# Pay-As-You-Go MARKET ATTRACTIVENESS INDEX 2021

## COVID-19 Pandemic Impact Analysis

LIGHTING GLOBAL
*Catalyzing markets for modern off-grid energy*

AN INNOVATION OF
WORLD BANK GROUP
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# Pay-As-You-Go Market Attractiveness Index 2021

**COVID-19 Pandemic Impact Analysis**

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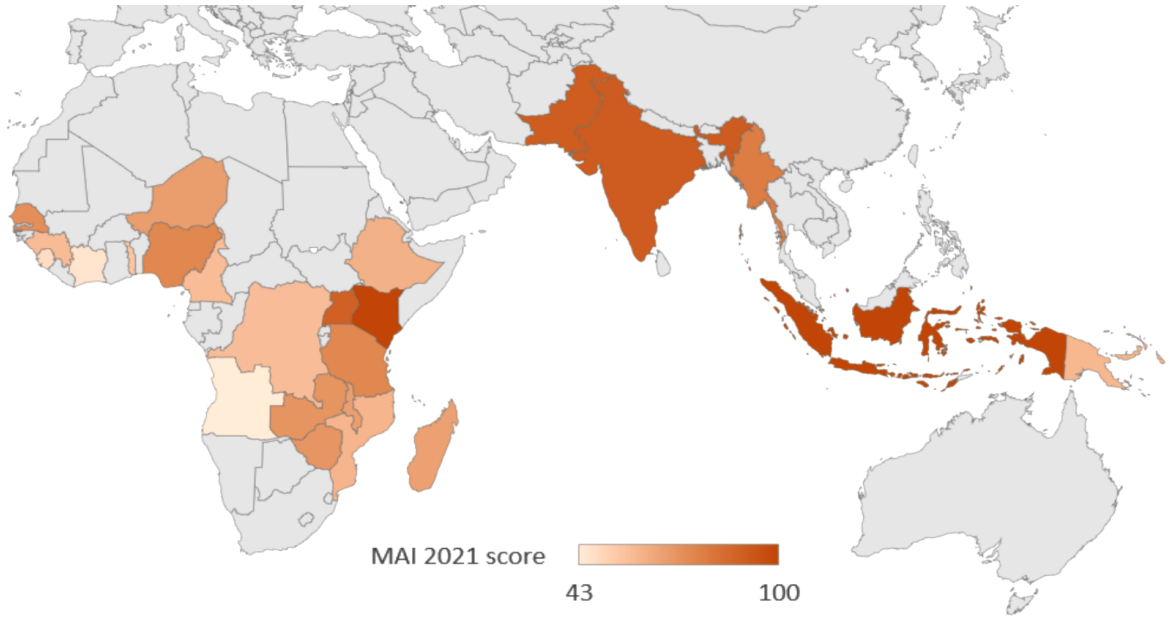
# 1. OVERVIEW

## 1.1 Objectives of the PAYGo Market Attractiveness Index (MAI)

**This report introduces the updated PAYGo MAI, a tool developed to provide information to companies, investors and policy makers on market attractiveness for pay as you go (PAYGo) energy services in 24 countries across Sub-Saharan Africa and Asia.**

The index comprises 67 indicators of market attractiveness, organised under three main pillars – demand, supply and enabling environment – and a variety of sub-pillars, explained in detail below. The 2021 version of the MAI has four fewer indicators than the 2019 version, as these indicators have been merged into other indicators in the Enabling Environment pillar.[1] The 2019 version of the MAI assessed the PAYGo market for 24 countries across Sub-Saharan Africa and Asia, which were selected with the aim to provide a representative range of geographies, market development, and context across each of the supply, demand and enabling environment pillars.[2] The 2021 version of the tool contains updated indicators and data for the same 24 countries (see Figure 1 below).

Figure 1: 2021 PAYGo MAI Countries




| MAI Country List | | |
|---|---|---|
| Angola | Kenya | Papua New Guinea |
| Cameroon | Madagascar | Senegal |
| Cote D'Ivoire | Malawi | Sierra Leone |
| Dem. Rep. of Congo | Mozambique | Tanzania |
| Ethiopia | Myanmar | Togo |
| Guinea | Niger | Uganda |
| India | Nigeria | Zambia |
| Indonesia | Pakistan | Zimbabwe |

Source: Vivid Economics

1 See Section 2.2 and the technical appendix for more information.

2 https://www.lightingglobal.org/resource/paygo-market-attractiveness-index-2019/

**The PAYGo MAI provides policymakers and practitioners with a flexible and accessible tool that can be used to examine the factors that make a national market favourable for the development of energy services through this business model and those that do not.** The tool provides a structure for decision-making criteria for use on entry into a market, and for deepening market penetration. The purpose is to provide a guiding framework and indicators that highlight the conditions and challenges in each market. The metrics included are intended to give an indication of various aspects of market attractiveness (such as size of population not connected to reliable electricity sources and policy incentives from renewable energy development), and supplement other quantitative and qualitative market research.

**The index is not a substitute for investor due diligence, neither does it contain subnational analysis.** It should be supported and complemented by targeted research conducted by the companies and investors themselves to enable detailed analysis supporting market entry decisions in specific locations and business models. In aggregating indicators to a national level, some indicators may lose valuable nuance that would be required to make sub-national entry and expansion decisions.[3]

**The PAYGo MAI is an Excel based index built for user-led comparison of country characteristics for market attractiveness.** It is designed for user flexibility and ease. The index incorporates clearly highlighted user input options, automated updating of results and a selection of outputs to quickly access performance across the overall index and its pillars. It provides an overview of the performance of a selected country, as well as the option to compare all countries across selected sub-pillars and indicators.

## 1.2 What's new in 2021?

**The 2021 PAYGo MAI builds on the 2019 and 2018 editions of the index and incorporates a few changes.** More detail on these changes is provided in the technical appendices to this report:

- Since the publication of the 2019 index, most data have become available and are updated in this year's version;
- Data sources for some indicators (such as ability and willingness to pay) have been updated to reflect changes to measurement methods or source data.
- Four indicators in the enabling environment pillar have been merged with other indicators to reflect changes to the survey questions in the underlying data.

## 1.3 Key findings

**The 2021 PAYGo MAI compares 24 country-level markets across Sub-Saharan Africa and Asia on 67 indicators of relevance to the development of PAYGo technologies. This version of the index finds that Indonesia and Kenya receive the highest overall score.** Indonesia is supported by a high score (100/100) on both the enabling environment and supply pillars, while Kenya is ranked highly across all three pillars. India, Pakistan, Uganda and Myanmar also receive high scores in the overall index which indicates relatively strong underlying market conditions, particularly in Asian countries. Table 1 below presents a comparison of country scores in the 2021 MAI and the 2019 MAI. Countries that have the largest changes in their scores are Nigeria, Niger, Mozambique, Papua New Guinea, and Cote d'Ivoire.

**Potential market segments within the index countries continue to grow.** Despite continued urbanisation across countries included in the index, rural populations are growing and access to energy remains a key development challenge. In some countries with high levels of energy access, poor grid reliability means that grid-connected households can comprise an important potential market for PAYGo products. Several countries in the index including India, Pakistan and Nigeria have high scores within the demand pillar, driven by a large proportion of the population with unreliable grid connections.

**The ongoing COVID-19 pandemic has impacted new PAYGo sales, while repayments have remained more or less stable in the short term.** Sales of PAYGo products across index countries increased by 32% between 2018 and 2019 but declined by 12% between 2019 and 2020. However, this high-level figure obscures significant differences between countries. In the two largest PAYGo markets, year-on-year sales declined by only 3% in Kenya; in Uganda, however, sales dropped a significant 48%. In contrast, sales grew by 55% in Nigeria and 26% in Tanzania over the same time period. Section 5.2 contains further details on the trends in sales of PAYGo products.

**The longer-term impacts of the pandemic remain uncertain, but the market continues to present a strong value proposition for consumers.** Uneven rollout of vaccines and weak economic performance

3 There are other tools available at a sub-national level. In particular: http://globalsolaratlas.info/and https://solargis.com/maps-and-gis-data/download/

Figure 2. Index structure and indicators

| DEMAND PILLAR | |
|---|---|
| **Market size** | |
| D_1 | Population size |
| D_2 | National population density |
| D_3 | Population density distribution |
| D_4 | Rural population |
| D_5 | Population growth rate |
| D_6 | Rate of Urbanisation |
| D_7 | Urban non-slum population |
| D_8 | Unconnected rural population |
| D_9 | Unconnected rban population |
| D_10 | Unreliable grid connections |
| D_11 | Number of electrical outages in a typical month |
| **Ability to pay** | |
| D_12 | GNI per capita |
| D_13 | Annualised off-grid household expenditure on lighting |
| D_14 | Proportion of population above global poverty level |
| D_15 | Income volatility |
| **Willingness to pay** | |
| D_16 | Borrowed from a store by buying on credit |
| D_17 | Cost of substinence electricity consumption |
| D_18 | Time to get connection |
| D_19 | Average kerosene prices |
| D_20 | Private credit bureau coverage |
| D_21 | Public credit registry coverage |
| D_22 | Mobile money account (age 15+) |
| D_23 | Paid utility bills; using a mobile phone (% paying utility bills, age 15+) |
| D_24 | Cheapest prepaid mobile voice product by country (in USD) |
| D_25 | Cost to get electricity (% of income per capita) |

| SUPPLY PILLAR | |
|---|---|
| **Access to finance** | |
| S_1 | Firms who don't identify access to finance as a major constraint |
| S_2 | Affordability of financial services |
| S_3 | Avaailability of early stage equity |
| S_4 | Financial Markets - Short Term Economic Risk |
| S_5 | Financial Markets - Long Term Economic Risk |
| **Operational considerations** | |
| S_6 | Rural access index |
| S_7 | Number of months with less than five hours of sunshine per day |
| S_8 | Cumulative month hours below 5 hours of sunshine per day |
| **Market penetration** | |
| S_9 | Number of PAYGo players in market |
| S_10 | Total decentralised solar capacity installed excluding minigrids |
| S_11 | Most recent sales volume of PAYGo, PICO and SHS products |
| S_12 | Cumulative sales volume of PAYGo, PICO and SHS products since 2014 |
| **Human capital** | |
| S_13 | Quality of management schools |
| S_14 | Local availabilty of specialied training services |
| S_15 | Quality of the education sysytem |
| S_16 | Gross tertiary education enrolment rate |
| S_17 | Living languages count |
| S_18 | Linguistic diversity index |
| S_19 | Availability of government certified training programmes for solar equipment installation |

| ENABLING ENVIRONMENT PILLAR | |
|---|---|
| **ICT** | |
| EE_1 | Mobile cellular subscriptions |
| EE_2 | Secure Internet servers |
| EE_3 | Individuals using the internet |
| EE_4 | SIM penetration |
| EE_5 | Mobile broadband use |
| EE_6 | Number of mobile connections per capita |
| **Legal and regulatory** | |
| EE_7 | Do national programs to develop or support stand-alone sysytems exist? |
| EE_8 | Has the government adopted international quality standards for stand-alone systems? |
| EE_9 | Are there environment regulations on disposal of solar devices and SHS components? |
| EE_10 | Do subsidies exist for solar modules? |
| EE_11 | Do duty exemptions for solar modules exist? |
| EE_12 | Do duty exemptions for other equipment related to stand-alone systems exist? |
| EE_13 | Do subsidies exist for stand-alone systems? |
| EE_14 | Do duty exemptions exist for stand-alone systems? |
| EE_15 | Do government incentives exist for renewable electricity? |
| EE_16 | Do specific financing facilities exist for operators in energy access? |
| **Willingness to pay** | |
| EE_17 | Depth of credit information index |
| EE_18 | Strehgth of legal rights index |
| EE_19 | GDP (PPP and constant 2011 US$) |
| EE_20 | Annaul GDP growth |
| EE_21 | Ease of doing business index (1 = easiest to 185 = most difficult) |
| EE_22 | Corruptions Perception Index |
| EE_23 | Global Perception Index |
| EE_24 | Cost of import |
| EE_25 | Cost to enforce a contract |
| EE_26 | Cost to start a business |
| EE_27 | Minimum paid-in-capital required to start a business |

Source: PAYGo MAI 2021

The ongoing COVID-19 pandemic has impacted new PAYGo sales, while repayments have remained more or less stable in the short term. Sales of PAYGo products across index countries increased by 32% between 2018 and 2019 but declined by 12% between 2019 and 2020.

across developing countries could adversely affect household finances, raise import and financing costs for PAYGo providers, and damage investor confidence. COVID-19 has made it even more critical to remain connected to the outside world, as learning and working has migrated to online portals, and therefore the need to power communication devices has never been greater. A detailed analysis of the impact of COVID-19 is included in Box 2.

Table 1: Country scores in MAI 2021 and MAI 2019

| Country (arranged by 2021 MAI score) | MAI score 2021 | MAI score 2019 | Change in rank (2019 – 2021) |
|---|---|---|---|
| Kenya | 100 | 99 | +1 |
| Indonesia | 100 | 100 | 0 |
| India | 91 | 92 | +1 |
| Pakistan | 90 | 92 | -1 |
| Uganda | 89 | 86 | 0 |
| Myanmar | 79 | 85 | 0 |
| Nigeria | 75 | 74 | +4 |
| Tanzania | 75 | 81 | -1 |
| Senegal | 73 | 79 | 0 |
| Zambia | 71 | 80 | -2 |
| Zimbabwe | 71 | 71 | +2 |
| Niger | 68 | 65 | +4 |
| Malawi | 67 | 76 | -3 |
| Madagascar | 67 | 68 | 0 |
| Ethiopia | 62 | 64 | +2 |
| Mozambique | 60 | 51 | +6 |
| Papua New Guinea | 59 | 73 | -5 |
| Guinea | 58 | 60 | +1 |
| Cameroon | 58 | 62 | -1 |
| Cote d'Ivoire | 58 | 65 | -5 |
| Togo | 55 | 53 | 0 |
| Sierra Leone | 48 | 48 | +2 |
| Congo, Dem. Rep. | 46 | 54 | -3 |
| Angola | 43 | 48 | -1 |

Source: PAYGo MAI 2021 and PAYGo MAI 2019

## 1.4 Using the PAYGo MAI and this report

**The PAYGO MAI Excel tool (accessed at the link below)** allows for deep dive in any of the countries and customised weighting of the index – see appendices to this report for a user manual and full list of indicators.

*https://www.lightingglobal.org/work-with-us/paygo-mai/*

**A detailed user guide for the tool is presented in Appendix B along with a complete description of the individual indicators.** The list of indicators includes the description, year, source, impact direction and rationale for each indicator.

**This summary report is structured as follows:**

- Section 3 provides an overview of the PAYGo market, introduces the structure of this index and reviews updates to the PAYGo MAI
- Section 4 reviews key findings of the PAYGo MAI across the demand, supply and enabling environment pillars
- Section 5 summarises the state of the PAYGo market as demonstrated by the updated PAYGo MAI.

# 2. Introduction to the PAYGo MAI

## 2.1 PAYGo MAI structure

The market attractiveness index is structured under three main pillars:

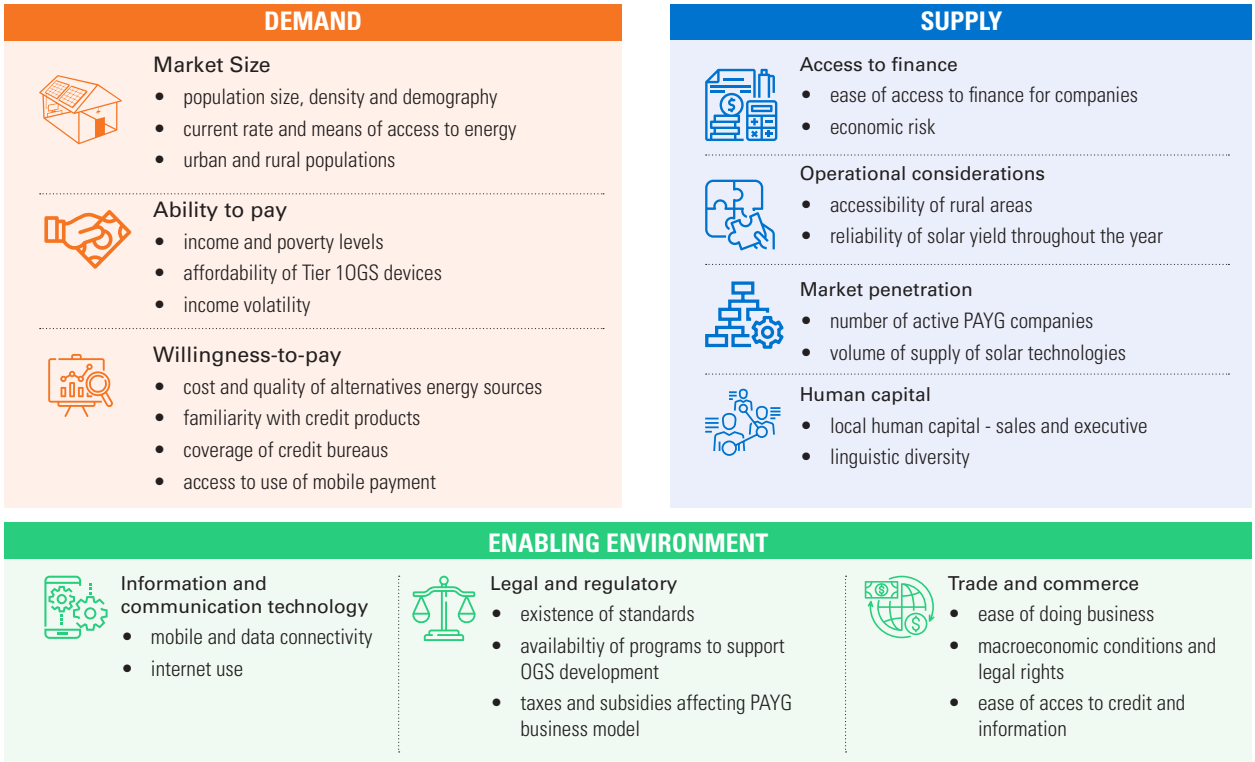
- **Demand:** the size of the addressable market, ability of customers to pay, and willingness to pay for PAYGo products[4];
- **Supply:** access to finance, operational considerations to provide PAYGo products, and potential partnership opportunities to support the PAYGo value chain, penetration of PAYGo and related products in the market, and access to human capital;
- **Enabling Environment:** this covers broader conditions to support the development of PAYGo markets that are not directly associated with the supply chain or in generating demand. This includes: information and communication technology sectors – mobile money, the legal and regulatory environment - and conditions for trade and commerce.

## 2.2 Interpreting the PAYGo MAI 2021 results

**The PAYGo MAI tool is just that – a tool – which presents a wide array of information in a comparable and consistent format.** It should be used and interpreted to provide information in an accessible format, as one source among many to inform business and policy decisions.

**The index measures overall market attractiveness by aggregating indicators based on their respective importance.** A weight is assigned to each individual indicator, sub-pillar, and main pillar. These weights determine how the values of the 67 indicators are aggregated into the overall score, with higher weights being assigned to more important indicators, sub-pillars and pillars. The default weights used in the index were chosen to allow comparisons across the 24 index countries. Users interested in a market segment or characteristic can change these weightings at the sub-pillar and pillar level. Users can also examine particular indicators of interest using the 'Country Deep Dive' and 'Indicator tab' sheets in the tool. Further details and instructions are provided in the technical appendix.

Figure 3: The PAYGo MAI is structured across demand, supply, and enabling environment pillars




Source: Vivid Economics

4 PAYGo products are off-grid solar devices that customers purchase using a mobile phone-based pay-as-you-go system, which allows customers to spread the cost of the device over a series of instalments. PAYGo products are typically higher-value off-grid solar devices such as solar home systems, which would otherwise be difficult to afford if purchased via an upfront cash payment.

**PAYGo technologies remain novel in many countries and the index is thus primarily designed to help users identify the attractiveness of a market for developing PAYGo.** For instance, the demand pillar includes indicators that estimate the size of the potential market for PAYGo products, such as the proportion of the population without a grid connection and the percentage of unconnected households who can afford a PAYGo deposit for a multi-light system. Similarly, the supply pillar comprises measures of meteorological suitability for solar power generation and ease of access to finance for businesses.

**Indonesia provides a practical demonstration of how the index's pillars and default weightings are tailored to generate relevant insights for future PAYGo activities.** Indonesia has the highest score of all countries on the supply pillar (by definition, the highest-scoring country receives a score of 100/100), which is comprised of four sub-pillars:

- Access to finance for businesses (default weighting: 30%, Indonesia's score: 99/100)
- Operational considerations for solar power generation (30%, 100/100)
- Current market penetration of PAYGo (20%, 55/100)
- Quality and availability of human capital for businesses (20%, 81/100)

Indonesia's high scores on three sub-pillars (which comprise 80% of the supply pillar) outweigh its low score in market penetration, producing its highly-ranked supply pillar score (100/100). This example demonstrates the logic behind the predefined weightings and indicators included in the index. PAYGo operators who are considering entering a market may consider market penetration to be relatively less important than other measures of market readiness.

**While the PAYGo MAI tool provides a convenient high-level assessment of market attractiveness, the results of the index must be complemented by deeper research and country focus studies.** There is no 'one size fits all' definition of market attractiveness for off-grid solar PAYGo products, and the scores presented by the index merely provides one interpretation of market attractiveness. As explained above, the index uses weights to aggregate multiple indicators into a single score. This can sometimes produce results that confirm expectations for one country while appearing counter-intuitive for other countries, especially when the default weights are used. Although users can adjust the weights to reflect the aspects of market attractiveness that are most important to them, the resulting scores are unlikely to be sufficient on their own to inform key business or policy decisions.

**Further in-country research is also important for overcoming the data limitations of the index, particularly in the light of the ongoing COVID-19 pandemic.** The data sources used in the index are limited to: sources with broad coverage across countries; official sources, which are reported at the national level (which may not pick up on regional differences, e.g. in India) and often draw on self-reported data; and most recently published data. The COVID-19 pandemic continues to impact market conditions, which may not be reflected by the index results. The 2021 version of the index has been updated with the intention of providing a timely assessment of market conditions. It harnesses the best available data as of April 2021, along with a qualitative assessment of pandemic impacts (detailed in Box 2). However, the rapid evolution of the pandemic means that even the best available data is unlikely to perfectly reflect current market conditions. Users are thus strongly encouraged to conduct detailed in-country research and stakeholder engagement to accurately assess national and regional PAYGo markets as well as the latest effects of the COVID-19 pandemic.

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# 3. Summary of results of the PAYGo MAI 2021

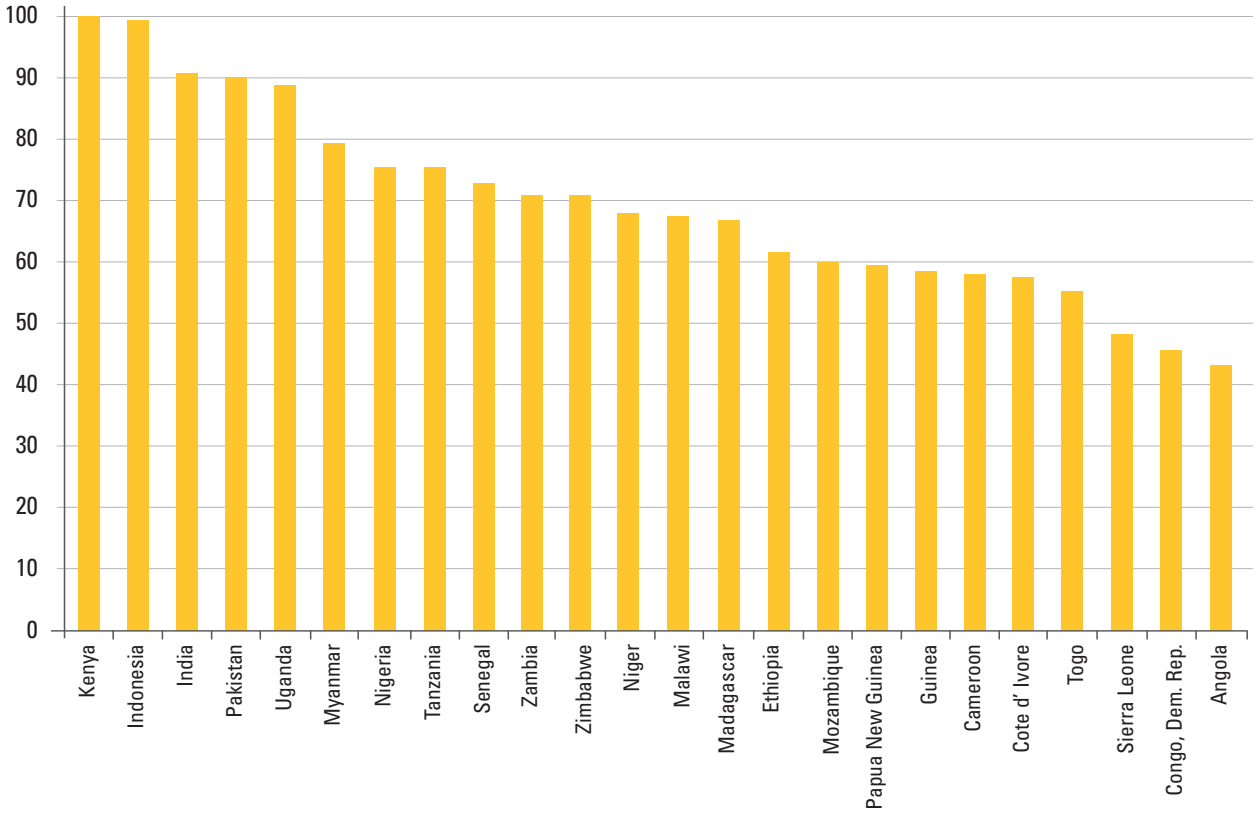
**This section provides a summary of results from the 2021 index and suggestions on how to interpret these results.** It presents results under 'default' weights for each of the pillars and sub-pillars and explains how to interpret these. The default weights are coded into the tool and can be retrieved at any time, but users are encouraged to edit these weights to generate results based on the combination of pillars and sub-pillars best adapted to their business models and factors of interest.

**Overall scores reflect the weighted totals of country scores across the demand, supply and enabling environment pillars.** The following pages provide a more detailed discussion of the overall scores as well as country scores under each pillar. All data and index scores cited in this section are included in the PAYGo MAI 2021, and all data sources are listed in the appendix.

## 3.1 Overall scores

**Under default weights, Indonesia and Kenya are tied for the highest overall market attractiveness score, followed by India and Pakistan (Figure 4).** These countries score higher than all other countries in the sample on a combined measure of demand, supply and enabling environment indicators. Sierra Leone, DR Congo and Angola score lower than other countries in the sample. The default weights of the three pillars in the PAYGo MAI place relatively larger weight on supply factors within the country, such as access to finance, operational considerations to provide PAYGo products, or potential partnership opportunities. To better understand which respective strengths of countries drive these overall scores, it is necessary to examine results at the pillar level.

Figure 4: PAYGo MAI 2021 – overall scores




*Note: The overall score presents a weighted average of the respective scores within the three main pillars of the index: demand, supply and enabling environment. The top-ranking country will always score 100. The default weights assign 20% of the overall score to the demand pillar, 50% to supply, and 30% to the enabling environment.*

Source: PAYGo MAI2021

## Box 1: Impact of COVID-19

The ongoing COVID-19 pandemic has impacted new PAYGo sales, while repayments have remained more or less stable in the short term. While the longer-term impacts on the market remain uncertain, it still presents a strong value proposition for consumers.

Sales of PAYGo products declined by 12% in 2020 but there are significant differences between countries. The impact of the pandemic on sales of new products has been highly uneven across countries. Total sales of PAYGo products across all 24 countries in the index declined by nearly 12% between 2019 and 2020, but this high-level figure obscures differences between individual countries. Year-on-year sales declined by only 3% in Kenya but 48% in Uganda, the two largest PAYGo markets. Sales even grew by 55% in Nigeria and 26% in Tanzania.

Investment into the sector has remained resilient. Total capital flows in 2020 remained stable compared to 2019(GOGLA 2021b). Equity funding in 2020 stood at $81m, a decline of 39% compared to 2019. However, this was more than offset by debt finance increasing 23% to $206m and a quadrupling in grant funding to $29m over the same period.

Confidence in making repayments decreased immediately following the pandemic, but these trends appear to have been temporary. Survey data suggests that up to 55% of customers found repayments a burden in the months immediately after the pandemic, but this declined to 32% by November 2020. Similarly, only 63% of customers felt confident in making repayments in June 2020, but this increased to 84% by November 2020 (60 Decibels 2021). Despite this, the write-off ratio for some PAYGo companies has more than doubled from 6.6% to 14.5% between December 2019 and December 2020 (GOGLA 2021c).

Continued deterioration of the macroeconomic environment could increase longer-term risks to PAYGo providers through greater exchange rate volatility and depressed revenue growth. The impacts on the PAYGo markets are uncertain as the pandemic is likely to persist for another couple of years, given the uneven vaccine rollout in developing countries(United Nations Economic and Social Council 2021). This could slow their economic recovery and attractiveness for PAYGo providers, in turn affecting progress towards SDG7, which was already inadequate before the pandemic(Lighting Global, GOGLA, and ESMAP 2020).The longer-term impacts may affect:

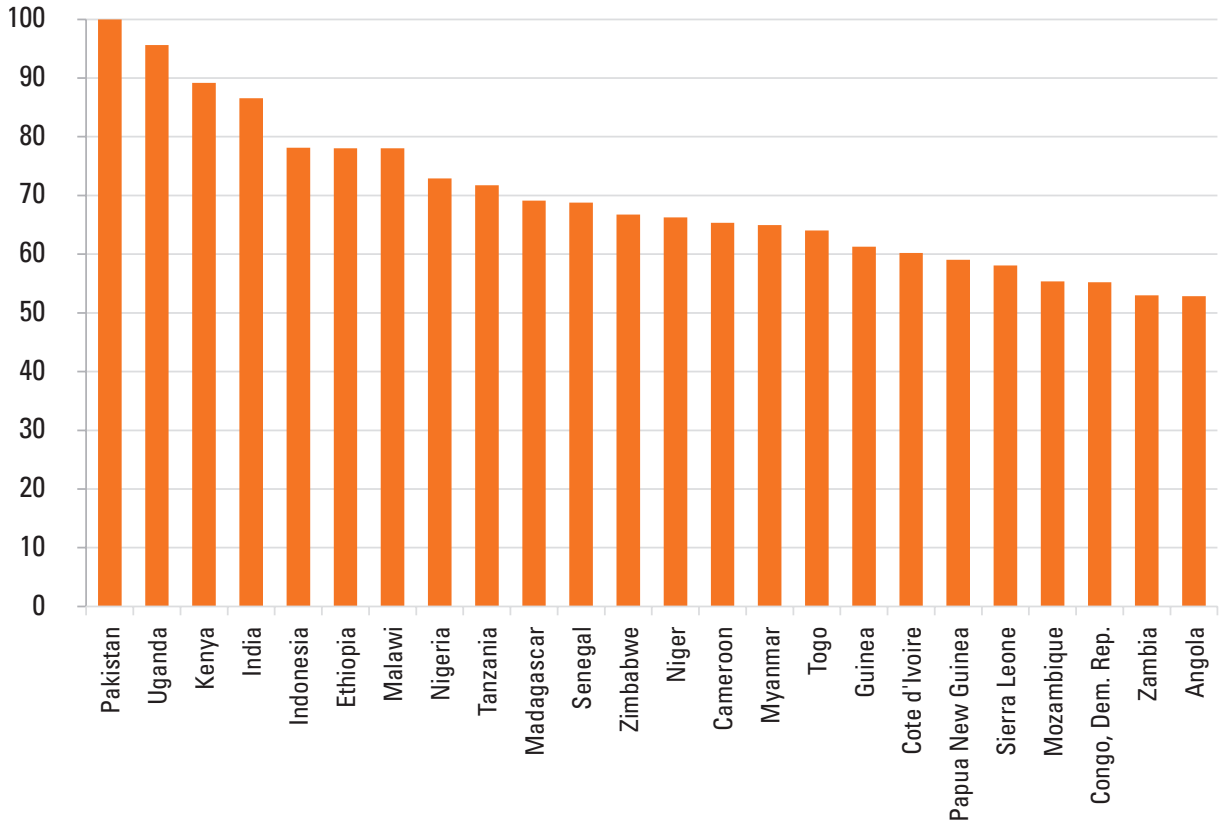
- New sales and repayments: interview evidence suggests that PAYGo providers have reported declines in new sales and repayments since the start of 2021. They attribute this to lower household income and employment due to lockdowns and slower economic growth, as well as governments raising taxes in response to tight fiscal budgets(GOGLA 2021a).
- Import costs: some countries have increased taxes and import tariffs on off-grid solar devices. (ibid).For instance, Kenya introduced a 14% value-added tax on off-grid solar products in July 2020, which is likely to increase product costs for end-users and reduce their affordability(GOGLA 2020).
- Exchange rates: deteriorating or volatile exchange rates arising from poorer macroeconomic performance can make it challenging for PAYGo companies to meet foreign currency liabilities arising from imports and financing from abroad(Balkenhol and Martínez Gutiérrez 2020).
- Sales and investor confidence: The portfolio quality of some PAYGo companies was a concern even before the pandemic (ibid.). Expectations of lower new sales and repayments could damage investor confidence, increasing financing costs for companies.

Concern among PAYGo providers about longer-term impacts of the pandemic on affordability could accelerate an emerging trend of targeting higher-income customers, who are able and more willing to purchase higher-capacity solar home systems (ibid). This strategy may help PAYGo providers weather the impact of the pandemic but come at the expense of energy access for low-income households, slowing down progress towards SDG7.

Despite this, PAYGo market still presents a strong value proposition for consumers. COVID-19 has made it even more critical to remain connected to the outside world, as learning and working has migrated to online portals, and therefore the need to power communication devices has never been greater.

## 3.2 Demand pillar results

Figure 5: Pakistan has the highest demand pillar score, followed by Uganda and Kenya




*Note: The demand pillar score presents a weighted average of three sub-pillars; that is market size, ability to pay, and willingness to pay. As with the overall index score, the top-ranking country will always score 100. The default weights assign 40% of demand pillar score to market size, 30% to ability to pay, and 30% to willingness to pay.*

Source: PAYGo MAI 2021

**Under the default weights, Pakistan receives the highest score in the demand pillar, followed by Uganda and Kenya (Figure 5).** Pakistan is a large market with especially strong scores in indicators relating to willingness to pay and market size. This South Asian country has a large population of 216 million people and a high population density of 275 people per square kilometre, second only to India. Furthermore, Pakistan has a relatively low level of income volatility with only 24% of people living below the national poverty line. Pakistan also scores exceptionally high on willingness to pay, as a large share of the population has experience buying on credit and enjoy low prices for a basic mobile plan.

**Uganda scores high on market size and willingness to pay, which offsets a slightly weaker score in the ability to pay indicator.** While Uganda's population is relatively small at only 44 million people, the population is growing at 3.2% per year and 76% of people live in rural areas. While the rural electrification rate has increased in recent years, 62% of the rural population

remain unconnected to the grid. Uganda scores high on willingness to pay, with 1,145 mobile money accounts per 1,000 adults. However, Uganda has a lower GNI per capita than most countries in the sample at USD 780.

**Kenya received the highest score in the willingness to pay sub-pillar of all countries.** Kenya has very high coverage of mobile money (1,859 accounts per 1,000 adults) and 37% of the adult population has experience using a mobile phone to pay utility bills. Kenya also has a relatively high score on the market size sub-pillar. Although only 28% of rural households lack access to electricity and grid reliability is generally high, Kenya's population of 52.5 million is larger than most other countries in Sub-Saharan Africa and 72.5% of people live in rural areas, presenting a large potential market for PAYGo products.

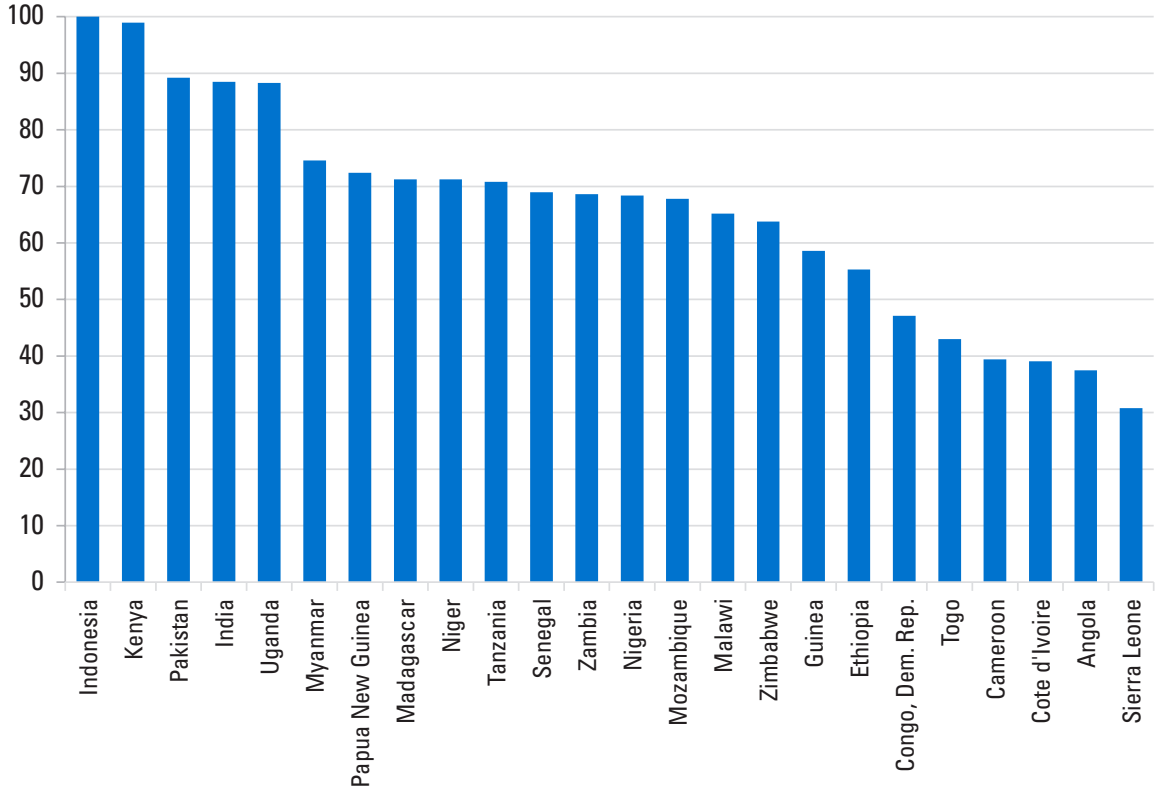
**Angola, Mozambique and Zambia have the lowest scores on the demand pillar.** Angola has the lowest willingness to pay among all countries. Few people have experience buying on credit or paying for utilities using a mobile phone, both of which are central to the PAYGo business model. The cost of getting an electricity connection is also among the lowest of all countries, which could make off-grid solar less attractive to households. Mozambique has the second lowest ability to pay of all countries. It has a very low GNI per capita of only USD 490 and 14% of households are unable to afford the PAYGo deposit for a multi-light system. There are only 12.3 mobile money accounts per 1,000 adults and basic mobile plans are also relatively expensive, reducing its score on willingness to pay. Zambia has a small market size and the lowest score on ability to pay. Zambia's relatively small population of about 18 million people can be difficult for PAYGo providers to reach, as 73% of them live in areas of low population density. Over half of the population is below the poverty line and 34% of households are unable to afford a PAYGo deposit.

Many countries score similarly well on demand-side indicators. The relatively small differences in performance between countries on the demand pillar suggests that most countries in the index possess some characteristics which support demand for PAYGo products.

## 3.3 Supply pillar results

**Under the default weights, Indonesia scores highest on the supply-side pillar, followed closely by Kenya.** Indonesia scores especially well on the access to finance and operational considerations sub-pillars. Financial services in Indonesia are affordable and there

Figure : Indonesia has the highest score on the supply pillar, while Kenya and Pakistan come second and third, respectively




*Note: The supply side pillar is composed of 4 sub-pillars: access to finance, operational considerations, market penetration and human capital. As with the demand side pillar, countries have an overall score, of which the top country scores 100. Of the 50% default weight assigned to the supply side pillar the sub-pillars have default weights of 30%, 30%, 20% and 20% respectively.*

Source: PAYGo MAI 2021

is a good availability of early stage equity. In addition, long-term and short-term risks on financial markets in Indonesia are classified as the lowest among countries in the index. Indonesia also receives perfect scores on all indicators related to operational considerations, as the country enjoys large amounts of sunshine and rural areas have relatively high levels of accessibility. Indonesia also performs well on human capital indicators, with a gross tertiary education enrolment rate of 36.3% which is higher than all other countries in the index. High scores on human capital indicators show that the local labour market can supply PAYGo companies with many of the skills needed to construct and utilise client and supply networks.

**Kenya scores highest on market penetration indicators.** It has the highest scores on number of PAYGo players in market (15) and sales of multi-light and solar home systems (over 2.2 million units sold since 2014). A total of 48.4MW of total decentralised solar capacity installed (excluding mini grids) indicates higher decentralised solar uptake in Kenya to date than in most other countries in the sample. The country also has strong and reliable sunshine throughout the year, and rural areas in Kenya are relatively more accessible than in other Sub-Saharan African countries. Kenya also has relatively strong performance on human capital indicators, with a good quality education system and management schools, as well as a government-certified programme for solar equipment installers.

**India and Pakistan are also highly-ranked countries on the supply pillar.** India leads the access to finance sub-pillar, with the highest scores for affordability of financial services and availability of early stage equity. However, India scores lower on operational considerations, as rural access is less developed than in comparison countries, and solar yield is lower in parts of the country. India also scores low on market penetration, with fewer PAYGo players (5) and lower sales than many comparison countries. Pakistan has high scores across three out of four sub-pillars on the supply side, but market penetration is significantly lower as shown by low PAYGo sales, low decentralised solar capacity installed (11.7MW) and only one PAYGo player. The PAYGo MAI does not provide insights on a sub-national level. For heterogenous countries like India, indicators on national level should be reviewed in conjunction with sub-national data and research to disaggregate.

**Cote d'Ivoire, Angola and Sierra Leone have the lowest supply side scores, facing barriers in access to finance, market penetration and operational issues, respectively.** In Cote d'Ivoire, 69% of firms identify access to finance as a major constraint, financial services are amongst the least affordable of the countries considered, and early stage equity is not readily available. In Angola, the global database used (International Renewable Energy Association) reports only 0.3MW of decentralised solar capacity installed, and no sales of multi-light and solar home systems have been reported by GOGLA since 2014. Sierra Leone faces a combination of low solar yield and barriers in access to finance, as 65% of firms in Sierra Leone identify access to finance as a major constraint, and economic risk on financial markets is classified as relatively high.

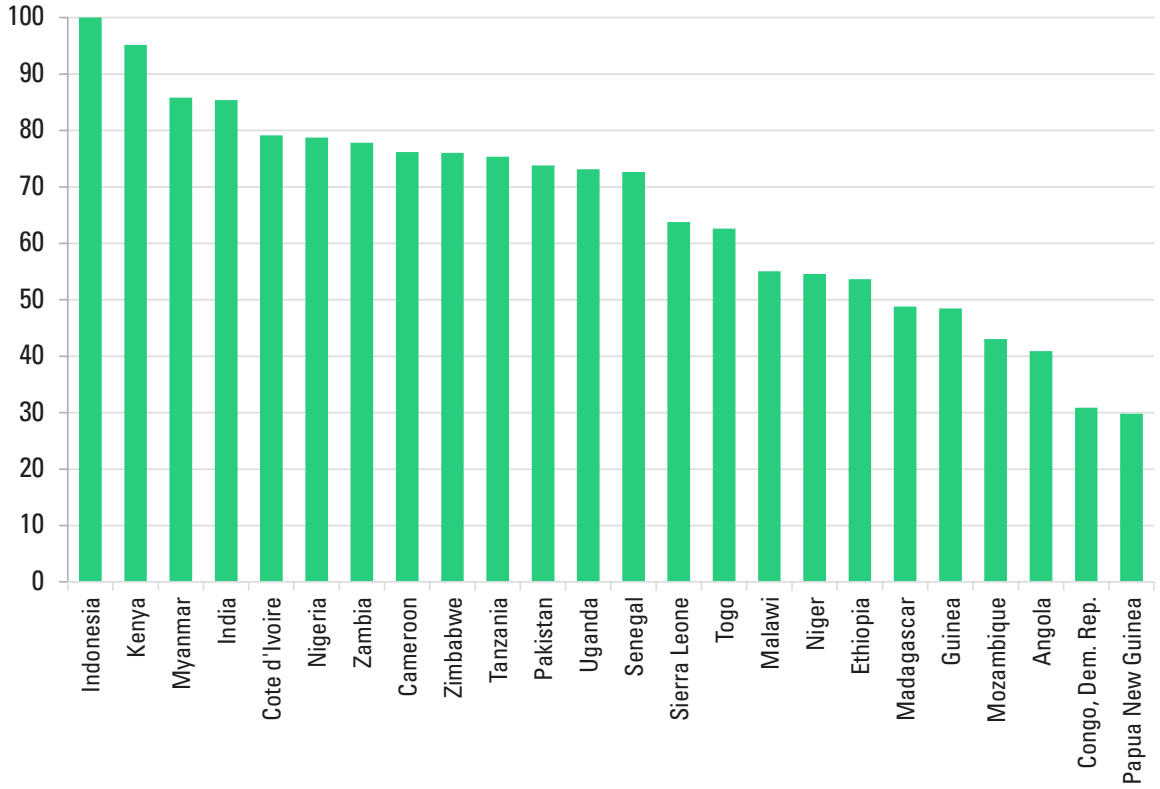
**There is a large difference between the highest and lowest country scores on the supply pillar.** Countries on the low end of the distribution score considerably lower than the top countries in the sample on most sub-pillars, indicating that overarching and systemic barriers to market development may exist in these countries.

## 3.4 Enabling environment pillar results

**Indonesia has the top score on the enabling environment pillar, followed by Kenya.** Indonesia holds the leading position on the ICT sub-pillar, having the highest share of the population using the internet (48%), secure internet servers per capita (1,878), mobile connection coverage (68%) and mobile broadband coverage (54%). Indonesia also scores highly on trade and commerce indicators. It has a large and strongly-growing GDP along with high levels of peaceable existence and relatively low corruption levels, indicating a business-friendly environment. Kenya has a perfect score on the legal and regulatory sub-pillar. It has implemented numerous policies to support the off-grid solar sector, including quality standards and fiscal incentives such as subsidies and duty exemptions for solar systems. Moreover, Kenya ranks highly on the trade and commerce sub-pillar due to its high GDP growth rate, strong legal rights and low import costs.

**Myanmar and India also score relatively high on the enabling environment pillar.** Like Kenya, the off-grid sector in Myanmar enjoys subsidies and duty exemptions for standalone home systems and the government also provides incentives to support the broader renewable electricity sector. While Myanmar's ICT environment is also better than most other countries in the index, the country's trade and commerce landscape may present difficulties to developers. Legal rights are weak and corruption perception is relatively high, signalling a challenging business environment. In contrast, India scores highest on trade and commerce, but the deployment of mobile phone-based PAYGo solutions may be hindered by the relatively low penetration of SIM cards (0.82 per capita) or numbers of persons who have used the internet (20%).

Figure 7: Indonesia has the highest score on the enabling environment pillar, followed by Kenya and Myanmar.




*Note: Enabling Environment is composed of three sub-pillars: Internet and Communication Technology (ICT), legal and regulatory, and trade and commerce. The same structure applies with the top country scoring 100. Of the 30% default weight assigned to the pillar, the sub-pillars have default weights of 50%, 30%, 20% respectively.*

Source: PAYGo MAI 2021

**DR Congo and Papua New Guinea have the lowest score on supply side sub-pillars, scoring below average across all three.** DR Congo scores lowest in the ICT sub-pillar, with 3.9 secure internet servers per million people, 8.6% of people using the internet and 0.3 unique mobile internet subscribers per capita. Papua New Guinea also scores poorly in the ICT sub-pillar, with the lowest SIM penetration across comparison countries, low internet use and few mobile broadband subscribers. Papua New Guinea receives low scores in the legal and regulatory sub-pillar due to lack of standards for standalone systems and renewable energy subsidies, but scores well in the trade and commerce sub-pillar thanks to low costs to start a business and to import, and strong legal rights.

**Like the supply pillar, there is a large diversity of country scores within the enabling environment pillar.** The pillars under 'enabling environment' include a set of indicators to evaluate the regulatory frameworks in place. These indicators are binary (values can only be 0 or 1) to partially explain the varying differences in final scores.

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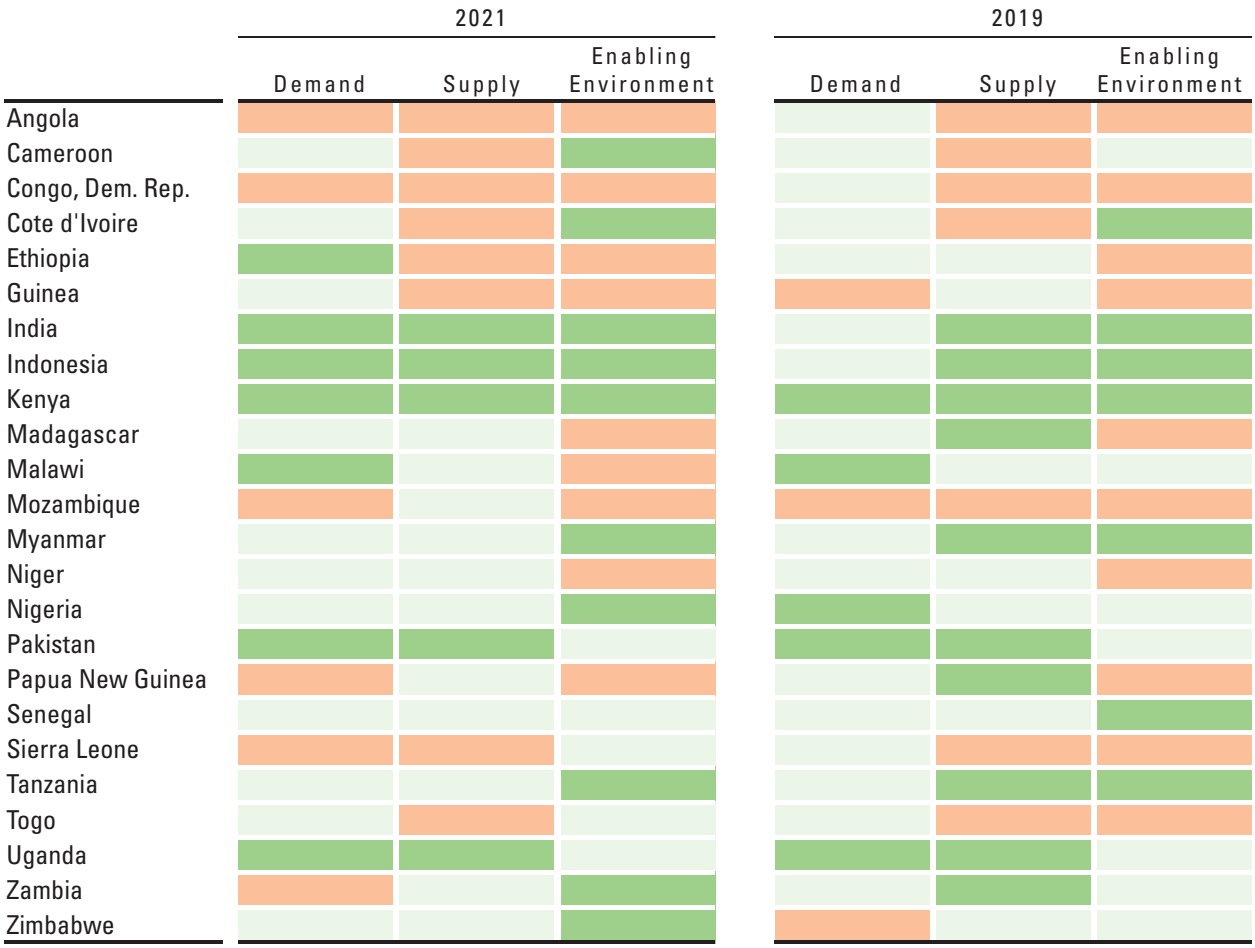
# 4. Closing remarks

## 4.1 Overview summary of index results

The scores in the PAYGo MAI provide a high-level overview of relative market attractiveness of the 24 countries in the index. Figure 8 shows the scores of each country in the index overall (for 2021 as well as 2019), and across the three main pillars, using a colour coded scoring system, or "heat map". Orange represents relatively poor scores, light-green mid-range scores, and dark green the highest scores within each pillar.

Figure 8. Heat map of country scores by pillar in MAI 2021 and MAI 2019




Source: PAYGo MAI 2021 and PAYGo MAI 2019

The top three countries, Indonesia, Kenya and India score highly across all three pillars. Pakistan and Uganda score well across the demand and supply pillars but perform less well on the enabling environment pillar. Myanmar, Nigeria, Tanzania, and Zimbabwe have medium scores on the demand and supply pillars, with high scores on the enabling environment pillar. The two lowest-scoring countries, DR Congo and Angola, have low scores in all three pillars. As shown in Figure 8, the sub pillar scorings have not changed dramatically for these countries compared to the 2019 MAI.

**Figure 6 provides a more detailed comparison of the scores across each of the sub-pillars in the index.** Some sub-pillars have a comparable number of countries marked orange, light green and dark green respectively, while some sub-pillars show a more 'clustered' performance across countries. For example:

- **Most countries have relatively low scores in the willingness to pay, market penetration and ICT sub-pillars**. This is because the index evaluates each country's performance against that of the best-performing country. The low

Figure 9: Heat map of country scores by sub-pillar

Source: PAYGo MAI 2021

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score of most countries in the willingness to pay, market penetration and ICT sub-pillars indicates that there is a large difference in the performance of most countries and that of the best-performing country in these sub-pillars. It also suggests that there is significant potential for most countries to improve in these sub-pillars.

- **Operational considerations have mostly relatively strong or relatively weak performers.** Although a good score on operational considerations is essential for developing a PAYGo market at scale, improving performance on this sub-pillar can be challenging. Performance on the operational considerations sub-pillar is highly dependent on a country's geography, as the underlying indicators measure sunshine availability and accessibility of rural areas.

- **Most countries score well on the human capital and trade and commerce sub-pillars.** This indicates that companies operating across multiple markets are unlikely to face problems with human capital and trade and commerce.

- **Kenya and India are the only countries with mid-range or high scores across all sub-pillars.** Although Indonesia and Kenya have the highest overall score, Indonesia has a poor performance on market size, which is compensated by high performance across other sub-pillars.

## 4.2 Emerging trends between the 2019 and 2021 editions of the PAYGo MAI

**There have been several developments in key indicators between the 2019 PAYGo MAI and the 2021 edition.** These are explored in the paragraphs below.

**Rural populations continue to increase in nearly all countries and rural areas will remain a key market for off-grid solar PAYGo products.** All countries in the sample are experiencing growth in the share of urban population. However, in all countries except Indonesia, the rate of population growth also outstrips the rate of urbanisation. This means the size of the rural population is increasing in absolute terms. Countries that are experiencing the largest increase in total rural population are Niger (3.8% per year), Uganda (2.8% per year) and Malawi (2.4% per year). There is a large overlap between the set of countries with high absolute rural population growth and countries with low access to electricity of rural population (Guinea, Malawi, Mozambique, Sierra Leone, and Zambia).

**Poor grid reliability remains a challenge in some countries, which can represent an opportunity for off-grid solar PAYGo providers.** Pakistan, India, Cameroon and Nigeria have high levels of urban electricity access but poor grid reliability. Grid-connected households in these countries can benefit from installing off-grid solar systems, which provide an alternative or backup source of electricity when the grid is unavailable. Urban households also represent an attractive customer base for off-grid solar PAYGo energy services, as they are usually easier to reach and have relatively higher incomes than their rural counterparts.

**PAYGo deposits are generally affordable across most countries, but additional financial support is needed to achieve universal energy access.** PAYGo improves the affordability of high-value off-grid solar devices by allowing households to spread its purchase cost over a period of time. The key barrier to affordability is thus the cost of the initial deposit, which is often a few times the size of the subsequent monthly instalment. Fortunately, at least 85% of unconnected households in all countries except Madagascar, Togo and Zambia are able to afford the PAYGo deposit for a multi-light system. Additional financial support such as consumer subsidies or concessional finance is needed to help bridge the affordability gap for the poorest households and achieve universal energy access.

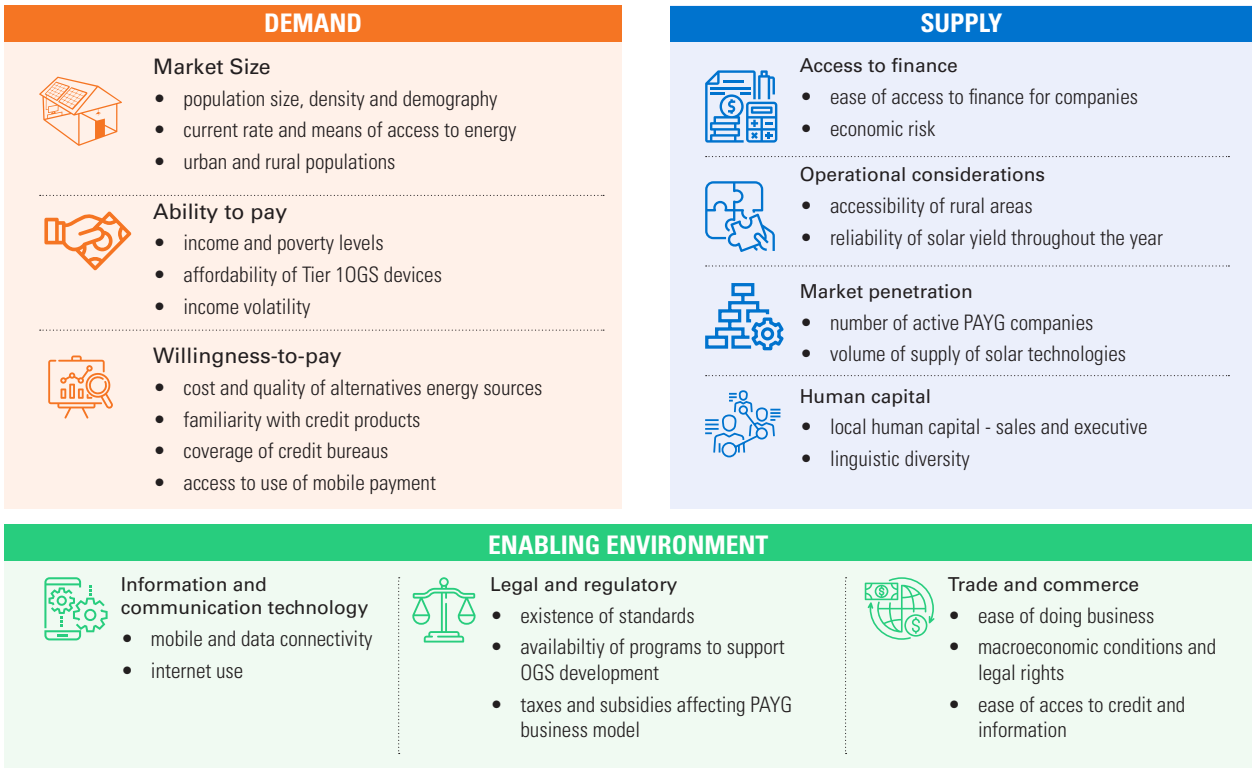
**Development of PAYGo in Asian countries can benefit from the region's rapid growth in mobile money.** Deployment of mobile-based PAYGo technology outside of East Africa was formerly limited by low penetration of mobile money. However, as mobile payments continue to grow rapidly in Asia, PAYGo might start to flourish. Between 2018 and 2019, the number of registered mobile money accounts grew by 72% in Indonesia and 133% in India, versus 21% in Kenya and 6% in Uganda. In India, growth in mobile payments has continued to accelerate over the past year catalysed by the COVID-19 pandemic, and supported by regulatory and government intervention, and innovative products and platforms (PwC India 2020).[5]

**Sales of high-value off-grid solar products across the 24 countries grew 32% between 2018 and 2019, but subsequently fell 12% between 2019 and 2020.** While the COVID-19 pandemic severely affected sales in the first half of 2020 (see Box 2), strong recoveries are evident in some countries for H2. In Cameroon, semi-annual sales of multi-light and solar home systems rebounded from 500 units in H1 2020 to 9,100 in H2 2020. Over the same time period, sales in Ethiopia and Mozambique have doubled while sales in Kenya and Senegal remained broadly stable. On the other hand, sales have continued to fall in other countries such as Uganda and Zambia, indicating that these markets will take longer to return to growth.

5 PwC India (2020) The Indian payments handbook – 2020–2025.https://www.pwc.in/assets/pdfs/consulting/financial-services/fintech/payments-transformation/the-indian-payments-handbook-2020-2025.pdf

# Appendix A – PAYGo MAI structure

Figure 10: The PAYGo MAI is structured across demand, supply, and enabling environment pillars




Source: Vivid Economics

The market attractiveness index is comprised of three main pillars:

- **demand:** size of the addressable market, ability of customers to pay, and willingness to pay for PAYGo products;
- **supply:** access to finance, operational considerations to provide PAYGo products, and potential partnership opportunities to support the PAYGo value chain, penetration of PAYGo and related products in the market, and access to human capital;
- **enabling environment:** broader conditions to support the development of PAYGo markets that are not directly associated with the supply chain or in generating demand. This includes: information and communication technology sectors – in particular mobile money, the legal and regulatory environment – and conditions for trade and commerce.

## 6.1 Demand side

**For a market to develop or grow there must be a demand – with ability and willingness to pay for the services offered.** PAYGo use will largely be driven by household users, although it is also increasingly explored for productive use appliances such as irrigation pumps for agriculture. The potential strength of demand will depend on a number of factors including:

- **the size of the market,** in this case, the size of population in rural and peri-urban areas which does not have access to electricity, as well as those with limited and/or unreliable access to the grid;
- **ability to pay,** which is influenced by income levels, household composition, seasonality of income and the cost of the service offered. It may also depend on consumer ability to access finance;
- **willingness to pay,** which depends on the cost and quality of alternative energy access options, information about and trust in the products offered, proportion of income spent on energy and so on.

## Market size

**Across Sub-Saharan Africa (SSA) while access to electricity is increasing, so is population growth, therefore the absolute number of unelectrified households remains important.** In the latest SGD7 tracking report, it is noted that the global population without access to electricity decreased to about 789 million in 2018 from 1.2 billion in 2010, with those still lacking access concentrated in Sub-Saharan Africa(ESMAP 2020).

Growth in electrification was slower than population growth in Sub-Saharan Africa between 2016 and 2018, causing an annual increase of 0.3 million people lacking access to electricity over the period.[6] Rates of electrification across SSA remain low – from 18% in Malawi and Niger to 75% in Kenya, the average for the region being 47%. Coupled with a gradual increase in incomes in recent decades, and expected continued growth, this suggests there will continue to be an important market of unmet or 'suppressed' demand for access to sustainable electricity services.

**The size of the market in years to come will depend on socioeconomic trends, in particular urbanisation and population growth, as well as income growth and purchasing power.** Rural customers are an important market segment for PAYGo energy, although they typically represent lower income market segments. Population growth in urban and peri-urban areas may put pressure on already stretched grid services, which may not be able to reliably meet the additional demand.

PAYGo markets have developed in peri-urban areas, where population density is sufficient to support distribution channels and there is an ability and willingness to pay for 'medium' sized energy solutions (Hystra 2017).[7]

PAYGo products not only provide a solution for basic energy access, but present an opportunity to be extended to higher tiers of energy access and for productive use of energy .PAYGo products can also complement the grid in countries where grid reliability is poor by serving as a backup source of electricity for grid-connected households during periods when the grid is unavailable(Lighting Global, GOGLA, and ESMAP 2020).

## Ability to pay

**Ability to pay will largely be determined by income levels and poverty distribution.** As incomes increase, consumers will be better able to afford energy services, either by purchasing a standalone system upfront or through the regular payments of a PAYGo model.

**Current expenditure on energy services may be a good indication of ability to pay.** Expenditure on generator fuels provides a benchmark for how much income is currently spent on energy services.

**Cashflow management for rural populations with wide monthly variation in income may also present a challenge.** This will differ from one country context to another, depending on the 'lumpiness' of income, and the PAYGo business model(Zollmann et al. 2017). A major reason cited by customers (75% of those interviewed) and sales agents (c. 50%) for customers defaulting related to seasonality of income (Barrie and Cruickshank 2017). Income volatility affects not just the ability to pay for the SHS technology, but also the ability to meet the PAYGo business model of regular repayment over time.

## Willingness to pay

**Willingness to pay depends on a complex set of factors, including price and quality of alternative means of energy access.** Those currently without access to sustainable electricity can face very high prices for a supply that is both insufficient and unreliable.

Consumers without access to the grid rely on expensive fuels with health and supply risks, whilst on average 34% of those with access to the grid experience a connection that works less than half of the time (Afrobarometer, 2016). In these circumstances, customers may be prepared to pay for a higher quality of energy service provided by a SHS under a PAYGo model. This is important for both rural and peri-urban areas, where SHS can provide an alternative or back-up solution to a grid connection.

6 Data from Global Tracking Framework, World Bank, 2020

7 Medium consumption refers to appliances that range between 30W (e.g. a fan) to 100W (e.g. a fridge)

**PAYGo companies may face a challenge in consumer awareness and trust when expanding into relatively new markets.** Providing consumers with reliable and understandable information and maintenance option strengthens trust in new products, increasing willingness to pay especially in early stages of market development. Often, replication of existing business models can be challenging, with there being a need to educate consumers in digital finance and new technologies, or to tailor payment collection methods (GSMA 2017a). In general, awareness on the customer side, ability to access and trust credited products can influence demand for PAYGo products.

**Leveraging established consumer confidence and awareness of financial services is an important facilitating mechanism for PAYGo operators.** Familiarity of consumers with credit or instalment-based payment is limited in some countries, which may limit demand for PAYGo products since the ownership model is unfamiliar. Financial inclusion is a key driver of PAYGo demand and may in turn also be supported from PAYGo market growth where this is accompanied by improved access to financial services.

## 6.2 Supply side

**For a market to develop and scale up, it must also be attractive to suppliers to operate a business model.** Suppliers need to be able to access consumers, deliver goods and services to them, and develop a system of trust in the product. The factors determining attractiveness to supply in the PAYGo market are organised under four sub-pillars:

- **access to finance:** for companies to establish and manage cashflow including making up-front capital investment which is recovered over time as a stream of repayments from end users;
- **operational considerations:** relating to distribution, including the 'last-mile' interface with customers, and technological considerations;
- **market penetration:** current level of supply and depth of related products available in the market;
- **human capital:** both local and ease of access to international labour markets to support development of PAYGo agents and supporting services;

### Access to finance for PAYGo companies

**Access to finance for business operations is a strong determinant for growth of the PAYGo off-grid solar sector.**[8] PAYGo companies are highly capital-intensive and can require up to eight times more capital than cash sale-based companies (Dalberg Global Development Advisors and Lighting Global 2018; Lighting Global, GOGLA, and ESMAP 2020). Early-stage companies in particular may find it challenging to raise capital. Investment in the off-grid solar sector is highly concentrated, with just ten companies receiving 78 percent of total investment in the sector between 2012 and 2019 (Lighting Global, GOGLA, and ESMAP 2020). Most of these are well-established "first-generation" companies that have become large enough to tap debt capital. Newer and smaller companies tend to be heavily reliant upon equity and grant investments, which are now relatively limited.

Access to finance is also a function of market attractiveness. Investors have historically been attracted to markets (e.g. East Africa) that are conducive to the development of PAYGo, in turn expanding the pool of capital available to PAYGo companies operating there and allowing them to scale (ibid.). As other markets become more conducive to PAYGo, one expects them to attract additional capital.

**PAYGo companies must front the capital for the value of solar products to the supplier and collect a stream of revenue over a period of years from customers.** Initial business start-up costs include a requirement for access to local currency to finance local operations. Consequently, multi-national operators need to be able to access local currency when establishing operations, and to subsequently exchange local currency to, for example, US dollars as they generate revenue.

**While most capital leveraged by PAYGo companies is international, country linked finance sources may be important when assessing the relative market attractiveness of a country.** For instance, in Uganda and Kenya M-KOPA was funded by Stanbic Bank (syndicated to also include CDC Group, FMO, and Norfund) and in Togo, BBOXX was provided with a line of financing from UTB. Availability of local finance may be particularly valuable for smaller companies and as markets grow over time.

8 Importantly, this section relates to the ease and cost of PAYGo companies raising capital to support business expansion. This is different from the extent to which consumers are willing and able to use credit-based models to purchase energy services (covered in section 2.1).

9 Includes meteorological data from: http://fr.allmetsat.com/climat/tanzanie-rwanda-burundi.php?code=63844

## Operational considerations for distribution of PAYGo products

**Practitioner interviews identify last-mile distribution in rural areas as a major supply side constraint.** The logistics of last-mile distribution are an important value driver, especially in retaining a stable customer base (interview evidence).

**Partnerships for last mile delivery are an important element of market attractiveness, especially for smaller, horizontally integrated companies**. Smaller companies often leverage existing service delivery networks to increase the chances of success in a new market. The source of these partnerships is not limited to the solar market – any market with wide reaching distribution networks presents a good opportunity. The best partnership strategy will often be specific to the country or the region.

**PAYGo companies may partner with existing credit organisations.** In some cases, consumers are already widely able to access credit through microfinance institutions (MFI) and/or savings and credit cooperative organisation (SACCO) loans. The potential for partnership will be determined by how well suited the credit organisation is to absorb PAYGo service offerings. In some instances, PAYGo companies are forming partnerships with / providing services directly alongside rural MFIs, and mobile network operators (MNOs), to establish mobile money networks in deep rural off-grid areas.

**On the technology side, for solar based PAYGo models, the resource yield – solar irradiation – may affect the potential size of the supply market.** Variation within the country and across the year is important. To be attractive as a product, there must be enough reliable and daily sunlight and irradiation to power the solar products and charge storage (battery).

## Market penetration and current levels of supply

The rapid growth of the PAYGo markets has been characterised by relatively low levels of competition, to date. Larger companies in the market have tended to be first or second movers in their respective country markets, and have been able to convert that advantage into near monopolistic and/or oligopolistic positions (Dalberg Global Development Advisors and Lighting Global 2018). However, some markets are now witnessing an increase in the number of PAYGo companies.

Whereas dominant market positions may dissuade new players, there is an increasing range of product and value propositions being offered by companies. While relatively new markets may offer good opportunities for entrants, there will remain opportunities for new products in already well-developed markets as consumer preferences evolve and consumers progress up the energy ladders.

Alongside the number of companies operating, the volume of similar technology products also provides an indication of the current or historic market conditions. For example, the sales of PAYGo, Pico and solar lantern products as recorded by GOGLA provide an interesting indicator. In general, a large volume of sales, in conjunction with a high number of players, may indicate a market which can support a large number of suppliers.

The relationship between competition and market attractiveness is complex. Early movers may have high shares of market penetration, especially in new markets that have challenging conditions. It may also signal capture by one strongly branded supplier or high barriers to entry, in which case the market resembles a 'natural monopoly'. In this case it is not clear that a 'high' concentration indicates an attractive market. Similarly, a 'low' concentration characterised by a large number of players increases competition but may also indicate a market that is growing and can support further entry / deepening.

## Conditions in the local labour market

PAYGo companies highlight access to human resources as one of the major constraints they face. In particular, companies need access to specific skills and experience for recruiting sales agents, technicians, credit officers and IT specialists. For executive human capital, companies typically rely on MBA graduates (Dalberg Global Development Advisors and Lighting Global 2018). Additional barriers include foreign worker restrictions and working in environments where a wide range of languages and dialects are spoken.

Recruiting field staff to operate local sales distribution networks is a pre-requisite to scale PAYGo models in new markets. Commission-based contractors may focus on the 'easy' customer segments, which are quickly saturated, then become increasingly inactive (Hystra 2017). Harnessing trained staff and local agents is key for the long-term sustainability and expansion of PAYGo companies, as well as being a principal cost item of their businesses.

## 6.3 Enabling environment

**The attractiveness of the market to both demand side customers and supply side operators is influenced by a broader country 'enabling' environment.** This is distinct from the supply and demand side indicators, in that it concerns broader market conditions, not those specific to the PAYGo value chain and its customers. The PAYGo MAI structures these indicators under three sub-pillars:

- **information and communications technology (ICT):** such as availability, access to and cost of online or mobile payment systems; mobile phone penetration and usage; mobile phone subscription costs and pricing structures; online banking prevalence and uptake and so on;
- **legal and regulatory:** relating to the energy sector in general, and standalone systems specifically, including tax regimes, quality standards, banking regulations and so on;
- **trade and commerce:** such as ease of doing business, macroeconomic conditions and forecasts, access to information.

### Information and communications technology

**Growth in usage of mobile phones and availability of mobile payment platforms has gone hand in hand with the development of PAYGo markets.** The effectiveness of PAYGo in reaching dispersed, low-income customers, has been linked to the spread of mobile telephones (USAID 2017), and 'advanced mobile infrastructure and mobile payment platforms' (PwC 2016). Mobile channels are important in a number of ways: enabling remote payment collection; providing a control/interface with PAYGo assets and services, communications between providers and users and support services/networks for providers (GSMA 2017b).

**There are alternatives to mobile money to collect payments, but these tend to be more complex and costly to administer.** Scratch cards have been used by providers such as Azuri Technologies or WakaWaka in Rwanda to launch their PAYGo solar operations, but this approach requires a complex stock of cards and agents to administer. Furthermore, most alternative mechanisms rely on a mobile connection. A more attractive alternative could be accepting air-time credit as form of payment, as has been used by a PAYGo company in Nigeria after partnering with a mobile network operator (GSMA 2017b).

### Legal and regulatory

**The legal and regulatory environment affects both the extent to which solar technologies are supported, and the business environment for PAYGo business models.** This includes power sector regulations, clean energy and energy access targets, fiscal incentives and specific policy support and standards for standalone solar systems. An important success factor for the development of early PAYGo systems was that they operated in an 'unregulated electricity space' (PwC 2016). A conducive regulatory and policy framework can be a major support to market development. One of the most important factors spurring solar growth is whether or not PAYGo systems are exempted from VAT and import tariffs which make small scale solar options more competitive relative to cheaper alternatives (Hystra 2017). Similarly, the European Union's flagship electrification programme in Africa, ElectriFi, emphasises the importance of clear and reasonable import tariffs and duties as well as value-added tax (ElectriFi 2016).

**The existence of standards for solar standalone systems is a key factor for off-grid solar providers.** These include standards for technology and equipment, certification standards for installers, or environmental standards for end-of-life disposal. Such standards, if enforced, reduce consumer uncertainty in the market by penalising lower quality products, helping to build consumer confidence and can play a part in increasing customer willingness to pay (Bensch, Grimm, and Peters 2015).

### Trade and commerce

**The environment for undertaking trade and commercial activity influences the market for businesses and financiers.** This includes transparency, corruption perception, access to and the cost of credit, and legal protection for corporations. These indicators are not specific to the PAYGo market but enable the establishment and growth of business operations at scale.

**The World Bank's Ease of Doing Business index covers a range of relevant factors, including administrative and legal costs that a company bears to undertake operations.** The overall Ease of Doing Business score for a country provides a high-level indicator of trade and commerce attractiveness, and sub-components of the Ease of Doing Business index are particularly relevant to PAYGo businesses.

**Market transparency facilitates predictability and stability, lowering risk for investors and increasing financing available to PAYGo companies.** Similarly, businesses prefer operating environments that are less prone to political and security risks. In the PAYGo context, such stability is particularly important, as PAYGo companies tend to be both newer and require high up-front investment (Dalberg Global Development Advisors and Lighting Global 2018).

**For PAYGo companies, a favourable wider credit environment is important for the long-term access to finance needed to keep up with quickly expanding markets and technology.** This means that the regulatory and policy environment for credit is an important indicator for the PAYGo business model. An established credit ecosystem supports confidence in the availability of a long-term finance stream for PAYGo companies, which can evolve with the companies' needs.

# Appendix B – Methodology and user manual

## 7.1 Overview

This technical annex provides a brief description of how to use and interpret the Excel based index.

The Pay-as-you-go Market Attractiveness Index (PAYGo MAI) is an Excel based index built for user-led comparison of country characteristics related to PAYGo market attractiveness. It is designed for user flexibility and ease of use. The index incorporates clearly highlighted user input options, automated updating of results and a selection of outputs to quickly access performance across the overall index and its pillars. It provides an overview of the performance of a selected country, as well as the option to compare all countries across selected sub-pillars and indicators.

The index comprises 67 indicators, organised under three pillars and ten sub-pillars. Users can select the importance (weight) placed on each of the three pillars, and on each of the sub-pillars within these three areas. The structure of the 67 indicators with sub-pillars and pillars in the index is shown in Figure 11.

The 2021 edition of the index covers 24 countries across Sub-Saharan Africa and Asia. These are Angola, Cameroon, DR Congo, Cote d'Ivoire, Ethiopia, Guinea, India, Indonesia, Kenya, Madagascar, Malawi, Mozambique, Myanmar, Niger, Nigeria, Pakistan, Papua New Guinea, Senegal, Sierra Leone, Tanzania, Togo, Uganda, Zambia and Zimbabwe.

## 7.2 Changes to the index between the 2019 and the 2021 editions

- **Some indicators have changed in the 2021 index to better reflect the underlying drivers of market attractiveness.** This will affect the scores of countries in the index. Changes include:
    - D_13, Affordability of Tier 1 off-grid solar systems: Annualised off-grid household expenditure on lighting and mobile phone charging from Bloomberg New Energy Finance has been replaced with estimates of the affordability of Tier 1 off-grid solar systems from the Off-Grid Solar Market Trends Report 2020. This indicator is a better measure of the ability of households to afford high-value off-grid solar products that are usually offered by PAYGo providers.
    - D_19, Cost of generator fuel: Average kerosene prices from Climatescope has been replaced with estimates of spending on generator fuel from the Off-Grid Solar Market Trends Report 2020. This indicator takes into account fuel prices and duration of generator usage, to better measure actual spending on generator fuels by households without a grid connection.
    - S_11, Most recent sales volume of multi-light and solar home systems: Sales of solar units has been replaced by sales of multi-light and solar home systems. This indicator better reflects sales of high-value off-grid solar products that are usually offered by PAYGo providers. The data source (GOGLA) remains unchanged.
    - S_12, Cumulative sales volumes of multi-light and solar home systems since 2014: Sales of solar units has been replaced by sales of multi-light and solar home systems. This indicator better reflects sales of high-value off-grid solar products that are usually offered by PAYGo providers. The data source (GOGLA) remains unchanged.
- **Data sources have changed to improve data coverage for some indicators in the 2021 index.** This will affect the scores of countries in the index. Changes include:
    - D_10, Unreliable grid connections: Data from the World Bank Enterprise surveys has been replaced by estimates from the Off-Grid Solar Market Trends Report 2020. The Market Trends Report provides better estimates of the number of households with an unreliable grid connection, as it combines data from the Enterprise surveys, Afrobarometer and surveys conducted for the ESMAP Beyond Connections reports.
    - D_14, Proportion of population that is not poor: The proportion of population above global poverty level (2011 PPP $2/day) based on Vivid Economics' projection using 2011 World Bank data presented in Pew Research Center (2015) has been replaced with the proportion of population above national poverty lines from the World Bank World Development Indicators. This indicator has been updated more recently.

Figure 11. Index structure and indicators

| DEMAND PILLAR | |
|---|---|
| **Market size** | |
| D_1 | Population size |
| D_2 | National population density |
| D_3 | Population density distribution |
| D_4 | Rural population |
| D_5 | Population growth rate |
| D_6 | Rate of Urbanisation |
| D_7 | Urban non-slum population |
| D_8 | Unconnected rural population |
| D_9 | Unconnected rban population |
| D_10 | Unreliable grid connections |
| D_11 | Number of electrical outages in a typical month |
| **Ability to pay** | |
| D_12 | GNI per capita |
| D_13 | Annualised off-grid household expenditure on lighting |
| D_14 | Proportion of population above global poverty level |
| D_15 | Income volatility |
| **Willingness to pay** | |
| D_16 | Borrowed from a store by buying on credit |
| D_17 | Cost of substinence electricity consumption |
| D_18 | Time to get connection |
| D_19 | Average kerosene prices |
| D_20 | Private credit bureau coverage |
| D_21 | Public credit registry coverage |
| D_22 | Mobile money account (age 15+) |
| D_23 | Paid utility bills; using a mobile phone (% paying utility bills, age 15+) |
| D_24 | Cheapest prepaid mobile voice product by country (in USD) |
| D_25 | Cost to get electricity (% of income per capita) |

| SUPPLY PILLAR | |
|---|---|
| **Access to finance** | |
| S_1 | Firms who don't identify access to finance as a major constraint |
| S_2 | Affordability of financial services |
| S_3 | Avaailability of early stage equity |
| S_4 | Financial Markets - Short Term Economic Risk |
| S_5 | Financial Markets - Long Term Economic Risk |
| **Operational considerations** | |
| S_6 | Rural access index |
| S_7 | Number of months with less than five hours of sunshine per day |
| S_8 | Cumulative month hours below 5 hours of sunshine per day |
| **Market penetration** | |
| S_9 | Number of PAYGo players in market |
| S_10 | Total decentralised solar capacity installed excluding minigrids |
| S_11 | Most recent sales volume of PAYGo, PICO and SHS products |
| S_12 | Cumulative sales volume of PAYGo, PICO and SHS products since 2014 |
| **Human capital** | |
| S_13 | Quality of management schools |
| S_14 | Local availabilty of specialied training services |
| S_15 | Quality of the education sysytem |
| S_16 | Gross tertiary education enrolment rate |
| S_17 | Living languages count |
| S_18 | Linguistic diversity index |
| S_19 | Availability of government certified training programmes for solar equipment installation |

| ENABLING ENVIRONMENT PILLAR | |
|---|---|
| **ICT** | |
| EE_1 | Mobile cellular subscriptions |
| EE_2 | Secure Internet servers |
| EE_3 | Individuals using the internet |
| EE_4 | SIM penetration |
| EE_5 | Mobile broadband use |
| EE_6 | Number of mobile connections per capita |
| **Legal and regulatory** | |
| EE_7 | Do national programs to develop or support stand-alone sysytems exist? |
| EE_8 | Has the government adopted international quality standards for stand-alone systems? |
| EE_9 | Are there environment regulations on disposal of solar devices and SHS components? |
| EE_10 | Do subsidies exist for solar modules? |
| EE_11 | Do duty exemptions for solar modules exist? |
| EE_12 | Do duty exemptions for other equipment related to stand-alone systems exist? |
| EE_13 | Do subsidies exist for stand-alone systems? |
| EE_14 | Do duty exemptions exist for stand-alone systems? |
| EE_15 | Do government incentives exist for renewable electricity? |
| EE_16 | Do specific financing facilities exist for operators in energy access? |
| **Willingness to pay** | |
| EE_17 | Depth of credit information index |
| EE_18 | Strehgth of legal rights index |
| EE_19 | GDP (PPP and constant 2011 US$) |
| EE_20 | Annaul GDP growth |
| EE_21 | Ease of doing business index (1 = easiest to 185 = most difficult) |
| EE_22 | Corruptions Perception Index |
| EE_23 | Global Perception Index |
| EE_24 | Cost of import |
| EE_25 | Cost to enforce a contract |
| EE_26 | Cost to start a business |
| EE_27 | Minimum paid-in-capital required to start a business |

Source: PAYGo MAI 2021

- D_22, Mobile money accounts per 1,000 adults: The percentage of respondents (age 15+) who report personally using a mobile money service in the past 12 months from World Bank Findex has been replaced with the number of registered mobile money accounts per 1,000 adults from IMF Financial Access Survey. This indicator has been more recently updated and so better reflects recent growth in mobile money accounts, particularly in India and Indonesia.

- D_24, Price of basic mobile plan: The price of the cheapest prepaid mobile voice product, 30 Calls / 100 SMS from the International Telecommunications Union (2017) has been replaced with the price of a "low consumption" data and voice mobile plan of 3G and above service, with 70 minutes voice, 20 SMS and 500MB data from the International Telecommunications Union (2021). This indicator has been updated more recently and takes into account the price of mobile data.

- S_4, Financial Markets - Short Term Economic Risk: The indicator and data source are unchanged, but the data provider BMI Research is now known as Fitch Solutions.

- S_5, Financial Markets - Long Term Economic Risk: The indicator and data source are unchanged, but the data provider BMI Research is now known as Fitch Solutions.

- S_9, Number of PAYGo players in market: The number of active PAYGo companies in a market at the given time of research from Dalberg has been replaced with the number of affiliate companies reporting B2C PAYGo sales in the last three years (2018-2020) from GOGLA. This indicator has been updated more recently.

- EE_1, Unique mobile subscribers per capita: The number of mobile cellular telephone subscriptions from the International Telecommunications Union(2017) have been replaced with the number of unique mobile subscribers per capita from GSMA Intelligence (2020) and the World Bank World Development Indicators. This indicator identifies unique mobile subscribers and thus individuals with more than one mobile subscription are only counted once.

- EE_10: This variable has been retired and is now covered under EE_15. It was formerly: Do subsidies exist for solar modules?

- EE_11: This variable has been retired and is now covered under EE_15. It was formerly: Do duty exemptions exist for solar modules?

- EE_12: This variable has been retired and is now covered under EE_14. It was formerly: Do duty exemptions for other equipment related to standalone systems exist?

- EE_13: This variable has been retired and is now covered under EE_14. It was formerly: Do subsidies exist for standalone systems?

- EE_20, Annual GDP growth rate: Expected GDP growth rate 2015 – 2025 from the World Bank World Development Indicators from has been replaced with GDP growth rate in 2019 from the World Bank World Development Indicators. This indicator is based on the latest available observational data, making it more reliable than a projection starting from 2015.

- **Some indicator descriptions have changed as a result of a change to the source data.** This is particularly the case for some indicators from RISE 2020 as detailed in Table 2.

- **All data in the index is the most recent data for the respective indicator available as of May 2021.** For every indicator, the year of data in the tool can be retrieved from the indicator tab.

Table 2 Updated variable descriptions between the 2019 MAI and the 2021 MAI

| Indicator | 2019 MAI variable description | 2021 MAI variable description |
|---|---|---|
| EE7 | Response to the question: Do national programs to develop or support standalone systems exist? | Response to the question: Are there national programs which aim to develop standalone systems or support the development of standalone systems? |
| EE9 | Response to the question: Are there environmental regulations on disposal of solar devices and SHS components? | Response to the question: Are there environmental regulations on the disposal of solar devices and standalone home system products or components? |
| EE14 | Response to the question: Do duty exemptions exist for standalone systems? | Response to the question: Are there duty exemptions and/or subsidies to support standalone home systems? |
| EE15 | Does the government offer other direct fiscal incentives for renewable electricity (e.g. capital subsidies, grants or rebates, investment tax credits, tax reductions, production tax credits, FITs for large producers?) | Does the government offer other direct fiscal incentives for renewable electricity (e.g. capital subsidies, grants or rebates, investment tax credits, tax reductions, production tax credits)? |
| EE16 | Are there specific financing facilities (access to credit etc.) available to support operators? | Are there specific financing facilities available to support operators/consumers to develop/ purchase standalone home systems? |
| S11 | The sum of solar units sold in latest half-year of available sales data (total of PAYGo and Cash sales) | Number of multi-light and solar home systems sold in the second half of 2020 |
| S12 | The cumulative sum of solar units sold since the second half of 2014 (total of PAYGo and Cash sales) | The cumulative sum of multi-light and solar home systems sold since the second half of 2014 |
| EE5 | Proportion of the population with mobile broadband use | Proportion of the population with a mobile internet subscription |
| EE19 | GDP in purchasing power parity, constant US 2011 prices | GDP in purchasing power parity, constant international 2017 prices |
| D17 | Cost of subsistence electricity consumption: Annual cost of subsistence consumption (30kWh/month) as a percentage of GNI per household of bottom 20% of population | Index: What is the cost per kWh that a residential consumer pays for the first 30 kWh of consumption per month? |

Source: Vivid Economics

## 7.3 Scoring and normalisation

**Each indicator in the index is normalised on a scale of 0-100.** The 'lowest' performing country scores 0, the 'highest' performing country scores 100, with all remaining scores defined on a relative scale between 0-100. The default normalisation approach is a linear scaling with the maximum data value assigned a score of 100 and all values assigned scores proportional to their distance from the max (see examples in Box 3).

### Box 2: Example indicator normalisation: rural population

- For rural population share (D_4), the country with the highest share of rural population is Papua New Guinea, where 87% of the population are classified as rural. Papua New Guinea therefore scores '100' on this indicator. The lowest value registered across the 24 countries is for Angola, with only 34% of the population classified as rural. Angola therefore scores '0' on this indicator.
- Countries receive a normalised score, based on their relative position between Papua New Guinea and Angola. For example, Myanmar has 69% of its population living in rural areas and therefore is assigned a score of '67', while Cameroon has 43% of its population in rural areas, scoring '17' on the scale.
- Specifically, the normalised score for Myanmar is calculated as: (69-34)/(87-34) * 100 = 67

**For some indicators, there are one or two countries with large 'outlier' values, which may distort the scores of other countries.** Because normalisation is carried out on the basis of a minimum and a maximum value (as explained in Box 3), for an indicator where the maximum value for a particular country is far greater than any other country in the index, this will result in a highly 'skewed' set of normalised scores. For example, for population size, India has over 1.3 billion people and would score '100'. The third largest country is Pakistan with 217 million people. However, Pakistan would score just '15' on its normalised score, as it is in relative terms far smaller than the 1.3 billion market size in India. This would mean the 21 other countries with less population than Pakistan have a very small range in their normalised scores for this indicator and variation amongst countries would not be captured, except for that between the largest countries and the rest.

**'Outlier' indicators with potential for skewing scores across the sample are identified as those with fewer than three countries receiving a score of 25 or above on a normal max-min distribution.** Most of these reflect indicators that relate to country size. For this selection of indicators, one of two approaches is taken:

- **For continuous variables with a large 'unconstrained' range, a log transformation is used.** The log transformation increases the scale of relative distribution of small values, while also preserving a relative distance between outliers and small values. This approach is selected for indicators D1, S10, EE2, EE19, D18 and D19 (see Table 3 below).

- **For continuous variables which take only a limited range of values, the scores are normalised around median value.** All values below the median are normalised between 0 and the median (which scores 50), while values above the median are normalised between the median and 1. The consequence of this is a more equal distribution of values between 0 and 1, with exactly half of the values scoring above 50 points by definition. This approach is selected for indicators S11, S12, D21 and D23 (see Table 3 below).

Table 3: Outliers are accounted for in 10 variables in the index

| Variable | Proposed solution | Rationale |
|---|---|---|
| D1. Population | Normalise – LOG | Continuous variable, large outliers at upper end of spectrum. Distribution fits natural log well to maintain variation but not 'skew' the distribution |
| S10. Total decentralised solar capacity installed excluding mini-grids | Normalise – LOG | As per above |
| S11. Most recent sales volume of multi-light and solar home systems | Normalise – median | Continuous variable, but constrained, and most interesting to 'centre' the distribution around a central sales volume across the countries in our sample |
| S12. Cumulative sales volumes of multi-light and solar home systems since 2014 | Normalise - median | As per above |
| EE19. GDP (PPP and constant 2017 international $) | Normalise – LOG | Continuous variable as per above |
| EE2. Secure internet servers per 1m people | Normalise – LOG | Continuous variable as per above |
| D18. Time to get grid connection | Normalise – LOG | Single outlier in continuous variable, apply logs as per above |
| D19. Generator fuel costs for unconnected households | Normalise – LOG | Single outlier in continuous variable, apply logs as per above |
| D21. Public credit registry coverage | Normalise – median | Discrete constrained variable, most logical interpretation is around median |
| D23. Paid utility bills using a mobile phone | Normalise – median | Discrete constrained variable, most logical interpretation is around median |

Source: Vivid Economics

**Where data is not available for all countries for an indicator, 'gaps' are filled to preserve the overall rankings of the countries in each sub-pillar.** The index uses raw data from a range of sources for 67 indicators, and data is not available for all countries for all 67 indicators. The indicator tab of the tool highlights where data is missing, and where the missing data has been filled with an estimated datapoint. The reason data gaps are 'filled' is to make sure the index can be computed for all countries on a comparable basis.

**To fill these data gaps, data is interpolated at the sub-pillar level to preserve the score for each country as if it was not missing any data.** The interpolation method ensures that the index can be viewed on a comparable basis for all countries for sub-pillars, pillars, and the overall index. To achieve this, any missing country data point for a particular indicator is replaced by the weighted average performance of the respective country across all other indicators in that respective sub-pillar. Country scores in sub-pillars

and pillars are thereby not affected by missing data. Interpolation is required for only a small proportion of data points, with just 3% of indicator scores based on interpolation to fill data gaps.

### 7.4 Pillars and sub-pillars

**The 10 sub-pillars are a weighted sum of individual indicator scores, following the index structure detailed in Figure 11.**The range of each sub-pillar is again scaled so that the highest performing country scores 100. Each indicator is weighted based on: (i) the relative importance of the indicator, (ii) whether it is binary, discreet, or continuous, (iii) the range of variation in the raw indicator scores across the 24 countries. In general, indicators that are considered more 'important' are given more weight in the index. Furthermore, binary indicators are given a lower weight than continuous, as countries can only receive either a full 100 score, or a 0 score on these indicators. Indicators with a wider range are assigned a higher weight for the same reason. This assessment is based on expert judgement and stakeholder engagement, used to provide a sensible calibration of the index. Critical indicators, such as the distribution of population density, are weighted highly. Box 4 provides an example of how indicators are weighted and aggregated up to the sub-pillar level.

**Each of the three main pillars is a weighted average of the sub-pillars it comprises.** The range of each pillar is scaled so the highest performing country scores 100. Users can define these weights to investigate which markets appear most attractive when different sub-pillars of the market are weighted differently. As a sub-pillar weight is modified, the scores and country rankings of the pillar within which it sits will be affected, as will the score and ranks on the overall index. Box 5 provides an example of how sub-pillars are weighted and aggregated up to the pillar level.

**The overall index score is a weighted average of the three main pillars.** The range of the overall index is scaled so that the highest performing country scores 100. Weightings can be manually adjusted on the PAYGo MAI tab for each pillar, and for each sub-pillar.

#### Box 3: Aggregating indicators to sub-pillar – worked example: India

**India is the highest scoring country on the 'Access to Finance' sub-pillar (within the 'supply' pillar) with a normalised score of 100.**

**This box explains how the normalised sub-pillar scores are calculated, as a result of weighting and aggregation across the individual indicators it comprises.** This is important, as receiving the highest normalised score of 100 on a sub-pillar does not imply that a country performs best across all the individual component indicators.

- **The Access to Finance sub-pillar comprises five individual indicators:**
  - S1. Firms who do not identify access to • S2. Affordability of financial services
  - S3. Availability of early stage equity
  - S4. Financial markets – short term economic risk
  - S5. Financial markets – long term economic risk
- **India's 'raw' score on the 'Access to Finance' sub-pillar is a result of the weighted average of its score on each indicator, multiplied by that indicator's weight.** It is important to note that the score of an indicator is derived by looking at the value of that indicator across all countries and assigning a normalised score from 0 to 100. For example, the value for S2. Affordability of financial services was 4.8, which is the highest value for all 24 countries. Therefore, the score for S2, Affordability of financial services, is equal to 100. The scores and weights for India are set out below:
  - S1. score of 82 multiplied by weight of 60%
  - S2. score of 100 multiplied by weight of 10%
  - S3. score of 100 multiplied by weight of 10%
  - S4. score of 85 multiplied by weight of 10%
  - S5. score of 85 multiplied by weight of 10%

- **The weights for each indicator are determined based on (i) its importance, (ii) its type (discreet or continuous), and (iii) the range of variation across countries.** In the 'Access to Finance' sub-pillar, following consultation with industry stakeholders it was clear that whether or not firms face constraints in access to finance was the most important indicator for the PAYGo context (S1. Firms who do not identify access to finance as a major constraint indicator), and therefore receives a weight of 60%. The remaining four indicators are less important and receive a weight of 10% each. In particular, S2 and S3 capture important information on the affordability of firm finance and availability of equity but are themselves already in index form from the Global Competitiveness Report, so receive a lower weight. Similarly, S4 and S5 present information on short- and long-term economic risk, but with limited variation across both two indicators which are in the form of an index score from BMI. While S2 to S5 present information that may be valuable, they are less important than S1 which receives the largest weight.

- **The 'raw' score for the 'Access to Finance' sub-pillar is therefore 86, which is then readjusted to reflect its position as the highest scoring country in this sub-pillar.** In practice this means India's raw score of 86 is scaled up by a factor of 1.16 to result in a normalised score in this sub-pillar of 100. The 'raw' scores of all other countries are also scaled up by the same factor so they maintain their relative position to India's normalised score of 100.

## Box 4: Aggregating sub-pillars to pillar and to overall index – worked example: Pakistan

**Pakistan is the highest scoring country on the 'demand' pillar, with a normalised score of 100, followed by Uganda, which scores 96.**

**This can appear counter-intuitive, as Pakistan does not score highest in any of the three sub-pillars within the demand pillar**. The following bullets set out how the process of weighting and aggregation at pillar level works, and the same process is then used to aggregate from the three main pillars to the overall index score.

- For the 'market size' sub-pillar, Uganda scores highest (100), while Pakistan scores 87
- For the 'ability to pay' sub-pillar, Indonesia scores highest (100), while Pakistan scores 74
- For the 'willingness to pay' sub-pillar, Kenya scores highest (100), while Pakistan scores 91

**Clearly, on any one of the sub-pillars, Pakistan is not the highest scoring country.** However, by virtue of the process of weighting these sub-pillars to arrive at the overall demand pillar score, Pakistan comes out on top. The default weights assigned to each of the sub-pillars 40%, 30% and 30% for market size, ability to pay, and willingness respectively. This places Pakistan first, and Uganda second in the demand pillar overall, as:

- **Pakistan's 'raw' weighted score across all three sub-pillars is 84.** This is the sum of each sub-pillar score and its weights, i.e. market size (score of 87 * weight of 40%), + ability to pay (score of 74 * weight of 30%) + willingness to pay (score of 91 * weight of 30%) = 89.
- **Uganda's 'raw' weighted score across all three sub-pillars is 80.** Similarly, this is: market size (score of 100 * weight of 40%), + ability to pay (score of 59 * weight of 30%) + willingness to pay (score of 76 * weight of 30%) = 77.

These 'raw' pillar scores are then re-adjusted so that the top scoring country scores 100, and the remaining countries' scores are adjusted accordingly. Specifically, to re-adjust Pakistan's score so that it receives 100 as the highest scoring country, its 'raw' score of 84 is multiplied by a factor of 1.19. Uganda's 'normalised' score on the demand pillar is therefore its 'raw' score of 80, multiplied by the readjustment factor of 1.19, which gives Kenya a demand pillar score of 96.

## 7.5 Using the index

The PAYGo MAI is built for user-defined comparison of country characteristics related to PAYGo market attractiveness. Five output tabs summarise index results by providing overall results for all countries in comparison (COUNTRY OVERVIEW and HEAT MAP tabs), country characteristics and relative performance (COUNTRY OVERVIEW and COUNTRY DEEP DIVE tabs), as well as indicator details and data (INDICATOR DETAIL TAB).

User modifiable cells are highlighted with a yellow background, and orange text. User selections are facilitated by a drop-down menu. In cases where user inputs can push the index into error, this is clearly highlighted. For example, users can select how to weight the pillars and sub-pillars, but if the user selects weights that do not sum to 100%, this is highlighted by a red error message. The user selection of weights on the PAYGo MAI tab will inform results shown on all subsequent tabs that show scores on the pillar level or overall scores (COUNTRY DEEP DIVE, HEAT MAP tabs). This is also highlighted in white text boxes on the respective tabs.

**There are five output tabs:**

- **The 'PAYGo MAI' tab**
  - This is the main summary tab and presents overall index scores, as well as scores across the three main pillars. Users can select at the top of the tab which pillar they want to display, from a choice of the overall index, or each of the three main pillars of the index. The bar chart, country scores and rankings will update automatically.
  - Users may also select a country to highlight. This provides a dark-green highlight to show the country selected on both the column chart and the text table of scores, ordered by country ranking. The index results for the country of choice are summarised in a light blue text box.
  - Finally, users can change the weight of each of the sub-pillars, and the three main pillars. The weights for each sub-pillar, and the three main pillars, should each sum to 100%. An error message will appear in red if this is not the case.
  - The index is presented with default weights based on market research and engagement. Clicking the 'Reset Weights' button will return the values of the pillar and sub-pillar weights to these default values.

Figure 12: 'PAYGo MAI' tab

**PAYGo Market Attractiveness Index 2021 SUMMARY RESULTS**

PILLAR DISPLAY: OVERALL SCORE

COUNTRY HIGHLIGHT: Indonesia

User-defined inputs are highlighted with a yellow background. Please define selection of overall scores or the three main pillar scores to display under 'PILLAR DISPLAY' dropdown. Select a country to highlight under 'COUNTRY HIGHLIGHT' dropdown and press the key 'Delete' in the drop-down to turn off country highlight. Please define weights for each pillar, and each sub-pillar, in 'USER DEFINED WEIGHTS', or click "Reset Weights" on the right to go back to default weights.

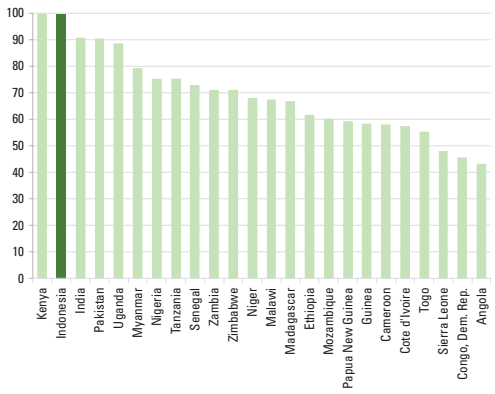
Reset Weights

HIGHER SCORE INDICATES BETTER PERFORMANCE

Indonesia scores 100/100 and ranks 2 out of 24 countries in OVERALL SCORE, based on the user-defined weights.

OVERALL SCORE

| Rank | Country | Score |
|---|---|---|
| 1 | Kenya | 100 |
| 2 | Indonesia | 100 |
| 3 | India | 91 |
| 4 | Pakistan | 90 |
| 5 | Uganda | 89 |
| 6 | Myanmar | 79 |
| 7 | Nigeria | 75 |
| 8 | Tanzania | 75 |
| 9 | Senegal | 73 |
| 10 | Zambia | 71 |
| 11 | Zimbabwe | 71 |
| 12 | Niger | 68 |
| 13 | Malawi | 67 |
| 14 | Madagascar | 67 |
| 15 | Ethiopia | 62 |
| 16 | Mozambique | 60 |
| 17 | Papua New Guinea | 59 |
| 18 | Guinea | 58 |
| 19 | Cameroon | 58 |
| 20 | Cote d'Ivoire | 58 |
| 21 | Togo | 55 |
| 22 | Sierra Leone | 48 |
| 23 | Congo, Dem. Rep. | 46 |
| 24 | Angola | 43 |




| | |
|---|---|
| **DEMAND SCORE** | 20% |
| *Market size* | 40% |
| *Ability to pay* | 30% |
| *Willingness to pay* | 30% |
| **SUPPLY SCORE** | 50% |
| *Access to finance* | 30% |
| *Operational Considerations* | 30% |
| *Market penetration* | 20% |
| *Human Capital* | 20% |
| **ENABLING ENVIRONMENT SCORE** | 30% |
| *ICT* | 50% |
| *Legal & Regulatory* | 30% |
| *Trade & Commerce* | 20% |

**WEIGHTS EXPLAINED**

Each pillar score is a weighted average of its sub-pillars' scores. The overall score is the weighted average of the three main pillars scores. For example, the demand score is the weighted average of the market-size, ability to pay and willingness to pay scores, and the overall score is the weighted average of the demand, supply and enabling environment scores.

Changing sub-pillar weights under one pillar leads to change in the scores of that pillar as well as the overall scores.

The weights of the three main pillars must sum to 100%. Similarly, the weights of each sub-pillar must sum to 100%. An error message will appear and red highlights indicate where the pillars or sub-pillar weights do not sum to 100%.

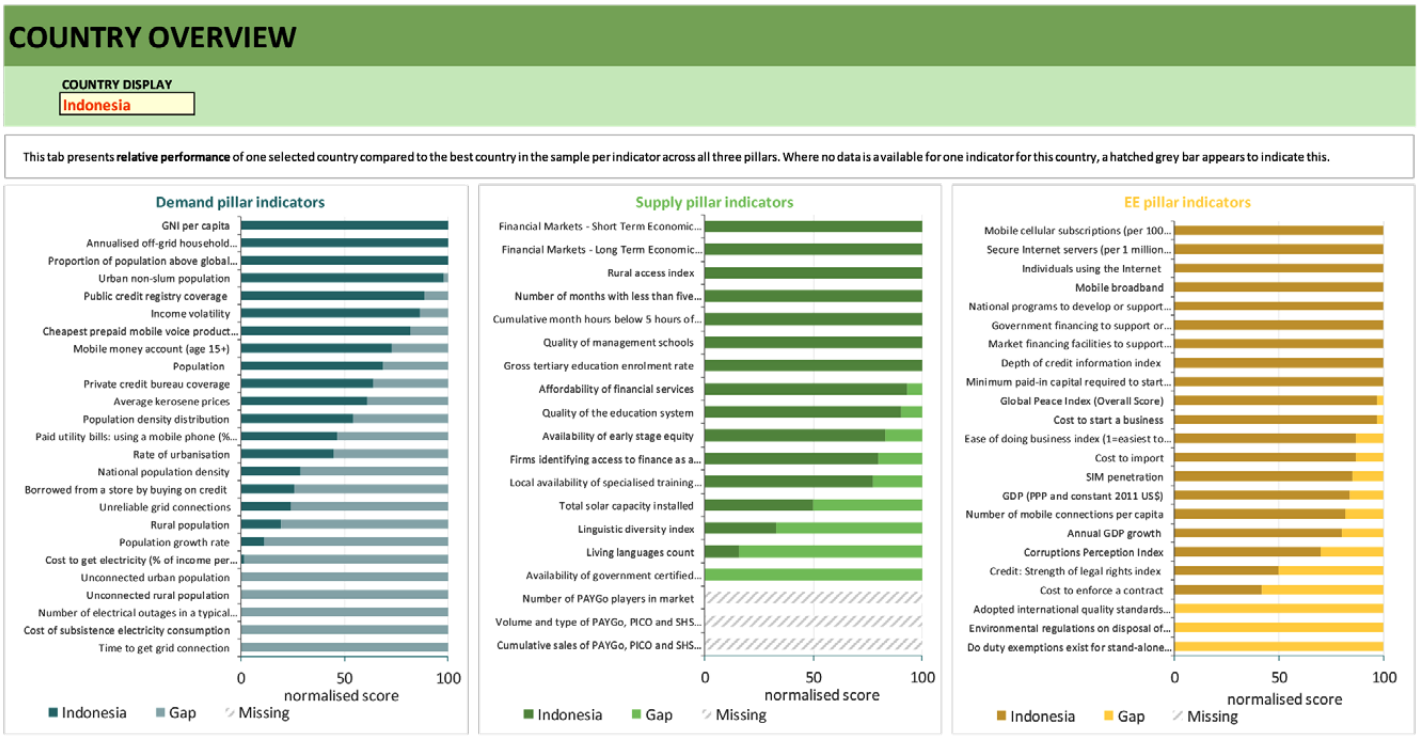
The yellow button "Reset Weights" will undo all user selections on weights and return default weights based on expert judgement.

Source: PAYGo MAI, 2021 version

- **The 'COUNTRY OVERVIEW' tab**

  - This tab aims to clearly highlight strengths and weaknesses of a selected country across the three PAYGo MAI Pillars Supply, Demand and Enabling Environment. A country is selected in the "COUNTRY DISPLAY" field and the figures will update to reflect this country choice. Indicators in each figure are re-ordered based on their normalised scores. The indicator data is sorted from highest to lowest score within each pillar.

Figure 13: 'COUNTRY OVERVIEW' tab




Source: PAYGo MAI, 2021 version

- **The 'COUNTRY DEEP DIVE' tab**

  - This tab provides an accessible summary of all indicators for a single country of interest. The top half of this tab presents a summary of the overall score, and sub-pillar scores for the country selected. It also shows a 'spider' diagram of scores across the overall index and the three main pillars, against a comparator country which the user can also select. The table and graph in this top panel are dependent only on the primary country selected, and the comparator country selected (see below). Note that overall scores and pillar scores in this tab are based on the current live selection of weights in the PAYGo MAI Tab.

  - The bottom half of the page shows the indicator scores – in both raw format and for the normalised scores (between 0 – 100). These tables update to display the scores for indicators for one sub-pillar at a time and depend on the primary country selected and on the sub-pillar selected (see below).

  - Users first select the country of interest in the 'COUNTRY DISPLAY' dropdown. This defines the country for which all indicators will be selected. The 'SELECT COUNTRY FOR COMPARISON' dropdown defines the second country to be displayed on the spider diagram.

  - By using the 'PILLAR DISPLAY' dropdown, the user selects which set of indicators will be displayed. The tab displays all the indicators, organised under sub-pillar headings, for one of the three main pillars at a time. For example, if the user selects 'DEMAND' they will see all the demand side pillars displayed under the three sub-pillar headings (market size, ability to pay, and willingness to pay).

Figure 14: 'COUNTRY DEEP DIVE' tab

## COUNTRY DEEP DIVE

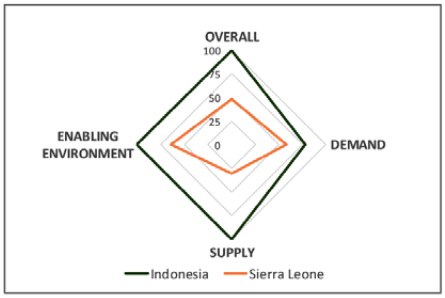
COUNTRY DISPLAY: Indonesia | PILLAR DISPLAY: DEMAND | SELECT COUNTRY FOR COMPARISON: Sierra Leone

User-defined inputs are highlighted with a yellow background. Please **define primary country** of focus to display in 'COUNTRY DISPLAY' dropdown. Please **define pillar** for which to display all indicator scores in 'PILLAR DISPLAY' dropdown. Select a **secondary country to display on the comparison graph** using 'SELECT COUNTRY FOR COMPARISON' and press the key 'Delete' in the drop-down if no comparison is required. Summary scores on this sheet are based on the user defined weights on the PAYGo MAI sheet.

The **country table** below shows the overall, three main pillars and their-sub-pillar scores for the selected country, and is independent of the pillar display.

| INDONESIA | Rank | Score | Average |
|---|---|---|---|
| **OVERALL SCORE** | 2 | 100 | 69 |
| **DEMAND** | 5 | 78 | 70 |
| *Market Size* | | *47* | *64* |
| *Ability to pay* | | *100* | *56* |
| *Willingness to pay* | | *57* | *54* |
| **SUPPLY** | 1 | 100 | 66 |
| *Access to finance* | | *99* | *57* |
| *Operational Considerations* | | *100* | *61* |
| *Market Penetration* | | *55* | *38* |
| *Human Capital* | | *81* | *71* |
| **ENABLING ENVIRONMENT** | 1 | 100 | 66 |
| *ICT* | | *100* | *42* |
| *Legal & Regulatory* | | *53* | *70* |
| *Trade & Commerce* | | *95* | *68* |

The **graph** below shows the overall and the three main pillar scores for the selected and comparator country, and is independent of the pillar display.




Indonesia scores 100 and ranks 2 out of 24 countries in OVERALL SCORE, based on the user-defined weights as defined in the PAYGo MAI tab.

Indonesia is strongest on the Ability to pay pillar, where it scores 100.

Indonesia's strongest sub-pillar is Ability to pay, while its weakest sub-pillar is Market Size.

On the DEMAND pillar, which is selected for display, Indonesia is especially strong on the indicator Ability to pay, with a score of 100.

**90% of data points are available for Indonesia.**

The **sub-pillar tables** below provide indicator scores - in both raw format and normalised scores - for the country and pillar display selected above. The sub-pillar tables do not include data on the country for comparison.

| MARKET SIZE | | Unit | Data | Score |
|---|---|---|---|---|
| D_1 | Population size | people | 270,625,568 | 69 |
| D_2 | National population density | people per sq km | 142.6 | 29 |
| D_3 | Population density distribution | % | 46.2 | 54 |
| D_4 | Rural population | % | 44.0 | 19 |
| D_5 | Population growth rate | % (CAGR) | 1.1 | 11 |
| D_6 | Rate of urbanisation | % (CAGR) | 1.2 | 45 |
| D_7 | Urban non-slum population | % | 69.4 | 98 |
| D_8 | Unconnected rural population | % | 3.2 | 0 |
| D_9 | Unconnected urban population | % | 0.1 | 0 |
| D_10 | Unreliable grid connections | % | 11.5 | 24 |
| D_11 | Number of electrical outages in a typical month | outages in a month | 0.5 | 0 |

| ABILITY TO PAY | | Unit | Data | Score |
|---|---|---|---|---|
| D_12 | GNI per capita | $ USD current prices | 4050.0 | 100 |
| D_13 | Affordability of Tier 1 OGS systems | % | 100.0 | 100 |
| D_14 | Proportion of population that is not poor | % | 90.6 | 100 |
| D_15 | Income volatility | % | 5.6 | 87 |

| WILLINGNESS TO PAY | | Unit | Data | Score |
|---|---|---|---|---|
| D_16 | Borrowed from a store by buying on credit | % | 6.9 | 26 |
| D_17 | Cost of subsistence electricity consumption | Score | 100.0 | 0 |
| D_18 | Time to get grid connection | days | 32.2 | 0 |
| D_19 | Cost of generator fuel | $ | 602.1 | 61 |
| D_20 | Private credit bureau coverage | % | 40.4 | 64 |
| D_21 | Public credit registry coverage | % | 30.9 | 88 |
| D_22 | Mobile money accounts per 1,000 adults | accounts per 1,000 adults | 1,463.8 | 73 |
| D_23 | Paid utility bills: using a mobile phone (% paying utility bills, age 15+) | % | 3.2 | 46 |
| D_24 | Price of basic mobile plan | $ USD | 4.2 | 82 |
| D_25 | Cost to get electricity (% of income per capita) | % | 233.8 | 2 |

Source: PAYGo MAI, 2021 version

- **The 'INDICATOR' tab**

  - The indicator tab allows users to see the latest year of data, raw data and normalised scores by country for a single indicator. Next to the main results table, users find a selection of further summary details. These include the pillar and sub-pillar location of the selected indicator, the unit of measurement, source, a description of the indicator as well as the direction of impact. In addition, Median and Average values for the selected indicator are displayed. Where the indicator value is unavailable for a country, the "year" column will display "Estimate", and the data column will display "n/a".

  - The user first selects which of the three main pillars from which they wish to select an indicator in the 'PILLAR DISPLAY' dropdown. Next, they select an individual indicator in the 'INDICATOR DISPLAY' dropdown. Finally, the user can select a country to highlight in the table of results, by using the 'COUNTRY HIGHLIGHT' dropdown. Only when PILLAR DISPLAY and INDICATOR DISPLAY match, will the overview table display values.

Figure 15. 'INDICATOR' tab

## INDICATOR TAB

| PILLAR DISPLAY | INDICATOR DISPLAY | COUNTRY HIGHLIGHT |
|---|---|---|
| DEMAND | D_1, Population size | Indonesia |

User-defined inputs are highlighted with a yellow background. Please **define pillar** for which to display indicator choice in 'PILLAR DISPLAY' dropdown. Please **define an indicator** to display scores in 'INDICATOR DISPLAY' dropdown. Select a **country to highlight** under 'COUNTRY HIGHLIGHT' dropdown and then press the key 'Delete' in the drop-down if no highlight is required.
Note: Please reselect "INDICATOR DISPLAY" after changing the selection of "PILLAR DISPLAY".

HIGHER SCORE INDICATES BETTER PERFORMANCE

**D_1, Population size**

| *Country* | *Year* | *Data* | *Unit* | *Score* |
|---|---|---|---|---|
| Angola | 2019 | 31,825,295.0 | people | 27 |
| Cameroon | 2019 | 25,876,380.0 | people | 23 |
| Congo, Dem. Rep. | 2019 | 86,790,567.0 | people | 47 |
| Cote d'Ivoire | 2019 | 25,716,544.0 | people | 23 |
| Ethiopia | 2019 | 112,078,730.0 | people | 52 |
| Guinea | 2019 | 12,771,246.0 | people | 10 |
| India | 2019 | 1,366,417,754.0 | people | 100 |
| Indonesia | 2019 | 270,625,568.0 | people | 69 |
| Kenya | 2019 | 52,573,973.0 | people | 37 |
| Madagascar | 2019 | 26,969,307.0 | people | 24 |
| Malawi | 2019 | 18,628,747.0 | people | 17 |
| Mozambique | 2019 | 30,366,036.0 | people | 26 |
| Myanmar | 2019 | 54,045,420.0 | people | 37 |
| Niger | 2019 | 23,310,715.0 | people | 21 |
| Nigeria | 2019 | 200,963,599.0 | people | 63 |
| Pakistan | 2019 | 216,565,318.0 | people | 64 |
| Papua New Guinea | 2019 | 8,776,109.0 | people | 2 |
| Senegal | 2019 | 16,296,364.0 | people | 14 |
| Sierra Leone | 2019 | 7,813,215.0 | people | 0 |
| Tanzania | 2019 | 58,005,463.0 | people | 39 |
| Togo | 2019 | 8,082,366.0 | people | 1 |
| Uganda | 2019 | 44,269,594.0 | people | 34 |
| Zambia | 2019 | 17,861,030.0 | people | 16 |
| Zimbabwe | 2019 | 14,645,468.0 | people | 12 |
| Median | - | 28,667,671.5 | people | - |
| Average | - | 113,803,117.0 | people | - |

**PILLAR**
Demand

**SUB-PILLAR**
Market Size

**Data Unit**
people

**Source**
World Bank, World Development Indicators

**Description**
Absolute population size

An indicator of absolute size of market

**Direction of impact**
Ascending

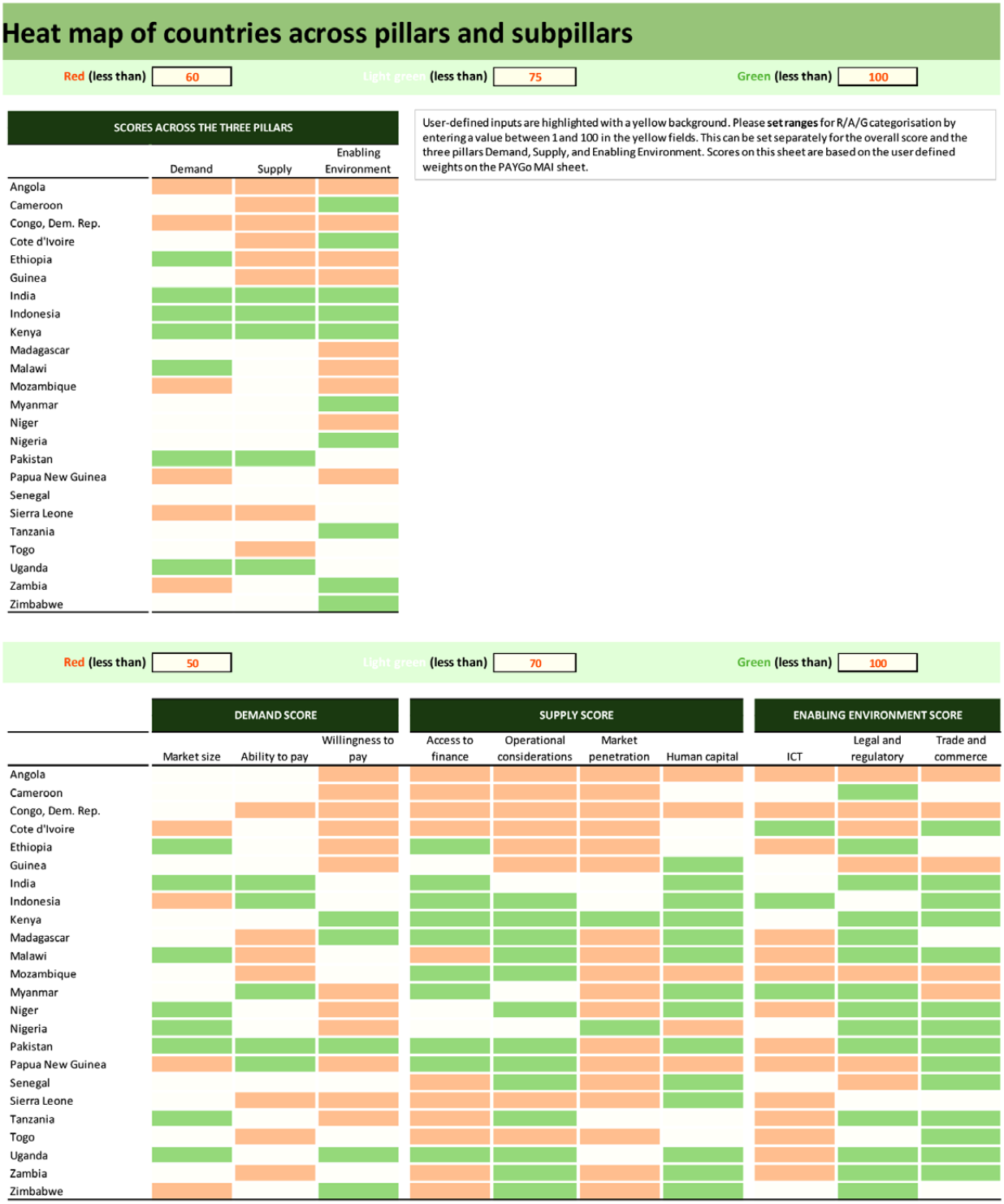
**Datapoints available for this indicator**
100%

* if data is missing for a particular country, the year will display 'Estimate'. The estimate for the score of this country on this indicator is based on the relative score of the country in the respective sub-pillar. The PAYGo MAI user guide explains this method in detail.

Source: PAYGo MAI, 2021 version

- **The 'HEAT MAP' tab**
  - Based on user selected definition of limits for "Orange", "Light Green" and "Dark Green", countries' scores are displayed as heatmaps. Heatmaps facilitate quick comparison of countries across pillars and sub-pillars. Again, the displayed scores are based on user selected weights in the PAYGo MAI tab.

Figure 16.: 'HEAT MAP' tab



## Heat map of countries across pillars and subpillars

Red (less than) 60 | Light green (less than) 75 | Green (less than) 100

**SCORES ACROSS THE THREE PILLARS**

| | Demand | Supply | Enabling Environment |
|---|---|---|---|
| Angola | | | |
| Cameroon | | | |
| Congo, Dem. Rep. | | | |
| Cote d'Ivoire | | | |
| Ethiopia | | | |
| Guinea | | | |
| India | | | |
| Indonesia | | | |
| Kenya | | | |
| Madagascar | | | |
| Malawi | | | |
| Mozambique | | | |
| Myanmar | | | |
| Niger | | | |
| Nigeria | | | |
| Pakistan | | | |
| Papua New Guinea | | | |
| Senegal | | | |
| Sierra Leone | | | |
| Tanzania | | | |
| Togo | | | |
| Uganda | | | |
| Zambia | | | |
| Zimbabwe | | | |

User-defined inputs are highlighted with a yellow background. Please **set ranges** for R/A/G categorisation by entering a value between 1 and 100 in the yellow fields. This can be set separately for the overall score and the three pillars Demand, Supply, and Enabling Environment. Scores on this sheet are based on the user defined weights on the PAYGo MAI sheet.

Red (less than) 50 | Light green (less than) 70 | Green (less than) 100

| | DEMAND SCORE | | | SUPPLY SCORE | | | | ENABLING ENVIRONMENT SCORE | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Market size | Ability to pay | Willingness to pay | Access to finance | Operational considerations | Market penetration | Human capital | ICT | Legal and regulatory | Trade and commerce |
| Angola | | | | | | | | | | |
| Cameroon | | | | | | | | | | |
| Congo, Dem. Rep. | | | | | | | | | | |
| Cote d'Ivoire | | | | | | | | | | |
| Ethiopia | | | | | | | | | | |
| Guinea | | | | | | | | | | |
| India | | | | | | | | | | |
| Indonesia | | | | | | | | | | |
| Kenya | | | | | | | | | | |
| Madagascar | | | | | | | | | | |
| Malawi | | | | | | | | | | |
| Mozambique | | | | | | | | | | |
| Myanmar | | | | | | | | | | |
| Niger | | | | | | | | | | |
| Nigeria | | | | | | | | | | |
| Pakistan | | | | | | | | | | |
| Papua New Guinea | | | | | | | | | | |
| Senegal | | | | | | | | | | |
| Sierra Leone | | | | | | | | | | |
| Tanzania | | | | | | | | | | |
| Togo | | | | | | | | | | |
| Uganda | | | | | | | | | | |
| Zambia | | | | | | | | | | |
| Zimbabwe | | | | | | | | | | |

Source: PAYGo MAI, 2021 version

# Complete list of indicators

## Demand side pillar indicators

Table 4: Market size indicators

| # | Name | | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| D_1 | Population size | Absolute population size | 2019 | World Bank, World Development Indicators | Ascending - An indicator of absolute size of market |
| D_2 | National population density | Average population density across country | 2019 | World Bank, World Development Indicators | Ascending - Dense populations typically easier to reach |
| D_3 | Population density distribution | Proportion of population that is "medium density", i.e. < 1000 pp / sq km and > 100 pp / sq km | 2018 | Vivid modelling, based on UN WPP density data | Ascending - Medium density population best target market for SHS style technologies |
| D_4 | Rural population | Proportion of population not living in urban areas | 2019 | World Bank, World Development Indicators | Ascending - Rural population an important market |
| D_5 | Population growth rate | Rate of population growth between 2015 and 2025 | prediction to 2025 | World Bank, World Development Indicators | Ascending - Indicator of future market size |
| D_6 | Rate of urbanisation | Rate of urbanisation between 2015 and 2025 | prediction to 2025 | World Bank, World Development Indicators | Ascending - Indicator of increase in population living in urban centres -- can be a driver of demand where grid is unreliable |
| D_7 | Urban non-slum population | Proportion of urban homes not classified as slums | 2018 | World Bank, World Development Indicators | Ascending - Slum populations typically less suited to technology solution which requires payback over a period of years |
| D_8 | Unconnected rural population | Proportion of rural population with no access to electricity. | 2018 | World Bank, World Development Indicators | Ascending - Indicator of relative market size in rural areas |
| D_9 | Unconnected urban population | Proportion of urban population with no access to electricity | 2018 | World Bank, World Development Indicators | Ascending - Indicator of relative market size in urban areas |
| D_10 | Unreliable grid connections | Proportion of households with an unreliable grid connection | 2019 | Off-Grid Solar Market Trends Report 2020 | Ascending - Households with an unreliable grid connection may use OGS solutions as an alternative / back-up |
| D_11 | Number of electrical outages in a typical month | Number of electric outages in a typical month as reported by businesses in the Enterprise Survey | various, latest 2019 | World Bank, Enterprise Surveys | Ascending - Households with an unreliable grid connection may use OGS solutions as an alternative / back-up |

Source: PAYGo MAI 2021

Table 5 Ability to pay indicators

| # | Name | | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| D_12 | GNI per capita | Annual gross national income per capita (Atlas method). GNI per capita is the dollar value of a country's final income in a year, divided by its population. It reflects the average income of a country's citizens. | 2019 | World Bank, World Development Indicators | Ascending - Higher income indicates higher ability to pay |
| D_13 | Affordability of Tier 1 OGS systems | Proportion of households able to afford the PAYGo deposit for a multi-light device (PAYGo deposit is less than 5% of three months' consumption) | 2019 | Off-Grid Solar Market Trends Report 2020 | Ascending –Indicates ability of households to afford the cheapest OGS product that is usually sold via PAYGo |
| D_14 | Proportion of population that is not poor | Proportion of population above national poverty lines | 2019 | World Bank, World Development Indicators | Ascending - Indicates relative share of population above ability to pay threshold income |
| D_15 | Income volatility | Weighted average volatility of crop yields for all major crop types (>5% of annual production) | 2019 | Analysis of FAO crop yield data 1990 – 2019 | Descending - Income volatility can present a challenge to PAYGo, as it presents a challenge to meet regular repayment schedules |

Source: PAYGo MAI 2021

Table 6 Willingness to pay indicators

| # | Name | | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| D_16 | Borrowed from a store by buying on credit | Denotes the percentage of respondents who borrowed any money in the past 12 months from a store by using instalment credit or buying on credit. (age group 15+) | 2014 | World Bank, Findex | Ascending - Previous experience with buying on credit increases willingness to enter a credit-based contract |
| D_17 | Cost of subsistence electricity consumption | Index: What is the cost per kWh that a residential consumer pays for the first 30 kWh of consumption per month? | 2019 | RISE 2020, SE4ALL | Descending–Low index score indicates high cost of alternative electricity consumption, increasing willingness to pay |
| D_18 | Time to get grid connection | Time required to get electricity (days) | 2019 | World Bank, Doing Business | Ascending - High effort required for getting grid connection partly increases willingness to pay |
| D_19 | Cost of generator fuel | Annual fuel expenditure on generators by unconnected households (US$ per household per year) | 2019 | Off-Grid Solar Market Trends Report 2020 | Ascending -High cost of alternative electricity consumption increases willingness to pay |
| D_20 | Private credit bureau coverage | Percentage of adults covered by private credit | 2019 | World Bank, Doing Business | Ascending - Indicator for financial inclusion and willingness to engage in a credit model |
| D_21 | Public credit registry coverage | Percentage of adults covered by public credit | 2019 | World Bank, Doing Business | Ascending - Indicator for financial inclusion and willingness to engage in a credit model |

| # | Name | | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| D_22 | Mobile money accounts per 1,000 adults | Number of registered mobile money accounts per 1,000 adults | 2019 | IMF Financial Access Survey | Ascending - Indicates share of population that could use mobile money based PAYGo payment mechanisms |
| D_23 | Paid utility bills: using a mobile phone (% paying utility bills, age 15+) | Among respondents reporting personally making regular payments for water, electricity, or trash collection in the past 12 months, the percentage who report making these payments through a mobile phone | 2017 | World Bank, Findex | Ascending - Indicates share of population already using mobile money to pay for similar service |
| D_24 | Price of basic mobile plan | Price of a "low consumption" data and voice mobile plan of 3G and above service, with 70 minutes voice, 20 SMS and 500MB data | 2020 | International Telecommunications Union | Descending - Lower cost of mobile phone products raises prevalence of mobile based payment mechanisms |
| D_25 | Cost to get electricity (% of income per capita) | All the fees and costs associated with completing the procedures to connect a warehouse to electricity are recorded, including those related to obtaining clearances from government agencies, applying for the connection, receiving inspections of both the site and the internal wiring, purchasing material, getting the actual connection working and paying a security deposit. | 2019 | World Bank, Doing Business | Ascending - High cost of setting up electricity connection increase willingness to pay for alternative. Given the focus on establishing the connection of a warehouse, this indicator reflects most closely the cost to get electricity for commercial use. |

Source: PAYGo MAI 2021

## Supply side pillar indicators

Table 7: Access to finance indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| S_1 | Firms who do not identify access to finance as a major constraint | Percentage of firms that do not state that they are identifying access to finance as a major constraint | various, latest 2019 | World Bank, Enterprise Surveys | Ascending - Indicates access to finance for SMEs. PAYGo has high upfront capital requirements - only repaid over time of repayment from customers. |
| S_2 | Affordability of financial services | Answer to the question: In your country, to what extent can small- and medium-sized enterprises (SMEs) access finance they need for their business operations through the financial sector? [1 = not at all; 7 = to a great extent] | various, latest 2019 | The Global Competitiveness Report 2019 | Ascending - Indicates access to finance for SMEs |
| S_3 | Availability of early stage equity | Answer to the question: In your country, how easy is it for start-up entrepreneurs with innovative but risky projects to obtain equity funding? [1 = extremely difficult; 7 = extremely easy] | various, latest 2019 | The Global Competitiveness Report 2019 | Ascending - Indicates access to early stage equity for start-up businesses |

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| S_4 | Financial Markets - Short Term Economic Risk | Index measure of the short-term economic risk of financial markets. It is a short-term measure of how easy it is for companies to operate in the country's financial markets. Amongst other parameters, this includes capital controls and currency risk. [0 to 100, 100 being the least risky] | 2021 | Fitch Solutions, 2021 | Ascending - Indicates ease of financial operations for businesses - PAYGo companies may need to work in different currencies / move capital with ease |
| S_5 | Financial Markets - Long Term Economic Risk | Index measure of the long-term economic risk of financial markets. It is a long-term measure of how easy it is for companies to operate in the country's financial markets. Amongst other parameters, this includes capital controls and currency risk. [0 to 100, 100 being the least risky] | 2021 | Fitch Solutions, 2021 | Ascending - Indicates ease of financial operations for businesses - PAYGo companies may need to work in different currencies / move capital with ease |

Source: PAYGo MAI 2021

Table 8 Supply side operational indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| S_6 | Rural access index | The Rural Access Index provides a consistent basis for estimating the proportion of the rural population which has adequate access to the transport system. The RAI was developed in 2003 as a measure of transport connectivity using spatial data and techniques and comprising data on both road density and road condition. Index updated for some countries in 2019 | various | Roberts, Peter; KC, Shyam; Rastogi, Cordula. 2006. Rural Access Index and World Bank. 2019. Measuring Rural Access: Update 2017/2018. | Ascending - Indicates ease of distributing OGS products to rural populations |
| S_7 | Number of months with less than five hours of sunshine per day | Number of months in a year where daily average sunshine hours is less than 5 | 2018 | Vivid modelling based on various sources | Descending - Indicates availability of solar resource to power technology |
| S_8 | Cumulative month-hours below five hours of sunshine per day | The difference between the threshold of 5 hours and daily average sunshine hours, summed across all months where average daily sunshine hours is less than 5 | 2018 | Vivid modelling based on various sources | Descending - Indicates availability of solar resource to power technology |

Source: PAYGo MAI 2021

Table 9 Market penetration indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| S_9 | Number of PAYGo players in market | Number of affiliate companies reporting B2C PAYGo sales in the last three years (2018-2020) | 2020 | GOGLA Sales and Impact Data (2018-2020) | Ascending - Active existing market demonstrates feasible conditions |
| S_10 | Total decentralised solar capacity installed excluding mini-grids | Sum of decentralised solar capacity, excluding mini-grids, installed in the country | 2018 | IRENA Off-Grid Renewable Energy Statistics 2020 | Ascending - Indicates broader penetration of similar decentralised solar products |
| S_11 | Most recent sales volume of multi-light and SHS | Number of multi-light and solar home systems sold in the second half of 2020. | 2020 | GOGLA | Ascending - Active market in most recent half-year of sales demonstrates feasible / attractive current conditions. Based on sales data collected from GOGLA members and Lighting Global associates. |
| S_12 | Cumulative sales volumes of multi-light and SHS since 2014 | The cumulative sum of multi-light and solar home systems sold since the second half of 2014. | 2020 | GOGLA | Ascending - Cumulative sales of OGS products indicates success in reaching consumer base |

Source: PAYGo MAI 2021

Table 10 Human capital indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| S_13 | Quality of graduate schools | Response to the survey question "In your country, to what extent do graduating students possess the skills needed by businesses at the following levels: University-level ". score 1-7, (1 = Not at all; 7 = To a great extent) | 2019 | The Global Competitiveness Report 2019 | Ascending - Indicates ease of recruiting management locally |
| S_14 | Local availability of specialized training services | Response to the survey question: "In your country, to what extent do companies invest in training and employee development?" score 1-7, (1 = not at all; 7 = to a great extent) | 2019 | The Global Competitiveness Report 2019 | Ascending - Indicates climate for specialised training in the local labour market |
| S_15 | Quality of the education system | Response to the survey question "In your country, to what extent do graduating students possess the skills needed by businesses at the following levels: a. Secondary education". score 1-7, (1 = Not at all; 7 = To a great extent) | 2019 | The Global Competitiveness Report 2019 | Ascending - Indicates alignment of local education systems to business needs |
| S_16 | Gross tertiary education enrolment rate | Gross enrolment ratio in tertiary education in % of relevant age group | 2019 | World Bank, World Development Indicators | Ascending - General indicator of availability of high-skill labour |
| S_17 | Living languages count | Count of living languages | 2017 | Simons, Gary F. and Charles D. Fennig (eds.). 2018. Ethnologue: Languages of the World | Descending - Language diversity can pose challenges for operating distribution networks |

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| S_18 | Linguistic diversity index | Variation of local languages, index. Index score 0 - 1 | 2017 | Simons, Gary F. and Charles D. Fennig (eds.). 2018. Ethnologue: Languages of the World | Descending - Language diversity can pose challenges for operating distribution networks |
| S_19 | Availability of government certified training programmes for solar equipment installation | Response to the survey question: "Is there a government certified program for solar equipment installers?" | 2015 | RISE 2016, SE4ALL | Ascending - Indicates specific government supported training for skills required for solar sector |

Source: PAYGo MAI 2021

## Enabling environment indicators

Table 11: Information and communications technology indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| EE_1 | Unique mobile subscribers per capita | Proportion of the population with a mobile subscription. This identifies unique mobile subscribers; individuals with more than one mobile subscription are only counted once | 2020 | World Bank, World Development Indicators and GSMA Intelligence 2020 | Ascending - Indicates favourable conditions for mobile / internet-based payment mechanisms |
| EE_2 | Secure Internet servers | Secure servers are servers using encryption technology in Internet transactions | 2020 | World Bank, World Development Indicators, from Netcraft | Ascending - Indicates favourable conditions for mobile / internet-based payment mechanisms |
| EE_3 | Individuals using the Internet | Internet users are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc. Annual weighted average of the percentage of the population | 2019 | World Bank, World Development Indicators, from International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database | Ascending - Indicates favourable conditions for mobile / internet-based payment mechanisms |
| EE_4 | SIM penetration | Proportion of the population making use of a SIM | 2020 | GSMA Intelligence Q4 2020, and World Bank, World Development Indicators | Ascending - Indicates favourable conditions for mobile / internet-based payment mechanisms |
| EE_5 | Unique mobile internet subscribers per capita | Proportion of the population with a mobile broadband subscription | 2020 | GSMA Intelligence Q4 2020, and World Bank, World Development Indicators | Ascending - Indicates favourable conditions for mobile / internet-based payment mechanisms |
| EE_6 | Mobile cellular subscriptions per 100 people | Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology | 2019 | World Bank, World Development Indicators, from International Telecommunication Union (ITU) World Telecommunication/ICT Indicators Database | Ascending - Indicates favourable conditions for mobile / internet-based payment mechanisms |

Source: PAYGo MAI 2021

Table 12 Legal and regulatory indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| EE_7 | Do national programs to develop or support standalone systems exist? | Response to the question: Are there national programs which aim to develop standalone systems or support the development of standalone systems? | 2019 | RISE 2020, SE4ALL | Ascending - Indicates favourable regulatory environment for OGS technology solutions |
| EE_8 | Has the government adopted international quality standards for standalone systems? | Response to the question: Has the government adopted international quality standards for standalone systems? | 2019 | RISE 2020, SE4ALL | Ascending - Indicates favourable regulatory environment for OGS technology solutions |
| EE_9 | Are there environmental regulations on disposal of solar devices and SHS components? | Response to the question: Are there environmental regulations on the disposal of solar devices and standalone home system products or components? | 2019 | RISE 2020, SE4ALL | Ascending - Indicates favourable regulatory environment for OGS technology solutions |
| EE_10 to EE_13 | These indicators have been retired | See Section 7.2 for more details. | | | |
| EE_14 | Do duty exemptions exist for standalone systems? | Response to the question: Are there duty exemptions and/or subsidies to support standalone home systems? | 2019 | RISE 2020, SE4ALL | Ascending - Indicates favourable regulatory environment for OGS technology solutions |
| EE_15 | Do government incentives exist for renewable electricity? | Does the government offer other direct fiscal incentives for renewable electricity (e.g. capital subsidies, grants or rebates, investment tax credits, tax reductions, production tax credits)? | 2019 | RISE 2020, SE4ALL | Ascending - Indicates favourable regulatory environment for OGS technology solutions |
| EE_16 | Do specific financing facilities exist for operators in energy access? | Are there specific financing facilities available to support operators/ consumers to develop/ purchase standalone home systems? | 2019 | RISE 2020, SE4ALL | Ascending - Indicates favourable regulatory environment for OGS technology solutions |

Source: PAYGo MAI 2021

Table 13 Trade and commerce indicators

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| EE_17 | Depth of credit information index | Depth of credit information index measures rules affecting the scope, accessibility, and quality of credit information available through public or private credit registries. (0=low to 8=high) | 2019 | World Bank, Doing Business | Ascending - Indicates availability of information on credit for consumers and companies |
| EE_18 | Credit: Strength of legal rights index | Strength of legal rights index measures the degree to which collateral and bankruptcy laws protect the rights of borrowers and lenders and thus facilitate lending. (0=weak to 12=strong) | 2019 | World Bank, Doing Business | Ascending - Indicates strength of legal rights and contracts for financial services |
| EE_19 | GDP (PPP and constant 2017 international$) | GDP in purchasing power parity, constant international 2017 prices | 2019 | World Bank, World Development Indicators | Ascending - Indicator of general economic conditions |
| EE_20 | Annual GDP growth | GDP growth rate in 2019 | 2019 | World Bank, World Development Indicators | Ascending - Indicates expected growth and improved economic conditions |
| EE_21 | Ease of doing business index (1=easiest to 185=most difficult) | Ease of doing business, from the World Bank Doing Business project. (1=easiest to do business, 185 most difficult) | 2019 | World Bank, Doing Business | Descending - Indicates ease of business operations |

| # | Name | Description | Year | Source | Impact direction and rationale |
|---|---|---|---|---|---|
| EE_22 | Corruptions Perception Index | The index, which ranks 180 countries and territories by their perceived levels of public sector corruption according to experts and business people (scale of 0 to 100, where 0 is highly corrupt and 100 is very clean) | 2020 | Transparency International | Ascending - Indicates perception of corruption |
| EE_23 | Global Peace Index | Ranks 163 independent states and territories according to their level of peacefulness. (1-5, 1 being very peaceful) | 2020 | Visions of Humanity | Descending - Indicates peaceful environment to conduct business |
| EE_24 | Cost to import | Documentary compliance captures the time and cost associated with compliance with the documentary requirements of all government agencies of the origin economy, the destination economy and any transit economies. | 2019 | World Bank, Doing Business | Descending - Indicates cost of import (general) - which will typically be required for OGS products |
| EE_25 | Cost to enforce a contract | Cost as a percentage of total claim | 2019 | World Bank, Doing Business | Descending - Indicates cost of enforcing contract |
| EE_26 | Cost to start a business | Cost as a percentage of income per capita | 2019 | World Bank, Doing Business | Descending - Indicates cost to start new business operations |
| EE_27 | Minimum paid-in capital required to start a business | Paid in capital as a percentage of income per capita | 2019 | World Bank, Doing Business | Descending - Indicates capital constraints to starting new business operations |

Source: PAYGo MAI 2021

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