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**Practical  
ACTION**

# **CAN MARKET MECHANISMS FACILITATE ENERGY ACCESS FOR PEOPLE LIVING IN EXTREME POVERTY?**

**Part 1: The Relationship Between Energy Access and Extreme  
Poverty**



**REPORT**

## Acknowledgements

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Front cover: Sibinga (Kenya) resident Elizabeth demonstrates how she uses her mobile phone to top up the energy meter connected to the solar home system installed on her roof. Credit: Practical Action/Edoardo Santangelo

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Transforming  
Energy  
Access

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## Abbreviations

ESMAP	Energy Sector Management Assistance Programme
FAO	Food and Agriculture Organization
FDP	Forcibly displaced people
GDC	Global Distributors Collective
GPA	Global Platform for Action
IDP	Internally displaced people
IRENA	International Renewable Energy Agency
MTF	Multi-Tier Framework for defining and measuring energy access (see Bhatia and Angelou, 2015)
PAYGo	Pay as you go
PPP	Purchasing power parity
To, T1, T2, T3, T4 or T5	Tier 0 etc under the MTF
UNHCR	United Nations High Commissioner for Refugees
WHO	World Health Organization
WTP	Willingness to pay

## Terminology

**Clean cooking energy:** Energy used for cooking (or heating) which produces low levels of fine particulate matter (PM<sub>2.5</sub>) and carbon monoxide (CO) (WHO, 2021).

**Clean cooking energy access:** Access to energy for cooking which achieves Tier 4 or higher under the Multi-Tier Framework for defining and measuring energy access (MTF), and therefore can be expected to produce low levels of fine particulate matter (PM<sub>2.5</sub>) and carbon monoxide (CO) (see Bhatia and Angelou, 2015). For this review, where the tier of access has not been stated in the source, use of biogas, LPG, electricity, ethanol, natural gas or solar energy has been assumed to equate to clean cooking energy access.

**Electricity access:** Access to electricity which achieves Tier 1 or higher under the Multi-Tier Framework for defining and measuring energy access (MTF). This excludes electricity relying on dry cell batteries and grid or off-grid supplies which do not achieve Tier 1 (and so fall into Tier 0).

**Extreme poverty:** Living on less than US\$2.15 per person per day in 2017 purchasing power parity (PPP) terms (World Bank, 2022d).

**Forcibly displaced persons:** The United Nations High Commissioner for Refugees (UNHCR, 2018) defines forcibly displaced persons as ‘those forced to move, within or across borders, due to armed conflict, persecution, terrorism, human rights violations and abuses, violence, the adverse effects of climate change, natural disasters, development projects or a combination of these factors’. This includes:

- Refugees: those who have been forced to flee their homes because of war, violence or persecution, often without warning, and who have rights to specific protections under international law once they obtain refugee status.
- Asylum-seekers: those who are seeking international protection from dangers in their own country, but whose claim for refugee status has not yet been determined.
- Internally displaced people (IDPs): those who have been forced to flee their homes because of war, violence, human rights violations or disasters but that remain in their own country.

**Fragile and conflict-affected countries:** There is no universally accepted definition for this term. However, there is some consensus that fragile and conflict-affected countries are characterized by poor governance, disputed legitimacy, weak capacity and institutions, high risk of conflict and insecurity, and poverty (World Bank, 2009a; OECD, 2015; Mercy Corps, 2019; Logan and Sacchetto, 2021). In this report the term is used to refer to those countries categorized by the World Bank as fragile and conflict affected (World Bank, 2023a).

**Indo-Pacific:** Those countries categorized by the UK Foreign, Commonwealth & Development Office as being part of the Indo-Pacific Region (see Appendix 7.3).

**Lack of electricity access:** Access to electricity which does not achieve Tier 1 or higher.

**Lack of clean cooking energy access:** Use as the primary means of cooking of any form of energy which does not qualify as clean cooking energy (as defined above).

**Market mechanisms:** In this report, a market mechanism refers to a financial intervention that has an impact on the affordability of energy products and services. These may include:

- a. mechanisms which form part of a company's business model and aim to spread the cost of a product over time, such as pay as you go (PAYGo);
- b. interventions by donors and/or governments to support affordability (such as results-based finance, grants or beneficiary subsidies) which may be employed directly or used to support mechanisms described in (a).

**Modern energy:** electricity or clean cooking energy (see definitions above).

**MTF Energy Access Diagnostic Reports:** a series of reports, based on surveys undertaken by the Energy Sector Management Assistance Program (ESMAP) between 2016 and 2018, looking in more detail at energy access in individual countries, including Bangladesh, Cambodia, Ethiopia, Kenya, Liberia, Myanmar, Nepal, Niger, Nigeria, Rwanda, São Tomé and Príncipe, and Zambia (Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2018, 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019).

**Sub-Saharan Africa:** Those countries categorized by the UK Foreign, Commonwealth & Development Office as being part of the sub-Saharan Africa Region (see Appendix 7.3).

**Tier:** Level of electricity or clean cooking energy access as defined under the Multi-Tier Framework for Defining and Measuring Energy Access.

**Traditional energy:** Energy produced by burning wood, charcoal or any other form of biomass, (other than in a clean cookstove which achieves Tier 4 under the MTF), kerosene, coal, candles or non-biomass waste.

# 1. Executive summary

This report has been produced as part of a review, focused on sub-Saharan Africa and the Indo-Pacific, of the potential for market mechanisms to enable people living in extreme poverty to meet their energy needs. The review has been funded by UK aid from the British people via the Transforming Energy Access (TEA) programme; however, the views expressed in this report do not necessarily reflect the UK Government's official policies.

This element of the review addresses the over-arching question: **Who and where are the people living in extreme poverty in sub-Saharan Africa and the Indo-Pacific and what are their energy needs and challenges?**

Within this, the report explores the following subsidiary questions:

- How do extreme poverty and lack of energy access align and interact?
- What are the most significant demographic groups of people living in extreme poverty who lack energy access?
- What are the energy needs of people living in extreme poverty and how do these differ from those of the general population, and between specific demographic groups?
- What are the critical challenges faced by people living in extreme poverty (and specific demographic groups) in accessing energy?
- What socio-economic characteristics of people living in extreme poverty most affect the ability of market mechanisms to enable them to access energy?

By exploring these questions, it aims to inform policymakers' and practitioners' decisions on how best to focus support through market mechanisms to ensure that people living in extreme poverty are not left behind in achieving energy access.

The report combines evidence from available literature, with re-analysis of data through the lens of extreme poverty, and consultations with key stakeholders to present an overall picture of the number of people living in extreme poverty without energy access in sub-Saharan Africa and the Indo-Pacific. In addition, it considers key drivers of poverty and lack of energy access and how these interact; similarities and differences in energy needs and barriers to energy access; and factors likely to hamper people's ability to take up market mechanisms. It looks at people living in extreme poverty in general, and six specific demographic groups – rural workers; residents of informal urban settlements; people in fragile and conflict-affected areas; displaced people; women and girls; and people with disabilities – to provide a more nuanced picture of how energy access, needs, and challenges vary for different groups and in different contexts.

Alongside this over-arching review, more detailed, context-specific reviews have been undertaken of energy access and extreme poverty in six countries in sub-Saharan Africa and the Indo-Pacific. Each review provides a country-level overview as well as in-depth explorations of energy access and extreme poverty for one of the demographic groups:

- Ethiopia and people in urban informal settlements;
- Nigeria and people in fragile and conflict-affected areas;
- Kenya and people with disabilities;
- Rwanda and displaced people;

- Nepal and women and girls;
- Zambia and people in rural areas.

Key messages from these country-specific reports have been incorporated into the main report, while findings and recommendations specific to countries and groups are summarized in each appendix.

Some of the main conclusions from this review on the potential for market mechanisms to support energy access among people living in extreme poverty are presented below:

- An estimated **312 million people living in extreme poverty in the Indo-Pacific and sub-Saharan Africa are without access to electricity, and 430 million do not have access to clean cooking energy. More than 90% live in sub-Saharan Africa and over half in just six countries. Most are in rural areas and/or conflict-affected countries**, indicating that the long-standing focus of energy access support on these areas should continue.<sup>1</sup>
- **Women and girls make up just over half of people living in extreme poverty who lack energy access.** Poverty and energy access rates among women and girls may be slightly higher than for men and boys but **differences in their energy needs, and the barriers to addressing these needs**, are more significant. **People with disabilities form a smaller group, but also have distinctive energy needs and barriers.**
- **People living in urban informal settlements, and forcibly displaced people in camp settings**, are significantly smaller groups but also **face distinct energy access challenges** indicating that specific market mechanisms may be needed to support them. **Displaced people living within host communities may be better served by mechanisms which support energy access for people living in extreme poverty more generally**, with the priority being ensuring that they are eligible for such mechanisms.
- **People living in extreme poverty have significantly lower levels of energy access than wider populations**, but people living in extreme poverty and people who lack energy access are not identical groups. There appear to be reasonably **consistent relationships between lack of electricity and clean cooking energy access among those living in extreme poverty and among populations as a whole**, across countries.<sup>2</sup>
- **Use of market mechanisms to improve access to agricultural productive uses of energy and energy uses geared toward climate change adaptation** could benefit the majority of people living in extreme poverty, who live in rural areas and work in agriculture.
- **Strong associations between extreme poverty, lack of education, and households with children or headed by youths** support the use of market mechanisms targeted at these groups and on increasing energy access for education and enabling children to take up educational opportunities.

- **Cost is unequivocally the greatest barrier to energy access for people living in extreme poverty**, while the **option to pay for energy products and services clearly increases their willingness to pay (WTP)**. This supports the proposition that market mechanisms, and specifically mechanisms which spread payment over time, have the potential to support significant increases in energy access among people living in extreme poverty.
- However, **significant minorities of people living in extreme poverty remain unwilling to pay for energy access**, even at a reduced price and in instalments, suggesting that other, non-financial barriers play a part and would need to be overcome.
- **Unavailability of suitable energy products and services forms one significant barrier** which particularly affects people living in extreme poverty. Market mechanisms which support development of markets and supply chains, and products aimed at people living in extreme poverty, may help to overcome this barrier.
- **Lack of awareness of energy options and their benefits can also reduce WTP for energy access**. In particular, while financial support alone may be successful in enabling electricity access among people living in extreme poverty, increasing access to clean cooking is likely to need additional forms of support such as awareness raising and behaviour change.
- The **ability of people living in extreme poverty to take up market mechanisms is influenced by a range of factors** which affect people living in extreme poverty more than the rest of the population. Some factors are common across demographic groups, including: seasonal and unreliable incomes; high cost to serve; low levels of mobile phone ownership, poor network coverage, and use of mobile money; lack of supporting documents; and low knowledge and awareness of mechanism functions and opportunities. **Addressing this core set of factors could have a significant impact on the ability of market mechanisms to reach people living in extreme poverty** and, therefore, to improve their ability to access energy. **Other factors affect reach to some groups far more than others**. For example, people in rural areas are especially affected by poor coverage of financial institutions. People in urban informal settlements and refugee camps face the unique barrier of restricted access for energy service providers. Similarly, mobility restrictions form a barrier faced by people with disabilities. **More targeted and specifically designed market mechanisms will be needed to enable inclusion of these groups**.
- The review has revealed a number of **gaps in the data around extreme poverty and energy access**. Actions to fill these gaps, and so improve understanding of the relationship between energy access and extreme poverty, are recommended in Section 6.

Accompanying this report are stand-alone reviews of energy access and extreme poverty in six countries in sub-Saharan Africa and the Indo-Pacific (see appendix 7.2). Each review provides a country-level overview as well as in-depth explorations of energy access and extreme poverty for one subgroup.

Findings and recommendations specific to countries and groups are summarized in each appendix.

The findings of this report feed into the accompanying report, 'Part 2: The Role of Market Interventions and Business Models', which investigates the ability of existing market mechanisms to address factors hindering their reach based on their current properties and recommends ways to improve this.

## 2. Introduction

This report has been produced as part of a review of the potential for market mechanisms to increase energy access for people living in extreme poverty. The report was funded with UK aid from the British people via the Transforming Energy Access (TEA) programme; however, the views expressed do not necessarily reflect the UK Government's official policies.

This report aims to address the over-arching question: **Who and where are the people living in extreme poverty and what are their energy needs and challenges?**

Within this, it explores the following subsidiary questions:

- How do extreme poverty and lack of energy access align and interact?
- What are the most significant demographic groups of people living in extreme poverty who lack energy access?
- What are the energy needs of people living in extreme poverty and how do these differ from those of the general population, and between specific demographic groups?
- What are the critical challenges faced by people living in extreme poverty (and specific demographic groups) in accessing energy?
- What socio-economic characteristics of people living in extreme poverty most affect the ability of market mechanisms to enable them to access energy?

The report brings together evidence from available literature as well as consultations with key stakeholders in the energy access sector to map the number of people living in extreme poverty who are without energy access in sub-Saharan Africa, South Asia, and the Indo-Pacific.<sup>3</sup> It looks at this demographic overall, as well as at six specific subgroups (rural workers; those living in urban informal settlements; those in fragile and conflict-affected areas; displaced people; women and girls; and people with disabilities). The report considers drivers of poverty and lack of energy access and how these interact; similarities and differences in energy needs and barriers to energy access; and factors likely to hamper people's ability to take up market mechanisms.

Attached as appendices to this report are stand-alone reviews of energy access and extreme poverty in six countries. Each review provides a country-level overview as well as in-depth explorations of energy access and extreme poverty for one subgroup:

- Ethiopia and people in urban informal settlements;
- Nigeria and people in fragile and conflict-affected areas;
- Kenya and people with disabilities;
- Rwanda and displaced people;
- Nepal and women and girls;
- Zambia and people in rural areas.

Overall, the report aims to provide policymakers and other actors with information to guide the targeting of energy access interventions. Findings are especially relevant to the development of market mechanisms to improve energy affordability. The report's findings, including its categorization of barriers to energy access and factors limiting market mechanism reach, feed into the accompanying report 'Part 2: The Role of Market Interventions and Business Models'. This analyses market mechanisms and their suitability to support energy access for people living in extreme poverty.

### 3. Extreme poverty, energy access, and energy needs

An estimated **667 million people, 8.4% of the world's population, live in extreme poverty** (World Bank, 2022b). At the same time, some **675 million people lack access to electricity, and ~2.3 billion people (nearly 30% of the world's population) were without access to clean energy for cooking** in 2021 (IEA et al., 2023).

The global extreme poverty rate has fallen by more than two-thirds since 1990, but this fall has slowed since 2014, and reversed in 2020 with the economic impacts of the Covid-19 pandemic (World Bank, 2022b). The recovery since has been slow, with lower growth in China and the Ukraine War combining with a series of climate shocks in the world's largest food producers to drive higher food and energy prices (ibid.). The average poverty rate in low- and middle-income countries in 2023 is expected to be very close to what it was in 2019 (18.3% compared to 18.6%) (Hadad et al. 2023).

Progress has also been made in increasing access to energy, with electricity access rising from 84% to 91% of the global population, and the number of people who have no access to clean energy for cooking falling from 2.9 billion to 2.3 billion, between 2010 and 2021. However, this progress too has slowed, and, without significant policy changes, some 660 million people are expected to remain without electricity and 1.9 billion without access to clean cooking energy in 2030 (IEA et al., 2023). **There is a real and growing danger that people living in extreme poverty will be left behind.**

**Lack of energy access is both a key element of poverty and one of the factors keeping people in poverty** (Practical Action, 2010). Energy services, i.e. what energy can be used for rather than how it is supplied, are what matter to people living in poverty (Practical Action 2014; interview with H. Hafes and A. Bartimeus, Shell Foundation, 24 April 2023). Lighting; cooking and water heating; space heating; cooling; information and communications; and earning a living, are identified as most critical (ibid.).

**The consensus is that people living in extreme poverty have the same broad energy needs as the wider population** – for household, productive or community use – and that these needs are common across the demographic groups (Practical Action, 2012, 2016).<sup>4</sup> Indeed, the literature does not generally distinguish the energy needs of extremely poor people from those of the wider population. Nor is there any evidence that the level (Multi-Tier Framework for defining and measuring energy access (MTF) tier) of energy access needed by people living in extreme poverty is significantly different from those they live alongside.

**What differences there are relate more to the context and the relative importance of different forms of energy to different groups** (Practical Action, 2016). Looking at respondents' answers to questions about what they would like to be able to use electricity for (as part of the MTF Energy Access Diagnostic Surveys), people living in extreme poverty (in common with the rest of the population) were most interested in televisions and radios and then refrigerators (Luzi et al., 2019, 2020; Koo et al., 2018; Padam et al., 2018; Pinto et al., 2019; and Dubey et al., 2020 and associated datasets).<sup>5</sup> Fewer people living in extreme poverty than among the rest of the population expressed interest in powering tools, computers, smartphones or fans (ibid.) However, these averages mask considerable variation from country to country.

**Access to energy is significantly lower among people living in extreme poverty than for populations as a whole**, with electricity access for households in extreme poverty in 2019 estimated at 37%, compared with a global average of 78% (World Bank, 2022b). This reflects, in part, lower levels of access in low-income countries where most people affected by extreme poverty live. The relationship between lack of access to energy for clean cooking and extreme poverty is less clear. In the countries with the highest rates of extreme poverty, high proportions of the population lack clean energy for cooking. However, in some countries where extreme poverty rates are relatively low, the proportion of people without access to clean cooking energy remains high (see Figure 1).

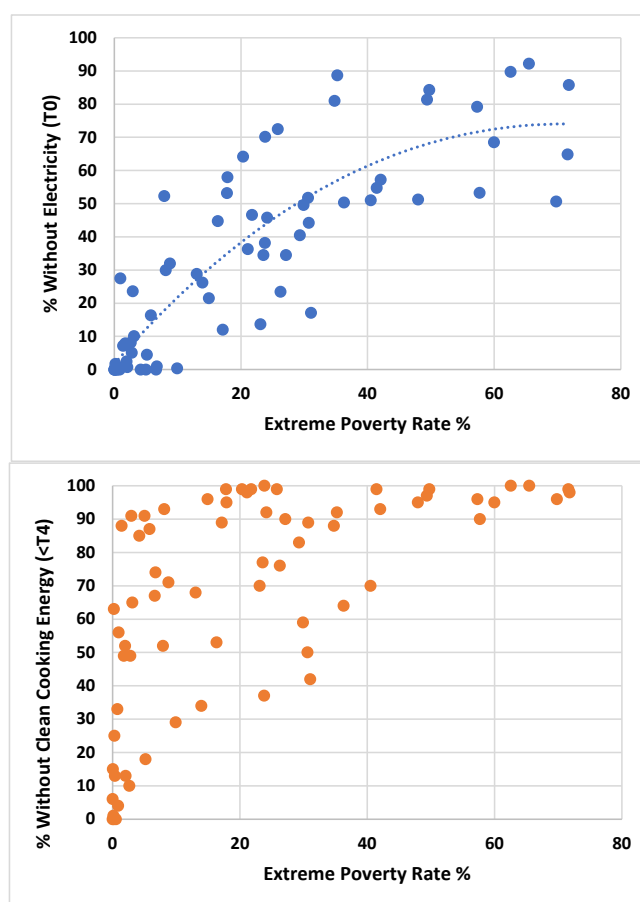


Figure 1: Population percentages without electricity and clean cooking energy vs. extreme poverty rates for sub-Saharan Africa and Indo-Pacific countries (Energy access data from IEA et al., 2023. Extreme poverty rates from World Bank, 2023b adjusted to 2023 using data from World Bank, 2022c and Hadad et al., 2023 as described in Appendix 7.1).

There is also evidence that **people in greater poverty have less access to electricity and clean cooking energy *within* countries** (see Figure 2).

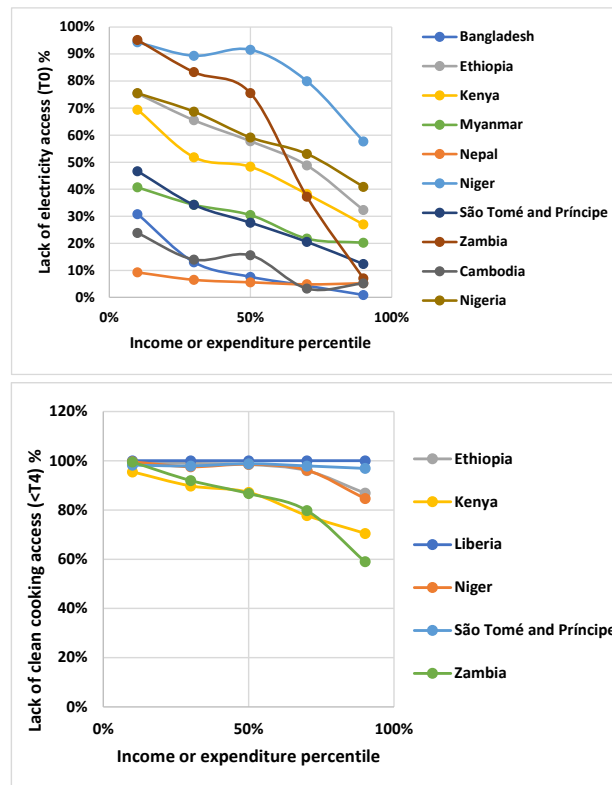


Figure 2: Lack of electricity and clean cooking energy access by household income/expenditure quintile (based on data from Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2018, 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019).

**People living in extreme poverty are predominantly rural, work in agriculture, are young, under-educated, and likely to have more children** (World Bank, 2020a, 2022b) (see Figure 3).

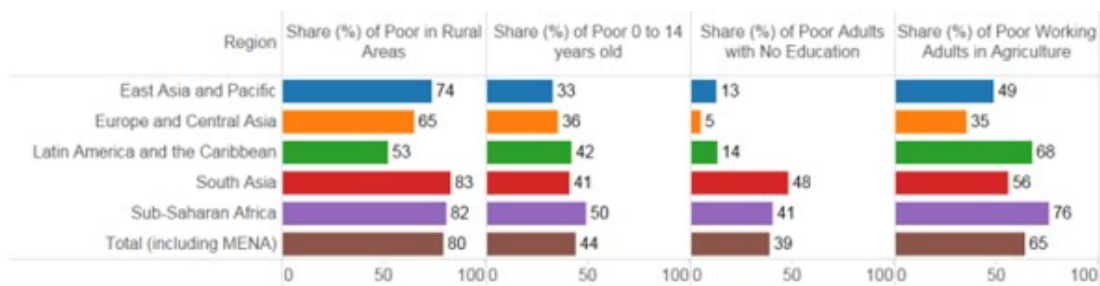


Figure 3: Share of people living in extreme poverty by region, residential area, youth, lack of education, and employment (Source: Castañeda et al., 2016)

The profile of the ‘new poor’ created by Covid-19 is somewhat different, being more urban, better educated, and less likely to work in agriculture (World Bank, 2020a). Increases in food prices will have hit poorer households particularly hard, but higher food prices may, in the long term, result in higher incomes for rural households working in agriculture,<sup>6</sup> while continuing to hurt poor urban households (World Bank, 2022b). However, these are only about 10% of those living in poverty, so that the total profile of global poverty will remain largely unchanged (ibid.). Climate change is also having a significant effect on poverty and is expected to drive up to 132 million additional people into poverty by 2030 with sub-Saharan Africa and South Asia worst affected (World Bank, 2020a). The need for energy for climate

change adaptation should not be forgotten when developing energy access support programmes.

**Four out of five (81%) of those living in extreme poverty (~540 million people) live in rural areas** and the incidence of rural poverty is more than four times higher than urban poverty (World Bank, 2020a). With two-thirds of people in low-income countries living in rural areas, reaching the extreme poor largely means reaching the rural poorest (UNDESA, 2021a).

Though rural poverty has fallen more sharply than urban poverty in recent decades (UNDESA, 2021b), **around 18% of rural people (compared to 5.3% in urban areas) are estimated to live in extreme poverty** (Castañeda et al., 2016). In many countries in sub-Saharan Africa extreme poverty affects over half of the rural population (UNDESA, 2021a).

Extreme poverty in rural areas is both chronic (affecting people for long periods and over multiple generations) and intermittent (with households moving above or below the extreme poverty line in response to the seasonality of rural incomes) (UNDESA, 2021a). It is perpetuated by exposure to weather related hazards; discrimination and exclusion; and difficulty accessing assets such as land and finance (ibid.). In addition, workers in rural areas are more than twice as likely to be engaged in informal employment than workers in urban areas (ILO, 2018).

**Rural poverty is closely associated with agricultural employment:** nearly two-thirds of adult workers (aged 15 and over) living in extreme poverty work in agriculture, and extreme poverty rates among these workers are more than four times higher than among non-agricultural workers (World Bank, 2020a). However, nearly a quarter of workers living in extreme poverty in rural areas work outside agriculture (Castañeda et al., 2016).

**Agricultural employment and extreme poverty are in turn linked to low educational attainment.** In 2018, 35% of poor adults worldwide, but only 9% of the non-poor, had no schooling (World Bank, 2020a). Although only 15% of adults have no formal education, nearly 25% of them live in extreme poverty (Castañeda et al., 2016). This varies across regions – in sub-Saharan Africa and South Asia more than 35% of poor adults have no education, whereas in East Asia and Pacific only 12% of poor adults have no education (World Bank, 2020a).

**People in rural areas are also less likely to access social protection.** More than half of those in rural areas lack healthcare coverage (compared to less than a quarter in urban areas) (ILO, 2017) and few social protection programmes are tailored to rural people's needs (UNDESA, 2021a). Long distances and opportunity costs of travel to service points, combined with landlessness and lack of formal identification or employment, can mean that people living in extreme poverty in rural areas are missed in household surveys and have difficulty accessing public services and social protection programmes (UNDESA, 2022).

Specific groups are disproportionately affected by extreme poverty in rural areas. Indigenous peoples are more than twice as likely to live in extreme poverty than their non-indigenous counterparts (ILO, 2020). **Young people (aged 15 to 24) are more likely to be unemployed** than adults and face challenges in accessing land, finance, and education. Elderly people are more likely than young people to work or to have worked in agricultural

and informal sectors and many lack savings, health insurance, and pension coverage (UNECE, 2017). They are also particularly impacted by inadequate access to infrastructure, transportation, public services, and healthcare (UNDESA, 2021a).

Alongside typical household, productive, and communal energy needs common in all settings (Efficiency for Access, 2021), **people living in extreme poverty in rural areas need energy to support agri-food systems**, given their importance for reducing hunger and drudgery and for raising incomes and adaptive capacity (FAO and IRENA, 2021). This includes energy for:

- *Solar water pumping* to enable irrigation and reduce dependence on rainfed agriculture and vulnerability to water scarcity driven by climate change (FAO and IRENA, 2021).
- *Cold storage and refrigeration* to reduce post-harvest crop losses, increase shelf life, and maintain produce quality (enabling products to be sold further afield and at higher prices), and to preserve medicines and vaccines.
- *Transportation to enable* more rapid movement of produce from farms to storage facilities and markets to reduce crop losses, maintain quality, strengthen farmers' negotiating capacity and allow better timing of crop sales to secure fair prices.
- *Agro-processing* to meet food needs and animal and poultry feed needs and convert crops into higher-value commodities (ibid.).

**Those in rural areas are particularly reliant on off-grid energy technologies** because of distances from grid infrastructure. Bioenergy (energy generated from biomass) also has a key part to play in meeting energy needs and providing additional income for farmers, with harvest waste and agro-processing residues being used to produce biogas for cooking, lighting, heat, electricity and transport fuel (ibid.).

Urban–rural gaps in energy access have narrowed over the past decade, but globally **rural electricity access in 2021 stood at 85% (compared to 98% in urban areas), while rural access to clean cooking energy stood at 51% (relative to 86% in urban areas)** (IEA et al., 2023).

**Rapid population growth and urbanization are increasing the number of people living in poverty in urban informal settlements** (UNDESA, 2023).<sup>7</sup> The number of people living in informal settlements grew to over 1 billion in 2018, with 80% attributed to three regions: Eastern and South-Eastern Asia (370 million), sub-Saharan Africa (238 million), and Central and Southern Asia (227 million) (ibid.).

Urban informal settlements often grow as a result of rural-to-urban migration (itself often driven by a desire to escape poverty in rural areas) or displacement due to environmental or political crises (Niva et al., 2019). As a result, **residents often have low incomes and few savings**. In addition, poverty is perpetuated by inadequate investment in quality job opportunities as well as urban services such as housing, safe water supplies, sanitation, drainage and solid waste collection, healthcare, emergency services, policing, and education (IIED, 2023). Poverty in urban informal areas is likely to have been exacerbated by Covid-19 (World Bank, 2020a) as well as increasing food prices since 2021 which have hit poor urban households particularly hard (World Bank, 2022b).

Growth in the number of informal urban residents is increasing demand for services, including energy, and demand is outpacing provision (UNDESA, 2023). **Most people in urban informal areas have limited access to electricity** (Singh, 2014). In Ethiopia, for instance, **informal settlers are found to have low levels of electricity use and predominantly use poor quality traditional cooking fuels** (Nibretu et al., 2021). Their energy needs have been under-prioritized in efforts to achieve universal energy access due to a primary focus on rural areas (Energy for Growth Hub, 2023). This reflects an assumption that people living in poverty in urban areas can gain access to national grids when this is not always the case. **Grid connection will often be the most economic means to gain electricity access in urban informal settlements, but off-grid solutions are overlooked as an alternative, at least in the short-term** (ibid.). Several stakeholders consulted flagged the need for a greater focus on energy access for informal urban populations.<sup>8</sup>

Residents of informal urban areas share many energy needs with others. For example, street lighting, clean cooking, information and communication were highlighted as priorities for residents of the 'Chamanculo C' informal settlement in Mozambique (Practical Action, 2015a). In addition, **energy to power appliances used by small and medium sized enterprises** such as beauty parlours, restaurants, and shops, and to attract customers through music and external lighting would not only improve residents' quality of life but also encourage income generation and poverty reduction (Singh, 2014; Practical Action, 2015a). **Clean cooking energy options are also critical** as people live in cramped conditions, making traditional fire cooking a safety concern, and have to pay for wood fuel, which they cannot collect as rural residents often can (Nibretu et al., 2021).

The low priority given to energy access for informal urban settlements is reflected in the lack of available data on energy access levels in informal urban areas (Practical Action, 2015a). In Ethiopia, for instance, energy access studies have focused on rural and urban centres, and urban informal settlements have received little attention (Nibretu et al., 2021).

**About 10% of the population, but almost 40% of people living in extreme poverty, globally, live in fragile and conflict-affected countries**, and this number is expected to rise in future (World Bank, 2020a; 2022b). Conflict and poverty are also positively correlated within countries: almost a quarter of poor people live in subnational areas with a history of conflict (ibid.). Poverty is driven by conflict rather than conflict by poverty (World Bank, 2020a). Between 2000 and 2019, poverty rates fell sharply in countries that were never (or only briefly) fragile or conflict-affected, but fell only marginally, or even increased, in recurrent or chronic fragile and conflict-affected countries (FCCs) (World Bank, 2020a).

Despite access rates having risen from 46% to 58% between 2010 and 2021, **421 million people in FCCs remain without access to electricity** (IEA et al., 2023). (This compares to a total 481 million people without electricity access in Least Developed Countries.) Poor energy access in areas affected by conflict and violence impedes development; traps people in extreme poverty; creates structural conditions for the persistence of conflict and social, political, and economic instability; and drives migration, terrorism, and human trafficking (Logan and Sacchetto, 2021).

Fundamentally, **energy needs are similar for those living in fragile and non-fragile settings** (Logan and Sacchetto, 2021). However, **energy access is also an essential element in creating the conditions needed to enable and sustain peace and stability and to escape fragility** (ibid.). It can contribute to development; assist displaced populations; and play a key role in peace building, for example, by reducing incentives for conflict and powering peacebuilding and humanitarian operations (NORCAP, 2020; Mozersky and Kammen, 2018). In particular, clean energy reduces dependence on biomass, which is especially high in conflict-affected areas, thus lowering tensions between groups and reducing vulnerability to climate change and environmental degradation (Logan and Sacchetto, 2021). In addition, by delivering economic benefits, including new jobs and improved livelihoods, it can ensure that people benefit more from stability than from violence. **Energy access is particularly important to address the needs of women and girls in fragile settings.** By reducing the need for biomass collection and improving lighting at night it can lower the risk of violence against women and girls, which is particularly severe in fragile and conflict-affected areas where resource degradation has occurred and law and order has broken down (ibid.).

Worldwide, **some 108 million people were forcibly displaced at the end of 2022** (UNHCR, 2023a). Most forcibly displaced people (FDPs) live outside formal camps, with roughly 60% of refugees and 50% of internally displaced people (IDPs) thought to live in urban areas, and only 6.6 million in camps (World Bank, 2022a; GPA, 2022).

**The consensus is that displaced people tend to live in poverty, and that extreme poverty is concentrated among groups fleeing conflict and violence** (GPA, 2022; World Bank, 2022a; Patel and Gross, 2019). However, displaced people are often not accounted for in national poverty surveys and data is only available for a limited number of refugee camps (Corral et al., 2020; UNHCR, 2019).

**The majority of displaced people have no access to sustainable energy solutions** (GPA, 2022). Of those living in formal camps in 2022, Chatham House and the Global Platform for Action (GPA) estimated that 94% lacked meaningful access to power and 81% had only basic biomass fuels for cooking. As of 2023, however, no global baseline for energy access in displacement settings exists and figures at region or country level are not available (ibid.).

Displaced people access energy in a variety of contexts from emergency and transit locations to longer-term camps and self-settled locations (GPA, 2022). Refugees and IDPs in emergency and transit locations (such as Tigray in northern Ethiopia) and closed camps (such as the Kakuma camp in Kenya) generally have low levels of energy access, with limited options, and are reliant on solutions provided by humanitarian agencies. Self-settled IDPs and refugees have more options, particularly if they live in urban areas with access to local markets (e.g. in Irbid in Jordan). Displaced people in South Asian countries are more likely to be grid-connected, whereas those in sub-Saharan Africa tend to live in remoter, rural areas so off-grid solutions are more common (ibid.).

Until recently, **the energy needs of FDPs have been under-explored and under-prioritized**, partly due to short-term planning and the reactive nature of humanitarian support (GPA, 2022). Evidence shows **strong similarities in energy needs for people in displaced and non-displaced settings** (World Bank, 2022a; Practical Action, 2020b;

GPA, 2022). **Access to electricity for lighting and communication is critical to improve safety and security and enable social interaction** (World Bank, 2022a). For example, street lighting to improve safety and security, especially for women and girls travelling at night, has been identified as a priority for refugees in camps in Rwanda (Practical Action, 2020b). In addition, there is an increasing focus on income generation, and the energy needed to support it, in displacement settings (ibid.). Also, distinct from non-displacement settings, **refugee camps require electricity to power humanitarian operations and facilities** (GPA, 2022).

**Energy for cooking is also a vital need among displaced people, particularly where there is a risk of resource conflict with host communities.** The diversity of nationalities and ethnicities present in displacement settings can create a diverse set of cooking needs, requiring a wide range of stoves and fuels (Practical Action, 2020b; Corbyn and Vianello, 2018). However, in common with other people living in poverty, displaced people often do not see emissions from traditional cooking as a significant problem and are more likely to prioritize usability and cost (Vianello, 2016). In camps in Kenya, displaced people ranked entertainment services more highly than clean energy for cooking (ibid.). Energy priorities of displaced people, which are often misaligned with those of humanitarian agencies, must be recognized if market mechanisms are to succeed (Vianello, 2016; Corbyn and Vianello, 2018; Practical Action, 2020b).

**FDPs are generally more disadvantaged than people living in surrounding communities (World Bank, 2022a). However, host communities may also be suffering deprivation** – semi-nomadic pastoralists neighbouring Kenya’s Kakuma camp live in conditions of extreme poverty with similarly low levels of energy access (Butorac, 2019). Humanitarian operations and the funding they attract can generate benefits for both host and displaced communities (Vianello, 2016). Kakuma camp itself has a ‘...dynamic economy, with busy marketplaces and diversity of commerce and light industry’ (Corbyn and Vianello, 2018: 31). Humanitarian energy interventions will be unsustainable if implemented in isolation from a general population with lower levels of energy access (ibid.).

**Women are over-represented among people living in extreme poverty, though the difference in poverty rates between men and women is small** (World Bank, 2020a; Castañeda et al., 2016). It is estimated that **globally, 388 million women and girls were living in extreme poverty in 2022, compared to 372 million men and boys** (Azcona and Bhatt, 2022). This partly reflects how poverty is measured at household level (UNDESA, 2021a), but also hides a complex pattern of gendered poverty rates at different ages and between different regions, which appears to be driven largely by parenthood and responsibilities for caring for young children (Boudet et al., 2021). In low-income countries, female-headed households are marginally (0.7%) poorer than male-headed households (Castañeda et al., 2016).

In 2018, **half of people living in extreme poverty, but only a quarter of the total population, were children** (below age 15), and two-thirds were under 24 (World Bank, 2020a). Poverty rates are also higher for households with younger household heads (Castañeda et al., 2016). There is a consistent pattern of declining rates of poverty with increasing age (ibid.). Poverty and household size, particularly numbers of children, are also strongly correlated (ibid.).

Like poverty, energy access is generally measured at the household level, and differences between men's and women's access considered through the lens of male- and female-headed households. There is some consensus that, on average, female-headed households have lower levels of energy access than male-headed households (IEA et al, 2022; Energia, 2023). However, other reports identified only minimal differences in access rates for male- and female-headed households, and found these differences varied significantly depending on context, with no group having greater overall access and income the primary cause of observed differences (IEA et al., 2018, 2019, 2020). In any event, comparisons between female- and male-headed households do little to reveal the effects of gendered power dynamics within households, or societal norms, on energy access, which are arguably the most significant issue for women and girls.

A lack of gender disaggregated data makes it difficult to determine variations in energy access *within* households (whether male- or female-headed) (Efficiency for Access, 2022). **There is some evidence that some groups of women have lower access to energy than men in some contexts** (Energia, 2019a), but it is not clear that these findings are generally applicable. There is a stronger consensus that **access to energy appliances varies between men and women, particularly productive use appliances** (Rosenberg et al., 2020; Energia, 2019a; 2019b). Appliance usage is often gendered based on societal norms and roles (Energia, 2019a). However, gendering often evolves over time: for example, female use of productive appliances has increased in rural parts of Nepal following male migration to urban areas (ibid.).

Women (and men) have both practical and strategic energy needs (EIGE, 2023). Practical needs relate to current gendered roles in society. Strategic needs relate to overcoming socially defined roles and improving their position in society (ibid.). **Practical energy needs of women and girls include reduced drudgery and exposure to indoor air pollution and other risks posed by use of traditional energy for cooking**, which is often a female responsibility (Wilhite, 2016; Efficiency for Access, 2022; World Bank, 2020b). Specific appliances, such as kitchen fans, lighting, irons, and sewing machines, are also commonly seen as facilitating women's roles as caregivers and enabling them to generate income (Efficiency for Access, 2022; Wilhite, 2016). **Lighting for roads and public spaces can improve women and girls' physical safety** (Elverhøi et al., 2012; Wilhite, 2016). Finally, **access to a mobile phone with charging enabled by electricity access allows independent communication** and can improve women's security by improving contact with family and other support networks (Wilhite, 2008).

**Electricity in schools, and lighting in homes and public spaces, can make it easier for girls to access educational opportunities** and so improve their social and economic position (Wilhite, 2016). **Lighting can also enable women's economic activity** inside and outside the home and, by expanding the working day, increase productivity and incomes for women engaged in informal sector activities, such as gardening, vending, and sewing (Wilhite, 2016). However, for lighting to have an impact, livelihood opportunities must first be available and accessible to women (Practical Action, 2015b). While expansion of the working day can result in higher incomes in some cases, it can also constitute increased self-exploitation (Radley and Lehmann-Grube, 2022).

**Energy access can support changes to gendered roles and expectations** although it is considered insufficient to drive social change alone (Wilhite, 2016; IRENA, 2019). For example, electrification and electric appliances may lead to increased male participation in domestic chores (Annecke, 2005). In addition, access to radios and televisions can result in improved awareness of gender issues and women's rights. A study in Bangladesh found that women in households with televisions were more self-determined and less accepting of domestic violence (ADB, 2010). Another study in India found that such women were less accepting of arranged marriages (Jensen and Oster, 2009).

As of 2021, some **1.3 billion people, about 16% of the global population, experienced significant disability** (WHO, 2022).<sup>9</sup> This is estimated to have grown by about 270 million over the last decade, and is expected to continue to rise (ibid.).<sup>10</sup> There is a strong correlation between disability and age, reflecting the accumulation of effects of disease, injury, and chronic illness over people's lifetimes (WHO and World Bank, 2011; Mont and Cuong, 2011; WHO, 2022; Mitra and Yap, 2021; Mitra, 2018; Mitra and Sambamoorthi, 2014). Women have higher prevalence of disability than men (WHO, 2022; Mitra and Yap, 2021) due to maternal health issues, access to healthcare, domestic violence, and intra-household access to resources (Mitra, 2018). Disabilities are more common in rural than in urban areas (Mitra and Yap, 2021; WHO and World Bank, 2011). Increased levels of disability are also likely in areas affected by conflict, infectious disease outbreaks or natural disaster (WHO, 2022).

Until recently it was believed that disability levels were very much lower in developing than developed countries (Mitra and Yap, 2021). More recent estimates, using internationally comparable definitions and methodologies, give markedly increased prevalence in low-income countries, but are still lower than for high-income countries (WHO, 2022).<sup>11</sup> Estimates for individual countries also vary significantly. For instance, according to the 2019 census, 2.2% (0.9 million) of Kenyans live with some form of disability, whereas the Disabilities Data Report 2023 estimates that 12.7% of adults in Kenya have some form of functional difficulty (Hanass-Hancock et al., 2023). The prevalence of disability also varies across regions, and between countries within regions (WHO, 2022), due to both differences in data collection and differences in population structure and the context in which disability is experienced (Mitra and Yap, 2021).

**There is widespread acceptance that disability and poverty form a cycle**, with disability leading to poverty through lower levels of education, employment and earnings, stigma, difficulties accessing services, and disability related expenditures, while poverty leads to disability through malnutrition, poverty-associated diseases, poor living and working conditions, and inadequate access to healthcare (Mitra, 2018, Groce and Kett, 2017, WHO and World Bank, 2011).<sup>12</sup> It has also been suggested that differential levels of poverty may only emerge as countries develop. In the poorest communities there may be little difference between persons with and without disabilities, as all suffer equally from poverty and deprivation. Only as development brings opportunities do those with disabilities fall behind (Groce and Kett, 2017; Mitra and Yap, 2022).

**People with disabilities, and their families, are more likely to be poor** than those without, even in the poorest countries (Mitra, 2018; Mitra and Yap, 2021; Mont and Cuong, 2011; WHO and World Bank, 2011; UNDESA, 2019; WHO, 2022). A systematic review of poverty and disability research in low- and middle-income countries found that more than

80% of the 150 studies reviewed showed a positive relationship between disability and poverty (Banks et al., 2017).

There are significant associations between disability and inequalities in health, work, and standard of living (Mitra and Yap, 2021) and strong evidence that people with disabilities suffer educational disadvantage (Mitra, 2018; WHO and World Bank, 2011; WHO, 2022). Unemployment is generally higher for those with than without disabilities (WHO, 2022; WHO and World Bank, 2011). Those with disabilities also generally earn less than those without disabilities (WHO and World Bank, 2011), though in low-income countries there may be no option but to work, so people with disabilities may beg or sell small items on the roadside while earning very little (Mitra, 2018). Evidence on differences in income between those with and without disabilities in low-income countries is more mixed. Some studies have found that households with disabilities have lower expenditures than those without, but others have not found this, or have found differences in only some countries (Mitra, 2018; Mitra et al., 2011; WHO and World Bank, 2011, UNDESA, 2019).

**Not only are those with disabilities more likely to live in poverty, they also have additional costs** for healthcare, housing, heating, transport, personal assistance and assistive products. Households which include people with disabilities also experience opportunity costs, when household members without disabilities stay at home to provide care and thereby forgo income or educational opportunities (Groce and Kett, 2017). Because of such costs, a household which includes someone with a disability can expect a lower standard of living than a household with the same income with no disabilities, and households which would otherwise sit above a poverty line may effectively be brought below that line (WHO, 2022; Mitra and Yap, 2021, UNDESA, 2019, Mitra, 2018; WHO and World Bank 2011; Mont and Cuong, 2011).

**Lower access to modern energy has been identified as one of the deprivations differentially experienced by those with disabilities** (WHO, 2022; UNDESA, 2019). In most countries, fewer people with than without disabilities have access to electricity (with the gap averaging ~2.5 to 3 percentage points) and clean cooking energy (with estimates of the average gap ranging from 2.9 to 7 percentage points) (UNDESA, 2019; Mitra and Yap, 2021).

**People with disabilities also often have additional energy needs.** Some need electricity to power assistive technologies (UNDESA, 2019; Kajima, 2018; Perera, 2019) and may require energy appliances designed or adapted for their use (Efficiency for Access, 2021, 2022). They are likely to spend longer periods in their homes (Perera, 2019), and may be less mobile, and therefore need more energy for lighting, heating, and cooling (UNDESA, 2019; Kajima, 2018; Efficiency for Access, 2021). Longer periods spent at home can also lead to greater exposure to indoor pollution from traditional fuels and so make access to modern energy even more important (UNDESA, 2019; Perera, 2019; Efficiency for Access, 2021). Access to electricity in schools, health facilities, and other community settings, is also particularly important to people with disabilities (UNDESA, 2019; Perera, 2019).

**Extreme poverty is highly concentrated in sub-Saharan Africa**, which had a poverty rate about four times the global average and accounted for 60% of people living in extreme poverty globally in 2019 (World Bank, 2022b). Extreme poverty rates in some sub-Saharan African countries have risen since the Covid-19 pandemic and the subsequent recovery, while others have fallen. In South Asia, all countries (with the exception of Sri

Lanka) are expected to have lower rates of extreme poverty in 2023 than prior to the pandemic (World Bank, 2020a; Hadad et al., 2023). The concentration of extreme poverty in sub-Saharan Africa is projected to increase in future (ibid.).

People without energy access are similarly concentrated geographically. **Some 80% of people without electricity live in sub-Saharan Africa** (IEA et al., 2023). **Lack of access to clean cooking is less concentrated, but ~40% of those without clean cooking live in sub-Saharan Africa and ~20% in the Indo-Pacific** (ibid.). Progress since 2010 has been driven by China, India, Indonesia, Brazil, and Pakistan. In most other low and-middle-income countries, the deficit has stood still or even increased, particularly in sub-Saharan Africa where the number without access has grown by 60% since 2000. By 2030, almost 60% of those without access are expected to be in sub-Saharan Africa (ibid.).

Some **424 million people are estimated to be living in extreme poverty in sub-Saharan Africa and 30 million in the Indo-Pacific** based on analysis of World Bank extreme poverty and population data (World Bank, 2022c, 2023b; 2023c; 2023d; Hadad et al., 2023).<sup>13,10</sup>

About **578 million of those without electricity live in sub-Saharan Africa and 48 million in the Indo-Pacific. Some 949 million people without clean energy for cooking are in sub-Saharan Africa and 473 million in the Indo-Pacific** (IEA et al., 2023).

**Rates of energy access among those living in extreme poverty are not generally separately measured and reported** (e.g. as part of the regular Sustainable Development Goal (SDG) 7 progress monitoring process). Numbers of people in sub-Saharan Africa and Indo-Pacific living in extreme poverty who lack energy access are not, therefore, directly available. However, there appear to be fairly **consistent relationships between lack of electricity access and lack of clean cooking energy access among those living in extreme poverty and among the population as a whole** (from analysis of data in Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019; Koo et al., 2018 and associated datasets) – see Figures 4 and 5.<sup>14, 15</sup> As might be expected, where general levels of access are low, rates of lack of access among people living in extreme poverty are very similar to lack of access among the population as a whole. As general levels of access rise, lack of access is increasingly, but not entirely, concentrated among those living in extreme poverty.

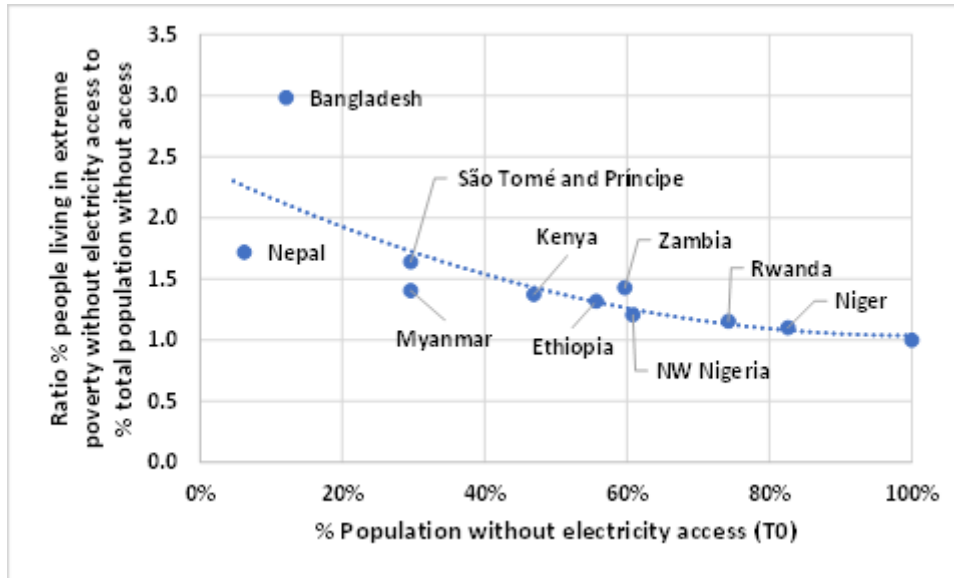


Figure 4: Ratio of percentage of people living in extreme poverty without electricity access to percentage of total population without electricity access against percentage of total population without electricity access<sup>11</sup>

Source: based on data from Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019; Koo et al., 2018 and associated datasets.

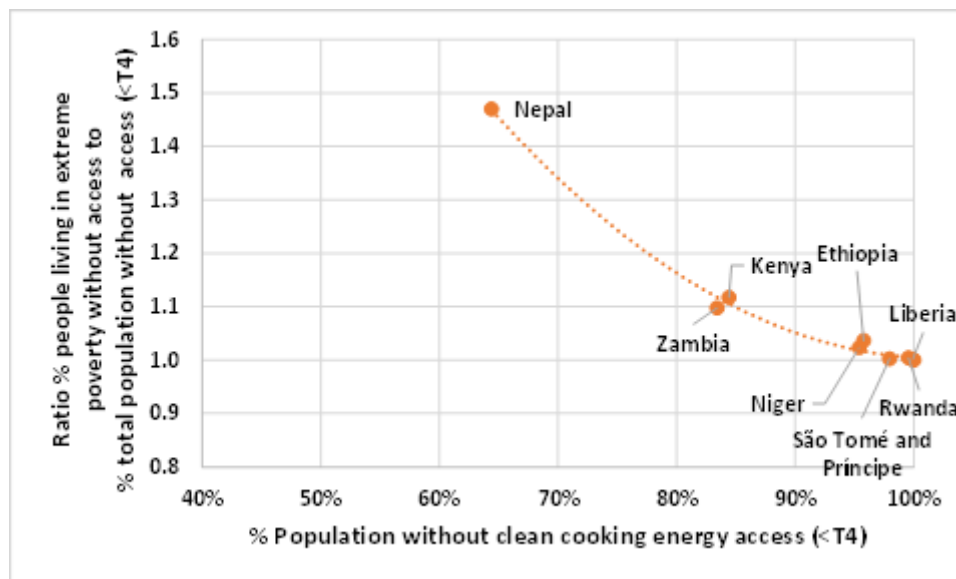


Figure 5: Ratio of percentage of people living in extreme poverty without clean cooking energy to percentage of total population without clean cooking energy against percentage of total population without clean cooking energy access<sup>11</sup>

Source: based on data from Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019; Koo et al., 2018 and associated datasets).

These relationships can be expressed as:

$$\text{Ratio of \% of extreme poor without electricity to \% of total population without electricity} = 1.38 \text{ NE}^2 - 2.77 \text{ NE} + 2.43$$

$$\text{Ratio of \% of extreme poor without clean cooking energy to \% of total population without clean cooking energy} = 3.27 \text{ NC}^2 - 6.68 \text{ NC} + 4.41$$

(Where NE is the percentage of total population without electricity and NC is the percentage of total population without clean cooking energy).<sup>16</sup>

Using these relationships, **it is estimated that there are some 310 million people living in extreme poverty in sub-Saharan Africa who lack electricity access and 2 million in the Indo-Pacific. Similarly, an estimated 406 million people living in extreme poverty in sub-Saharan Africa and 25 million in the Indo-Pacific lack clean energy for cooking.**<sup>17</sup>

**About 1,370 million people live in rural areas of sub-Saharan Africa and Indo-Pacific of whom an estimated 349 million people are living in extreme poverty** (World Bank, 2023e, 2022c, 2023b, 2023c, 2023d; Hadad et al., 2023 ).<sup>13,18</sup> **Some 530 million people in these areas are without electricity access, and over 1 billion without clean cooking** (IEA et al., 2023). Using the same relationships between lack of energy access among those living in extreme poverty and among the (rural) population as a whole (described above) it is estimated that **some 278 million people in these rural areas live in extreme poverty and lack electricity access. On the same basis, an estimated 339 million people living in extreme poverty in these areas lack access to clean cooking energy.**<sup>15</sup>

An estimated **415 million people live in informal settlements in sub-Saharan Africa and the Indo-Pacific** (World Bank 2023c, 2023d, 2023f, 2023g).<sup>19</sup> This is about 40% of the total urban population in these regions. About **105 million people in urban areas in these regions live in extreme poverty.**<sup>20, 21</sup> Data is not available on how many people living in informal settlements in urban areas are in extreme poverty.

An estimated 102 million urban residents in sub-Saharan Africa and the Indo-Pacific lack electricity access and about 410 million are without clean cooking (IEA et al., 2023). **Data is not available to estimate numbers of people living specifically in informal urban settlements who do not have access to electricity or clean cooking.**

Of the countries in sub-Saharan Africa and Indo-Pacific, 29 are classified by the World Bank as fragile or conflict affected (World Bank, 2023a). Approximately **843 million people live in these fragile and conflict-affected countries, of whom 267 million are estimated to be living in extreme poverty.**<sup>16,22</sup> Some **403 million people without electricity and 668 million without clean cooking** live in these countries (IEA et al., 2023). It is estimated (based on the same relationships between lack of energy access among those living in extreme poverty and among the population as a whole, described above) that **some 201 million people living in extreme poverty in these countries lack electricity access and 255 million are without clean energy for cooking.**<sup>16</sup>

An estimated **33 million FDPs are in sub-Saharan Africa and 8 million in Indo-Pacific** with the largest numbers in Democratic Republic of the Congo (DRC), Sudan, Ethiopia, Nigeria, Afghanistan, and Somalia (UNHCR, 2023b).<sup>23</sup> Lack of data on income or consumption levels among displaced people mean it is **not possible to estimate how many of the FDPs in these regions are living in extreme poverty.** Nor does any global baseline for energy access in displacement settings exist (GPA, 2022). Thus, the **number of displaced people in sub-Saharan Africa and the Indo-Pacific without energy access is unknown.** Without data on either the number of FDPs living in extreme

poverty or the number without energy access, **numbers of FDPs who are *both* living in extreme poverty *and* do not have energy access cannot be estimated.**

**Of the 1,195 million women and girls in sub-Saharan Africa and Indo-Pacific, 231 million are estimated to be living in extreme poverty** (World Bank, 2022c, 2023b, 2023c, 2023d, 2023h; Hadad et al., 2023; Azcona and Bhatt, 2022).<sup>24,25</sup> Assuming that levels of energy access are approximately the same for women and men, it is **estimated that about 314 million women and girls in these regions are without electricity access and 710 million lack access to clean energy for cooking** (IEA et al., 2023).<sup>24</sup> Based on the relationship between lack of access among people living in extreme poverty and among total populations discussed above, it is **estimated that 158 million women and girls living in extreme poverty are without electricity access and 219 million without access to clean energy for cooking** in these regions.<sup>24</sup>

There are an **estimated 278 million people with disabilities in sub-Saharan Africa and Indo-Pacific** (Mitra and Yap, 2021; Mitra and Sambamoorthi, 2014; WHO, 2022, World Bank 2023c, 2023d).<sup>24</sup> Despite evidence that people with disabilities are on average poorer than those without, there is **insufficient data on extreme poverty rates among those with disabilities to estimate how many of these 278 million people are living in extreme poverty.** The number probably lies between 54 and 75 million.<sup>24</sup> **An estimated 86 million people with disabilities are without electricity and 182 million without clean cooking access** across the two regions (Mitra and Yap, 2021; UNDESA, 2019; IEA et al., 2023).<sup>24</sup> There is insufficient data to estimate the number of people with disabilities who are both extremely poor *and* lack access to electricity or clean cooking.

The numbers across the regions and demographic groups are summarized in Table 1. The vast majority of people living in extreme poverty without energy access are in sub-Saharan Africa, and most are in a relatively few countries. People living in rural areas and in fragile and conflict-affected countries form the two largest groups affected. Women and girls also form a significant group with distinct energy needs. Residents of informal urban areas, and forcibly displaced people (particularly those living in camps) are much smaller groups, but again have distinct needs and challenges in accessing energy. As discussed above, lack of data hampers estimation of numbers of people living in extreme poverty who lack energy access in some cases. These points are discussed further in Section 6: Findings and recommendations.

Table 1. Who and where are the people living in extreme poverty without access to energy<sup>26</sup>

Area or group	Total population (millions, 2023)	People living in extreme poverty (millions, 2023)	People without electricity (millions, 2021)	People without clean cooking energy (millions, 2021)	People living in extreme poverty without electricity (millions, 2023)	People living in extreme poverty without clean cooking energy (millions, 2023)
Sub-Saharan Africa	1,183	424	578	949	310	406
Indo-Pacific	1,204	30	48	473	2	25
Top 6 countries (highest at the top to lowest at bottom)	Indonesia Pakistan Nigeria Bangladesh Ethiopia Philippines	Nigeria DRC Ethiopia Tanzania Madagascar Mozambique	Nigeria DRC Ethiopia Tanzania Uganda Mozambique	Nigeria Bangladesh Pakistan Ethiopia DRC Philippines	DRC Nigeria Tanzania Ethiopia Madagascar Mozambique	Nigeria DRC Ethiopia Tanzania Madagascar Uganda
% in top 6 countries	49%	49%	48%	48%	53%	50%
Rural	1,372	349	530	1,010	278	339
Urban informal	415	?	?	?	?	?
Fragile and conflict affected	843	267	403	668	201	255
Displaced people	41	?	?	?	?	?
Women and girls	1,195	231	314	745	158	219
People with disabilities	278	54–74	86	182	?	?

## 4. Barriers to energy access

Market mechanisms aim to enable people living in extreme poverty to gain access to modern energy by helping to overcome barriers. Most directly, they address low affordability and willingness to pay (WTP) which remain key barriers to energy access (SEforALL, 2022). Well-designed mechanisms can also help overcome other, non-financial, barriers – and mechanisms which do not recognize these barriers are unlikely to succeed. Broadly, **barriers to energy access can be grouped under the categories of cost/affordability, availability, and awareness** (Practical Action, 2012). The drivers of barriers, and the scale of their impacts, differ for different demographic groups, as summarized in Table 2 and discussed below.

Table 2. Barriers to energy access

	Applies to:						
	Extreme poor generally	Women & girls	People with disabilities	Rural	Urban informal	Displaced people	Conflict affected
<b>Low income</b>							
Limited financial means to purchase energy products and services	✓		✓	✓		✓	
Additional energy needs increase overall cost of energy required						✓	
<b>Seasonal or unreliable income</b>							
Variable incomes leading to risk aversion, preference for low value purchases, and deterring investment in energy products	✓			✓	✓		✓
<b>High cost to serve</b>							
Remoteness, low population density, low demand, small markets, etc.	✓			✓			✓
High energy/fuel costs from lengthy supply/distribution chains	✓			✓			
<b>Energy products/services not available</b>							
Lack of grid, unreliable energy/fuel supply, inadequate product distribution channels, and lack of support services, e.g. maintenance	✓			✓		✓	✓
Low mobile phone ownership, network cover, and internet access make it difficult to find, buy, and pay for energy products and services	✓	✓		✓		✓	
Specific needs not met by available technologies		✓	✓	✓		✓	
<b>Movement/engagement barriers</b>							
Restrictions on access by energy companies to communities				✓		✓	✓

Difficulties accessing transport and public spaces (markets, shops, etc.)			✓	✓		✓	
<b>Poor coverage by support programmes</b>							
Legal restrictions on rights to access programmes						✓	
Exclusion from energy access programmes		✓	✓				
<b>Social obstacles</b>							
Cultural norms and stereotypes limit movements and engagement between energy providers and potential customers		✓	✓				
Stigma, social exclusion, and low expectations		✓	✓				
Low control over resources due to unequal power dynamics		✓				✓	
Competition and conflict/tension with other communities/groups						✓	✓
<b>Application requirements</b>							
Lack of supporting documentation	✓			✓	✓	✓	✓
Complex and lengthy application processes	✓						
Lack of permanent residence	✓				✓	✓	
Rented housing makes energy access reliant on landlord	✓			✓	✓		
<b>Low awareness and prioritization</b>							
Low education and literacy	✓	✓	✓	✓			
Low access to mobile phones, internet, TV, radio, etc.	✓	✓		✓		✓	
Lack of information in accessible forms (e.g. braille)			✓				
Availability of inadequate alternatives (e.g. biomass and illegal connections)				✓	✓		
Additional household costs reduce capacity to pay for energy			✓				

*Note:* A tick in the ‘Extreme poor generally’ column means the barrier applies to people living in extreme poverty in general, a tick in a group column means that the barrier applies to that group alone or to a greater degree than people living in extreme poverty in general

**Cost and affordability of energy access are critical issues for all of the demographic groups** considered in this review.<sup>27</sup> For instance, affordability is the biggest barrier to energy access (specifically grid connection) for people in urban informal settlements (Singh et al., 2014; World Bank, 2012, 2019). Affordability challenges limited the use of improved cookstoves by displaced people in three camps in Rwanda, and lighting, phone charging, and entertainment were unaffordable (Practical Action, 2020b; Patel and Gross, 2019; Corbyn and Vianello, 2018; GPA, 2022). Furthermore, the solar appliance sector continues to predominantly serve customers living above the US\$3.20 per day poverty line, reflecting significant affordability challenges for those living below this line (Efficiency for Access, 2022).

**On average, about 30% of people asked as part of the MTF Energy Access Diagnostic Surveys carried out in 12 countries between 2016 and 2018 put costs**

**as the greatest barrier to grid connection** (Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019; Koo et al., 2018, and associated datasets).<sup>28</sup> Analysis of the data from the surveys from the six countries for which more detailed reviews have been carried out (see Appendices 7.2) indicates that **this rises to 36% for people living in extreme poverty**, varying between ~60% in Rwanda and Kenya and 5% in Ethiopia (ibid.).<sup>29</sup>

**All groups reviewed in this study are affected by low incomes**, due to combinations of low education and skills, social exclusion and prejudice in labour markets, restrictions on economic activity, and poor access to markets. For instance, people living in rural areas (and particularly indigenous and ethnic minority groups) have less access to education and employment (UNDESA, 2021a; ILO, 2020) and face greater challenges to reach markets (Mikou et al., 2019). Girls and people with disabilities often struggle to access education and may face prejudice and social exclusion when seeking employment (Wilhite, 2016; UNDESA, 2021a). People in fragile and conflict-affected areas also have limited employment opportunities (Mercy Corps, 2019).

**For some groups energy affordability is affected by higher living costs.** For instance, not only are households which include people with disabilities poorer than those without people with disabilities, they often have additional energy needs, so that meeting energy needs is more costly than for others (UNDESA, 2019; Perera, 2019; Kajima, 2018; Mont and Cuong, 2011). At the same time, **providing energy access to people living in extreme poverty in areas which are remote or difficult to access, or where population densities (and hence energy demand) are low, carries additional costs** (interview with Y.E. Ruff and J. Vrba, Energy Saving Trust, 21 April 2023). For instance, low affordability of energy in fragile and conflict-affected areas is partly driven by high costs, reflecting the higher costs and risks associated with operating in these areas (Sacchetto et al., 2020; Logan and Sacchetto, 2021).

**Uncertainty and variable earnings exacerbate affordability challenges.** For those working in agriculture, cash flows are tied to harvest cycles (UNDESA, 2021a). People living in urban settlements who work in the informal economy are also vulnerable to shocks and fluctuating earnings (Singh, 2014; World Bank, 2012). High levels of insecurity and uncertainty in fragile and conflict-affected settings make people more cautious about spending (Mercy Corps, 2019). Uncertainties surrounding their futures, and unpredictable changes in incomes as humanitarian agencies' budgets fluctuate, make displaced people reluctant to invest in energy solutions (NORCAP, 2020; Practical Action, 2020b). Such uncertainty often leads people living in poverty to resist investing in energy services and to favour energy procurement in small quantities, even if it is more expensive in the long run (Singh, 2014).

Despite increasing interest in energy and appliances for agricultural productive use (SEforALL, 2022; Efficiency for Access, 2022; FAO and IRENA, 2021), the evidence that additional incomes recompense costs (and match fossil fuel-based alternatives) is patchy (FAO and IRENA, 2021; Energy4Impact, 2020). High upfront costs mean that they are unlikely to be accessible to people living in extreme poverty in rural areas (CEEW, 2018; SNV, 2014). Affordability is also reported to be a major barrier to energy access for enterprises in refugee camps (Corbyn and Vianello, 2018; Practical Action, 2020b).

**Access to, and control over, resources also influence whether people can access energy.** Displaced people, for example, are often subject to restrictions on both employment and use of natural resources for income generation (Practical Action, 2020b; Patel and Gross, 2019; Corbyn and Vianello, 2018; Butorac, 2019; Vianello, 2016). For women and girls, limited control over household finances and decision-making power within households may mean that their specific energy needs are not addressed (Energia, 2019a).

Evidence on WTP for energy among people living in extreme poverty specifically is limited. Data collected by Practical Action (2016) for *Poor People's Energy Outlook 2016* indicated that respondents' WTP varied depending on the form of energy access but did not clearly show any relationship between WTP and poverty rates in the communities surveyed (though neither did it exclude such a relationship). One analysis of 2010–13 data from Senegal, Rwanda, and Burkina Faso found that households would be willing to pay 12–15% of household incomes for electricity access (Sievert and Steinbuks, 2020). It also found that as households' overall expenditure rose, so did their WTP for electricity access, implying that WTP would be lowest among those living in extreme poverty (ibid.).

Analysis of data from the Multi-Tier Framework Surveys (Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2019; Luzi et al., 2019; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019; Koo et al., 2018 and associated datasets) carried out between 2016 and 2017 for five of the six countries for which a more in-depth country-specific review has been undertaken (see Appendices 7.2) indicates (see Figure 6) that, for a grid connection: <sup>30,31,32</sup>

- **A lower proportion of people living in extreme poverty were willing to pay the full connection fee upfront** than of the rest of the population, with the difference averaging 11 percentage points. However, some people living in extreme poverty in each country did express WTP up front.
- **The option to pay in instalments increased WTP among people living in extreme poverty, by 24 percentage points on average.** It generally reduced the WTP gap between people living in extreme poverty and the wider population.
- In all the countries, except Nepal, **some people living in extreme poverty (on average ~20%) remained unwilling to connect**, even in instalments or if the fee were waived. A lower proportion of the wider population were also unwilling to pay on any terms. This indicates that **other barriers would need to be overcome.**

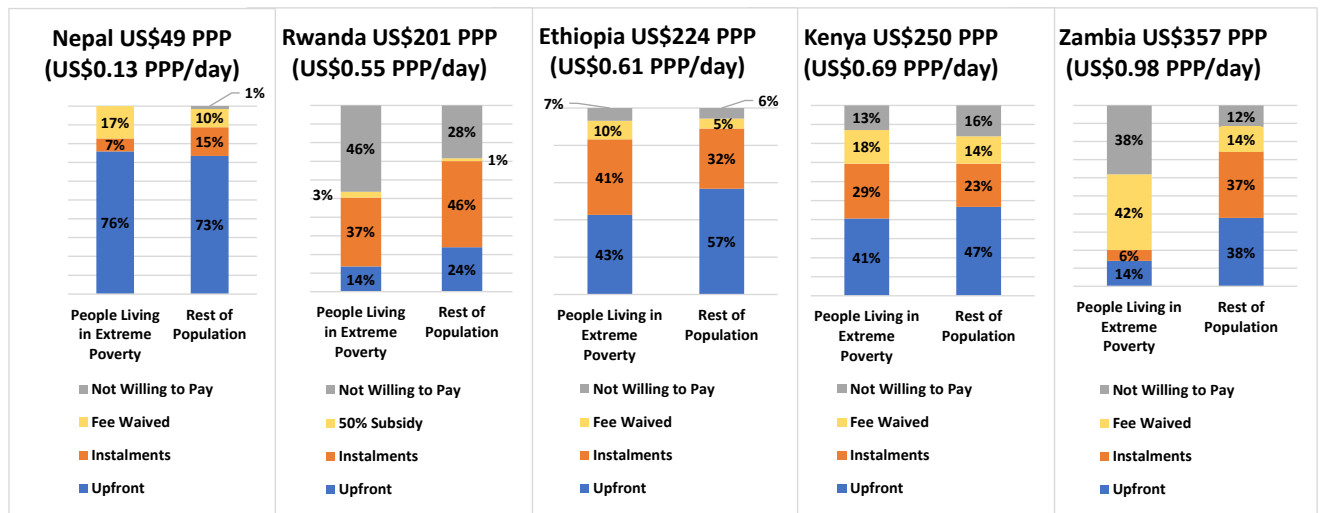


Figure 6. Willingness to pay for a grid connection

Source: Koo et al., 2018; Luzi et al., 2019; Padam et al., 2018; Pinto et al., 2019; and Dubey et al., 2020 and associated datasets.<sup>33</sup>

There appears to be some relationship between WTP and price (in purchasing power parity (PPP) terms), with WTP substantially lower in Zambia (where the price is highest) than Nepal (with the lowest price). However, on this basis WTP in Rwanda appears anomalously low, and the relationship may, instead, be with poverty rate (and implicitly depth), with Zambia having the highest extreme poverty rate, followed by Rwanda, and Nepal the lowest (see Figure 7).

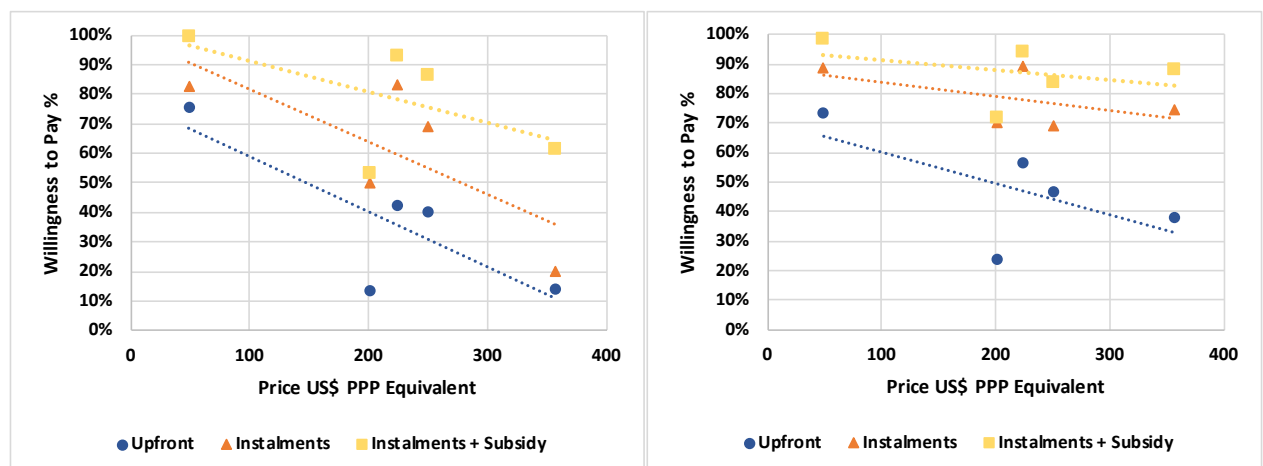


Figure 7. Variation in willingness to pay for a grid connection with price and extreme poverty rate

Source: Luzi et al., 2019, 2020; Koo et al., 2018; Padam et al., 2018; Pinto et al., 2019; and Dubey et al., 2020 and associated datasets<sup>32</sup>

On average **18% fewer people living in extreme poverty were willing to pay for a Tier 1 solar home system than for a grid connection** (presumably due to a combination of price and the level of electricity provided); see Figure 8.<sup>34,35</sup> (The exception was in Rwanda, where ~11% more people living in extreme poverty were willing to pay the price upfront, and 3% more once the option to pay a subsidized price in instalments was

included.) The overall pattern, however, was similar with **lower levels of WTP among people living in extreme poverty than among the rest of the population. The option to pay in instalments again resulted in increased WTP, and offering a subsidy increased it further.** However, about 38% of people living in extreme poverty remained unwilling to pay even a subsidized price in instalments, indicating further financial support or removal of other barriers would be needed for this group.

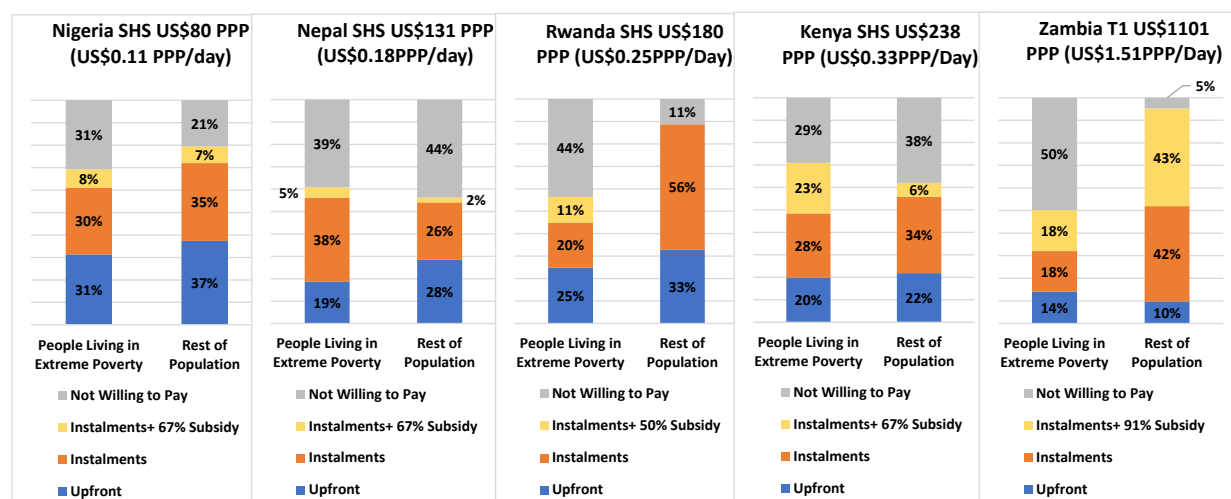


Figure 8. Willingness to pay for a Tier 1 solar home system (SHS)

Source: Luzi et al., 2019, 2020; Koo et al., 2018; Pinto et al., 2019; and Dubey et al., 2020 and associated datasets<sup>33</sup>

The picture from the three countries where people were asked about their WTP for a more aspirational improved cookstove is less clear (see Figure 9).<sup>36</sup> The option to pay by instalments still resulted in increased WTP, but in two of the countries WTP actually appeared higher among people living in extreme poverty than among the rest of the population (possibly reflecting a wider range of factors affecting purchase decisions). Some 37% of people living in extreme poverty, on average, remained unwilling to pay even a subsidized price in instalments.<sup>33</sup>

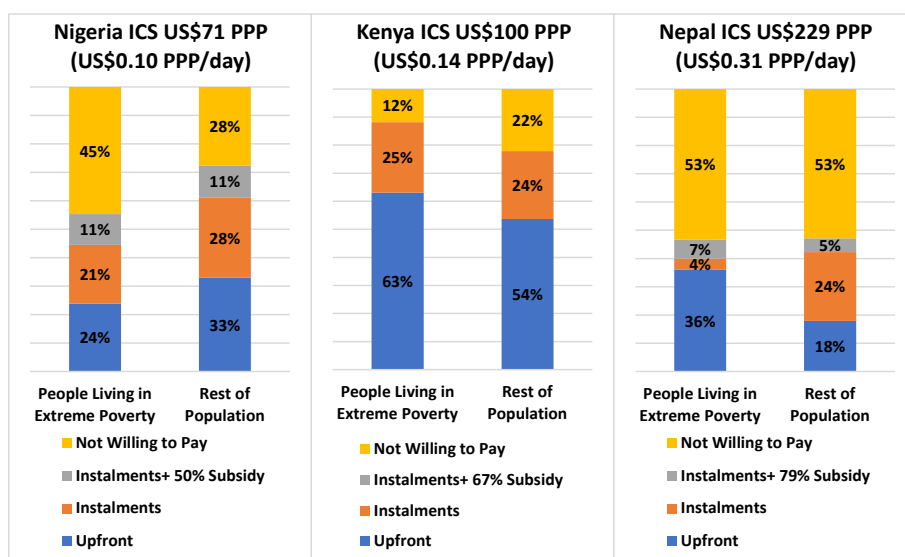


Figure 9. Willingness to pay for aspirational improved cookstove (ICS)

Source: Luzi et al., 2019; Dubey et al., 2020; and Pinto et al., 2019 and associated datasets <sup>37</sup>

Respondents to the MTF Energy Access Diagnostic Surveys who said they wouldn't be willing to pay for a grid connection, a solar home system or an improved cookstove were asked 'why not?' About 74–80% of people living in extreme poverty said it was because they couldn't afford it (even in instalments) (Luzi et al., 2019, 2020; Koo et al., 2018; Padam et al., 2018; Pinto et al., 2019; and Dubey et al., 2020 and associated datasets).<sup>33</sup> Ongoing electricity and fuel costs are an issue for a much lower percentage (<5%) of people living in extreme poverty.<sup>33</sup> Taken together, the evidence confirms that upfront costs form the greatest barrier to energy access for people living in extreme poverty, and that market mechanisms which spread cost over time are needed and have the potential to enable access.

Alongside affordability issues, people living in extreme poverty face **non-financial barriers to energy access**. These barriers may directly prevent or discourage take-up of energy access, or they may reduce WTP. (See Table 2 for a summary of these barriers and how they apply to different groups of people living in extreme poverty.)

Even where people would in principle be willing to pay for them, **suitable energy products and services may not be available** (FAO and IRENA, 2021). **Grid systems often do not extend to rural and remote communities**, so connection is not an option. Just under 50%, on average, of those without a grid connection in the 12 countries in sub-Saharan Africa and Indo-Pacific where MTF Energy Access Diagnostic Surveys were carried out between 2016 and 2018 said distance from the grid was the reason they were not connected.<sup>33</sup> In the six countries for which a more detailed review has been carried out (see Appendices 7.2) the percentage was slightly lower (46%) for people living in extreme poverty.<sup>33</sup> Even where the grid is present, unreliable and poor quality supply may prevent energy needs being met and discourage connection.<sup>38</sup> This was an issue for only 1% of people living in extreme poverty who did not have a grid connection, but also for 7% of those who said they would be unwilling to pay for a connection (in the six countries for which a more detailed review has been carried out, see Appendices 7.2).<sup>33</sup>

Weak distribution channels mean that **off-grid products, clean fuels, and maintenance services are also frequently unavailable** in such communities. The solar appliance sector still predominantly serves people in areas covered by the national grid (Efficiency for Access, 2022). More than 10% of people living in extreme poverty asked as part of the MTF Energy Access Diagnostic Surveys in the six countries for which a more detailed review has been carried out (see Appendices 7.2) gave lack of availability of products or repair services as the reason they were unwilling to pay for off-grid options.<sup>39</sup> Though only ~2% on average of people living in extreme poverty said availability of clean fuels was an issue, others have found it deters take-up of clean cooking in some contexts (interview with L. Umala, Clean Cookstove Alliance, 17 April 2023)), .<sup>34</sup>

Informal settlements are also difficult for the grid to reach and have limited distribution channels for electrical appliances, modern cookstoves, and fuels (World Bank, 2012; Singh et al., 2014). Camps for displaced people are often physically remote, limiting availability of energy infrastructure and services (Corbyn and Vianello, 2018). Government and relief agencies can be reluctant to extend grid systems or support energy market development in camps and urban informal settlements because it may convey a sense of permanence (UNDESA, 2021; Singh, 2014). Companies are deterred by the perception that refugees cannot afford products, limiting availability of solar systems and productive use technologies (Practical Action, 2020b; Corbyn and Vianello, 2018). In fragile and conflict-affected areas, energy infrastructure is vulnerable to attack and supplies of fuel and other products may be disrupted (Spyrou et al., 2019). Management of electricity systems may be degraded by weak government, corruption, and lack of finance in a context of political instability and tension (Logan and Sacchetto, 2021; Sacchetto et al., 2020). Off-grid energy options are less reliant on government capacity but will still be hampered by inadequate regulation and financial systems and by higher risk and costs (ibid.).

**People living in extreme poverty who do not have mobile phones or internet access, or live in areas where network coverage is limited, may struggle to purchase or pay for energy goods and services.**<sup>40</sup> Mobile phones and the internet can enable access to products and services which are not available locally. However, in rural areas, fixed broadband is often unavailable and internet access depends on mobile phone ownership and sufficient mobile connectivity, which can be cost prohibitive for people living in extreme poverty (ITU, 2023). In addition, women have lower access to mobile phones and the internet than men (FAO, 2023; ITU, 2022), hampering their ability to purchase energy products online. Disparities are especially great in rural areas due to lower broadband coverage, literacy rates, and digital skills linked to structural inequalities and social norms limiting access to education and certain types of employment (FAO, 2023). Finally, people with disabilities report significantly lower internet use than people without disabilities and are less likely to own or have access to mobile phones, radios or TVs (UNDESA, 2019), limiting their ability to access energy products and services.

**Even where basic energy products are available, products which meet local needs may not exist.** Available clean cookstoves often do not match families' requirements in terms of size, cooking speed, local ingredients, and cooking practices (Practical Action, 2020a). Lack of productive use appliances adapted to local contexts or users' needs has also been identified as a particular issue (GDC, 2022; Practical Action, 2020a). For example, solar irrigation pumps in Kenya were often unsuitable for small-scale farmers' needs (ibid.). Energy products and services, particularly productive use appliances,

designed or adapted to the needs of people with disabilities are also rarely available (Efficiency for Access, 2021; Power Africa, 2022).

**Physical, financial and legal restrictions on movement and engagement between companies and customers can also hamper energy access.** In rural areas, long distances and inadequate roads and transport services limit access to markets where energy products are sold (Mikou et al., 2019). For people living in extreme poverty, who have limited means to travel, this barrier is higher than for others. It is a particular issue for people with disabilities who are often prevented by barriers in the physical environment from accessing public spaces and transport, making buying energy products and paying for energy services difficult (WHO, 2022; UNDESA, 2019; Power Africa, 2022). Suppliers' access to displacement camps may be restricted by government or managing agency policies, while displaced people are prevented from leaving camps to purchase energy products (Vianello, 2016).

**Support programmes do not always include all groups.** Some groups, such as displaced people and people with disabilities, may not be included in energy access programmes, designed to support people living in poverty. Even where they are nominally included, lack of awareness and prejudice among those implementing such programmes may prevent them from benefiting from support (WHO, 2022; UNDESA, 2019; Groce and Kett, 2017). Displaced people, who disproportionately live in urban informal settlements, may also be disproportionately excluded from government and utility led programmes designed to increase energy access (Energy for Growth Hub, 2023). This can occur when large household sizes and widespread use of energy inefficient appliances in urban informal settlements mean that electricity consumption levels exceed the qualifying threshold for subsidization (Singh, 2014).

**Social obstacles** form at least as great a barrier to energy access as physical or legal restrictions. **Structural inequalities and discriminatory social norms prevent women and girls from accessing energy services and benefiting from them** (Energia, 2019a). Their continuing lack of equal ownership and control over assets, paid employment, public services, and infrastructure, together with greater domestic workloads, prevent them from engaging equally in society as independent socio-economic agents (ibid.). This, combined with **cultural norms which constrain their mobility and ability to engage with others**, can limit women's access to energy markets. **Intra-household dynamics can also affect women's ability to determine what energy is accessed**, how it is used and who benefits from its use (FAO, 2023; Efficiency for Access, 2022; IRENA, 2019;; Energia, 2019a). There is also evidence that the energy needs of women are under-prioritized by companies, as shown by the limited availability of gender disaggregated survey data (Efficiency for Access, 2022).

**Social exclusion and stigma mean that people with disabilities are often confined to the home** (UNDESA, 2019; World Bank, 2009b), hampering their ability to access energy products. Furthermore, attitudes and low expectations among those with disabilities and their families (World Bank, 2009b) may prevent them seeking out and taking advantage of energy access opportunities. For instance, in Kenya most people with disabilities do not actively participate in family, social, and economic activities and only 59% were likely to be consulted about household decisions (NCAPD, 2008).

**Administrative processes and the requirement to meet eligibility criteria and provide supporting documentation can also form a barrier** to energy access for those living in extreme poverty. About 9%, on average, of those asked as part of the MTF Energy Access Diagnostic Surveys in sub-Saharan African and Indo-Pacific countries gave this as the reason they did not have a grid connection (ibid.). However, the scale of this barrier is very much context specific. It rose to 32% among people living in extreme poverty, but did not register at all in the surveys undertaken in Rwanda and Zambia.<sup>41</sup>

**People living in rented accommodation are often dependent for energy access on their landlords**, and this can act as a significant barrier. For instance, in Zambia 9% of people living in extreme poverty (30% in urban areas) said this was why they did not have a grid connection (Dubey et al., 2020).<sup>38</sup> **Lack of land tenure and legal recognition** are barriers to electrification of informal urban settlements (Singh et al., 2014; World Bank, 2012). In the absence of formal energy services, electricians and landlords often act as de-facto suppliers, setting tariffs and placing restrictions on electricity use (Energy for Growth Hub, 2023).

**Lack of formal identification is another barrier to energy access.** Informal and temporary housing means that residents are often unable to provide documents (such as proof of residence) required for electrification (World Bank, 2012) or purchase of LPG (Singh et al., 2014). Displaced people also often lack identity documents (UNHCR, 2020).

**The priority they place on energy access drives the decisions** that people make (including people living in extreme poverty) and their WTP for energy products and services. This in turn **depends on awareness of energy options and their benefits, and hence on access to accurate and readily available information.**

This is a **particular issue in relation to clean cooking energy.** About 40% on average of those unwilling to pay for an improved cookstove (when asked as part of the MTF Energy Access Diagnostic Surveys in sub-Saharan African and Indo-Pacific countries), said it was because they had no need for one (Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2018, 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019).<sup>38</sup> Displaced people, among others, have little awareness of clean cooking benefits (Vianello, 2016). Low awareness of the financial and health benefits is one of the reasons people in informal urban settlements do not take up clean cooking options (Singh et al., 2014; World Bank, 2012). Willingness to pay for productive use appliances is also often low because of low awareness of technologies' benefits (FAO and IRENA, 2021; Energy4Impact, 2020).

**People living in extreme poverty face additional barriers in obtaining information** needed to make decisions about energy access. In general, they have **fewer educational opportunities** and lower levels of literacy (World Bank, 2020a; Castañeda et al., 2016). In rural areas this is especially true for indigenous and ethnic minority groups who tend to lack access to education in a language they understand (UNDESA, 2021a). Women and girls face greater challenges in accessing education than men, especially in rural areas, as cultural attitudes often mean that their education is opposed or under-prioritized (ibid.). Education outcomes are also lower for people with disabilities due to difficulties comprehending information, unsuitable learning environments, and stigma and other barriers to access (World Bank, 2017).

**Lower levels of access to mobile phones and the internet** among people living in extreme poverty (World Bank, 2022b), particularly in rural areas (UNDESA, 2021a; ITU, 2022) and among women (FAO, 2023; ITU, 2022), displaced people (Mercy Corps, 2019), and people with disabilities (Mitra and Yap, 2022; UNDESA, 2019), can also hamper access to information. Informal routes to accessing information **may also be affected by social exclusion and lower levels of social engagement** for some groups of people living in extreme poverty, particularly women and people with disabilities (Banks et al., 2017, NCAPD, 2008).

**Information on energy products may also not be available in local languages.** For instance, technologies are often imported without local language manuals, making them difficult to operate and maintain (FAO and IRENA, 2021). **Language barriers are especially significant for indigenous and ethnic minority groups living in rural areas**, for whom access to education is lower than for ethnic majority populations (UNDESA, 2021a; UNESCO, 2016). Similarly, it **may not be provided in forms accessible to some groups** (e.g. braille for people with visual impairment) (WHO, 2022).

**The priority placed on modern energy access may also be affected by available alternatives.** For instance, a particular issue affecting WTP for clean cooking options in rural areas is the **availability of ‘free’ biomass fuel** (interview with H. Adair-Rohani, World Health Organization, 8 May 2023). In the long term, ‘free’ biomass fuel is paid for by the time and labour of gathering it and the burden of ill-health generated by its use. However, it is often a difficult decision for people living in extreme poverty in rural areas to forgo this ‘free’ good in favour of clean stoves and fuel with much higher monetary costs. Similarly, **in informal urban settlements residents often connect to the grid illegally** (Singh et al., 2014; World Bank, 2012), and the wide availability of highly polluting and unsafe traditional fuels reduces demand for cleaner alternatives (World Bank, 2012).

Prioritization of energy access may also be a greater challenge for **some groups who face other additional household costs**. For instance, people with disabilities often have higher accommodation, transport, and care costs, which are likely to cause them to place a lower priority on energy (Mont and Cuong, 2011).

There is thus a complex web of barriers and challenges standing between people living in extreme poverty and the energy access which would meet their needs. The relative significance of these barriers varies between demographic groups, and will depend on the national and local context. An initial assessment of the relevance of these barriers to demographic groups is set out in Table 2. Market mechanisms can help to overcome many of these barriers. The accompanying report ‘Part 2: The Role of Market Interventions and Business Models’ looks at how effective different types of market mechanism will be in overcoming different barriers.

## 5. Factors restricting the reach of market mechanisms

Various factors can affect the ability of people living in extreme poverty to take up market mechanisms designed to improve energy affordability (i.e. mechanisms' 'reach' to these groups). The energy access literature rarely focuses specifically on reach factors, instead ignoring them or conflating them with barriers to energy access. To address this, we have explored factors which hamper the ability of people living in extreme poverty to access other forms of financial support and where factors which act as barriers to energy access may also affect market mechanisms' reach.

Table 3 summarizes factors likely to affect market mechanism reach and assesses which groups of people living in extreme poverty are most likely to be affected. Many of these parallel barriers to energy access, but the focus here is on their interaction with market mechanisms specifically. More detailed explanations of such factors and their effects are provided in the rest of this section.

Table 3: Factors reducing the reach of market mechanisms

	Applies to:						
	Extreme poor generally	Women & girls	People with disabilities	Rural	Urban informal	Displaced people	Conflict affected
<b>Seasonal or unreliable income</b>							
Reduces creditworthiness, the suitability of regular financial commitments, and creates hesitancy in taking on commitments	✓			✓	✓	✓	✓
<b>High cost to serve</b>							
Remote, inaccessible, and poorly connected communities and low value transactions	✓			✓			✓
Small support amounts required lead to high transaction/delivery costs	✓						
<b>Opportunity cost to access</b>							
High cost (time, transport, etc.) to the applicant of applying			✓	✓			✓
<b>Poor coverage by financial services</b>							
Poor and remote communities have limited coverage by financial institutions and market mechanism providers				✓	✓		✓
Low levels of mobile phone ownership, network coverage, and access to the internet hamper use of mobile money	✓		✓	✓			
<b>Movement and engagement barriers</b>							
Restricted access by market mechanism providers to poor communities					✓	✓	
Inability to physically access banks, places to submit applications, etc.			✓				
<b>Poor coverage by support programmes</b>							
Legal restrictions on accessing support programmes			✓			✓	
Prejudice among staff managing application processes		✓	✓				
<b>Social obstacles to access</b>							
Social norms limiting movements and engagement		✓	✓				

Stigma, social exclusion, and low expectations among individuals and their families		✓	✓				
<b>Application requirements</b>							
Complex and unclear application processes			✓				
Applicants lack supporting documentation (to show eligibility)	✓	✓	✓	✓	✓	✓	
Lack of permanent residence					✓	✓	
<b>Awareness and prioritization</b>							
Low awareness			✓				
Low education and basic and financial literacy	✓		✓				
Low access to mobile phones, internet, TV, radio, etc.	✓		✓				
Lack of information in accessible forms (e.g. braille)			✓	✓			

*Note:* A tick in the ‘Extreme poor generally’ column means the factor applies to people living in extreme poverty in general; a tick in a group column means that the factor applies to that group to a greater degree than people living in extreme poverty in general.

**Seasonal or unreliable incomes hinder the capacity of people living in extreme poverty to take up financial support.** For example, as discussed above, the incomes of smallholder farmers are typically tied to harvest cycles (FAO and IRENA, 2021) and the incomes of displaced people often depend on humanitarian assistance prone to fluctuation (Practical Action, 2020b). Income variability can increase risk aversion and reduce willingness to borrow (Mercy Corps, 2019). In fragile and conflict-affected areas this is compounded by low confidence in the security of financial institutions which are vulnerable to attack by armed groups (ibid.). Income variability and low financial resilience are likely to reduce people’s ability and willingness to engage with business models requiring regular fixed payments such as pay as you go (PAYGo). Income variability may also hinder eligibility for market mechanisms and reduce providers’ willingness to extend support due to the risk of payment default.

**Many people affected by extreme poverty live in places or under circumstances that increase the cost of providing financial support.** For example, rural areas often have low population densities and poor infrastructure connections (Quak, 2018), meaning that market mechanism providers often face higher operating costs when trying to run businesses or implement external market interventions (Energy Catalyst, 2021). For example, physical remoteness is likely to raise marketing and transportation costs for market mechanism providers when recruiting customers or collecting payments (ibid.). In addition, low population densities also make it harder for mechanism providers to recover investment and operating costs, potentially deterring them from working in remote and hard to reach locations (Quak, 2018).

**Physical remoteness may also reduce people’s willingness and ability to engage with market mechanisms due to higher travel and opportunity costs.** These include forgone earnings when travelling, researching opportunities, registering with market mechanism providers, and making purchases. Given their lower incomes, monetary costs will disproportionately affect those in extreme poverty. Furthermore, opportunity costs are likely to be especially high for people with disabilities that affect their mobility, as travel is likely to be more time-consuming and costly, especially if special transportation is required (UNDESA, 2019).

**The availability of financial services is limited for people living in extreme poverty.** For example, physical services, such as bank branches and ATMs, are more

prevalent in urban areas than in rural – often because rural communities are remote or poorly connected (UNCTAD, 2021). The availability of financial services in urban informal settlements is also limited because service providers can be reluctant to enter settlements, viewing residents as risky borrowers (given their illegal status and vulnerability to relocation) and being concerned about safety (World Bank, 2012).

As of 2021, there were on average only eight commercial bank branches per 100,000 adults in countries categorized as fragile, compared to 22 in non-fragile countries (Chehade et al., 2021). This is driven by a range of factors including poor macroeconomic conditions (such as high inflation, slow growth, and high unemployment) creating risk aversion and prioritization of only a small customer base, as well as poor connecting infrastructure (Mercy Corps, 2019). Subsequently, access to long-term finance is often limited and replaced by short-term or relationship-based credit and cash transactions (ibid.).

The limited geographical footprint of financial institutions will affect the reach of external market interventions such as results-based financing schemes and end-user subsidies when they are managed by financial institutions. Availability will also affect business models involving third-party financing partnerships where companies partner with financial institutions that provide loans to potential customers. In some cases, the scarcity of formal financial institutions, such as commercial banks, can be overcome if market mechanism providers work with informal alternatives such as community savings clubs and self-help groups. This has helped communities in Kenya with access to informal Saving and Credit Cooperatives (see Appendices 7.2 for more details). Scarcity of physical financial institutions can also be overcome by mobile money and, therefore, is less likely to affect business models using digital financial services such as mobile-enabled PAYGo (FAO, 2023).

**The accessibility of financial institutions is limited for people affected by extreme poverty.** Groups will be affected by minimum deposit levels required to open accounts and fixed transaction costs, as these will equal a larger share of their limited incomes (UNDESA, 2021a). Another wide-reaching barrier is the need for specific documents, such as pay slips, tax payments, identity cards and proofs of residence, which those in the informal economy (in urban informal settlements as well as rural areas), displaced people, people with disabilities, and women are less likely to possess (UNDESA, 2019; 2021a; UNHCR, 2020; FAO, 2023). Limited confidence in the security of financial institutions can also lower people's willingness to engage: for instance, due to a mutual distrust between urban informal residents and authorities (Singh, 2014); new or underdeveloped services in rural areas (UNDESA, 2021a); and when institutions are vulnerable to attack (Mercy Corps, 2019).

Certain groups face unique barriers to financial inclusion. For example, Wilhite (2016) reported that in many parts of South Asia and sub-Saharan Africa gender norms mean that women do not maintain bank accounts in their name, as household finances are controlled by husbands or senior family members. Women are especially affected by barriers to financial inclusion in fragile and conflict-affected contexts, where they are 11% less likely than men to have a formal account, and 38% less likely than women in non-fragile contexts (Chehade et al., 2021). People with disabilities also face exclusion because of the physical inaccessibility of financial institutions; lack of knowledge of application processes; complex eligibility criteria; high time and transport costs; and staff prejudices (UNDESA, 2019; Mitra, 2005).

Limited availability and accessibility of financial services could potentially increase risk aversion to financial commitments involved in market mechanisms. In addition, limited engagement with financial institutions, either saving or borrowing with them, will mean that people are less likely to have credit histories or records of regular savings, potentially hindering the implementation of business models involving repayments. For example, potential beneficiaries of a market mechanism may be excluded due to a perceived lack of creditworthiness.

**Low levels of mobile phone ownership, mobile connectivity, and use of mobile money hinder the reach of mobile-enabled PAYGo.** Conditions for PAYGo uptake are worse in rural areas than in urban areas; the averages for mobile phone ownership in Least Developed Countries are 70% and 91% in 2021, respectively (ITU, 2021). Mobile connectivity is also poorer with 13% of the rural population having no mobile signal at all and another 13% only having access to a 2G network (ITU, 2023). Similarly, mobile money account ownership was 8% higher in fragile than non-fragile contexts in 2017, suggesting high demand for PAYGo in such settings, but a need for improved distribution (Chehade et al., 2021). Those affected by extreme poverty in rural areas and in fragile contexts may be prevented from using PAYGo to support energy access by problems using mobile money.

Mobile-enabled PAYGo mechanisms can provide women with greater autonomy in paying for energy technologies (FAO, 2023). However, while narrowing, there remains a gender gap in mobile phone ownership (7% in 2021) with rural women worst affected. The gap is widest in middle-income countries in South Asia, with women being 19% less likely than men to own a mobile phone in 2020, and slightly lower in sub-Saharan Africa (13%) (ibid.). A gender gap is also evident in mobile money use. In 2021, 30% of women but 36% of men had accounts in sub-Saharan Africa (excluding high-income countries). In South Asia the gap was larger (6% of women and 17% of men). However, account ownership was equal in East Asia and the Pacific (6% for both men and women) (ibid.).

Mobile phone accessibility is limited for displaced people. Governments are increasingly implementing legal requirements for all subscribers to have proof of ID to activate and use a SIM card (UNHCR, 2020). This presents a challenge for displaced people who commonly lack access to identity documents. However, in some cases governments have been more flexible. For instance, in Ethiopia, a refugee ID card jointly issued by the Administration for Refugee-Returnee Affairs and UNHCR permits refugees legal access to a SIM card. Informal workarounds can also occur such as bulk activation of SIMs purchased and registered by humanitarian organizations (ibid.).

**Market mechanism providers have restricted access to certain communities living in extreme poverty.** As mentioned, governments and relief agencies can be reluctant to develop services and economies in both urban informal settlements and refugee camps because this might indicate a sense of permanence that they do not wish to convey to citizens (GPA, 2022; Singh, 2014). These restrictions will hamper engagement between people living in extreme poverty and market mechanism providers, such as government agencies and financial institutions managing market interventions and off-grid companies offering different payment models.

**Factors that exclude people from social protection are also likely to hinder market mechanism reach.** Marginalized groups, including people with disabilities and those in the informal economy, are frequently excluded from social protection because they

lack legal coverage (including proof of residence), have low and volatile earnings, and struggle with complex administrative procedures (ILO, 2017; UNDESA, 2019). People with disabilities are not always informed about support programmes (even disability targeted ones) and face additional barriers to enrolment including lack of physical accessibility of grant offices and staff prejudices, especially towards mental illness (UNDESA, 2019). The reach of external market interventions to such groups, especially end-user subsidies, will be affected by such barriers, as eligibility is typically based on location, requiring proof of residence, and registration in local or national databases. Additional barriers to social protection in rural areas are also likely to hinder market mechanism reach, including challenges and costs in identifying and registering beneficiaries, monitoring payments, and controlling for potential errors as well as opportunity costs faced by participants in terms of travel and lost income (UNDESA, 2021a).

**Discriminatory social norms are likely to hinder the ability of certain people living in extreme poverty to travel and engage with market mechanism providers.**

For example, women spend a disproportionate amount of time and labour on unpaid care work and other domestic chores meaning they have less time to spend outside of the home than men (IRENA, 2019; Energia, 2019a). In addition, women often require their husband's signature for financial transactions or are unable to travel alone or meet with men outside their family (Mercy Corps, 2019). These limit women's financial autonomy and are also likely to limit women's ability to engage with market mechanism providers freely, for example, when speaking with sales agents and learning about payment models, or NGO staff or government officials administering end-user subsidies, just as they limit their ability to engage with energy access providers.

**The ability of people living in extreme poverty to understand and extract benefits from market mechanisms will be hindered by limited access to education.**

As mentioned, low access to quality education affects all groups in extreme poverty (IIED, 2023; UNDESA, 2021a; UNHCR, 2023a). By limiting basic and financial literacy (Mercy Corps, 2019), low access to educational opportunities is likely to hamper people's ability to understand information about market mechanism opportunities, for example, physical and digital marketing and supporting documents outlining business models and participation in external market interventions.

**The digitalization of information related to market mechanism opportunities is also likely to hamper understanding for those in extreme poverty with limited access to the internet.**

As mentioned, access to the internet is lower in rural than in urban areas and among women than among men (ITU, 2023). In addition, people with disabilities report lower access to the internet and use of mobile phones, TVs, and radios than people without disabilities (UNDESA, 2019) and, when their mobility is constrained, will struggle to access physical marketing, such as community roadshows and product fairs organized by last-mile distributors (GDC, 2022; interview with C. Miller, Global Distributors Collective, 24 April 2023). Along with ethnic minority groups, they may also have specific information requirements, such as braille or first languages, that are not met by market mechanism providers.

**The extent to which market mechanism reach will be affected by knowledge and awareness will vary depending on the mechanism.**

Lack of awareness will strongly affect mechanisms requiring beneficiaries to proactively engage, especially external interventions such as end-user subsidies and sales results-based financing, as well as

business models relying on consumer financing. However, awareness is less likely to limit the reach of mechanisms based on traditional payment arrangements. For example, business models such as small purchase sizes and barter payments on their own do not require understanding of new transaction types. The former can be used with cash payments, and the latter is a form of transaction that is common to people living in extreme poverty.

The ability of people living in extreme poverty to take up market mechanism support (i.e. mechanisms' 'reach') is influenced by a variety of factors. Importantly, as energy access is typically a household matter, the extent to which certain factors affect the reach of market mechanisms to specific individuals will be influenced by whether they live alone or with others, as well as by intra-household dynamics. For example, if a woman does not own a mobile phone but another household member does, this may not affect her ability to benefit from mobile-enabled PAYGo. Lower mobile phone ownership among women may, therefore, be more significant for women living alone or in female-headed households (FAO, 2023). The same is likely to apply to people with disabilities.

Nevertheless, wide-reaching barriers, such as high-income variability, lack of documentation, limited availability and accessibility of financial services, and low levels of financial literacy (among others), affect the reach of several market mechanisms to many groups. Other factors, such as restrictions on market mechanism providers' access to refugee camps and urban informal settlements and special informational requirements, only affect certain groups. This suggests that addressing a core set of general factors may have a wide-reaching impact on the reach of market mechanisms to many people living in extreme poverty, but more specialized business models and interventions will also be needed to reach subgroups with more specific challenges.

## 6. Findings and recommendations

Some conclusions can be drawn from this review about the potential for market mechanisms to support energy access among people living in extreme poverty, and how they could be focused and designed to have the greatest impact:

1. With progress on energy access slowing in recent years, **there is a real and growing danger that people living in extreme poverty, who are likely to be hardest to reach, will be left behind** – market mechanisms focused on people living in extreme poverty are needed to enable them to meet their energy needs.
2. **People living in extreme poverty have significantly lower levels of energy access than wider populations.** However, while there is considerable overlap between people living in extreme poverty and people who lack energy access, they are by no means identical – **it is not only people living in extreme poverty who lack energy access, and some of those in extreme poverty do have access.** Relationships between lack of electricity and clean cooking energy access among those living in extreme poverty and among populations as a whole seem to be reasonably consistent across countries. These relationships may be used to:
  - a) estimate numbers of people living in extreme poverty who are without electricity or clean cooking energy access in countries where data is not available;
  - b) identify countries where energy access among people living in extreme poverty relative to the wider population is higher or lower than would be expected, and hence consider what circumstances or policies may lead to this.
3. **An estimated 312 million people living in extreme poverty in the Indo-Pacific and sub-Saharan Africa are without access to electricity, and 430 million do not have access to clean cooking energy. Most are in rural areas and/or conflict-affected countries,** validating the long-standing focus of support for energy access in these areas.
4. **More than 50% of people living in extreme poverty who are without electricity and clean energy for cooking live in just six countries,** indicating that focusing market mechanism support on these countries is likely to benefit the greatest number of people living in extreme poverty.
5. **Differences in women and girls' energy needs, and barriers to addressing these needs (within-household power dynamics and societal norms) are significant.** Furthermore, **access to clean energy for cooking (which most impacts women and girls) is an even greater and more intractable issue for those living in extreme poverty.** Though extreme poverty and energy access rates among women and girls are difficult to establish (given that both are measured at household level), this highlights the need for energy access market mechanisms targeted at women and access to clean cooking energy.

6. An estimated 278 million people with disabilities live in sub-Saharan Africa and Indo-Pacific and there is evidence that poverty levels are higher and energy access rates lower among people with disabilities (and the households they live in) than among the wider population. However, **it is unclear how many people with disabilities who are living in extreme poverty also lack energy access.** Like women, **people with disabilities have distinctive energy access needs (including clean energy for cooking), and the barriers they face also largely relate to social exclusion, prejudice, and power dynamics within households.** Positive measures should be taken to ensure that people with disabilities are included in target groups for market mechanism support.
7. **People living in extreme poverty in urban informal settlements form a significantly smaller group** than rural residents, and the extent to which they lack energy access is unclear. However, the **challenges they face in accessing energy are distinctive** and market mechanisms tailored to support them will be needed if this group is not to be left behind.
8. **Displaced people, and specifically displaced people living in formal camp settings, are the smallest of the demographic groups considered** (about 6 million). The **energy needs and contexts in which displaced people based in formal camps access energy are distinct from those of the wider population,** indicating that specific market mechanisms may be needed to support them. In contrast, **displaced people living within host communities may be better served by mechanisms which support energy access for people living in extreme poverty more generally,** with the priority to ensure that they are eligible for such mechanisms.
9. Given the **clear evidence that children and young people are most likely to be affected by extreme poverty, ways should be sought to enable households including young children, or headed by youths, to access energy** through suitably designed market mechanisms.
10. Conversely, it has been suggested that older people should be considered as a focus for market mechanisms supporting energy access. However, **given that older people are less likely to live in extreme poverty, this may not be a priority** (save to the extent that old age is accompanied by disability).
11. Evidence that **extreme poverty is linked to low educational opportunity would also support the focus of market mechanisms on energy for education** (for schools, lighting to study at home, or products which lighten the burden of household tasks on girls and so enable them to attend school), particularly in rural areas, to help break the cycle between low educational opportunity and extreme poverty.
12. Given that most people living in extreme poverty are in rural areas, a **continued focus of market mechanisms on energy for agricultural productive uses** would seem to be indicated.

13. Targeting market mechanisms at **energy access to support adaptation might help alleviate some of the increases in extreme poverty expected to result from climate change.**
14. **Cost is unequivocally the greatest barrier to energy access for people living in extreme poverty**, while the **option to pay for energy products and services clearly increases their WTP**. This supports the proposition that market mechanisms, and specifically mechanisms which spread payment over time, have the potential to support significant increases in energy access among people living in extreme poverty.
15. However, **significant minorities of people living in extreme poverty remain unwilling to pay for energy access**, even at a reduced price and in instalments. Either greater financial support would be needed to bring in this group, or other barriers would need to be overcome.
16. **Unavailability of suitable energy products and services also forms a significant barrier**. Market mechanisms which support development of markets and supply chains, and products aimed at people living in extreme poverty, may help to overcome this barrier.
17. **Lack of awareness of energy options and their benefits can also reduce WTP for energy access**. In particular, while financial support alone may be successful in enabling electricity access among people living in extreme poverty, increasing access to clean cooking is likely to need other forms of support (e.g. awareness raising and behaviour change) as well.
18. **Other barriers to access may be group or context specific**. For instance, in some countries administrative processes form a significant barrier to grid connection. Similarly, the need for provision by landlords can prevent tenants from getting energy access in some places. Mechanisms need to be designed to overcome these obstacles and ensure these groups do not continue to be excluded.
19. The **ability of people living in extreme poverty to take up market mechanisms (i.e. mechanisms' 'reach') is influenced by a diverse range of factors which affect people living in extreme poverty more than the rest of the population.**
20. **Several of these factors are common across demographic groups** (including seasonal and unreliable incomes; high cost to serve; low levels of mobile phone ownership, poor network coverage, and use of mobile money; lack of supporting documents; and low knowledge and awareness of mechanism functions and opportunities). **Addressing this core set of factors could have a significant impact on the ability of market mechanisms to reach people living in extreme poverty** and, therefore, to improve their ability to access energy.

21. **Other factors affect reach to some groups far more than others.** For example, people in rural areas are especially affected by poor coverage of financial institutions. People in urban informal settlements and refugee camps face the unique barrier of restricted access for energy service providers. Similarly, mobility restrictions form a barrier which people with disabilities face. **More targeted, and specifically designed market mechanisms will be needed to enable inclusion of these groups.**

(Part 2 of this study investigates the ability of existing market mechanisms to address factors hindering their reach based on current properties, and recommends ways to improve this.)

22. This review has revealed a **number of gaps in the data around extreme poverty and energy access.** As discussed above, lack of data hampers estimation of the size of some groups living in extreme poverty who lack energy access. In particular:
- Neither extreme poverty rates nor energy access rates are published specifically for *informal* urban areas.
  - Income and consumption data (and hence poverty rates) are not available for forcibly displaced people. Nor, as the Global Platform for Action (GPA, 2022) notes, is comprehensive data on energy access in displacement settings available.
  - Some data exists on extreme poverty rates and energy access among people with disabilities, but more extensive and systematically available data would be beneficial.

To improve understanding of the relationship between energy access and extreme poverty so that market mechanisms can be most effectively focused, we would suggest the following:

- Engage with the Energy Sector Management Assistance Program (ESMAP) to encourage them, in any future MTF Energy Access Diagnostic Surveys, to:
  - categorize locations surveyed as rural, urban (formal), and informal urban (not just rural and urban);
  - include a question on whether households include any people with disabilities (separate from questions on employment);
  - analyse data gathered through the lens of extreme poverty.
- Work with GPA, UNHCR, and other humanitarian agencies, to develop more systematic and comprehensive data on extreme poverty rates and levels of energy access among displaced people (both within and outside refugee or IDP camps).
- Engage with the Disability Data Initiative (at Fordham University) to discuss whether better and wider data on extreme poverty and energy access among people with disabilities can be secured.

## 7. Appendices

### 7.1 Methodology

This review sought to answer the research questions set out in the Introduction to this report, and feed into the review of market mechanisms, by exploring existing literature; analysing available data; and informal consultations with stakeholders working in the sector.

Literature relating to each of the following topics was identified and reviewed:

- numbers of people in each of the six identified demographic groups;
- drivers and rates of extreme poverty, generally and for each group;
- levels of energy access and differences in access between people living in extreme poverty and the rest of the population (generally and for each group);
- energy needs among people living in extreme poverty and for each group;
- barriers to energy access for people living in extreme poverty (generally and for each group);
- factors likely to limit the reach of market mechanisms to people living in extreme poverty and how the effects of such factors may vary between groups.

Relevant sources were identified through the research team's knowledge of the sector; by online key words searches for relevant information; by seeking out reports and publications from energy access and poverty-oriented organizations and databases; by following up citations; and through recommendations from key stakeholders (see below).

To complement and expand the literature review, a series of informal consultations were conducted with stakeholders in the energy development sector, including members of Transforming Energy Access partner organizations, other programme delivery organizations, and international donors. These consultations aimed to capture stakeholders' views on the research questions and ensure that relevant knowledge and experience was incorporated.

A complete list of literature sources reviewed can be found in Section 8, References. A list of organizations consulted is available in Appendix 7.4.

#### Data analysis

Alongside the review of literature, data from a number of sources was brought together to estimate numbers of people living in extreme poverty and examine how energy access rates differ between people living in extreme poverty and the rest of the population. Available data was also analysed to provide an indication of the relative scale and importance of different energy access needs and barriers to energy access, to people living in extreme poverty, and how WTP for energy access differs between people living in extreme poverty and wider populations.

Notable sources were the various data series held in the World Bank's open database; *Tracking SDG 7: The Energy Progress Report 2023* (IEA et al., 2023); and the *Beyond Connections: Energy Access Diagnostic Reports* for countries in sub-Saharan Africa and Indo-Pacific (Brutinel et al., 2019, 2020; Dave et al., 2018; Dubey et al., 2020; Koo et al., 2018, 2019; Luzi et al., 2019, 2020; Padam et al., 2018; Pinto et al., 2019, 2020; Samad et al., 2019) and the associated datasets available online. These, and other sources of data used

to arrive at estimates in the report, are referenced in the body of the report. The methods used to arrive at estimates from the available data are described below:

**a) Population/group size estimates:**

- (i) *National* – 2021 population figures for each of the countries in sub-Saharan Africa and Indo-Pacific (see Appendix 7.3) were drawn from World Bank (2023c). Rates of population growth from World Bank (2023d) were then applied to the 2021 population numbers to derive estimated 2023 population numbers.
- (ii) *Rural* – Percentages of rural populations in total populations from World Bank (2023e) were applied to national population figures (from (i) above).
- (iii) *Informal urban areas* – Percentages of urban populations in total populations from World Bank (2023f), and then percentages of populations living in informal settlements in urban populations from World Bank (2023g), were applied to national population figures (from (i) above).
- (iv) *Fragile and conflict-affected areas* – Taken as a sub-set for those countries in sub-Saharan Africa and Indo-Pacific designated by the World Bank as fragile or conflict affected (World Bank, 2023a) from national population figures (from (i) above).
- (v) *Displaced people* – Population data is accurate as of the end of 2022 and was downloaded from the UNHCR (2023b) *Refugee Data Finder* webpage.
- (vi) *Women and girls* – Percentages of women and girls in total populations, from World Bank (2023h), were applied to national population figures (from (i) above).
- (vii) *People with disabilities* – Disability prevalence rates for countries in sub-Saharan Africa and Indo-Pacific (see Appendix 7.3) were taken from Mitra and Yap (2021) or (for countries for which Mitra and Yap (2021) did not include figures) from Mitra and Sambamoorthi (2014). These rates were then adjusted so that average rates across countries aligned with regional rates from WHO (2022). For the countries for which neither Mitra and Yap (2021) nor Mitra and Sambamoorthi (2014) give rates, regional rates from WHO (2022) were used. These prevalence rates were then applied to national population numbers (from (i) above) to estimate numbers of people with disabilities.

**b) Extreme poverty rates and numbers of people living in extreme poverty:**

- (i) *National* – Extreme poverty rates for the most recent survey year were taken from World Bank (2023b). To enable comparison between countries, these were used to estimate extreme poverty rates for 2023. To achieve this, rates were first estimated for 2019. For countries where World Bank (2023b) contained extreme poverty rates from surveys after 2019, these 2019 rates were estimated by straight line interpolation between rates before and after 2019. For countries where the most recent survey was carried out before 2019, the 2019 poverty rate was extrapolated from the rate for the most recent survey year using changes in regional extreme poverty rates from World Bank (2022c) as follows:

$$P_{19} = P_s + (R_{19} - R_s) * P_s / R_s$$

Where  $P_{19}$  is the national extreme poverty rate in 2019;  $P_s$  is the national extreme poverty rate in the most recent survey year (from World Bank (2023b));  $R_{19}$  is the

relevant regional 2019 extreme poverty rate from World Bank (2022c); and  $R_s$  is the relevant regional extreme poverty rate for the year in which the most recent survey was carried out in the country in question, from World Bank (2022c). National extreme poverty rates were then brought to 2023 by applying the changes in extreme poverty rates between 2019 and 2023 given in Hadad et al. (2023). For countries for which Hadad et al. (2023) does not provide a country-specific change in poverty rate, the relevant region average change was used, factored to reflect the ratio between the regional and national poverty rate in 2019) as follows:

$$P_{23} = P_{19} + \Delta R * P_{19} / R_{19}$$

Where  $P_{23}$  is the national extreme poverty rate in 2023;  $P_{19}$  is the national extreme poverty rate in 2019 (from above);  $\Delta R$  is the average change in the poverty rate between 2019 and 2023 for countries in the region (from Hadad et al, 2023); and  $R_{19}$  is the relevant regional 2019 extreme poverty rate from World Bank (2022c).

These 2023 extreme poverty rates were then applied to the national population figures (from (a) (i) above) to give estimates of number of people living in extreme poverty.<sup>42</sup>

- (ii) *Rural* – For each country, the rural population percentage (from World Bank, 2023e) was multiplied by the relevant regional ratio of percentage of people living in extreme poverty in rural areas to percentage of total population in rural areas (from World Bank, 2022c), to give an estimated percentage of people living in extreme poverty in rural areas. This percentage was then applied to the estimated national number of people living in extreme poverty (from (i) above) to give an estimate of the number of people living in extreme poverty in rural areas for each country.
- (iii) *Informal urban areas* – Data on extreme poverty rates specific to people living in informal urban areas was not found, so numbers of people in informal urban areas living in extreme poverty could not be estimated.
- (iv) *Fragile and conflict-affected areas* – Taken as a sub-set from national numbers of people living in extreme poverty as (i) above for those countries in sub-Saharan Africa and Indo-Pacific designated by the World Bank as fragile or conflict affected (World Bank, 2023a).
- (v) *Displaced people* – Data on extreme poverty rates specific to displaced people was not found, so numbers of displaced people living in extreme poverty could not be estimated.
- (vi) *Women and girls* – Extreme poverty rates for women and girls were derived by taking ratios of poverty rates between women and men from data given by Azcona and Bhatt (2022) and applying these ratios to national extreme poverty rates (estimated as above). These rates were then applied to population numbers for women and girls (from (a) (vi)), to estimate numbers of women and girls living in extreme poverty.
- (vii) *People with disabilities* – Insufficient data on extreme poverty rates among people with disabilities was available to estimate numbers of people with

disabilities living in poverty with any confidence. However, a range was estimated, with the lower bound set by assuming that extreme poverty rates among people with disabilities are the same as for the wider population (i.e. using the rates from (i) above). The upper bound was then based on the assumption that extreme poverty rates among people with disabilities are  $1.38 \times$  extreme poverty rates among the wider population, as found on average for people with severe disabilities by Mitra (2018) in a study in Malawi, Tanzania, and Uganda. These rates were then applied to estimated numbers of people with disabilities from (a) (vii) above.

**c) Electricity and clean cooking energy access rates:**

- (i) *National* – Numbers of people without access to electricity in 2021 were taken from IEA et al. (2023). Numbers of people without access to clean cooking energy were estimated by applying 2021 rates of access to clean cooking energy from IEA et al. (2023) to 2021 national population figures from World Bank (2023c).
- (ii) *Rural* – Numbers of people without access to electricity in rural areas in 2021 were taken from IEA et al. (2023). Numbers of people without access to clean cooking energy in rural areas were estimated by applying rates of access to clean cooking energy from IEA et al. (2023) to 2021 national population figures from World Bank (2023c).
- (iii) *Informal urban areas* – Information on levels of electricity and clean cooking energy access specifically in informal urban areas could not be found.
- (iv) *Fragile and conflict-affected areas* – Taken as a sub-set for those countries in sub-Saharan Africa and Indo-Pacific designated by the World Bank as fragile or conflict affected (World Bank, 2023a) from national numbers of people without electricity and clean cooking energy from (i) above.
- (v) *Displaced people* – Insufficient data was available to enable estimates to be made of numbers of displaced people without energy access.
- (vi) *Women and girls* – National electricity and clean cooking access rates for 2021 were taken from IEA et al. (2023) and applied to numbers of women and girls by country calculated as described in (a) (vi) above. (This assumes that energy access rates among women and men are the same. Given that energy access is measured at household level, and evidence of any difference in access rates between men and women is unclear – see Section 3 of this report – this would seem a reasonable starting assumption.)
- (vii) *People with disabilities* – Electricity access rates among people with disabilities were estimated by taking the percentage point differences in access rates between people with and without disabilities from Mitra and Yap (2021), or (for countries for which Mitra and Yap did not include a figure) from UNDESA (2019).<sup>43</sup> These differences were then applied to the national electricity access rates from IEA et al. (2023) as follows:

$$P = L + G \times L / T$$

Where:

- P is the calculated percentage of people with disabilities without electricity access;
- L is the percentage of people without electricity access, nationally, from IEA et al. (2023);

- G is the percentage point difference in electricity access between people with disabilities and the population as a whole (from Mitra and Yap, 2021 or UNDESA, 2019);
- T is the percentage of the population as a whole without electricity from Mitra and Yap (2021) or UNDESA (2019).

These rates were applied to estimated numbers of people with disabilities from (a) (vii) above. The same process was followed to estimate numbers of people with disabilities who lack clean cooking energy.

**d) Relationship between energy access rates among people living in extreme poverty and the wider population:**

Two parallel, complementary approaches were taken to explore this relationship:

- The MTF Energy Access Diagnostic Reports for Bangladesh, Kenya, and Nepal (Samad et al., 2019; Dubey et al., 2020; Pinto et al., 2019) provide figures for the percentages of each income/expenditure quintile in the population who lacked electricity access (i.e. had Tier 0 or no access) when surveys were undertaken. The equivalent reports for Ethiopia, Myanmar, Niger, São Tomé and Príncipe, and Zambia (Padam et al., 2018; Koo et al., 2019; Brutinel et al., 2019, 2020; Luzi et al., 2019) provide figures for the percentages of each income/expenditure quintile in the population who have no electricity access whatsoever, have off-grid access, and have grid connections. They also provide figures for the proportions of grid and off-grid access which achieve each MTF tier of access. These were combined to estimate the percentages of each income/expenditure quintile who had Tier 0 or no access in each country. By extrapolating and interpolating between the percentages with Tier 0 access in different income/expenditure quintiles, estimates were made of the percentages of people whose income/expenditure fell below the extreme poverty rate for the country at the time of the survey (from World Bank, 2023b) who lacked electricity access – i.e. the rate of lack of electricity access among people living in extreme poverty (see Figure 10).

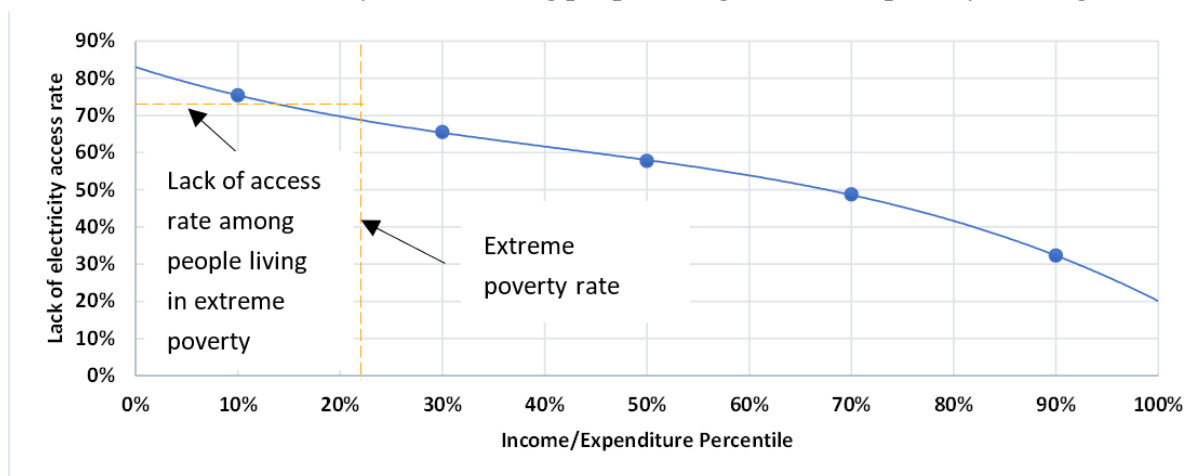


Figure 10: Example plot of lack of electricity access vs. income/expenditure

The ratio between lack of electricity access among people in extreme poverty and the population as a whole was then calculated for each of these countries.

Similarly, the MTF Energy Access Diagnostic Reports for Ethiopia, Kenya, Liberia, Niger, São Tomé and Príncipe, and Zambia (Padam et al., 2018; Dubey et al., 2020; Pinto et al., 2020; Brutinel et al., 2019, 2020; Luzi et al., 2019) provide figures for the percentages of each income/expenditure quintile in the population not cooking with clean stoves or fuels. The same process as described above (for lack of access to electricity) was followed to derive ratios between lack of clean cooking energy access among people in extreme poverty and the population for each of these countries.

- (ii) For each of the countries for which a more detailed country-specific review was undertaken (see Appendices 7.2), i.e. Ethiopia, Kenya, Nepal, Nigeria, Rwanda, and Zambia, the datasets from the MTF Energy Access Diagnostic Surveys (Padam et al., 2018; Dubey et al., 2020; Pinto et al., 2019; Luzi et al., 2019, 2020; Koo et al., 2018) were downloaded and re-analysed through the lens of extreme poverty. The respondent households were first split into those living in extreme poverty and the rest of the population. To do this, daily household expenditures (where these were available, i.e. for Ethiopia, Kenya, Nepal, and Nigeria) or incomes (for Rwanda and Zambia) were calculated and then divided by the number of household members to derive a per person daily income/expenditure. For Ethiopia, Kenya, Nepal, Rwanda, and Zambia, these were then ranked from highest to lowest, and the portion falling below the extreme poverty rate at the time of the survey (from World Bank, 2023b) were categorized as living in extreme poverty, while those ranked above this were categorized as ‘rest of population’.<sup>44</sup> For Nigeria, where the survey covered only the north-west of the country, for which no extreme poverty rate was available, the per person daily expenditures were converted into US\$ using the PPP conversion factor for the year in which the survey was carried out (from World Bank, 2023i). Those households for which this US\$ PPP daily expenditure fell below \$2.15 were categorized as living in extreme poverty while those with expenditure above this were categorized as ‘rest of population’. Households were then identified as having grid, off-grid or no electricity access, and the percentages of households living in extreme poverty, and percentages of households in the rest of the population with grid, off-grid or no access, were calculated. These were then converted into percentages lacking electricity access, using the proportions of grid and off-grid access in Tier 0 from the relevant MTF Energy Access Diagnostic report.

The same process was followed to establish percentages of households living in extreme poverty, and among the rest of the population, which were not using clean energy for cooking.

The ratios calculated for each country were then plotted against the lack of electricity access among the population as a whole (see Figure 4) and lack of clean cooking access among the population as a whole (see Figure 5).<sup>45</sup> Curves fitted to these plots were used to derive the observed relationships described in Section 3 of this report.

**e) Numbers of people living in extreme poverty who lack energy access:**

- (i) *National* – Electricity access rates, and rates of access to clean cooking energy for 2021 for populations as a whole in each country in sub-Saharan Africa and Indo-Pacific were taken from IEA et al. (2023). The relationships between energy access among whole populations and people living in extreme poverty (as described in (d) above), were then applied to these rates to give estimated rates of energy access for people living in extreme poverty. These access rates were then applied to numbers of people living in extreme poverty (from (b) (i) above), to estimate numbers of people living in extreme poverty without electricity and clean cooking energy access in each country.
- (ii) *Rural* – Rural electricity and clean cooking access rates for 2021 for each of the countries in sub-Saharan Africa and Indo-Pacific were taken from IEA et al. (2023). The relationships between energy access among whole populations and people living in extreme poverty (as described in (d) above), were then applied to these rates to give rates of access for people living in extreme poverty in rural areas. These access rates were then applied to numbers of people living in extreme poverty in rural areas (from (b) (ii) above), to estimate numbers of people living in extreme poverty without electricity and clean cooking energy access in rural areas.
- (iii) *Informal urban areas* – As neither extreme poverty rates nor rates of energy access for people living in informal urban areas were available (see (b) and (c) above), it was not possible to estimate numbers of people living in extreme poverty in informal urban areas who lack energy access.
- (iv) *Fragile and conflict-affected areas* – Taken as a sub-set for those countries in sub-Saharan Africa and Indo-Pacific designated by the World Bank as fragile or conflict affected (World Bank, 2023a) from national numbers of people living in extreme poverty without electricity and clean cooking energy from (i) above.
- (v) *Displaced people* – In the absence of systematic data on extreme poverty rates and levels of energy access among displaced people (see (b) (v) and (c) (v) above), it was not possible to estimate numbers of displaced people living in extreme poverty who lack energy access.
- (vi) *Women and girls* – Rates of energy access for people living in extreme poverty for each country, from (i) above, were applied to numbers of women and girls living in extreme poverty from (b) (vi) above to estimate numbers of women and girls living in extreme poverty without energy access.
- (vii) *People with disabilities* – Without better data on extreme poverty rates among people with disabilities it was not viable to estimate numbers who are living in extreme poverty without energy access.

**f) Energy needs among people living in extreme poverty**

As part of the surveys for the MTF energy access diagnostic reports, respondents who did not have grid connections were asked what appliances they would like to use if they had an electricity supply to support them. The datasets from the surveys for each

of the countries for which a more detailed country-specific review was undertaken (i.e. Ethiopia, Kenya, Nepal, Nigeria, Rwanda, and Zambia, see Appendices 7.2) (Padam et al., 2018; Dubey et al., 2020; Pinto et al., 2019; Luzi et al., 2019, 2020; Koo et al., 2018) were re-analysed. Respondent households were categorized as living in extreme poverty, or being part of the rest of the population, as described in (d) (ii) above. The percentages of respondents in each group who had indicated they would like to be able to use each type of appliance (TVs, radios, etc.) were then calculated. This provided a basis for comparing the views of people living in extreme poverty on their energy needs, with those of the rest of the population.

**g) Willingness to pay for energy access among people living in extreme poverty**

The surveys for the MTF Energy Access Diagnostic Reports also included questions on WTP for grid connections, solar home systems, and improved cookstoves. Respondents were asked whether they would be willing to pay for each of these upfront at full price, at various levels of reduced price, and in instalments over between 3 and 24 months. For each of the countries for which a more detailed country-specific review was undertaken (i.e. Ethiopia, Kenya, Nepal, Nigeria, Rwanda, and Zambia, see Appendices 7.2), the responses to these questions in the associated datasets (Padam et al., 2018; Dubey et al., 2020; Pinto et al., 2019; Luzi et al., 2019, 2020; Koo et al., 2018) were re-analysed. Respondent households were categorized as living in extreme poverty, or being part of the rest of the population, as described in (d) (ii) above. The percentages of respondents in each group who said they would be willing to pay a) the full price upfront; b) the full price in instalments; and c) a subsidized price in instalments were calculated. This enabled comparisons to be made of WTP among people living in extreme poverty and among the rest of the population.

**h) Barriers to energy access among people living in extreme poverty**

As part of the surveys for the MTF Energy Access Diagnostic Reports, respondents without grid connections were asked which was the main barrier preventing their household from connecting. In addition, those who had said they were not willing to pay for a connection, a solar home system, or an improved cookstove (even at a subsidized price and in instalments), were also asked why they remained unwilling to pay. For each of the countries for which a more detailed country-specific review was undertaken (i.e. Ethiopia, Kenya, Nepal, Nigeria, Rwanda, and Zambia, see Appendices 7.2), the responses to these questions in the associated datasets (Padam et al., 2018; Dubey et al., 2020; Pinto et al., 2019; Luzi et al., 2019, 2020; Koo et al., 2018) were re-analysed. Respondent households were categorized as living in extreme poverty, or being part of the rest of the population, as described in (d) (ii) above. The percentages of respondents in each group who chose each reason why they did not have a grid connection, or were unwilling to pay for a connection, a solar system or an improved cookstove were then calculated. Comparing the percentages between the two groups provided insights into differences in barriers to energy access between people living in extreme poverty and the rest of the population.

## 7.2 Standalone country reports

Accompanying this report are stand-alone reviews of energy access and extreme poverty for six countries in sub-Saharan Africa and the Indo-Pacific. In each country a particular demographic group was explored in detail:

- Energy access among people living in extreme poverty in Ethiopia, with a focus on informal urban settlements
- Energy access among people living in extreme poverty in Kenya, with a focus on people with disabilities
- Energy access among people living in extreme poverty in Nepal, with a focus on women and girls
- Energy access among people living in extreme poverty in Nigeria, with a focus on fragile-and-conflict-affected areas
- Energy access among people living in extreme poverty in Rwanda, with a focus on displaced people
- Energy access among people living in extreme poverty in Zambia, with a focus on rural residents

The above reports can be accessed via the link below:

<https://practicalaction.org/energy-and-extreme-poverty/>

## 7.3 UK Foreign, Commonwealth & Development Office priority countries in sub-Saharan Africa and Indo-Pacific

### Sub-Saharan Africa

- Angola
- Benin
- Botswana
- Burkina Faso
- Burundi
- Cabo Verde
- Cameroon
- Central African Republic
- Chad
- Comoros
- Congo
- Côte d'Ivoire
- Democratic Republic of the Congo
- Djibouti
- Equatorial Guinea
- Eritrea
- Eswatini
- Ethiopia
- Gabon
- Gambia
- Ghana
- Guinea
- Guinea-Bissau
- Kenya
- Lesotho
- Liberia
- Madagascar
- Malawi
- Mali
- Mauritania
- Mauritius
- Mozambique
- Namibia
- Niger
- Nigeria
- Rwanda
- São Tomé and Príncipe
- Senegal
- Seychelles
- Sierra Leone
- Somalia
- South Sudan
- Sudan
- Togo
- Uganda
- United Republic of Tanzania

- Zambia
- Zimbabwe

#### **Indo-Pacific**

- Afghanistan
- Bangladesh
- Cambodia
- Federated States of Micronesia
- Fiji
- Indonesia
- Kiribati
- Laos
- Malaysia
- Maldives
- Marshall Islands

- Myanmar
- Nauru
- Nepal
- Pakistan
- Philippines
- Papua New Guinea
- Samoa
- Solomon Islands
- Sri Lanka
- Thailand
- Timor-Leste
- Tonga
- Tuvalu
- Vanuatu
- Vietnam

### **7.4 List of stakeholder organizations consulted**

The following stakeholders were consulted:

1. Acumen/60 Decibels/Pioneer Energy Investment Initiative: Powering Livelihoods Using Solar (PEII+)
2. CLASP/Energy Saving Trust (EST)/Low Energy Inclusive Appliances programme (LEIA)
3. Clean Cooking Alliance
4. Energizing Development Partnership (EnDev)
5. The Global Distributors Collective (GDC)
6. Sustainable Energy for All (SE4ALL)
7. Shell Foundation
8. SolarAid
9. Global Off-grid Lighting Association (GOGLA)
10. Global Energy Alliance People and Planet
11. Energy 4 Impact (E4I)/Mercy Corps
12. World Bank/Energy Sector Management Assistance Programme
13. International Organization for Migration (IOM)
14. Global Platform for Action (GPA)/United Nations Institute for Training and Research (UNITAR)
15. United Nations Department for Economic and Social Affairs (UNDESA)
16. United Nations High Commissioner for Refugees (UNHCR)
17. World Health Organization (WHO)

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## 9. Endnotes

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<sup>1</sup> The analysis and data which form the basis of this conclusion are described in Appendix 7.1 Methodology

<sup>2</sup> Based primarily on analysis of data from the MTF Energy Access Diagnostic Reports for countries in sub-Saharan Africa and Indo-Pacific, and associated datasets, as described in Appendix 7.1

<sup>3</sup> For the remainder of this report, 'sub-Saharan Africa and the Indo-Pacific' is used to refer to countries listed in Appendix 7.3.

<sup>4</sup> Interview with L. Umala, Clean Cookstove Alliance, 17 April 2023; interview with S. Wheeldon, Global Off-Grid Lighting Association, 18 April 2023; interview with C. Ragazzi, Mercy Corps, 19 April 2023; interview with Y.E. Ruff and J. Vrba, Energy Saving Trust, 21 April 2023; interview with C. Miller, Global Distributors Collective, 24 April 2023; interview with J. Porcaro and M. Lazopoulou, Sustainable Energy for All, 25 April 2023; interview with S.M. Leitner and N. Hzami, GIZ – Energizing Development, 2 May 2023.

<sup>5</sup> See Appendix 7.1 Methodology for description of analysis undertaken.

<sup>6</sup> After the 2008 and 2011 food price crises in Bangladesh, Cambodia, Ethiopia, India, and Uganda, World Bank poverty assessments found that higher food prices had led to agricultural income growth and higher agricultural wages, and so raised the incomes of poor households (World Bank 2022b).

<sup>7</sup> Households are classed as living in informal settlements if they experience one or more of the following: 1) Lack of access to improved water source; 2) Lack of access to improved sanitation facilities; 3) Lack of sufficient living area; 4) lack of housing durability; and 5) Lack of security of tenure (UN Habitat, 2015).

<sup>8</sup> Interview with S. Wheeldon, Global Off-Grid Lighting Association, 18 April 2023; interview with F. Hinrichs and B. Koo, World Bank – ESMAP, 27 April 2023; and interview with H. Adair-Rohani, World Health Organization, 8 May 2023.

<sup>9</sup> Disabilities include many types of functional limitation, each on a spectrum of severity, and their impacts depend on the individual affected and their environment (UNDESA, 2019). There is thus no clear boundary between those who have and do not have disabilities, and the disability status of individuals may change over time. 'Disability is an ambiguous demographic' (Mitra, 2018).

<sup>10</sup> Due to larger total population, growing numbers of elderly people, and larger numbers of people with non-communicable diseases, who are living longer and ageing with disabilities (WHO, 2022).

<sup>11</sup> There may still be an element in these figures of under-reporting in low-income countries, due to differences in understanding and expectation of disability, but there are also factors (such as differences in population age structure and health conditions), which suggest that part, at least, of this difference is probably real.

<sup>12</sup> Others argue that, rather than forming a cycle, poverty and disability are both manifestations of similar processes of marginalization, reflecting society's organization (Yeo, 2005).

<sup>13</sup> Excludes Afghanistan, Cambodia, Eritrea, Equatorial Guinea and Papua New Guinea, for which insufficient data is available.

<sup>14</sup> For description of how estimates are arrived at, see Appendix 7.1 Methodology.

<sup>15</sup> This conclusion must, particularly in relation to clean cooking energy, be treated with caution, since data for the comparison is available for only a limited number of countries, almost all in sub-Saharan Africa and with low national rates of energy access. The relationships derived may, therefore, underestimate the extent to which lack of access is concentrated among the extreme poor in countries where general levels of access are higher.

<sup>16</sup> Equations derived by fitting curves to observed points on graphs

<sup>17</sup> Total population figures include Afghanistan, Cambodia, Equatorial Guinea, Eritrea, and Papua New Guinea. Numbers of people in extreme poverty exclude these countries, for which data is not available.

<sup>18</sup> For description of analysis, see Appendix 7.1 Methodology.

<sup>19</sup> See Appendix 7.1 Methodology for description of how estimates are arrived at.

<sup>20</sup> Estimated by subtracting estimates of number of people living in extreme poverty in rural areas from total number of people in extreme poverty in each country.

<sup>21</sup> Excludes Afghanistan, Cambodia, Equatorial Guinea, Eritrea, and Papua New Guinea, for which insufficient data is available.

<sup>22</sup> Excludes Afghanistan, Papua New Guinea and Eritrea which are classified as fragile or conflict affected, but for which extreme poverty data is not available

<sup>23</sup> This includes refugees under the mandate of the United Nations High Commissioner for Refugees (UNHCR), asylum seekers, IDPs of concern to UNHCR and other people in need of international support. The UNHCR database does not hold data on the number of forcibly displaced people in Cabo Verde, Equatorial Guinea, the Federated States of

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Micronesia, Kiribati, Laos, Maldives, Marshall Islands, Mauritius, Samoa, São Tomé and Príncipe, Seychelles, Timor-Leste, Tonga, Tuvalu, Vanuatu or Vietnam.

<sup>24</sup> This figure includes Afghanistan, Cambodia, Eritrea, Equatorial Guinea, and Papua New Guinea.

<sup>25</sup> See Appendix 7.1 Methodology for description of how estimates are arrived at.

<sup>26</sup> See Appendix 7.1 for how figures are arrived at. Total population numbers, and numbers of people who lack energy access *include* Afghanistan, Cambodia, Equatorial Guinea, Eritrea, and Papua New Guinea. Numbers of those in extreme poverty, or who are in extreme poverty and lack energy access exclude these countries (for which poverty data is unavailable). The figures for the individual groups do not sum to the total for the two regions because the various groups overlap.

<sup>27</sup> Under the Multi-Tier Framework energy access is regarded as unaffordable if electricity and cooking energy, together, cost more than 10% of household income. For people living in extreme poverty, therefore, energy costs greater than \$0.215/person/day (in 2017 purchasing power parity terms) are, by definition, unaffordable (Bhatia and Angelou, 2015).

<sup>28</sup> Costs included connection fees, house wiring costs, and ongoing energy payments.

<sup>29</sup> See Appendix 7.1 Methodology for description of how estimates are arrived at.

<sup>30</sup> It is recognized that responses given regarding willingness to pay cannot be taken entirely at face value, and so percentages of people saying they would be willing to pay at a particular price point may not be entirely realistic. However, broad inferences may be drawn from the overall pattern of responses.

<sup>31</sup> See Appendix 7.1 – Methodology for description of analysis.

<sup>32</sup> Data on willingness to pay for a grid connection in NW Nigeria was not available

<sup>33</sup> See Appendix 7.1 – Methodology for description of analysis.

<sup>34</sup> See Appendix 7.1 – Methodology for description of analysis.

<sup>35</sup> People in Ethiopia were asked about their willingness to pay for a Tier 2, rather than a Tier 1, SHS

<sup>36</sup> In none of the countries were people asked about willingness to pay for an MTF Tier 4 or 5 cookstove.

<sup>37</sup> See Appendix 7.1 – Methodology for description of analysis.

<sup>38</sup> Interview with S.M. Leitner and N. Hzami, GIZ – Energizing Development, 2 May 2023; interview with F. Hinrichs and B. Koo, World Bank – ESMAP, 27 April 2023.

<sup>39</sup> See Appendix 7.1 – Methodology for description of analysis.

<sup>40</sup> Interview with S.M. Leitner and N. Hzami, GIZ – Energizing Development, 2 May 2023; interview with F. Hinrichs and B. Koo, World Bank – ESMAP, 27 April 2023; interview with S. Wheeldon, Global Off-Grid Lighting Association, 18 April 2023.

<sup>41</sup> See Appendix 7.1 – Methodology for description of analysis.

<sup>42</sup> Data on extreme poverty rates for Afghanistan, Cambodia, Eritrea, Equatorial Guinea, and Papua New Guinea was not available from World Bank (2023b), so these countries are not included in estimates of numbers of people living in extreme poverty.

<sup>43</sup> For countries for which no figure was available from either Mitra and Yap (2021) or UNDESA (2019), the regional average for either sub-Saharan Africa or Indo-Pacific from Mitra and Yap (2021) was used.

<sup>44</sup> This approach was adopted because income/expenditure data provided by respondents was thought more likely to be reliable in relative terms than in absolute terms.

<sup>45</sup> Ratios from the first of these approaches, using data from the MTF Energy Access Diagnostic reports, were used where available.

# **CAN MARKET MECHANISMS FACILITATE ENERGY ACCESS FOR PEOPLE LIVING IN EXTREME POVERTY?**

## **Part 1: The relationship between energy access and extreme poverty**

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