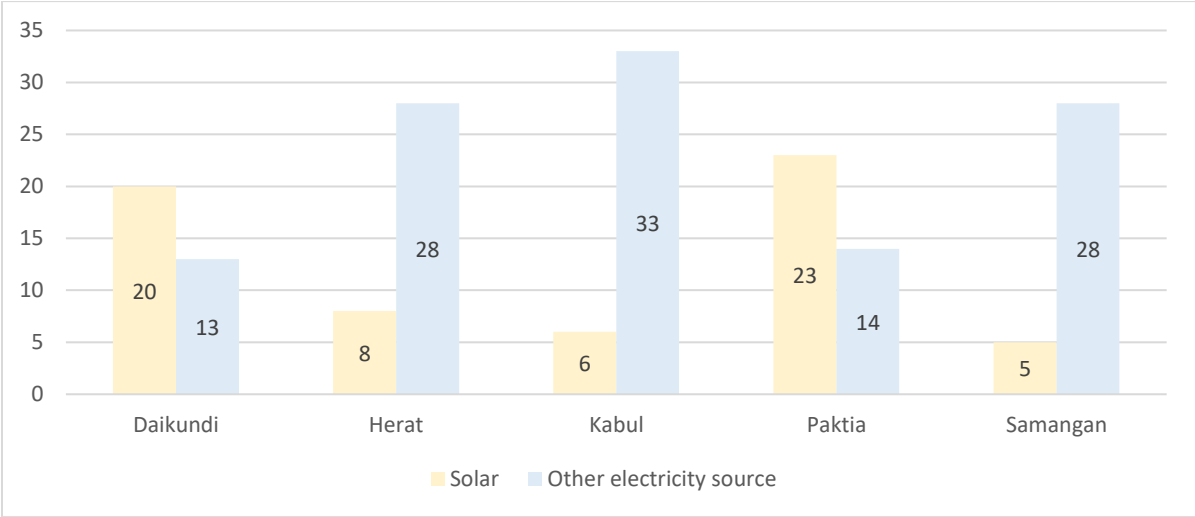
Figure 94 penetration of solar solutions by type of business / community institution



While solar power is still reasonably popular amongst businesses (62 businesses out of 179, with just over a third having some form of solar electricity provision), the use of solar is sector-reliant. 22 of the 41 retail businesses used solar electricity (20 as their main source of electricity). In contrast, only 1 of the 19 construction businesses did (using solar as a back-up device for lighting). Small businesses are also more likely than their larger counterparts to use solar energy.

Owning a solar solution was also dependent on province. In Daikundi and Paktia, where there was no grid, levels of solar were elevated. In Herat, Kabul and Samangan, solar was more apparent in communities where there was no grid connection. Indeed, only one business used their solar as a back-up for grid.

Figure 95 Businesses with a solar device or other electricity source, by province

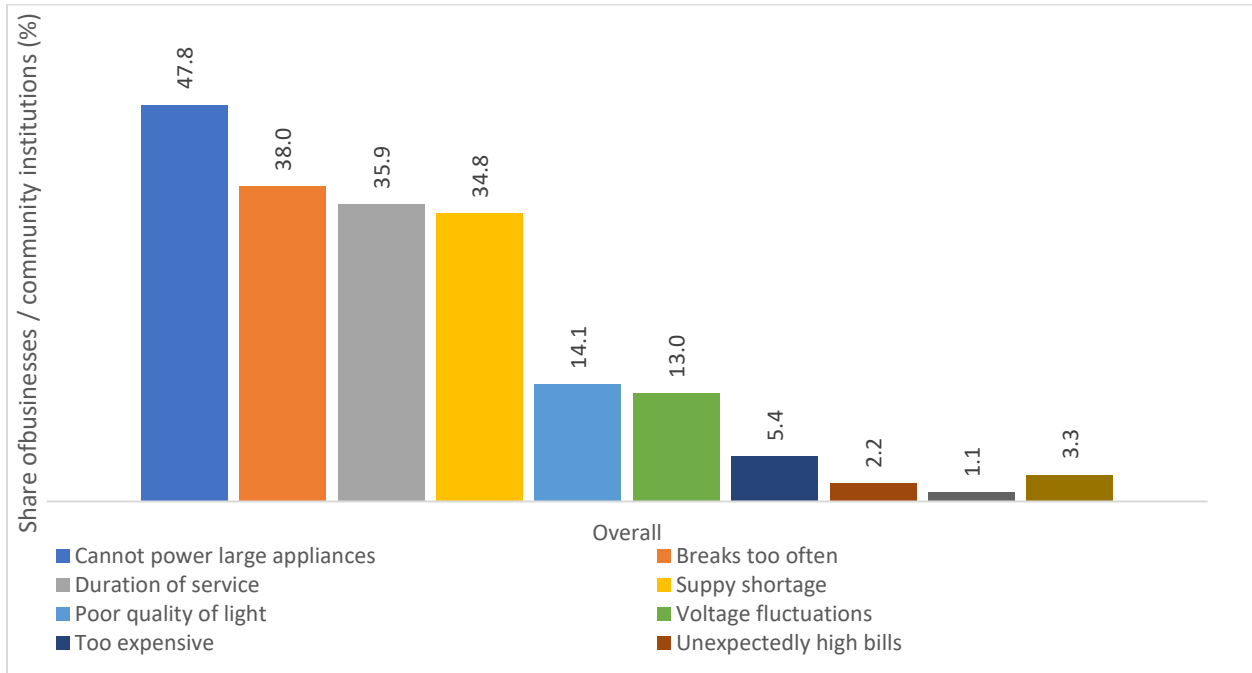


Among the business and enterprise respondents whose establishments use solar energy, close to half note that fluctuations in supply had damaged tools and equipment at their place of work.

*Solar energy has a lot of fluctuations. Lights get damaged, as often as three times a week. Each time it costs us AFN 100 to replace. I know a shopkeeper whose place burned down because of solar. The solar device we use now cost AFN 3,500 and we have had it for five years. But we have had to change the battery after one year.*

Shopkeeper, Daikundi

Figure 96 Main issues related to off-grid solar system for businesses and community institutions (overall)



Unlike grid electricity where payments are made to the government, off-grid solutions are almost entirely in the realm of the private or informal sector. While there is growing interest in the government and non-government organisations to provide enhanced off-grid solar solutions to businesses and community institutions<sup>32</sup>, many organisations such as retail shops buy solar devices much the same way households do - in the marketplace. All 62 businesses in the research sample bought their solar devices (for an average of AFN12,028, approximately US\$150).<sup>33</sup>

Figure 97 Useful only for lighting - a solar panel at a metalworks shop in Nili, Daikundi



<sup>32</sup> Including DABS working to expand solar solutions for government buildings, and Mercy Corps working with small businesses and community institutions such as [hospitals and universities](#).

<sup>33</sup> Five of the 62 businesses responded that they did not know how much the solar device their business uses were purchased for



For business and community institution users of solar energy, cost was a significant source of complaint in the qualitative research, not so much because of the initial investment but because of frequent follow-up costs related to batteries, inverters and other maintenance. 24 of the 62 businesses with solar surveyed responded that their solar devices breaking was a major problem.

**Voices from Afghanistan: Business spending on solar**

*Since there is no grid power here I bought a solar system, I bought it for 16,000 AFN five or six months ago. It is not strong enough. I bought an inverter for 4,000 AFN which was 1,000 watts, but it broke. I bought another one, but it didn't work either. In the end, I was forced to buy a 1,500 watts inverter. Now the quality is better. I still use gas in the winter for heating - each winter I use about 30 to 40 KGs of gas which costs me 3,000 to 4,000 AFN.*

Printing shop owner, Charkh, Daikundi

*I bought solar system for 11,000 AFN and paid another 7,500 for the battery. I spent 38,000 AFN on a refrigerator, 28,000 AFN on another refrigerator. The inverter cost me 4,000 AFN. And then, after one year, I had to replace the battery for another 7,500 AFN! Overall, over half of our income goes to energy, batteries, gas... and our business is not going well.*

Grocery store owner / butcher, Charkh, Daikundi

#### D. Other off-grid solutions: Generators, rechargeable batteries, mini-grid, pico-hydro

Outside of grid electricity and solar, other electricity solutions comprise a minor portion of the household electricity mixture.

- **Generators**

**Household** usage of generators does not appear to be frequent: 104 respondents out of over 3,000 stated that their household owned a generator. Over half of these (54) were in Kabul province. Generators are rarely the primary source of electricity, only 16 households responded that it was, and thus mainly used as backup for grid electricity in the households who owned one. Households generally own one generator only, and have exclusive usage. Generators tend to be most used in the cold winter months (when other sources of energy are less reliable). Their fuel, usually gasoline, is readily available in the winter months at 40-50 AFN per litre (approximately 50 US cents per litre).

Figure 98 Not a common sight for households



Generators owned by respondent households were usually purchased, with the cited price fluctuating widely but revolving around a median of AFN 11,500 (and an average of AFN 14,000). The age of the generators of the households interviewed ranged from zero to 20 years, but most commonly, generators have been in use for 5-6 years. The costs of repair over the past year are non-negligible, with a mean of AFN 3,600, equivalent to about US\$45 (and a median of AN 1,500 or US\$20).

Generators are normally used only for a few (mean 3, median 2) hours a day, with their usage limited perhaps by the noise – the most concerning problem for the generator owners among the sample interviewed. The most common household usage for generators is water pumps (50 out of 104 households) and lighting (44 of 104), followed by mobile phone charging, appliances, work-related energy usage and entertainment.

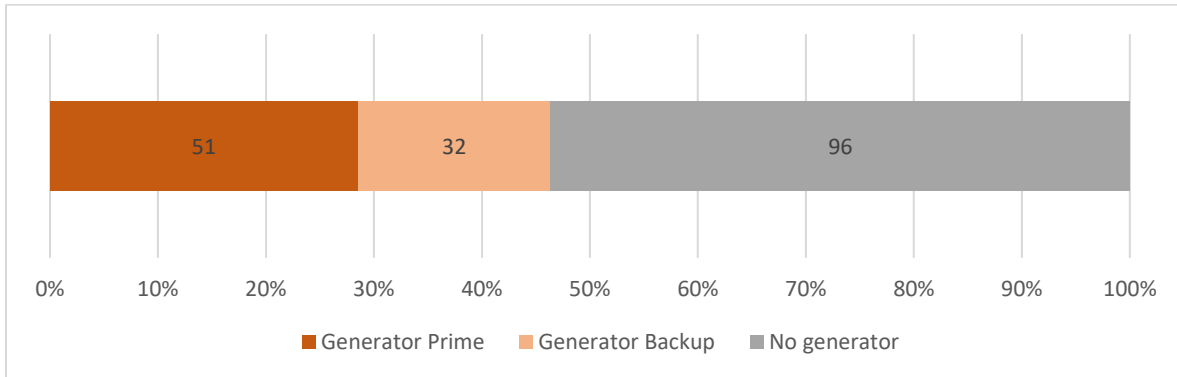
*We use up to 80 litres of diesel oil per month, at a cost of 45 AFN per litre!*

Male, Langar, Kabul

While generator usage amongst households is negligible, their ownership is much higher among **businesses**. This is the case for both generators as the primary electricity solution, as well as back-up generators for when the grid is not working. 46% of the businesses in the sample used a generator – 28.5% of all businesses, over a quarter, using it as their primary source of electricity (Figure 99). This is a similar number to the 48% of firms owning or sharing a generator in the World Bank 2013-2014 Enterprise Surveys.<sup>34</sup> While caution is needed in comparing data with different sampling techniques, generator usage still appears high in both, especially relative to households.

<sup>34</sup> Enterprise Surveys [www.enterprisesurveys.org](http://www.enterprisesurveys.org), The World Bank.

Figure 99 Number of businesses with generator as prime, generator as back-up and with different electricity solutions



Despite recurrent costs for fuel, generators have capacity advantages over solar. The use of appliances and tools could quickly drain the low-quality solar solutions available that households use.

*We use a 6.6 horsepower generator, it can produce 7.5 kW power. We use it in the mornings, and from six to noon it uses up two litres of diesel. The cost is AFN50 per litre. We use our generator to power the TV, the lights and the water pump. We have 45 lights - solar energy would not be strong enough.*

Hotel owner, Daikundi

Generators had high usage rates especially in sectors with high electricity intensity demands such as carpentry, metalwork and construction in areas without access to grid. The most common usage for generators among business and institution respondents is powering electronic devices (56%), powering a pump (47%) and lighting (46%).

*I use a generator in my carpentry shop to use my electric tools, and to charge our cell phones. We use solar power for lightning when we work at night; we have three lights in the shop which we turn with solar energy and rechargeable batteries.*

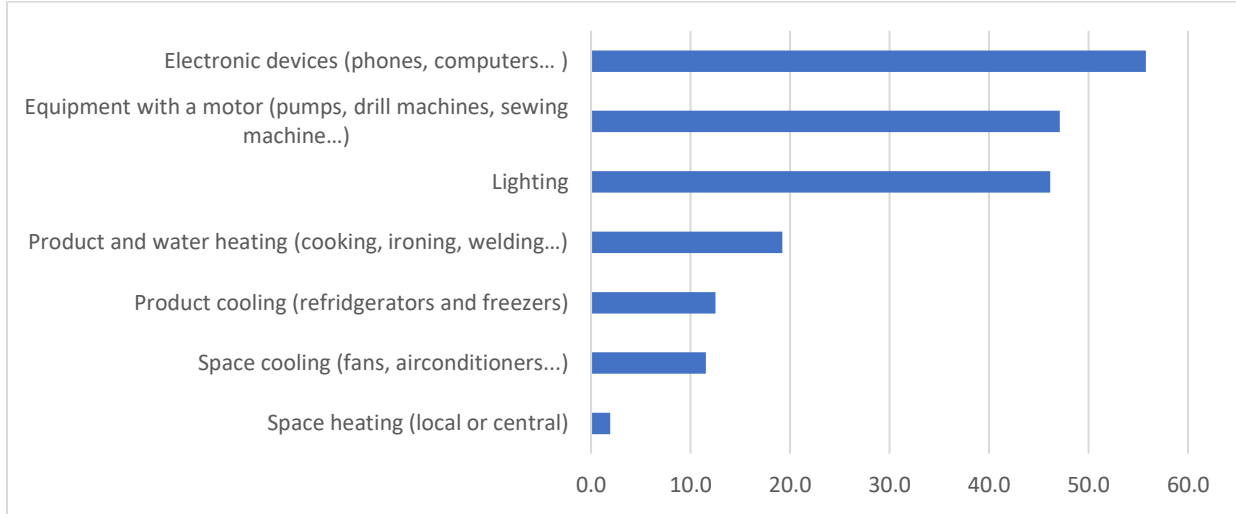
Carpentry business owner, Lab-e-Aab, Samangan

Figure 100 Left: A carpenter's electricity supply of choice - a generator covered in sawdust in Deh Yahya, Kabul. On the right, carpenters at work in Nili, Daikundi.



The majority of business / community institution respondents had one generator, but half of the ten interviewed factories had two. One shop in ten had more than one. These were used mainly to power electronic devices but also for motor equipment and lighting.

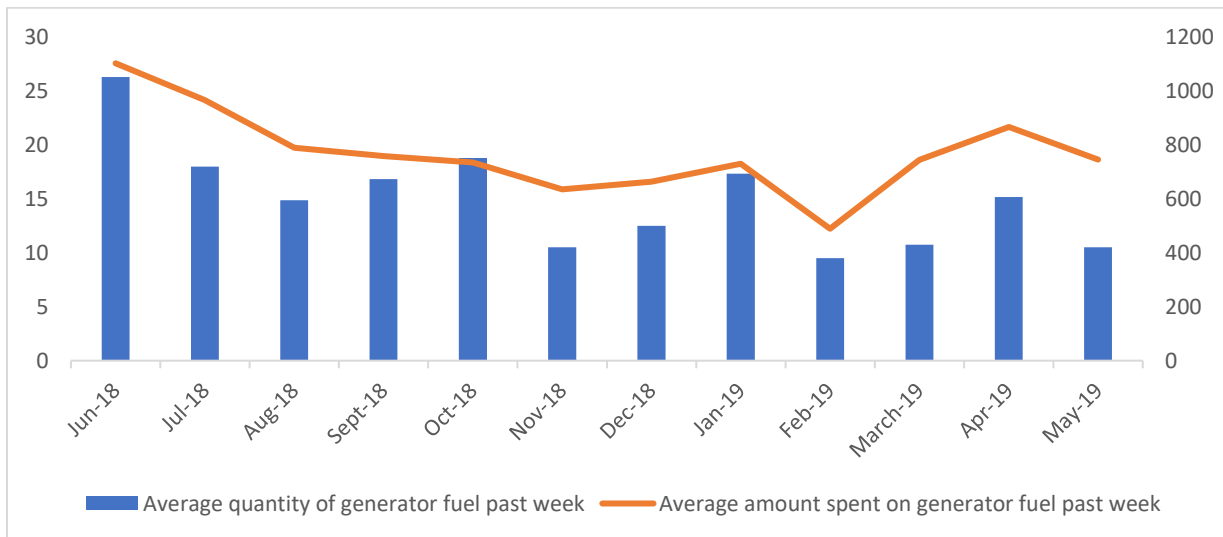
Figure 101 Business and Institution generator use



In terms of problems, two thirds of businesses and institutions remark upon the fragility of the generator, which tends to break; about half find it costly; and one in four criticises the fluctuations in electricity supply. Although permanent injuries caused by generators are rare for the sample interviewed for this project, over half of business respondents note that equipment had been damaged due to the generator.

Generators are purchased in the private market, along with any needed repairs, and the private purchase of diesel or petrol/gasoline to fuel the generator. Generators used by businesses / institutions are powered by diesel or petrol. Usage decreases slightly in the hottest and the coldest months, possibly linked to a general downturn in businesses these times of year.

Figure 102 Generator fuel use over time for shops



With the wide range in the type of businesses in the communities and the sample, along with their electrical supply, attitudes to cost also varied. Some businesses are almost completely reliant on electricity in their production and consume a lot of it – therefore being much more sensitive to the costs of fuels for their generators. At a focus group discussion in Daikundi (where there was no grid), energy intensive businesses including a carpenter and a metalworker protested about generator fuel costs taking up a high proportion of their revenue. The tailor in the focus group however, was much less concerned.

*We can make 5,000 to 6,000 AFN each day and we pay 1,000 to 1,500 AFN for diesel and we have other expenses too... after all expenses we can only save 1,000 to 1,500 AFN.*

Metalworker, Sang-e-Moom, Daikundi

- **Rechargeable Batteries**

Figure 103 Defunct rechargeable battery shop



Rechargeable batteries are in **negligible usage amongst households**: 114 households (3.7%) of the sample noted that rechargeable batteries were part of their energy mix. As was the case for generators, battery usage appears to be clustered in certain locations.

*Field observation: The photograph shows a battery charging shop in Shewaki, a village in Kabul province. The business used a diesel generator, still on the premises, to charge batteries (similar to car batteries). This option was supplanted as community members connected to the grid or accessed solar solutions.*

While they are almost unheard of in Daikundi, they appear to be comparatively more common in Samangan (particularly in the location of Talkhaki, close to the grid but not – yet – connected to it) and Herat (again, near places connected to the grid but not as yet connected themselves).

Individual households will normally (85%) own only one rechargeable battery. The majority of battery owners charges their battery at home (66 of 115), or at a neighbour’s house (16 of 115). Only a minority pays to recharge them in shops (21 of 115), usually a few hundred AFN per month. The batteries in use by the interviewed households are not strong enough to power large appliances, a fact noted among their most important limitations. They are almost exclusively used for lighting and charging mobile phones.

Figure 104 Rechargeable batteries in an everyday goods shop, Dasht-e-Barchi, Kabul

21 of the 179 **businesses** use rechargeable batteries (11.7%), **higher than in the household sample**. Rechargeable batteries can be charged at a shop or at homes.

Where rechargeable batteries are used for businesses and community institutions, they are mostly used for lighting.

*We don't have grid power yet to use as energy source to our works. We use rechargeable batteries in our shop for lightning and charging our phones.*

Mechanic in rural Samangan.

*Field observation: The rechargeable batteries shown in the photo to the left were charged at the shop-owner's home. He then brought the batteries into his grocery and everyday goods store to power the refrigerator, lightbulb, radio and for mobile phone charging.*



- **Mini-grid & pico-hydro**

Mini-grid solutions are equally uncommon in the communities surveyed, with only 42 out of a total of over 3,000 household respondents noting that such mini-grids were part of their energy mix during the baseline phase. These were located in the Kabul district of Kata Bolandi, in Dasht-e-Barchi, and the mini-grid system in usage there was powered by diesel. The mini-grid took the form of a privately owned, large 8-cylinder diesel engine which provided electricity to approximately 400 households for four hours each evening (5pm to 9pm). It could not handle a large usage load and was restricted to lighting, mobile phone charging and sometimes television. With the arrival of grid electricity in the latter half of 2018, this solution was decommissioned.

*It is just much more affordable. With the mini-grid, we paid up to 45-50 AFN per kWh. Now, with the grid connection, up to 200kWh, we pay 2.5 AFN. Then, up to 400, we pay 4 AFN. It goes up to 10 AFN per kWh.*

Male, Kata Bolandi, Dasht-e Barchi, Kabul

Figure 105 Mini-grid (later defunct when the grid was connected) in Kata Bolandi, Dasht-e Barchi, Kabul





In the same vein, the sample interviewed for this study contained very few households connected to a pico-hydro system. The majority of the 54 pico-hydro beneficiaries were located in the community of Majghandak in Herat (35 households), and Charkh in Daikundi (15 households). These pico-hydro systems are shared. They have been in place for two to ten years. Seasonal variations are by far the most important challenge – indeed, the system generates electricity in the winter and spring, but not in summer and fall.

*Figure 106 The pico-hydro system in Majghandak, Herat*





## 4) Aspirations for better energy, and willingness to pay

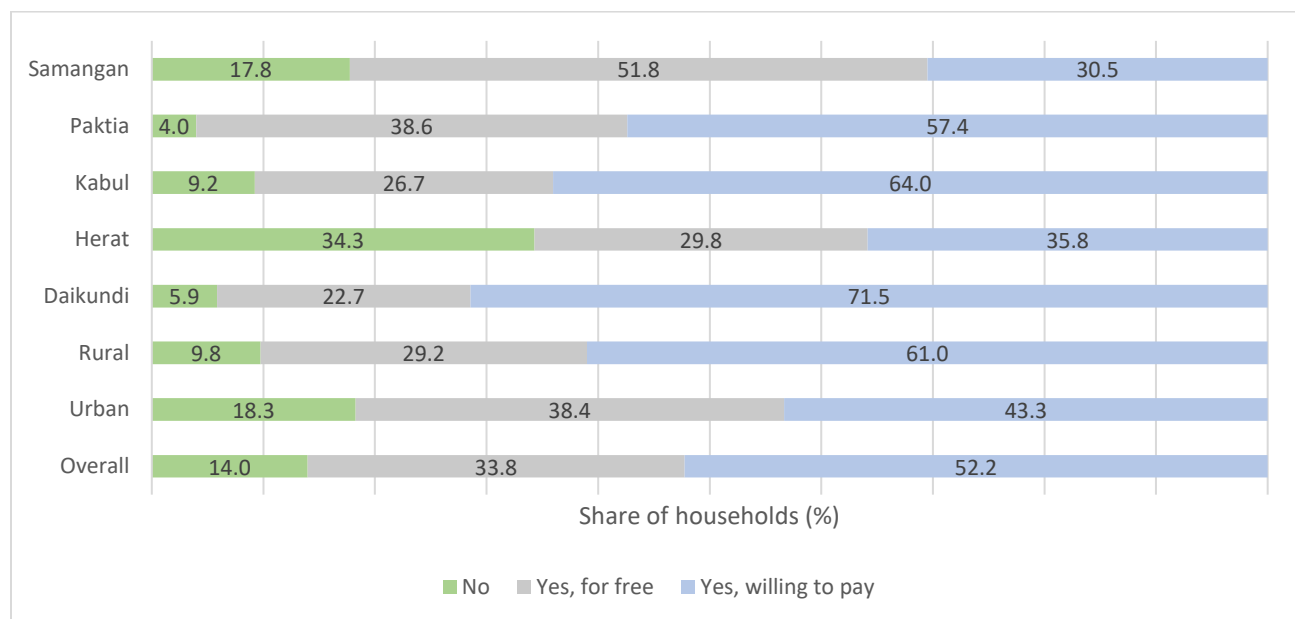
### A. Aspirations

The households and enterprises in the sample would often express their aspirations for improved energy solutions, whether they were using poorer quality solar panels and dreamed of using more appliances if connected to the grid, or already using grid electricity but desiring enhanced quality, reliability and/or affordability.

- **Households**

When asked whether they would like their electricity to be better, some 85% of household respondents answered in the affirmative (Figure 107). Over half of the respondents overall stated that they were willing to spend money on such an improvement. This share was higher in the non-grid locations, and higher in rural than in urban contexts, proof of the desire to be connected to the grid at a price, and to improve the grid performance where it is the most unreliable (Kabul).

Figure 107 Share of households who would like their electricity to be better



*If grid electricity comes and connects to our homes, it's like a blind person who becomes capable to see. I mean it would have a huge impact on our life. Now, we cannot use many electric devices at home such as a washing machine, fans, etcetera... but with having grid power we would be able to use those things.*

Mechanic, Lab-e-Aab, Rural Samangan

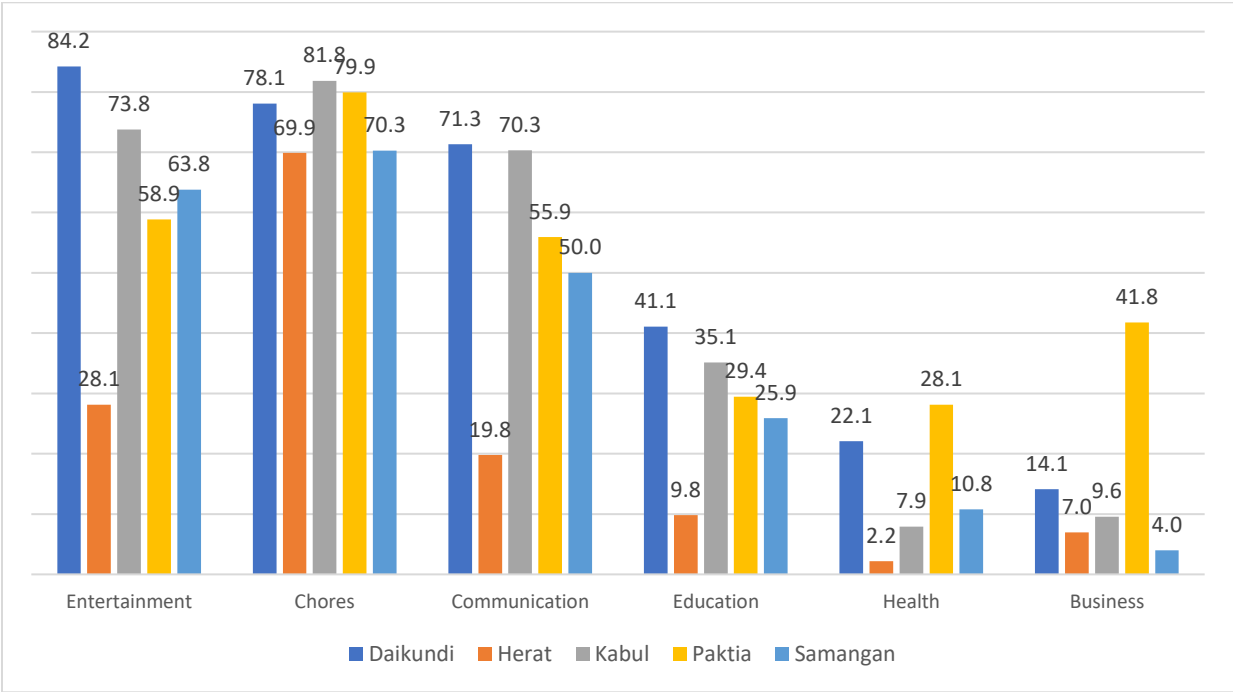
Households in communities without grid not only thought they would connect to the grid soon, but spoke of the multiple appliances and benefits that having better electricity would allow the household to accrue. Household respondents in qualitative research stated that better electricity would be useful to them primarily for entertainment (TV, radio) and household chores. This was also recognised in qualitative discussions with community members who *already had access to the grid*.

While there were common complaints about cost restricting usage, many research participants noted the strengths of their enhanced electricity and energy supply.

*Electricity has a very good impact on our life... we can prepare tea very quickly for guests... Our house is always bright. We charge our cell phones and can contact our family members who are living abroad. We use fans in summer. We use an iron, a heater to warm the room, [water] boiler, we use a refrigerator to keep our food cold and fresh, and we watch TV programs to know about the situation of Afghanistan and other countries. I sew and do my tailoring under lights. Also, we use internet and Facebook and we can contact each other very easily."*

Female, Yakatoot, Samangan

Figure 108 If your power were better, what would you want to use it for?



In the qualitative interviews, respondents spoke of how much difference energy could make in their daily lives and in the work around the household - using washing machines rather than washing by hand, or vacuuming rather than scrubbing floors - both women and men being quite aware of the impacts of energy on household work and its potential benefits.

*If we had better energy, we would use the best electric devices at home, such as washing machine, tailoring machine, vacuum cleaner, fan and other things. In fact, these are the main needs of a family and women really need those things at home, but unfortunately, we don't have better energy/electricity and can't use those appliances*

Majghandak, Herat

Also very common in the qualitative research was a simple focus not just on health, economic activities or household work, but on quality of life - the ability to cool or heat for comfort, watch television, read or study in the evenings, and entertain guests in well-lit, comfortable homes.

*If we could have better electricity, then since we have a washing machine, I would use it and wash all the clothes in the washing machine, but since we don't have enough electricity, we can't do that. And we also have water tank - if we had better electricity, we could buy a water pump and use it to fill the tank with water. And, if we could have better electricity, we could use it in winter for heaters and cooking. In summer we could use the refrigerator, and we could watch television, and we could study using a computer!*

Sar-e Nili, Daikundi

### Powering agriculture

Villagers in rural communities would often speak about a desire for enhanced electrical solutions; whether it was grid connection, generators or solar panel and battery systems to help draw water from waterways and to then pump water from reservoirs to their agricultural lands. With many households being primarily agrarian, the use of generators and solar was brought up by research participants during data collection across the research study.<sup>35</sup> Key informant interviews and informal discussions with research participants described how households would draw water from ground-water wells using electricity. Generators could be bought, hired or borrowed to draw water up into storage facilities or for immediate distribution across farms and gardens. New and improved solar was deemed better way to draw water for irrigation.

*Figure 109 Pumping water from the river to a storage unit using a diesel generator. Samangan. Advertisement in Herat.*



A Department of Energy and Water (DEW) employee in Samangan noted in a Key Informant Interview that an unintended effect of the uptake in electrical water pumps was the disruption of water table levels, compounded by the lack of enforced regulations on irrigation.

<sup>35</sup> A 2019 Economist Article “Making the desert bloom - cheap solar panels boost the Afghan poppy crop” draws attention to this phenomenon in regard to illicit opium production.

- **Businesses and Community Institutions**

Almost all the different businesses and community institutions indicated they used and needed energy in some way in their operations. The importance of electricity is universally acknowledged by business and institutional respondents, with two thirds of both business and institution respondents noting that it was “very important” and an additional 30% stating that working without electricity was simply not possible. This is in line with data by the Afghanistan Chamber of Commerce and Industries (ACCI): According to a survey of 900 businesses of all sizes conducted by ACCI, 80% of businesses report that their primary concern relates to the lack of adequate electricity.<sup>36</sup> Unreliable electricity provision and water supply affect the Afghan economy as a whole but their importance was stressed particularly by carpenters, metal workers and car mechanics. 80% of all interviewed businesses state that their workplace had suffered from lack of electricity in the past.

*Figure 110 A variety of shops in Dasht-e-Barchi, Kabul*

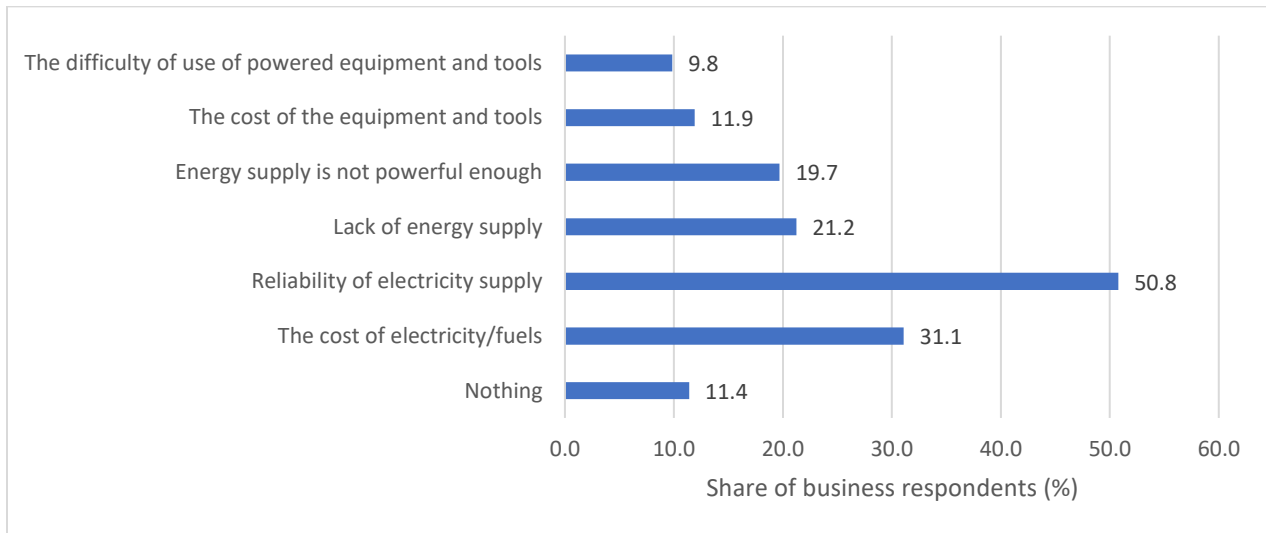
Many of the local authority figures in the Community Profiling phase of the research<sup>37</sup> lamented the lack of industry, jobs and businesses in their communities – many pointing to inconsistent electrical supplies as one of the undergirding reasons. Even in areas of urban Herat where there is a relatively steady supply of grid electricity (compared to Kabul, and to communities that lacked any grid access at all), metalworkers complained about the high cost of electricity consumption and how these expenses hurt their bottom-line profits.



<sup>36</sup> ACCI Survey Reveals More Than 50% of Afghan Private Firms are Optimistic about Future. Wadsam (June 6, 2013), <http://www.wadsam.com/acci-survey-reveals-more-than-50-of-afghan-private-firms-are-optimistic-about-future-344/> (accessed October 1<sup>st</sup>, 2019)

<sup>37</sup> Community Profiling was done before the finalisation of research tools and the baseline phase, where Samuel Hall enumerators conducted fieldwork in each of the 30 sample communities including geographic mapping and key informant interviews with community leaders. See: Methodology and Fieldwork Annex.

Figure 111 What prevents you from using more powered tools/equipment/machinery/appliances?



From a small-to-medium enterprise (SME) perspective, unreliable and costly electricity can hamper and restrict:

- A business owner's ability to make a living (through decreased production or the cost of operations)
- The decision of a business owner to employ more people
- The ability of an Afghan community to provide goods and services for themselves

If electricity were more readily available and affordable, the stated immediate changes made would be an upgrade in equipment for 70% of respondents, and working longer hours for 60%. A third of business and institution respondents state that it is likely their establishment would both become more productive and employ more people.

*I am a shopkeeper. If I had better and more energy, I would use refrigerator to keep my foodstuffs fresh and cool, such as cheese, yogurt, milk, vegetables, drinks and other things. But now I can't keep those things in my store...*

Shopkeeper in Lab-e-Aab, rural Samangan without connection to grid electricity

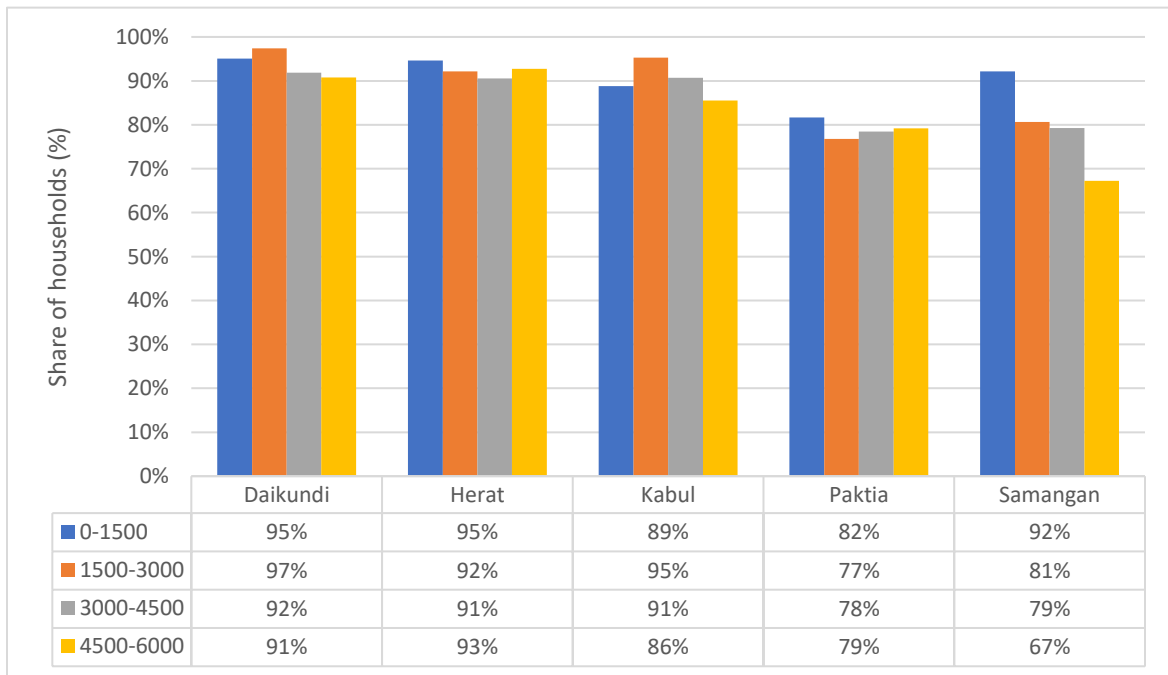
## B. Expected cost of, and willingness to pay for, grid electricity

- **Households**

Household and business / institution respondents not currently connected to the grid were asked if they would be willing to pay X – a randomly generated amount - for a connection to the grid “tomorrow, if it were possible”. Based on information obtained from the World Bank project team, the maximum value was set at AFN 6,000 (US\$76) for households. The amounts presented to the respondents were random below this bound.

The following graph represents an estimate of the proportion of respondents who, proposed a price within the given range, responded in the positive. It emerges that overall, the willingness to pay for a grid connection appears rather high, though less high in Paktia and Samangan than in the other provinces. Overall, at a price of up to AFN 1,500 (US\$19) for an immediate grid connection, nine out of ten off-grid respondents responded positively. This is still the case for 84% of off-grid respondents at (the more realistic) price range of 4,500 to 6,000 AFN (Figure 112).

Figure 112 Professed Willingness to pay for grid connection upfront

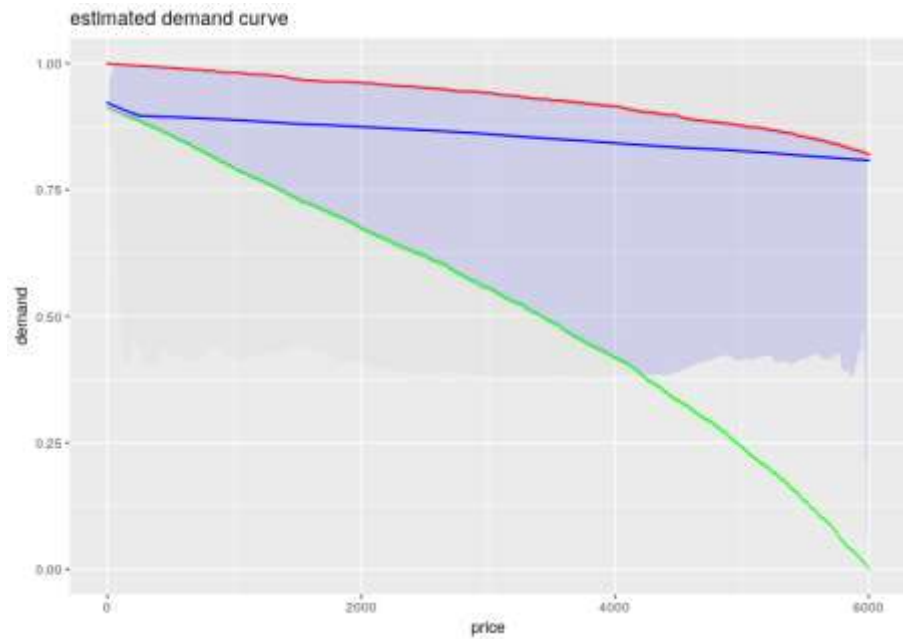


The demand curve of a service or device such as grid power or a solar home system is an estimate of the degree of penetration (subscription to the service) that might result for each price-point in a range. To estimate this curve, each respondent was presented a hypothetical price to be connected to the grid and asked whether he/she would be willing to pay that amount. The prices were randomly selected from a uniform distribution between zero and the estimated average cost of connecting a household to the local grid, to simulate different levels of subsidy.<sup>38</sup>

<sup>38</sup> For a more detailed description of the approach, please refer to the relevant annex to this document.

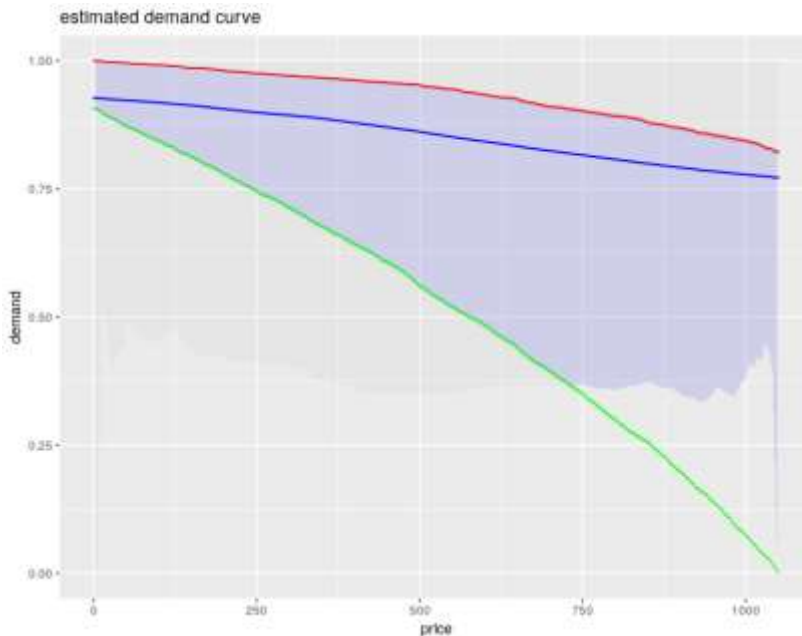
The blue line in the visual represents the estimate of the demand curve for a grid connection. Demand is found to be rather inelastic, barely dropping with rising proposed prices of connection. This indicates that it would not be necessary today to provide financial incentives / contributions to help the majority of off-grid households bear the financial burden of the grid connection.

Figure 113 Estimated demand curve: Immediate grid connection



Similarly, the demand curve for payment spaced out over six months is rather flat:

Figure 114 Estimate demand curve: Immediate grid connection, payment spaced out over six months



This indicates that schemes allowing households to pay for their grid connection over time are not a necessity in the Afghan context. Most off-grid households could and would find the means to afford a grid connection if it were offered to them. This may be due to the opportunities for borrowing, freely available to most respondents, and the perception that the gains (financial, social, health-related) would greatly exceed the cost.



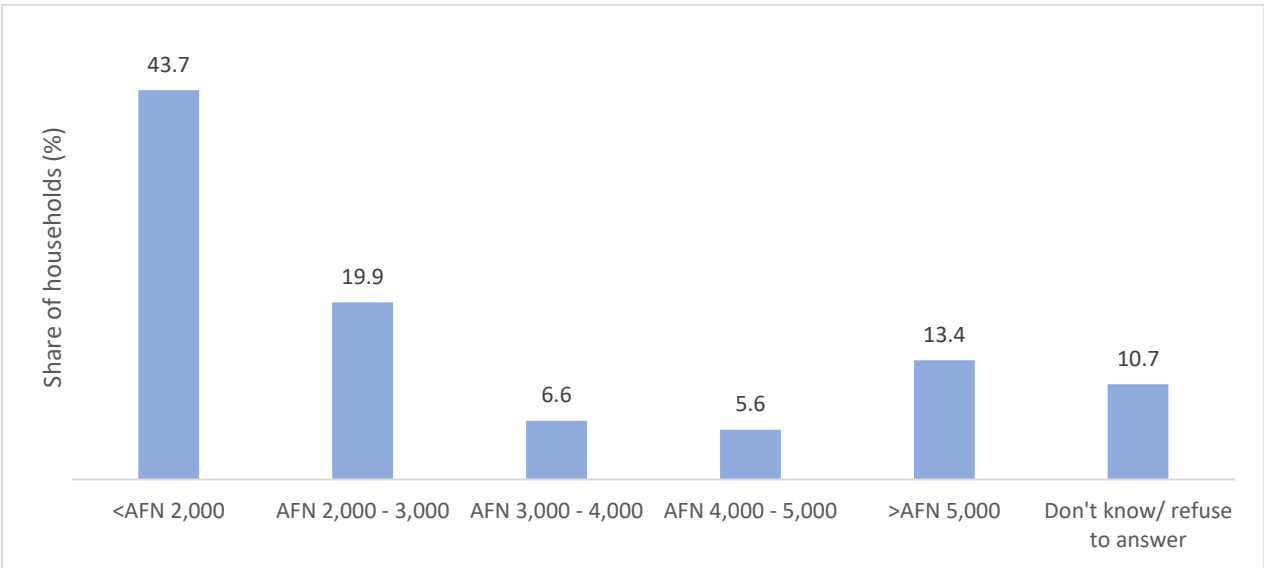
Connecting to the grid involves costs in wiring to the household to be able to connect lights and different rooms. The research team asked interviewees who were not connected to the grid about the estimates around these costs, along with their estimations of ongoing usage costs after the grid was connected.

Figure 115 Wiring and meters



The perceived cost of internal wiring for over 4 in 10 households that are not yet connected to the grid is below AFN 2,000 (US\$25). Another 3 in 10 households estimated this cost between AFN 2,000 and AFN 5,000 (US\$25-\$64) (Figure 116).

Figure 116 Perception of hypothetical cost of wiring



A respondent who connected to the grid in the first few months of the panel data collection (in late 2018), discussed how much it had cost his household:

*Getting connected to the grid cost approximately 11,000 AFN (5,000 for registration, 1,000 for the meter, 3,000 for the wiring and the rest for other miscellaneous expenses).<sup>39</sup>*

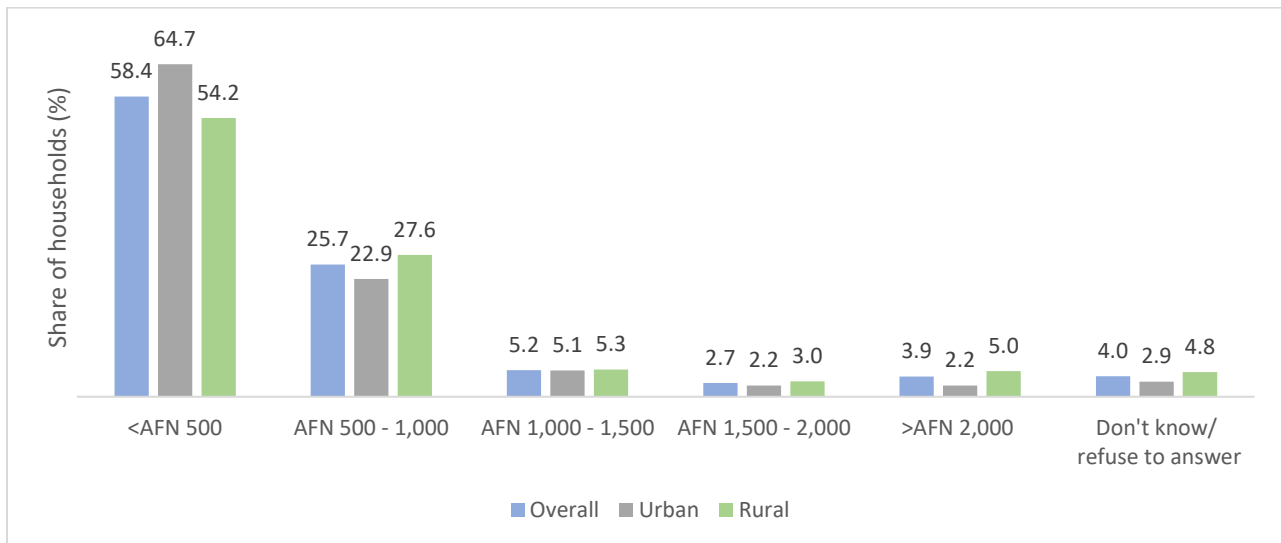
Male, Dasht-e Barchi, Kabul

In a similar vein, many respondents underestimate the “running cost” of electricity usage. When asked how much they thought their monthly electricity costs would be if they did get a grid connection, the vast majority of household respondents cited very modest amounts. **Close to 6 in 10 households without a grid connection estimate that their monthly cost of electricity would be less than AFN 500 (US\$6.00).** This compares to an average expenditure of electricity in the participants with grid of between AFN 525 (US\$6.70) and AFN 851 (US\$10.85) per month. Rural households tend to estimate higher electricity bills than urban households, which is in line with the reported actual comparison costs in the survey results. The qualitative research also discussed willingness to pay, which was closely connected with households’ aspirations for using appliances.

*If we could have access to reliable grid power, which we could use for washing machines, irons, electric heating and other types of machines, I think we could pay AFN 2,000 to 2,500 for it.<sup>40</sup>*

Sar-e-Nili, Daikundi

Figure 117 Perception of hypothetical cost of monthly electricity bill



<sup>39</sup> The approximate equivalent of US\$140 in total, US\$64 for registration, US\$13 for the meter and US\$38 for the wiring.

<sup>40</sup> US\$25-\$32

### How much does electricity cost in Afghanistan?

The price of electricity is dependent on usage:

- 0-200 kW: AFN 2.5 per kW
- 201-400 kW: AFN 3.70 per kW
- 401-700 kW: AFN 5.75 per kW
- 701-2000 kW: AFN 8.25 per kW
- Above 2000 kW: AFN 10 per kW

*This way poor families are able to pay their bills. They consume less and will pay less. The rate for commercial and government buildings is AFN 12 per kW no matter what their consumption.*

*Key informant interview, DARS power engineer*

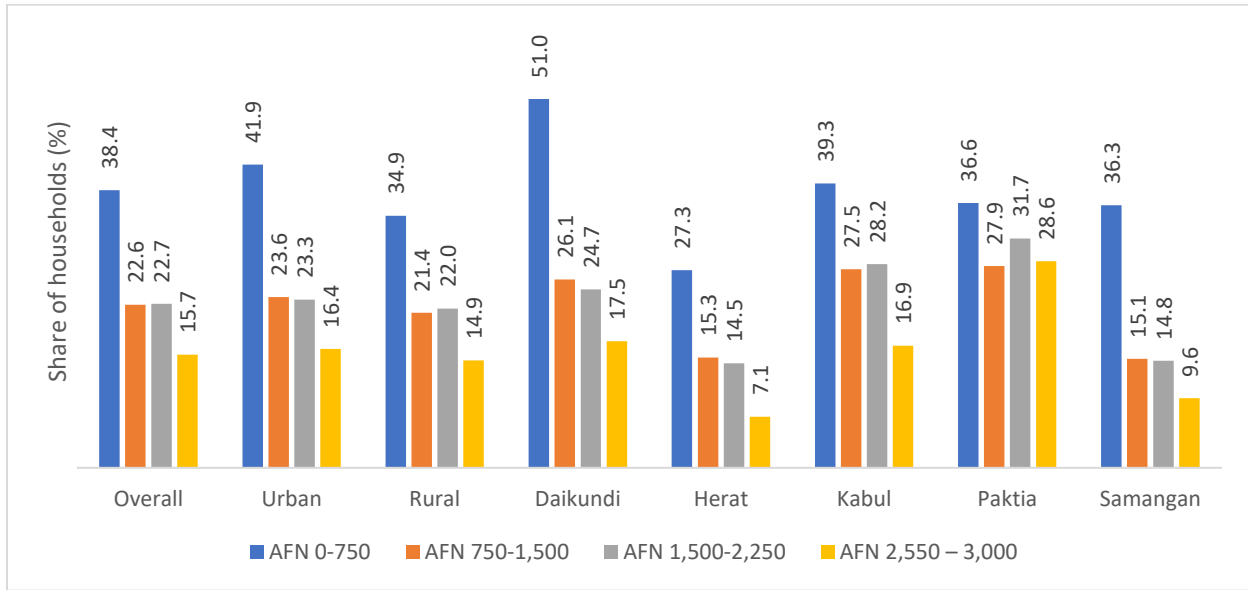
**Willingness to pay for solar power** solutions should be assessed keeping in mind some important caveats. Almost everyone who does not have grid already has some sort of solar device. Grid is largely preferred to solar power, as solar energy is perceived, rightly or wrongly, as unable to power large devices. Almost everyone who does not have grid now expects to get it in the near future.

*Within three years after getting grid power, all of us sold our old fuel lanterns, solar home systems and solar lanterns at the bazaar in Aybak. We all use grid now. No one has a stand-alone power system anymore.*

Dawlatabad, Samangan

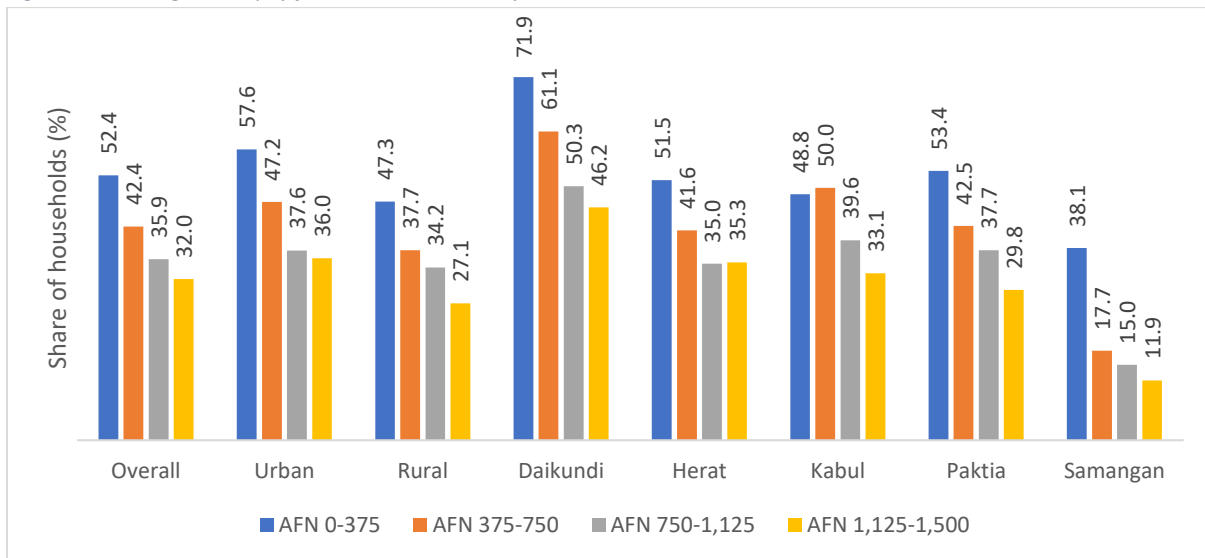
The following graph represents an estimate of the proportion of all respondents (including those with grid and with solar) who, proposed a price within the given range, responded in the positive. Almost 4 in 10 of all households are willing to pay for a solar lantern with phone charging for up to AFN 750 (Figure 118). The share drops as price increases. Households in Daikundi and Paktia (both provinces without electricity grid) are more likely to be willing to pay for a solar lantern than households in Herat, Samangan, and to a lesser extent, households in Kabul.

Figure 118 Willingness to pay for a solar lantern with phone charging



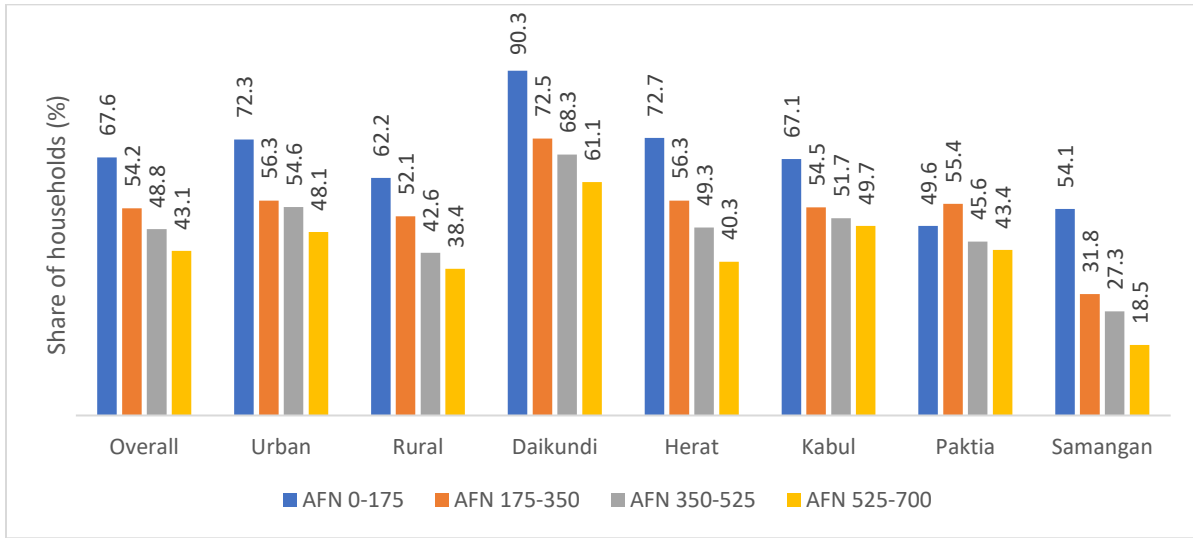
Close to one third of the households are willing to pay between AFN 1,125 (US\$14.50) and AFN 1,500 (US\$19) in instalments spaced out over 2 years (Figure 119).

Figure 119 Willingness to pay for a SHS in 24 monthly instalments



Renting a SHS is an even more popular option, as close to 2 in 3 households are attracted by such a scheme for a price of up to AFN 175 (US\$2.20) per month (Figure 120). The share drops as rent increases, but remains quite high at 43%.

Figure 120 Willingness to pay for monthly rent for a SHS



**Price elasticity and value proposition for solar products: IFC’s Lighting Afghanistan experiences in Bamyan Province**

IFC’s Lighting Afghanistan is an initiative aimed at supporting the development of a market for quality-verified, affordable, reliable and sustainable solar products, ranging from solar lantern to solar home systems, through market-based approaches. During its 3 years of implementation, the initiative supported local private sector firms in importing high quality solar products, helped establishing/strengthening distribution channels to reach the neediest households in rural off-grid areas and designed and implemented awareness campaigns to inform consumers on the benefit of purchasing quality verified products with two years warranty versus standard low-quality alternatives.

The Lighting Afghanistan program is a component of a global initiative, Lighting Global, active in several countries in Africa and South/South-East Asia. The results obtained by the program in Afghanistan depict a quite unique picture: solar PV and especially solar home systems in Afghanistan are ubiquitous. However, the market penetration of high-quality products, such as those supported by the Program, has been particularly low, as compared to both nearby countries (i.e. Pakistan, India) and those facing similar percentages of off-grid population (i.e. Kenya, Tanzania). The main reason for this - according to local distributors - is the higher price of high quality products as compared to alternatives already available in the market.

This did not come as a surprise for the program: similar feedback was recorded in other countries, and consumer awareness campaigns were designed precisely to overcome such issues. In addition, consumer financing was provided through local Micro Finance Providers, to alleviate the affordability gap. However, even with such instruments in place, sales plunged. In an effort to better understand the value proposition and price point of quality verified solar products, the program piloted the direct distribution of quality verified solar lanterns and SHS through three branded shops in Bamyan, an unelectrified rural Province located in the remote central highlands of the country. The idea was to collect first-hand visitors’ feedback and track sales at different selling prices. The results demonstrate that solar PV is a highly considered and a mature commodity, with well-known price points – i.e. a 20% reduction of prices for one-week, increased sales by 400% as compared to the average weekly sales of the previous four weeks without incentive.

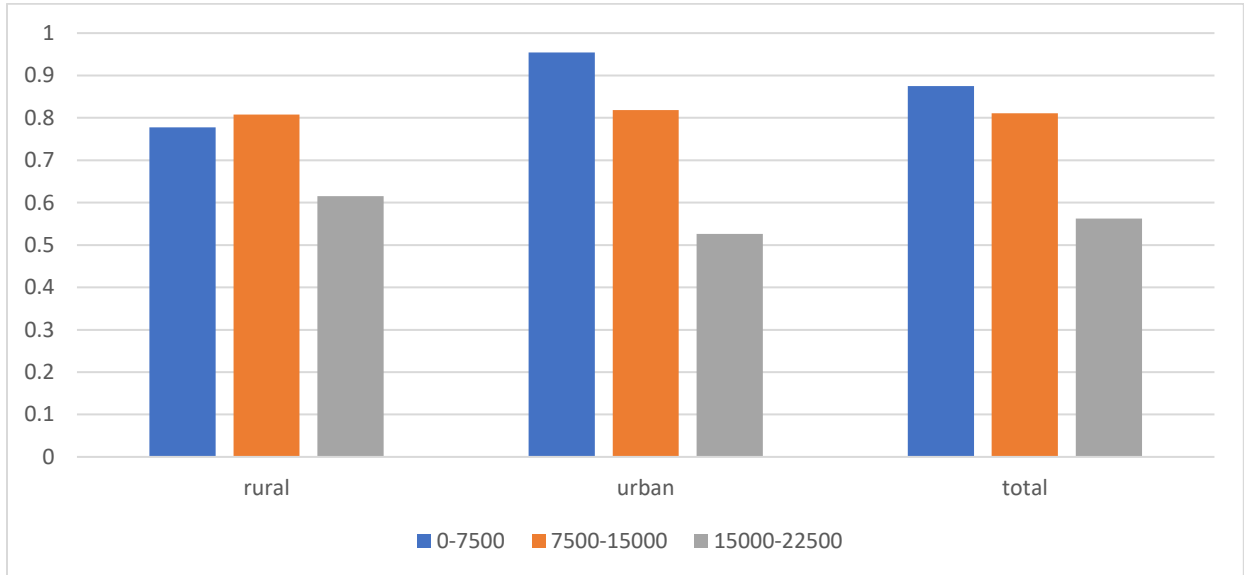
Which consequences for the market? The low quality of the standard solar products available in the market in Afghanistan and the high price sensitivity of rural customers has not hampered the diffusion and the trust of customers towards this technology. However, as this survey highlights, most of the households relying on standalone solar PV for their energy needs perceive this technology only as an interim solution before being served by the grid. Nevertheless, as most energy planning studies highlight, given the remoteness, low population density and rough terrain of Afghanistan, stand-alone solutions might be the most cost-effective way to electrify large portion of the rural population for years to come. Adopting and promoting the diffusion of quality standards, in this regard, is a valuable approach to improve the efficacy of the energy services provided by solar products

- **Businesses and Community Institutions**

The willingness to pay for a grid connection is high among businesses and institutions, but not as high as it is for households. This reflects the fact that a number of them do not require electricity to function.

*Nota bene: the sample is not large enough to allow for a split by type of respondent, sector, etc.*

Figure 121 Professed willingness to pay for grid connection upfront: businesses and institutions



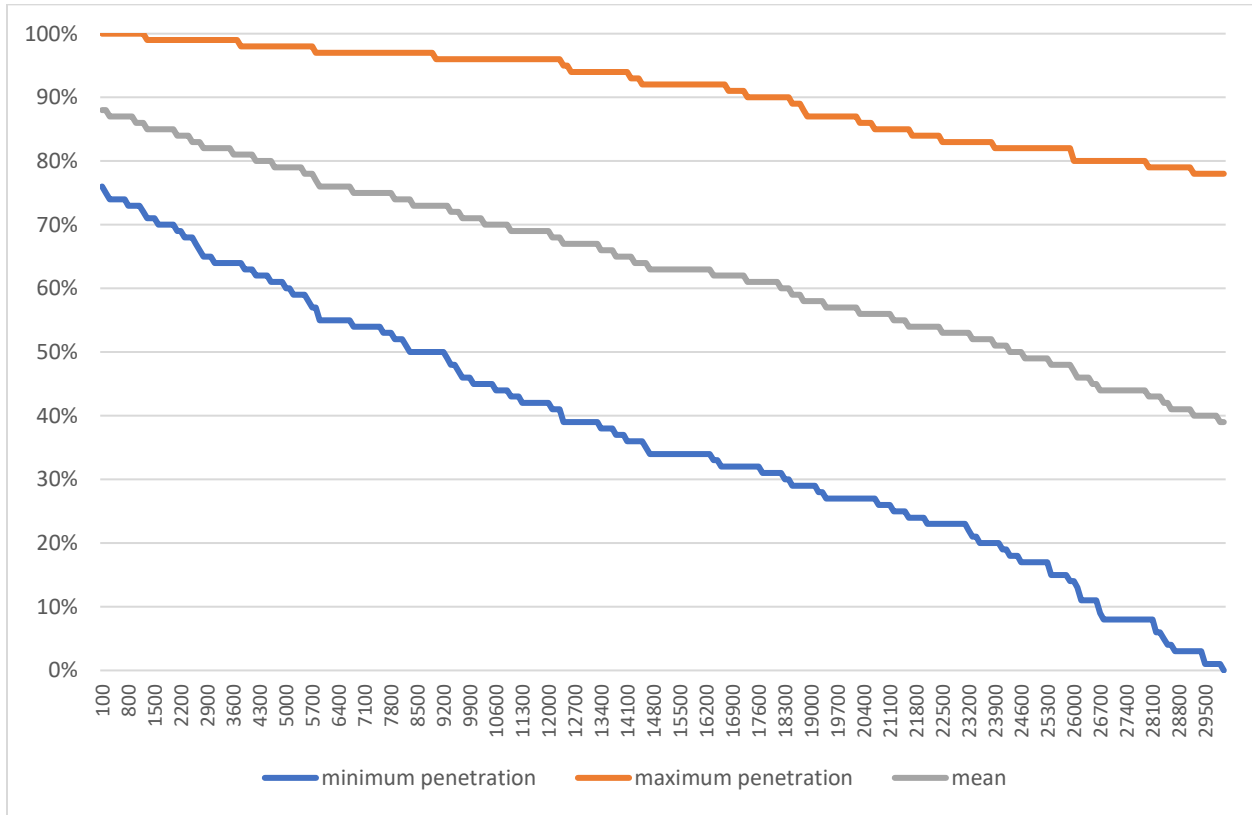
*To be honest we could make all our system electric and we could pay up to 100,000 for electricity because all the machines we use are electric. Currently we pay 40,000 to 50,000 AFN for diesel and gas. I know we would have to pay once for having electricity but we could use it for years and we could increase our prices and we could make more money.*

Hotel owner, Charkh, Daikundi

For businesses and institutions, the demand curve is less narrow in the low price ranges, implying that there are certain economic and institutional actors (25% of those consulted) who simply do not feel the need to be connected to the grid. The relatively steady maximum penetration (i.e. the red line which illustrates the percentage of respondents unwilling to pay the quoted price, or less) indicates that a certain small segment of the population are simply not willing to pay for a grid connection no matter what the price.



Figure 122 Estimated demand curve for immediate grid connection, business and institution respondents



## 5) Cooking and heating

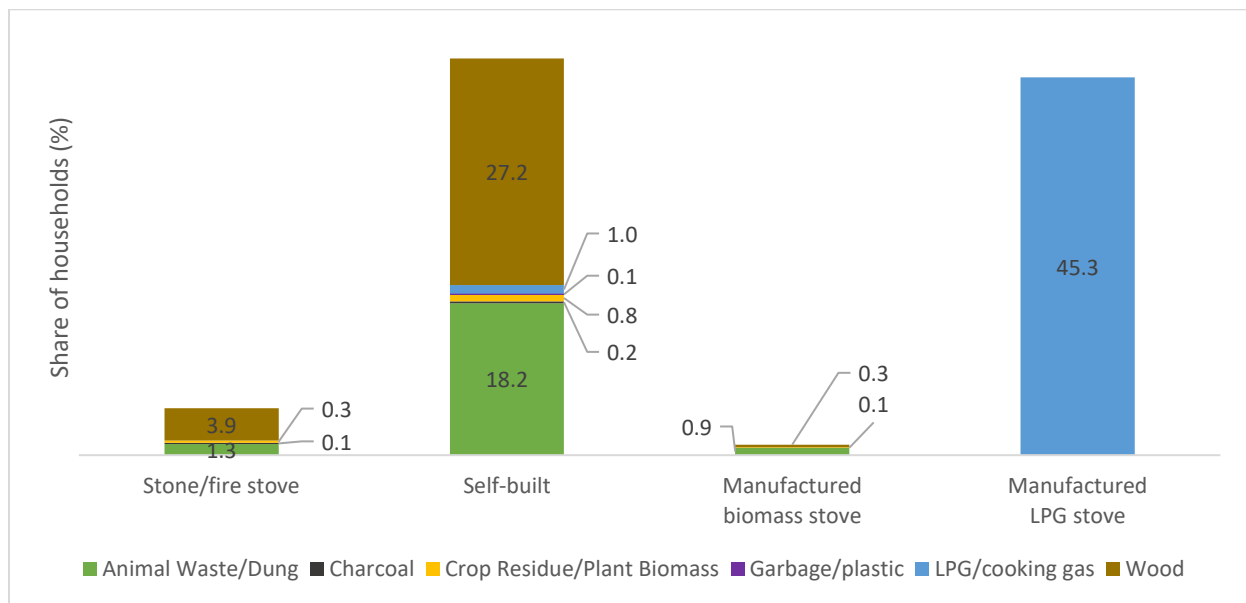
Along with electricity, cooking and heating are the central energy demands for Afghan households.<sup>41</sup> The cross-over between electricity and cooking/heating is low, with electric stovetops as the main cooking device being rare; electric heating less so but still not dominant compared to using solid fuels. Heating, while inherently seasonal, was necessary in all the sample households during the cold Afghan winter months. Both cooking and heating constitute different mixtures of fuel, with linkages to an interplay of fuel collection practices, gendered experiences of energy and health implications.

### A. Cooking solutions

Cooking usually (65%) takes place inside the dwelling in a designated area, but it is not unusual for it to occur in a separate dwelling (17%) or outdoors (12%).

**Approximately 48% of the interviewed households primarily cook with a self-built stove, fuelled mainly with wood and/or animal waste. Another 45% surveyed households primarily cook with a manufactured LPG stove, mostly of Iranian design - over 7 in 10 LPG stoves are Iranian stoves. Less than 6% use a stone/fire stove as primary cooking solution (Figure 123).**

Figure 123 Primary cooking solution / fuel



*We are living in a clean environment now. Everyone cooks with gas. The wooden stoves we used to use caused so much dust and pollution. And the Areekain [oil lamp] was not as good as the energy we now use to power the lights.*

Male, Kata Bolandi, Dasht-e-Barchi, Urban Kabul

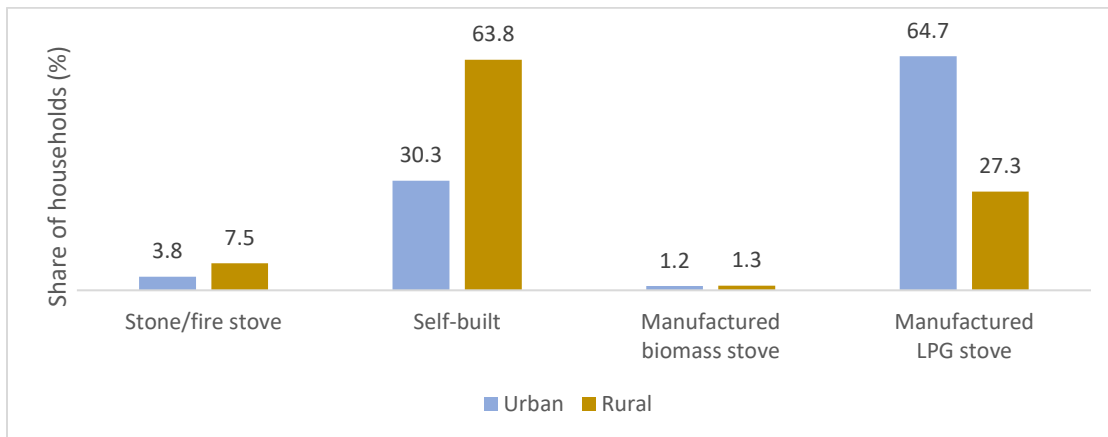
<sup>41</sup> Energy for transportation was not included within the scope of the study.

Figure 124 Impressions of stoves



In urban areas, the share of households using a manufactured LPG stove as a primary cookstove rises to 64%, while less than 1 in 3 households use a self-built stove (Figure 125). In rural areas, the share of LPG users drops to 27%, while 2 in 3 households primarily cook with a self-built stove (Figure 125). Over the course of this study, LPG stoves were the only type which was purchased by studied households on a regular basis (15-30 per month for a household sample of over 3000), leading to a slow but steady increase in LPG stove ownership.

Figure 125 Primary cookstove, urban vs rural



The large majority of interviewed households in Kabul (83%) primarily cook with an LPG stove. Samangan is the province with the least LPG primary stoves (9%), as almost 9 in 10 households primarily cook with self-built stoves.

*Gas [LPG] is better than using wood in a dygdan (local stove) for cooking. This is because it is very easy to cook on an oven rather than the dygdan in which we used dung, wood and firepower.*

Female, Karte Naw, Urban Kabul

Many households use more than one form of energy for cooking, a phenomenon known as stove-stacking. A household may use LPG to heat tea, but then wood and/or animal waste as solid fuels for meals; depending on both the type of stove or the ownership of a *tandour* bread oven. Choice in fuel mixture also depended on the comparative availability and cost of LPG versus wood, dung or other biofuels.

*We use liquid gas for cooking, because there is not anybody to bring us other things. But in the case we can find other materials for cooking like wood, animal droppings and anything else, then we will use that as well to save our money.*

Malikiha, Herat province

One third of **businesses and community institutions** cook on their premises (62 out of the 179 business and community institutions). Almost all (61 of the 62) use an LPG stove to cook. In practice, smaller shops may simply have an LPG stove for the staff to cook their lunches while at work.

## B. Heating solutions

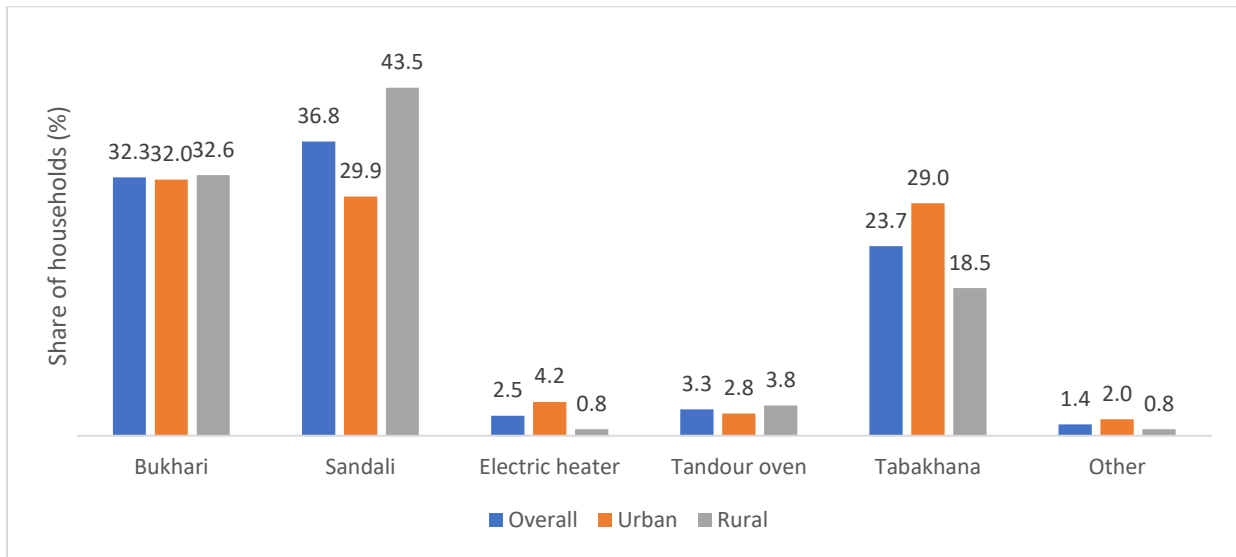
Heating constitutes a major use of fuel and energy demand during the colder months in Afghanistan. While there is some diversity in the fuel type and heating solutions that Afghans in the sample employed, all heating solutions represented a necessary expense for households, which of course, was highly seasonal.

Figure 126 Collected brush transported on the back of donkeys, Aybak, Samangan



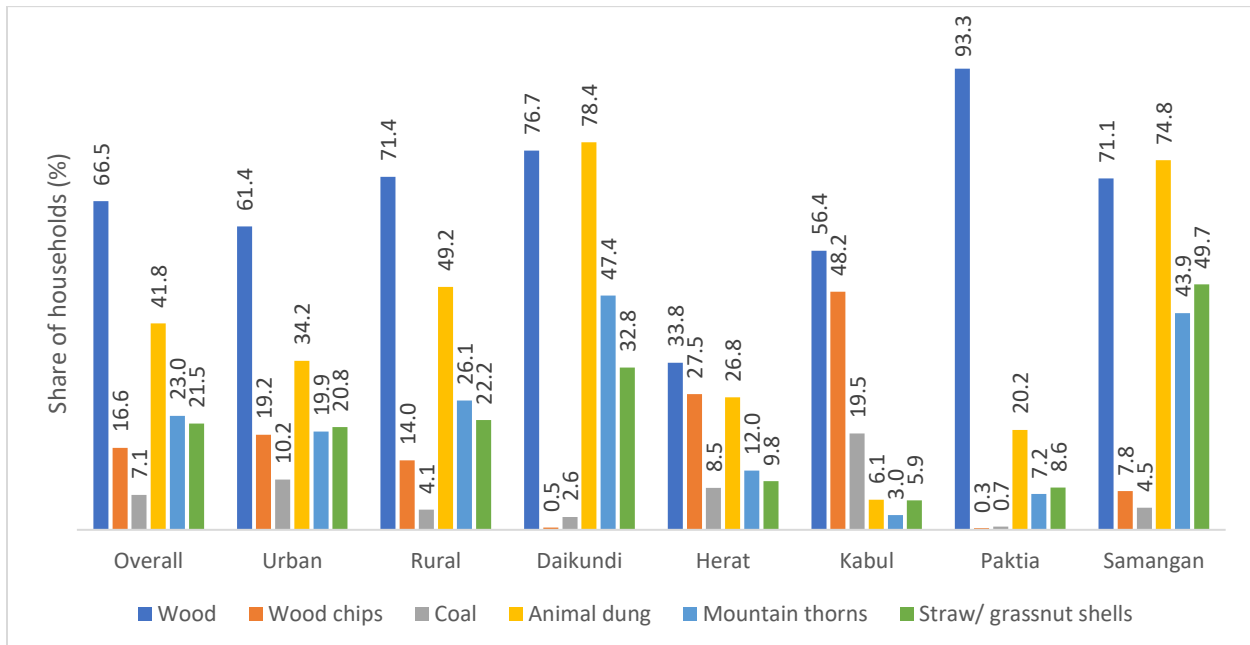
Electrical heating solutions were relatively uncommon amongst interviewees, with most still reliant on wood and other solid fuels burnt by different heating methods, including *bukhari* (space heating stoves), *sandali* (a heater in an enclosed space, often a blanket or rug over a table with the heater underneath), and *tabhakhana* (a central ducted heating system, although rarely with gas in the study sample). Tandour ovens are used to make bread and are usually made from clay.

Figure 127 Primary heating stove



The most common heating fuel remains wood, followed by animal dung and other vegetal material (Figure 128). Coal remains rare, possibly due to the fact that cooking and heating solutions are often one and the same. About 24.3% of surveyed Afghan households use their primary cooking stove for space heating (28.8% of rural households and 19.8% of urban households), especially users of biomass stoves (rather than LPG). For instance, the traditional heater is widely used to bake bread, or make tea.

Figure 128 Heating fuel usage



\*Note: A household may give multiple answers

Figure 129 Bukhari wood heater, doubling as a stove to prepare breakfast



#### Voices from Afghanistan: cooking and heating

*We turn on the wood heater in the morning, to heat the home and prepare breakfast. We boil water on the wood heater to wash clothes and bathe. We cook food using a gas stove. In the wood heater, we burn fruit cartons, wood and coal. When it is snowing, the heater is on all day. We buy wood and coal at the beginning of the winter. In winter the price of fuel, including wood, is more expensive.*

Kata Bolandi - Dasht-e-Barchi, Kabul

*Nota bene: To read the entire case study, please refer to the relevant annex.*

**Businesses and community institutions** usually require heating (217 out of 253 had a heater, while 36 had none). In a similar profile to households, 70 of the 253 use *bukharis*, while *sandalis* and *tabakhanas* are also in common usage (Figure 130). One major difference to households is the relatively high use of gas heaters.

*We use gas for cooking, and for winter, when the weather gets cold, we use gas heaters.*

Photography and printing press business owner in Sang-e-Moom, Daikundi

There are also 36 enterprises who do not use any heating whatsoever (Figure 130). The one tandoor oven in usage was in a bakery business, the bakers deriving warmth from the source of their bread-making (Figure 130).

*Our fuel or heating sources in the winter are wood, coal and gas (LPG). We bring heated coals in the stove to put it in the sandali in the shop because using the sandali is very economical. We use LPG for cooking which costs 150 AFN in a day. Wood is always expensive during the winter. Our shop is located very far from our home, so we cook food in the shop for ourselves.*

Shopkeeper, Talkhaki, Samangan

Figure 130 Heating sources of businesses and community institutions

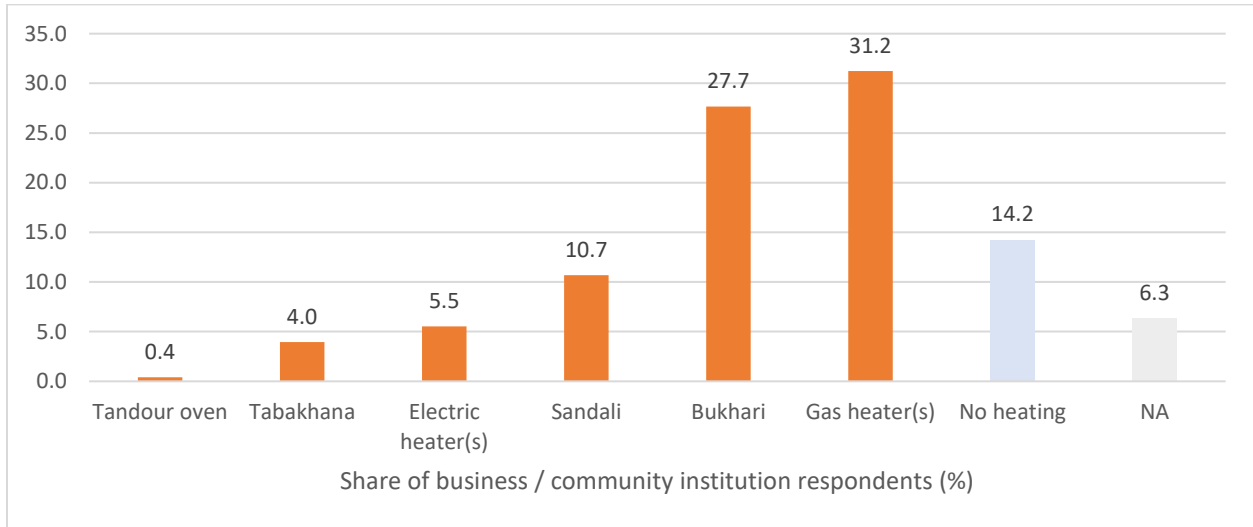


Figure 131 Chicken coop business, Yakatoot, Samangan :a bukhari space heater can be seen towards the right, to stop the chickens from freezing



The share of businesses and community institutions that do not use heating could be attributed to many businesses not running at nights when it is coldest; but also, many businesses operating from small booths or open-fronted shops where heating is not practical or even possible.



Figure 132 Difficult to heat: An open shop in Dasht-e-Barchi, Kabul, with warmly dressed vendors sitting in the January sun



We use gas for cooking and some other things, but we don't use it for warming the shop. My [motorcycle repair] booth has lots of holes so how could I keep it warm in winter? Also, since all the motorcycles use petrol, we cannot use wood [for heating] which would be very dangerous.

Motorcycle repair shop owner, Sang-e-Moom, Daikundi

### C. Cooking and heating fuel collection and expenditure

When asked about the spending on fuels used for cooking (over the past month) and heating (over the past year given that heating material is commonly purchased in bulk in the fall), household respondents' answers displayed considerable variation, and qualitative research confirmed that costs may vary widely depending on what fuel is used, how it is collected, and where it comes from - for example, the use of dung from home agriculture, or of gathered wood, means that these sources are free in terms of financial costs, though opportunity cost and life impacts may be high.

- **Cooking fuel**

Cooking fuels are always or mostly available to over 90% of the households (Figure 133). No significant differences are noted between urban and rural areas. Kabul is the province with the highest fuel availability (95%), while in Paktia the share drops to 83% (Figure 133).

Figure 133 Cooking fuel availability

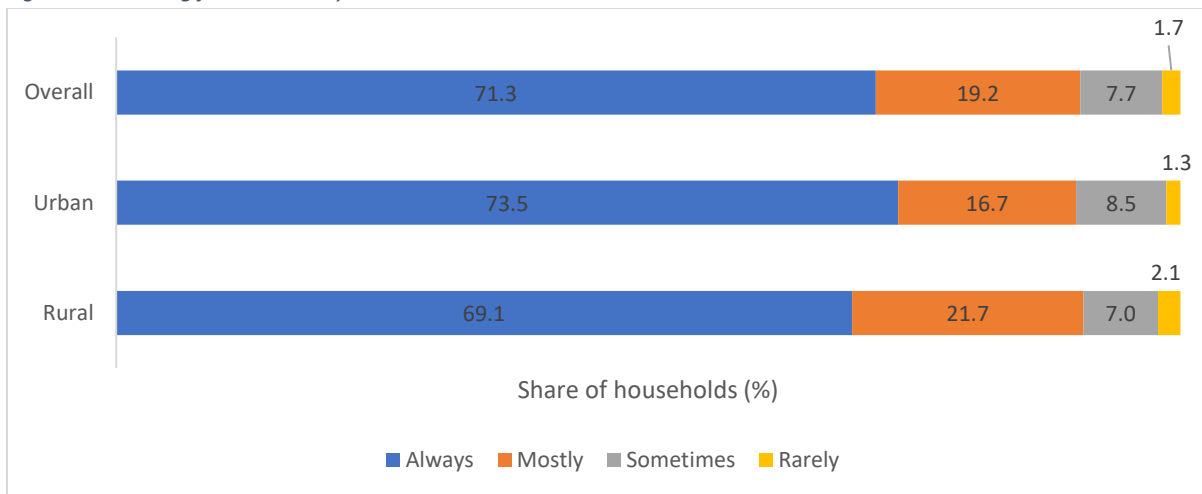
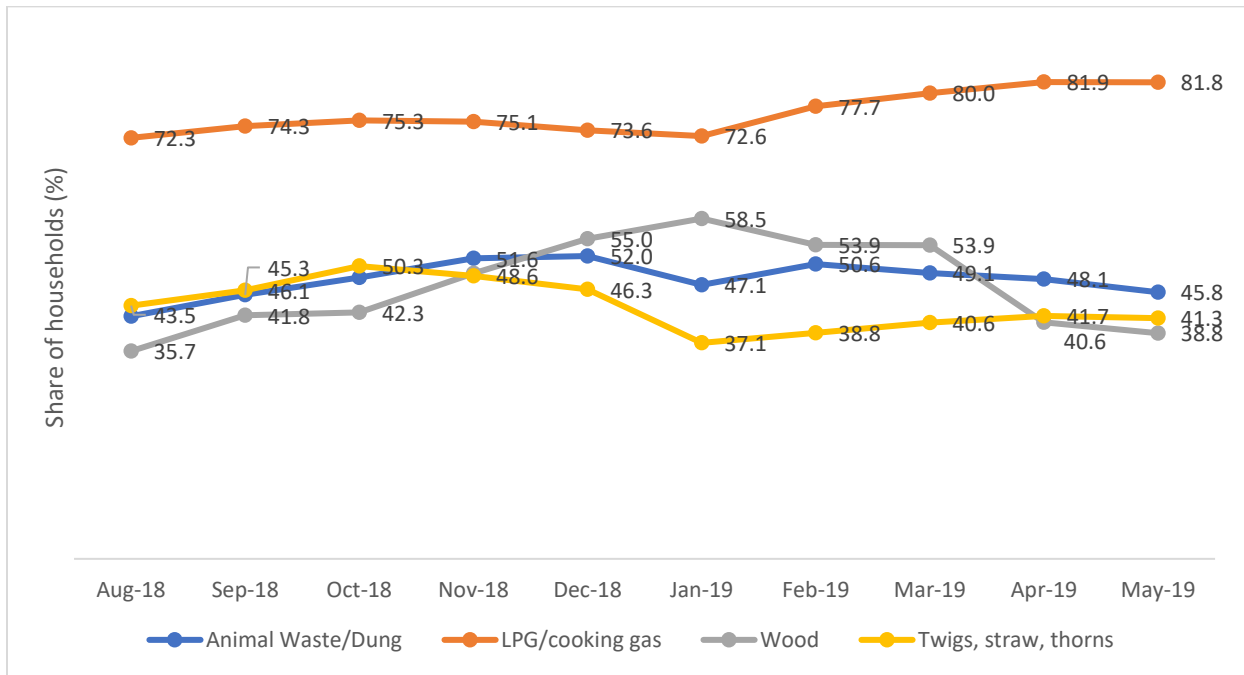




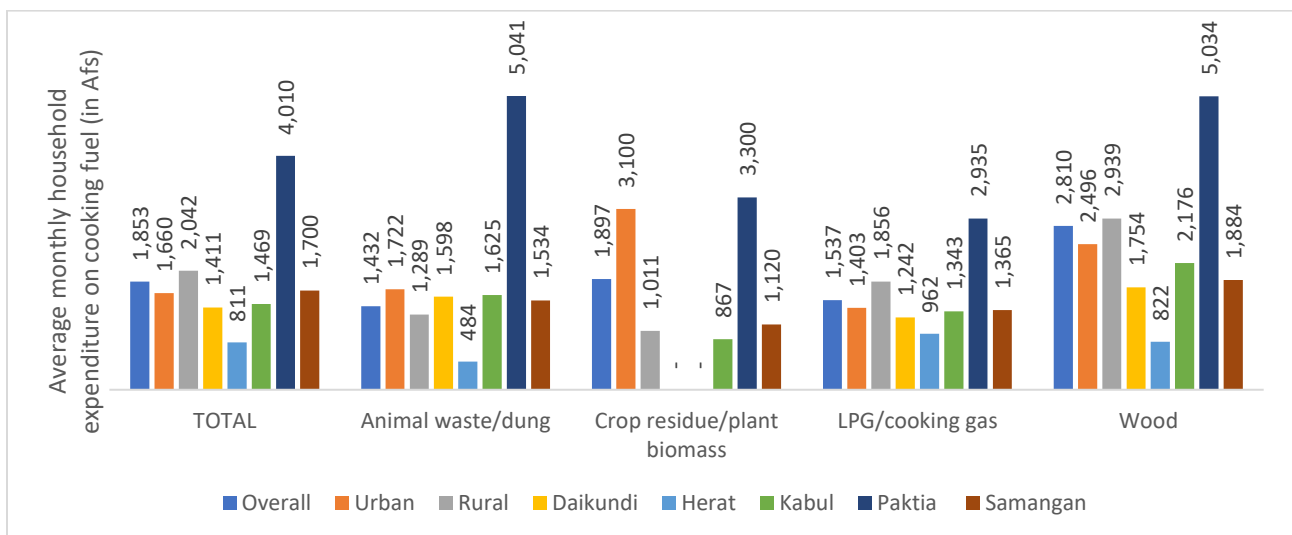
Figure 136 Cooking fuel usage over time



\*More than one response possible

On average, an Afghan household in the research sample reportedly spends 1,853 AFN (approximately US\$24) per month on fuels for cooking (Figure 137). Wood is the cooking fuel for which households tend to have the highest average expenditure at 2,810 AFN (US\$36) per month, while the average household expenditure for animal waste is 1,432 AFN (US\$18.50) per month and for LPG is 1,537 AFN (US\$19.50) per month. Households in Paktia have the highest expenditure at 4,010 AFN per month, and Herat has the lowest at 811 AFN per month (US\$10.50) (Figure 137).

Figure 137 Average monthly household expenditure on cooking fuels (overall, urban/rural, by province)



- **Heating fuel**

*A single household uses up to 2,800 kg of wood in a year, and each kilogram costs AFN 15.<sup>42</sup> The cost of wood and liquid gas is not fair to poorer families who do not have electricity, or solar. People also use coal in their bukharis and sandalis, but it is really not healthy.*

Engineer and Senior Advisor, Ministry of Energy and Water (MEW)

Fuel is an expense for urban households throughout the year, but mainly in winter for rural households.

Many households in Afghanistan buy all or almost all their winter fuel in one bulk purchase, at one certain time of the year (the period leading into winter across October and November). This is especially the case in urban areas such as Kabul, where there is a reliance on purchased fuels in contrast to more rural areas that access biomass including animal waste and wood, twigs, bushes and shrubs from agricultural lands.

#### **Voices from Afghanistan: Buying wood for the winter**

The project team conducted fieldwork in a bazaar in Kabul focussed on selling wood and coal used for fuel. Most of the fuels are used in bukhari space-heaters. One of the larger vendors discussed his business operations with Samuel Hall, lending some qualitative insights into heating fuels in Kabul.

*“All types of people come here, some rich, some middle to poor. The only difference for us is that rich people buy more and pick the good quality but poor people buy less, pick the cheaper quality and negotiate the prices too much. (...) Some rich customers buy 5 to 10 Kharwar [560kg each], poorer customers buy on average 2 Kharwar. The amount of wood and coal purchased by customers is also depending on family size, and how many bukhari are in use.”*

Figure 138 The Kabul fuel market



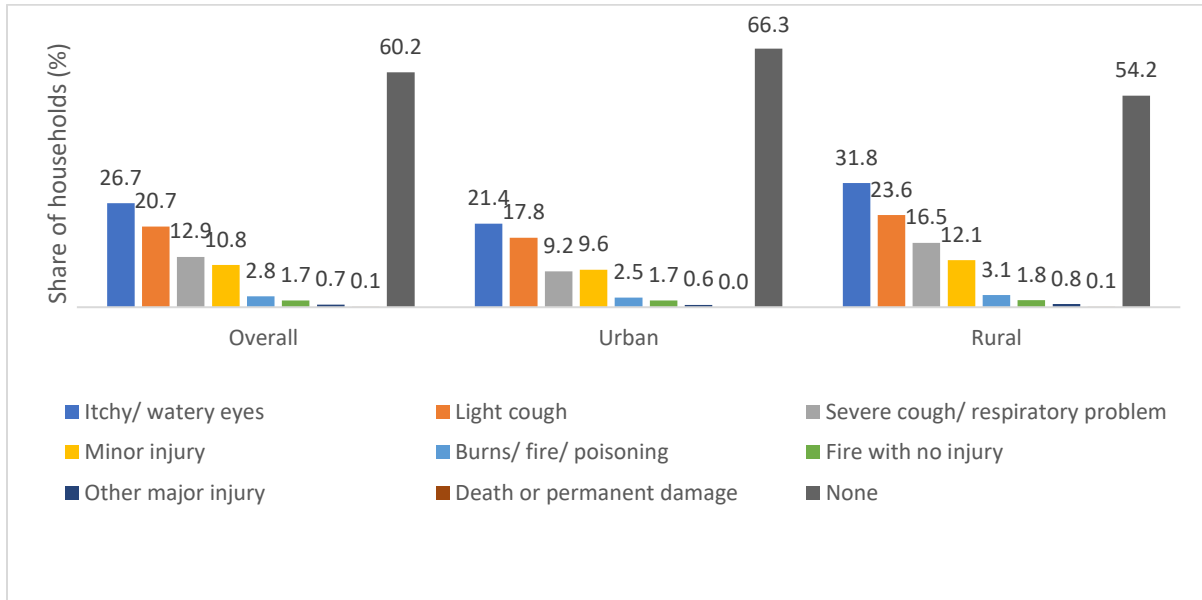
<sup>42</sup> AFN15 is equivalent to approximate 20 US cents (with the calculated estimate of wood as fuel costing above US\$500).

## D. Health and Safety

Air pollutants, both within the household (household air pollution or HAP) and broader, outdoor ambient pollution are a significant health risk in Afghanistan. The World Health Organization estimates that HAP causes 27,000 deaths per year in Afghanistan, and that ambient outdoor air pollution causes approximately another 11,000 deaths.<sup>43</sup>

The health effects from cooking and heating were not always perceived as detrimental to one’s health in the quantitative component of the research. A third of respondents did report that a household member suffered from a cough due to fumes from cooking and/or heating, one in four reported eye problems and one in ten a minor injury having occurred in the household (Figure 139). However, 60% said that cooking and heating had not had any negative health impacts on them or their families (Figure 139). The qualitative components of the research pointed to concerns however, with health worries from cooking, heating and/or gathering fuel such as coughing, chest infections, sore eyes and sore hands brought up frequently in focus group discussions and seasonal case studies.

Figure 139 Share of households by type of harm related to cooking/heating solutions (overall, urban/rural)



The bulk of the health-related externalities of energy use is suffered by women. Chores like cooking, cleaning dusty floors, baking bread and heating water lead to symptoms such as sore eyes from the dust, coughs from the smoke, as well as burns. Sickness due to collecting animal waste or washing with unclean water are also mentioned.

*I am suffering from sore eyes because the smoke produced from wood and animal waste has caused this problem. The rest of my family members are fine and they have not experienced any health problems, neither from fuel, nor from electricity.*

Female, Khwaja Chasht, Daikundi

<sup>43</sup> World Health Organization, [Afghanistan – Environmental Health](#), 2018

Health concerns related to energy that were discussed in qualitative research were varied, but the most common were indeed breathing problems or coughs and eye problems. Many instances of injury or accident were mentioned in the focus groups, including minor burns but also accidental death as a result of fire, explosion or electrocution. In the qualitative interviews, health concerns are frequently mentioned in relation to aspirations for “cleaner” energy.

*We use coal as an energy source and we put it in the sandali to warm the room, but it is dangerous for our health and it causes us headaches and low blood pressure. If we could afford it, we would use electricity because it's safe and clean. (...) Using dung while cooking causes health problems such as breathing problems, eye problems and headaches. Currently I am suffering from breathing problems - I can't walk for long and I know it's all because of using dung and its smoke that we use for cooking and the furnace.*

Female, Khwaja Chasht, Daikundi

Figure 140 most frequently used terms regarding the health impacts of fuel use



*My wife has problems with her chest due to the smoke, and her eyes are always sore.*

Male, Urban Paktia

Children also suffer from the dust, and can get injured collecting fuel such as thorny bushes and wood.

Despite these considerable health issues, the interviewed individuals, particularly the women, frequently expressed appreciation in light of the improvement compared to earlier times.

*In the past, lighting and cooking were very problematic. But gas and electricity has made everything easier. Gas is risky to use, we need to be careful. But still.*

Female, Urban Kabul



### Externalities: Pollution in Kabul

Fuels used in cooking and heating not only cause issues as direct ambient pollutants for household respondents, but can also contribute to deleterious air pollution on a broader scale. Kabul has recorded some of the worst air pollution levels in the world in the years leading up to 2019. Conjoining with the high altitude of the city, the mountainous terrain and frequent atmospheric inversions, the cooking and especially heating practices within Kabul leads to high toxicity of the air, and severe health implications.

During the Community Profiling Phase of the Energy Diaries research, a community leader in western Kabul spoke about the challenges facing the community, including the lack of infrastructure and employment. The community leader also cited pollution. *“The other challenges are air pollution, some [people] don’t have the purchase power to buy fuels so they burn rubber of worn-out vehicle tires, that pollutes the air.”*

Figure 141 Kabul Skyline



*PM2.5, SOx and NOx are multiples of generally accepted safe levels. According to the Ministry of Health, some 3,000 deaths per year in Kabul are attributable to the toxic air quality: in a sample of 200 hospital patients, 80% had elevated levels of lead (indicative of leaded gasoline). Indeed, so serious are the perceptions of poor air quality that the US Defense Department has been petitioned to include exposure to Kabul’s toxic air quality conditions in military service personal histories. Self-generation of electricity is likely a large contributor to local air pollution. As grid power delivered to Kabul has increased in recent years, the use of diesel self-generation will have declined (other things equal), but with renewed economic and industrial growth, power shortages remain widespread, and estimates of the current self-generation capacity in commercial and industrial enterprises is between 25-100 MW. Much residential heating and cooking is from burning wood, coal and wastes, – though LPG has begun to replace it for cooking. Greater availability of grid-electricity can only be beneficial from the point of view of reducing emissions from heating and cooking, though it is likely to exacerbate difficulties of meeting peak demand.*

World Bank, 2016: *Energy Security Trade-Offs under High Uncertainty*



## 6) Concluding remarks

Back in 2005, after almost three decades of war, Afghanistan was a country mostly dark at night: virtually all the rural population was off grid, relying on polluting and unsustainable lighting devices such as kerosene/LPG lanterns, candles and battery torches. 12 years after, with 97.7% of the population having some access to basic electricity services, Afghanistan is ahead of other countries (i.e. Nepal 95.5%, Bangladesh 88% and Kenya 63.8%). This spectacular growth can be traced back to two distinct interventions: the construction of transboundary transmission lines between Afghanistan and nearby countries, and the subsequent expansion of the grid in urban and peri-urban of the country. On the other, the ubiquitous diffusion of standalone solar home systems that, as further corroborated by this survey, provided most of rural Afghans with access to basic electricity services.

Donor-funded interventions, which in the past decade have distributed solar home systems in rural areas, probably played a role in demonstrating the effectiveness of the solar technology among rural communities. Notwithstanding government support, most of the households have purchased solar products themselves and it is remarkable that solar home systems have reached all the segments of the population, even the poorest one - a striking difference compared to many other contexts, like Kenya, where grid connection is still low but solar penetration is far from reaching everybody. This is a great achievement in a context where a large percentage of the population lives in remote and scattered communities and where grid expansion faces several complex structural challenges to be overcome – even today, less than 40% of the population is connected to the grid. Nevertheless, there is a gap between the current experience and the aspirations of households and enterprises and the desired quality of energy to both on-grid and off-grid communities in the country.

The Afghanistan Household and Enterprise Energy Diaries Study was an almost three-year effort to better understand energy usage patterns across the country, at the local level. Born out of the Afghanistan Energy Study and the desire for quality data from the ground - that is, from households and enterprises themselves – the Diaries Study aimed to provide information anchored in the local context of Afghanistan, from rural Daikundi to urban Kabul, agrarian households with one small solar panel and battery set to metalworkers using 3-phase grid electricity, families using animal dung and collected brush to households using LPG, thus spanning the breadth and depth of the household and enterprise energy landscape of Afghanistan. Knowing what is in use at the moment, challenges in energy provision as well as the ability and willingness to pay of households and businesses are all crucial in being able to scale up energy solutions. It is hoped that the findings of this study have filled some crucial knowledge gaps, and can contribute to paving the way forward in Afghanistan's unique energy trajectory. This is made all the more urgent by the numerous intersections energy has with other areas important for households and enterprises – including health, education, communications and sustainable development.