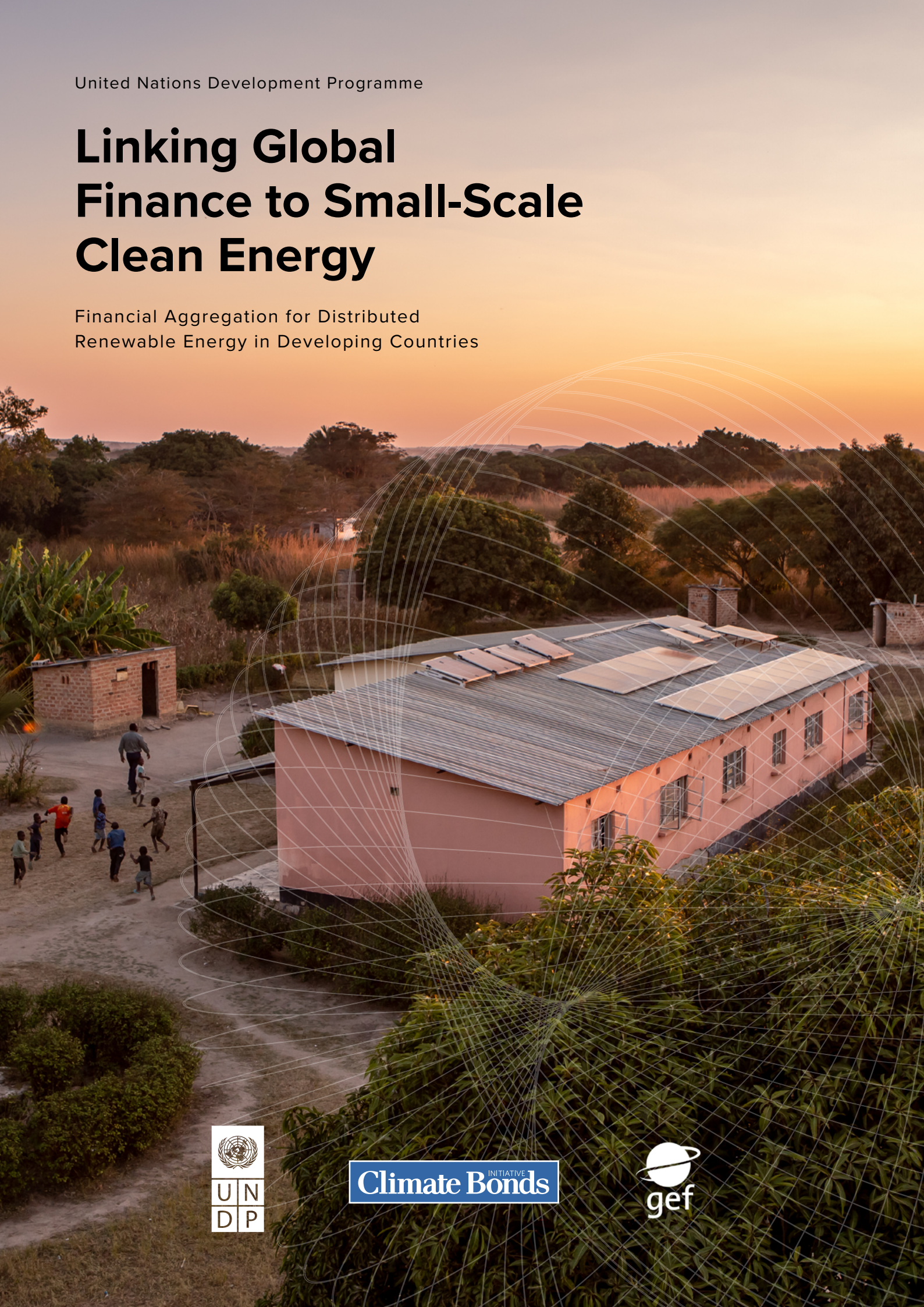
United Nations Development Programme

Linking Global Finance to Small-Scale Clean Energy

Financial Aggregation for Distributed Renewable Energy in Developing Countries



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The Climate Aggregation Platform (CAP)

The Climate Aggregation Platform (CAP) is a Global Environment Facility (GEF) funded project implemented by UNDP, which, in partnership with the Climate Bonds Initiative, seeks to promote the scale-up of financial aggregation for small-scale, low-carbon energy assets in developing countries.

The project aims to advance and raise awareness for innovative solutions to market barriers for financial aggregation – with the goal to increase access to low-cost financing for low-carbon energy. In so doing, the project can improve the lives of people in developing countries, bringing about affordable, reliable, and clean energy.

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The Climate Bonds Initiative

The Climate Bonds Initiative (Climate Bonds) is an international investor-focused not-for-profit organisation working to mobilise the USD100tn bond market for climate change solutions. It promotes investment in projects and assets needed for a rapid transition to a low-carbon, climate-resilient, and fair economy. The mission focus is to help drive down the cost of capital for large-scale climate and infrastructure projects and support governments seeking increased capital markets investment to meet climate and greenhouse gas (GHG) emission reduction goals.

Climate Bonds conducts market analysis, policy research, and market development; advises governments and regulators; and administers a global green bond standard and certification scheme. Climate Bonds screens green finance instruments against its Climate Bonds Taxonomy to determine alignment and uses sector-specific certification criteria. Climate Bonds Certification is a labelling scheme. Rigorous scientific criteria ensure that it is consistent with the 2˚C global warming limit of the Paris Agreement. Certification requires initial and ongoing third-party verification to ensure the assets meet the metrics of Sector Criteria.

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The Global Environment Facility was established on the eve of the Rio Earth Summit to tackle our planet's most pressing environmental problems. Since then, it has provided more than USD21.7bn in grants and mobilized an additional USD119bn in co-financing for more than 5,000 projects and programs. The GEF is the largest multilateral trust fund focused on enabling developing countries to invest in nature, and supports the implementation of major international environmental conventions including on biodiversity, climate change, chemicals, and desertification. It brings together 184 member governments in addition to civil society, international organisations, and private sector partners. Through its Small Grants Programme, the GEF has provided support to more than 27,000 civil society and community initiatives in 135 countries.

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Cover photo: Zambia-health centre with solar panels ©UNDP - Karin Schermbrucker for Slingshot

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Foreword

Climate impacts, exacerbated by the COVID-19 pandemic and the current energy crisis, continue to mount. Never has it been more important to act together, at an accelerated pace and scale, to transition to affordable renewable and sustainable energy sources and leave no one behind. Achieving such goals requires extremely ambitious measures, and new financial tools are needed to pave the way.

UNDP is committed to increasing energy access where it is lacking. By speeding up investment in distributed renewable energy solutions, especially for those hardest to reach and in crisis contexts, we aim to increase access to clean and affordable energy for 500 million people. Partnerships like this one between UNDP and Climate Bonds can catalyse impact better than individual action.

The transition toward a clean energy future is happening everywhere, albeit unevenly, and too many constraints prevent innovative solutions from being deployed. Access to finance is critical to enabling clean energy deployment. The thematic debt market is already enabling trillions to be channelled towards the green, resilient and inclusive economy of the future globally – yet some barriers to its tremendous potential remain, particularly in emerging markets.

Thematic debt instruments such as green bonds can be valuable tools to inject significant capital into small-scale renewable energy solutions that provide lower-cost energy than their fossil fuel equivalents. Low-carbon energy complies with the Climate Bonds Taxonomy and lends itself to the green bond universe. The recent announcement of the first-ever green bond transaction to finance distributed renewable energy across developing countries using securitisation highlights the evolving nature of this sector.

Existing fossil fuel energy systems are often deeply ingrained, making the change difficult, but we are on the cusp of a tipping point for an energy transition. By speeding-up investment in distributed renewable energy solutions, we can increase clean and affordable energy access. Small-scale assets also generate important social co-benefits, such as productive energy use and reduction of gender inequality.

This market-leading research investigates the great potential of financial aggregation to unlock finance necessary for the widespread adoption of clean energy in developing countries. However, many of the lessons can be applied more broadly across any sector dominated by small-scale enterprises. The partnership between UNDP and Climate Bonds aims to help mobilise global capital to bring clean energy access to 500 million people and empower other practitioners with the knowledge needed to navigate the challenges faced in financing small-scale clean energy projects.

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Acronyms

ABS	Asset-backed security
B2C	Business-to-consumer
CAGR	Compound annual growth rate
C&I	Commercial and industrial
CAP	Climate Aggregation Platform
DESCO	Distributed energy service company
DFI	Development finance institution
DM/EM	Developed Market(s)/Emerging Market(s)
DRE	Distributed renewable energy
D-REC	Distributed renewable energy certificate
ESG	Environmental, social and governance
EV	Electric vehicle
FCDO	UK Foreign, Commonwealth & Development Office
FX	Foreign exchange
GOGLA	Global Off-Grid Solar Lighting Association
GSS	Green, Social and Sustainability
ICT	Information and communications technology
IEA	International Energy Agency
IRENA	International Renewable Energy Agency
KES	Kenyan Shilling
KPI	Key performance indicator
LMD	Last-mile distributors
MAI	Market Attractiveness Index
MFI	Microfinance institution
OGR	Off-grid renewable(s)
OGS	Off-grid solar
PAYGO	Pay-as-you-go
P-REC	Peace renewable energy certificate
P2P	Peer-to-peer
PV	Photovoltaic
PULSE	Productive use leveraging solar energy
RBF	Results-based financing
SDG	Sustainable Development Goal
SEforALL	Sustainable Energy for All
SHS	Solar home system(s)
SME	Small- and medium-sized enterprise(s)
SPV	Special purpose vehicle
SNAT	Supranational
SSA	Sub-Saharan Africa
UGX	Ugandan Shilling
USD	United States Dollar
XAF	Central African Rand

1. Report outline

This report was developed as part of the Climate Aggregation Platform (CAP), a Global Environment Facility (GEF)-funded project implemented by UNDP, which, in partnership with the Climate Bonds Initiative, seeks to promote the scale-up of financial aggregation for small-scale, low-carbon energy assets in developing countries.

The report provides information on the current landscape for Distributed Renewable Energy (DRE) and the potential of financial aggregation to address the existing financing gap in developing countries. The majority of evidence detailed in this report focuses on sub-Saharan Africa (SSA). However, UNDP intends to support small-scale, low-carbon energy markets across all developing countries.

Available literature relevant to this topic alongside market analysis serves as the basis for identifying the key barriers to broader adoption of financial aggregation as a means to extend affordable finance to the sector. The barrier identification process serves as the premise for highlighting potential market enablers and directs the research towards case studies where success has been observed in practice. Several insights and recommendations are drawn from the analysis along with areas for further investigation. This process is supplemented by dozens of semi-structured informal interviews with stakeholders (complete list provided in the appendix) to ensure the analysis and conclusions reflect the current experience of practitioners operating in this space.

The report is intended to update existing knowledge and fill gaps in information. Future engagements between critical stakeholders including private and public financiers, impact investors, development agencies, commercial banks, financial intermediaries, government programmes, policymakers, energy companies, and other sector experts can benefit from the information enclosed to help achieve the ultimate goal of financial aggregation: the establishment of a liquid capital market to enable large-scale capital flows towards promising small-scale renewable energy initiatives.

UNDP is looking to expand the work in this report further and build on the existing data and insights. The Climate Aggregation Platform (CAP) project plans to develop a framework for assessing different markets' readiness for financial aggregation in the small-scale, low-carbon energy sector, and to conduct in-depth assessments at the regional and country level.

The team is particularly thankful for the contributions and peer reviews conducted by Christine Eibs Singer (SEforALL), Olivia Coldrey (SEforALL), Sagar Gubbi (Ecoforge), Arun Gopalan, Alison Harwood (Milken Institute), Daniel Waldron (Acumen), Ahmed Badr (IRENA), Tarig Ahmed (IRENA), Mateo Salomon (UNDP) and Kirthisri Rajatha Wijeweera (UNDP).

2. Executive summary

Further finance is needed to achieve SDG7

Electricity penetration rates are notably lower in developing countries, and direct actions are needed to address the access and financing gap if SDG7 is to be achieved.[1]

Distributed renewable energy (DRE) and other small-scale, low-carbon energy solutions are vital to achieving universal access, especially as a means of reaching those most underserved. Some significant distributional discrepancies are also evident, with financial commitments concentrated in a few countries and thus failing to reach many of those most in need of international support. Likewise, intranational discrepancies are apparent whereby private firms gravitate towards more accessible and higher-income markets. In other markets with less infrastructure and lower ability-to-pay, results-based financing (RBF) and other targeted mechanisms are necessary to de-risk investment and increase affordability.

Energy access is growing, yet finance fails to keep pace

Despite energy access seeing unprecedented growth and capital inflows over the last decade, investments have been highly concentrated and far from sufficient to enable the sector to reach its full potential. While the customer base is considerably larger than ten years ago, an estimated 620m people are predicted to remain without access by 2030 under current and planned policies before the start of the COVID-19 crisis.[2] The energy access deficit remains large – as does the potential for DRE and other small-scale, low-carbon energy solutions to address it. Solar home systems (SHS) and pico-solar are the dominant technologies in the off-grid sector despite most companies failing to achieve profitability.[3] Mini-grids play an essential role in increasing electrification rates. However, they are still at an early stage of market development, attract considerably less financing and require different types of capital compared to SHS. Clean cooking applications hold great promise but attract comparatively low amounts of funding due to a lack of policy support for the industry and affordability constraints.[4]

WOMEN eMujer students, Peru
Photo credit: Jasmin Ramirez Romero UNDP Peru

Sustainable finance is growing and could help stimulate the sector

There is a fundamental shift in how capital is allocated in global capital markets. The triple threats of climate change, environmental degradation, and social inequalities, which the COVID-19 pandemic has further exacerbated, have led to the development of a sustainable finance market to directly address these challenges at scale. The thematic or labelled debt market, which comprises an expanding universe of green, social, and sustainability bonds/loans as well as sustainability-linked instruments, has grown considerably over the last decade.

The use of mainstream financial tools such as green, sustainable, and social (GSS) bonds can encourage wider sources of capital to invest, with aggregative financing models for distributed energy having the potential to improve the availability and reduce the cost of capital for such solutions. These instruments present opportunities to address the critical need for funding from the sell-side along with the growing buy-side demand and appetite from investors.

New financial mechanisms are needed to link global finance to small-scale, low-carbon energy assets

Financial aggregation can potentially unlock new sources of capital investment for the development of DRE projects and businesses in developing countries by providing the opportunity to invest in a diversified portfolio and gain exposure to small-scale, low-carbon energy assets. These assets can be pooled in a special purpose vehicle (SPV) to create asset-back securities (ABS) that funnel large-scale finance into small-scale enterprises and projects. Many advanced economies have thriving ABS markets, but these are yet to flourish in Emerging Markets (EM), where capital markets remain immature.[5]

Financial aggregation remains nascent

While holding great potential, financial aggregation for DRE and other small-scale low carbon energy assets is still at a nascent stage and faces a range of barriers. Markets for financial aggregation require innovation and time to reach maturity, viability, and scale; a typical financial aggregation transaction is complex, involving numerous steps and multiple stakeholders. Furthermore, financial aggregation and ABS are not the only mechanism through which capital could be unlocked and should be considered alongside other solutions which aim to reach the same goal.

This report summarises the key issues contributing to existing financing gaps in order to advance discussions and raise awareness for innovative solutions to current barriers for financial aggregation. With the exception of tenor mismatches and ticket sizes, it is unlikely that these general barriers can be overcome solely by any financial aggregation mechanism alone. To overcome the significant challenges ahead, more work and complementary mechanisms are required before financial aggregation can unlock financing at scale towards energy access. This report lays the foundational knowledge for stakeholders to identify and understand these challenges and work towards solutions.

Disentangling the effects of each barrier on the financing of DRE in developing countries is a profoundly complex undertaking. However, these general barriers (see section 4.1) and barriers specific to financial aggregation (see section 7) represent the leading issues that need to be addressed if financial aggregation is to reach its potential as a solution to scale up investment for DRE and other small-scale, low-carbon energy solutions. This report outlines general barriers as challenges to SME financing in developing countries before detailing other barriers specific to financial aggregation.

Key enablers to financial aggregation are emerging within the sector

The enablers featured in this report (see section 8) highlight the immediate opportunities to advance financial aggregation transactions. Data, standardisation, and KPIs deliver necessary information for investors to isolate investible projects that match their desired risk-return profile. In terms of aggregating small-scale financing into a larger investment instrument, the flow of information and quantification of business metrics helps to streamline the process. However, a sufficient number of investible opportunities need to be generated and bundled collectively to create the ticket sizes demanded and justify the transaction costs incurred by investors.

There is a need to create an open-ended revolving vehicle connecting multiple buy-side and sell-side actors. Pipelines of this nature can serve as the basis for other risk mitigation mechanisms such as guarantees or concessional financing lines and attract new potential sources of finance from climate-first investors.

Additional co-benefits created by these businesses can also attract broader thematic finance, provided the impacts can be quantified and verified. Hence, financial aggregation can be complemented through carbon credits and and other instruments such as distributed renewable energy certificates (D-RECs).

The sector is continuing to evolve and innovate rapidly

While the overall industry undergoes both a financial and business innovation phase, different business models are being trialled across a diverse range of business structures within each sector across different geographies. This represents a challenge for financial aggregation, which requires uniform and standardised receivables as a basis for transparency and modelling.

As this market grows, it will likely follow a similar path to other developed asset-backed security markets, which initially had many different offerings that, over time, converged towards a common standard.[6]

This convergence is indicative of a maturing market that will see several barriers reduced through a mixture of market-based solutions and public sector reforms. However, an array of sector-specific challenges remain across the various technologies.

Financial aggregation can be a part of the solution but relies on other complementary measures

Several systemic issues around the prevailing market dynamics are worth considering. To be successful, financial aggregation may need to be combined with other de-risking mechanisms such as concessional financing, guarantees, subsidies, or tax-exemptions, to name a few. Financial de-risking instruments and incentives can transfer investment risks to public actors, such as development banks, and are vital to reducing the cost of capital for small-scale renewable energy.[7] UNDP has previously suggested public sector interventions to reduce, transfer or compensate for early-stage market development risks before aggregation opportunities can be created in a more mature market.[8] The role of the public sector extends beyond financial incentives into other areas such as policy, legislation, and regulation – none of which has been the focus of this report. As part of the Climate Aggregation Platform (CAP) Project, UNDP plans to develop a market assessment framework and a series of assessments at the regional and country level, which will help to draw a better picture of the policy and regulatory framework in given geographies and provide the basis for future work.

At this early stage of market development, sophisticated finance should be created with additional technical assistance and capacity building for local enterprises. Given these companies collect payments from consumers, the financing arm of these companies are a quasi-financial institution. Therefore, many DRE enterprises deserve to be treated on par with other microfinance institutions (MFIs), which receive support to help develop capabilities related to organisational development, risk management, operational, and financial self-sufficiency during their early phases. Equity investors, local commercial banks, and other financial intermediaries play a role here as they are often directly involved with local companies during their early stages.

Local sell-side actors see an abundance of opportunities available but need buy-side expertise to help develop their businesses and access superior financing options. In turn, the predominant issue for the buy-side is scale; various actors are actively executing deals but only in a limited size, suggesting that meaningful investment will only materialise if the current barriers are reduced. The inertia created by this problem is not simply affecting financing but also slowing electrification rates and preventing further progress towards the achievement of the SDGs. The disconnect can only be overcome via better collaboration between investors, financial intermediaries, and the DRE industry. A mutual appreciation of the challenges on each side of the financing equation is the first step towards enabling solutions.

Table 1: Summary of barriers to finance of small-scale clean energy in developing countries

GENERAL BARRIERS TO FINANCE	BUY-SIDE BARRIERS	SELL-SIDE BARRIERS
Credit risk	Lack of track record	Support of domestic expertise
Unfavourable credit terms	Transparency and data	Access to suitable finance
Access to suitable finance	Business risk	Deal/ticket size
Currency risk	Correlation risk	
Country risk	Structuring challenges	
Sector-specific issues	Currency convertibility risk	
High-cost business models	Foreign Exchange (FX) rate risk	
Tenor mismatch	Legal risk	
Market fragmentation	Exit strategy	
Immature markets		

Some competing priorities remain as open questions for the sector

DRE has the potential to lift millions of people out of energy poverty, create millions of jobs, help tackle and build resilience to climate change, and contribute to the achievement of the SDGs – however, while efforts have been made to set clear goals and improve coordination in the sector, energy access remains a complex and multifaceted issue. The various stakeholders in the sector have different measures of success and often must find a balance between competing and sometimes conflicting priorities.

For investors, this means finding the correct balance between maximising financial returns and environmental, climate, and social impact. For energy companies, it may be about balancing growth vs. profitability or commercial viability vs. servicing hard-to-reach, lower-income customers effectively.

Unlocking financing opportunities using a sophisticated mechanism in a highly complex, fragmented sector housed within undeveloped capital markets is a challenging undertaking. There is a broad consensus from many buy- and sell-side actors that financial aggregation holds great potential for small-scale renewable energy in developing countries. Yet, there are hardly any examples that have turned this potential into reality.

The DRE sector in developing countries is at an early stage. It may still be premature to consider financial aggregation a viable option in the vast majority of these markets. Nevertheless, ABS markets in developed countries experienced similar challenges but became an established asset class. Developing countries can leverage best practices from more developed markets to fast-track this financial innovation.

Overall, while there has been an increase in off-balance-sheet financing in the past few years, GSS instruments have yet to gain traction in the DRE sector.[9] The global thematic debt market is far from reaching its full potential to finance small-scale renewable energy in EM. Green as well as social and sustainability bonds could be leveraged to this end. Addressing the barriers highlighted in this paper can unlock this potential by helping more companies access the market via receivables securitisation.

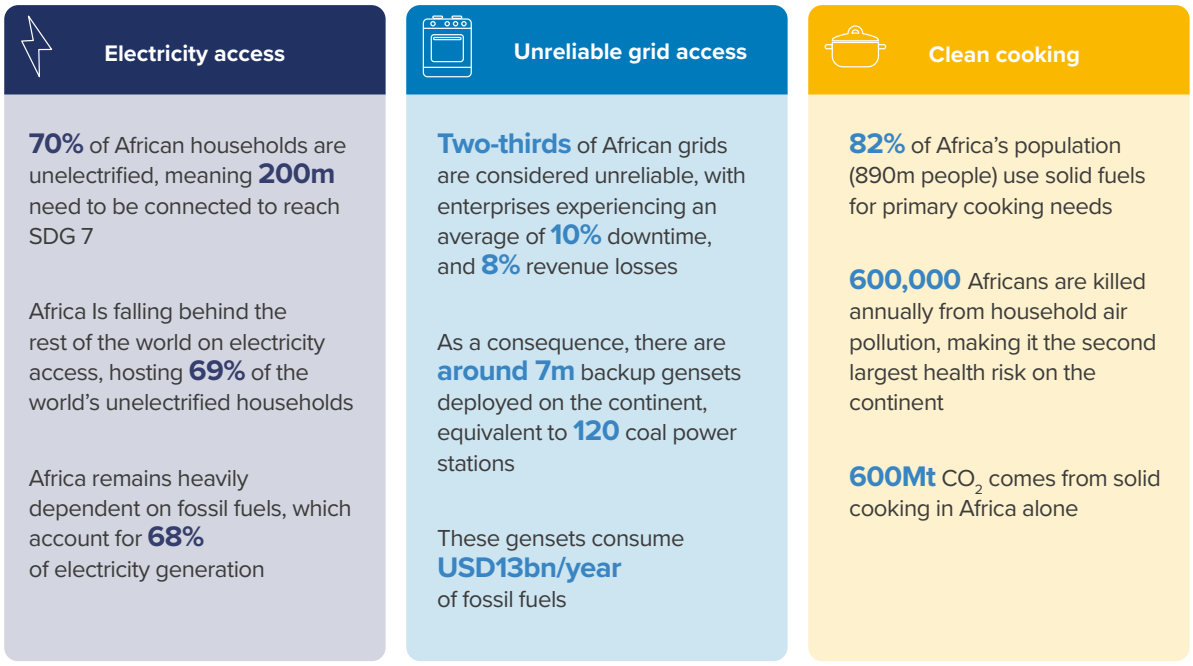
This paper intends to update existing knowledge and outline the challenges at hand to spark further conversation on what is necessary for these financing solutions to progress further - and to guide future work as part of UNDP's Climate Aggregation Platform, its broader energy offer, and hopefully other initiatives.

3. Introduction

3.1 Climate urgency: mobilise finance to achieve SDG7

Sustainable Development Goal 7 (SDG7) aims to ensure access to affordable, reliable, sustainable, and modern energy for all.[10] Electricity penetration rates are notably lower in developing countries, and direct actions are needed to address the access and financing gap if SDG7 is to be achieved. DRE solutions and other small-scale, low-carbon energy solutions are vital to achieving universal access, especially as a means of reaching those most underserved.

Figure 1: Africa's key energy trends and climate impacts



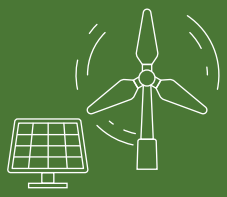
Source: adapted from Catalyst Off Grid Energy Advisors. 2021. Unlocking Climate Finance to Accelerate Energy Access in Africa.[11]

Globally, an estimated 759m people lacked access to electricity in 2019, down from 789m in 2018.[12] According to the IEA, about 620m people were predicted to remain without access by 2030 under current and planned policies before the start of the COVID-19 crisis.[13] A further one billion people are connected to an unreliable grid, of which 153m are in SSA and the rest in Asia-Pacific.[14]

The majority – over three-quarters – of people without electricity access live in SSA, where most of the population remains unelectrified.[15] There have been improvements in the region due to grid extensions as well as the deployment of DRE solutions such as off-grid solar (OGS). Still, in absolute terms, the number of people lacking access increased to 612m due to the steady increase in total population (while globally, the number almost halved).[16]

Despite energy access seeing unprecedented growth and capital inflows over the last decade, investments have been highly concentrated and far from sufficient to enable the sector to reach its full potential. The IEA estimates USD14bn in international financial flows to developing countries in 2018, down from the all-time-high of USD21.4bn in 2017.[17] While overall public financial flows have tripled between 2010-18, annual investment in access to electricity and access to clean cooking needs to reach USD35bn and USD25bn respectively by 2025 to be consistent with SDG7 targets.[18, 19]

Figure 2: Primary indicators of global progress towards SDG 7 targets

2010		Latest Data
1.2bn people without access to electricity		**759m** people without access to electricity (2019)
3bn people without access to clean cooking		**2.6bn** people without access to clean cooking (2019)
16.4% share of total final energy consumption from renewables		**17.1%** share of total final energy consumption from renewables (2018)
5.6 MJ/USD primary energy intensity		**4.1** MJ/USD primary energy intensity (2018)
USD10.6bn international financial flows to developing countries in support of clean energy		**USD14bn** international fnancial flows to developing countries in support of clean energy (2018)

Source: adapted from IEA, IRENA, UNSD, World Bank, WHO. 2021. Tracking SDG 7: The Energy Progress. Report. World Bank, Washington DC.

However, this positive trend masks some significant distributional discrepancies, with financial commitments concentrated in a few countries and thus failing to reach many of those most in need of international support. The lack of access to capital and the high cost of financing for small and medium-sized enterprises (SMEs) in developing countries constitute a barrier to the sector's expansion. The potential for adoption of DRE globally – and especially in SSA – is vast, far greater than the market's current size.

For instance, the OGS sector is expected to experience a 6% sales CAGR over the next decade to reach 823m users worldwide by 2030, most of which currently lack access to electricity. Of these, 389m are expected to have an OGS product providing Tier 1 service or above.[21, 22]

With each household spending an average of USD200 per year on energy services, the market for companies offering OGS solutions is estimated at USD24bn annually.[23] Even with a more modest estimate of USD50-100 (broadly in line with the current average spend), the market could reach tens of billions USD over time, comparable in size to today's global microfinance markets. The potential is even more significant when considering the impact of the PAYGO model in increasing reach by offering consumer finance. The UN estimates that an annual investment of USD35bn in access to electricity is needed by 2025 to be consistent with SDG7 targets and in support of other SDGs and net-zero emissions in line with the Paris Agreement.[24]

Financing constraints for SMEs have been exacerbated by the COVID-19 pandemic, which has highlighted the need for collective action to tackle global issues.[25] The use of mainstream financial tools such as GSS bonds can encourage wider sources of capital to invest, with aggregative financing models for distributed energy having the potential to improve the availability and reduce the cost of capital for such solutions. These instruments present numerous opportunities to address the critical need for funding from the sell-side and the increasing demand from buy-side investors and financiers.[26]

3.2 Aim of the report

This report was developed as part of the Climate Aggregation Platform (CAP), a Global Environment Facility (GEF)-funded project implemented by UNDP, which, in partnership with the Climate Bonds Initiative, seeks to promote the scale-up of financial aggregation for small-scale, low-carbon energy assets in developing countries.

The report discusses the state of financial aggregation solutions for DRE and other small-scale, low-carbon energy solutions by updating existing knowledge and filling gaps in information, as well as identifying further opportunities on the sell- and buy-side (i.e., project and finance aggregation). The intention is to summarise the key issues contributing to existing financing gaps rather than provide the deep-dive analysis necessary to address each issue and specific context. In so doing, the report will advance discussions and raise awareness for innovative solutions to current market barriers of financial aggregation.

Financial aggregation is complementary to other measures that can be taken to improve the flow of finance to small-scale low-carbon energy markets. From an investor perspective, financial aggregation provides the opportunity to invest in a diversified portfolio and gain exposure to small-scale low-carbon energy assets. These assets can be pooled in a special purpose vehicle (SPV) to create asset-back securities (ABS) that funnel large-scale finance into small-scale enterprises and projects. Many advanced economies have thriving ABS markets, but these are yet to flourish in EM, where markets remain immature.[27]

While holding great potential, financial aggregation for DRE and other small-scale, low-carbon energy solutions is nascent and still faces a range of barriers. Markets for financial aggregation require innovation and time to reach maturity, viability, and scale; a typical financial aggregation transaction is complex, involving numerous steps and multiple stakeholders. Barriers thus range from a lack of credit information on end-users to varying underwriting standards and hence portfolio quality, to differing approaches to SPV structures, to a lack of investor appetite and awareness. The information contained in this report is intended to serve as a conduit between financial practitioners and their energy sector counterparts to promote a greater understanding of their individual requirements that need to be addressed to overcome the existing challenges.

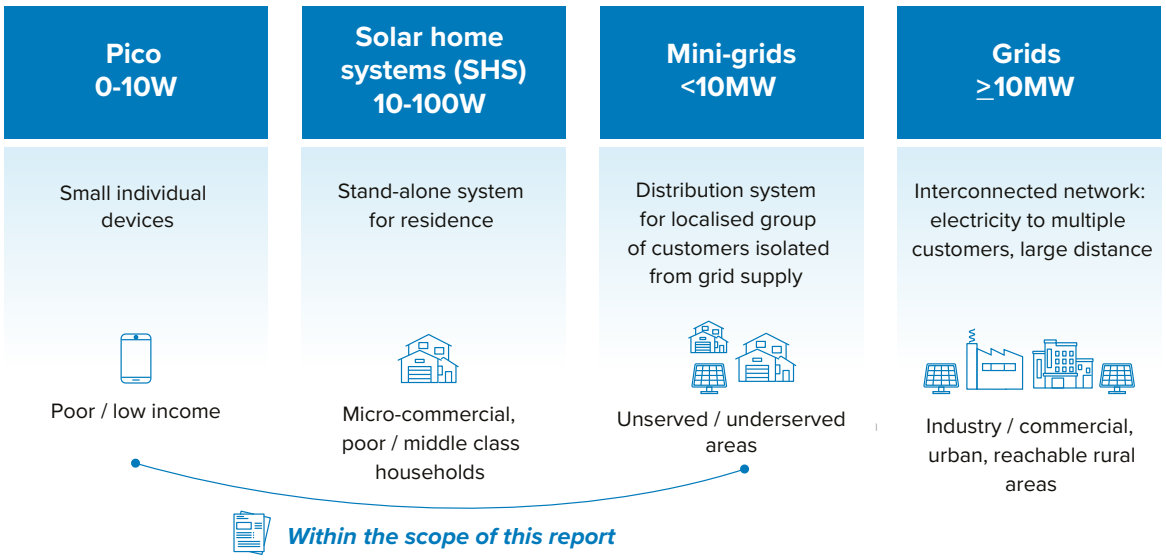
The report starts by outlining the general financing issues for DRE before delving into how financial aggregation can help unlock new financing opportunities. The sections that follow detail the key forms of aggregation models in operation within the DRE sector before analysing the barriers specifics to financial aggregation and potential enablers to overcome these barriers. The final sections of the report summarise various insights and conclusions before indicating areas for further research.

3.3 Overview of small-scale, low-carbon energy solutions

Historically, on-grid connections have served as the least-cost pathway to increase electrification among non-rural populations, however technological advancements are enabling to DRE solutions (e.g., OGS, mini-grids, etc.) to become increasingly cost-effective solutions in rural areas.[28] For instance, the World Bank estimated that by 2030, 490m people could be served at least cost by 210,000 mini-grids, mostly solar-hybrids, requiring an investment of USD220bn.[29]

The full scope of small-scale, low-carbon energy solutions extends to several sub-sectors, not all of which are detailed in this report (further information is included in the appendix). The report focuses mainly on DRE solutions since these are the sectors where most data and literature are available and of particular interest for financial aggregation. Commercial and industrial (C&I) as well as productive use applications are only mentioned briefly, while energy-efficient solutions for buildings, lighting, industrial, and agricultural applications are outside the scope of this report. However, they could also benefit from its findings. Many of the findings may also be relevant for grid-connected solutions such as rooftop solar and other sectors such as clean cooking, e-mobility, etc.

Figure 3: Renewable technologies and electricity access options



Source: adapted from OECD. 2019. Achieving clean energy access in sub-Saharan Africa.[30]

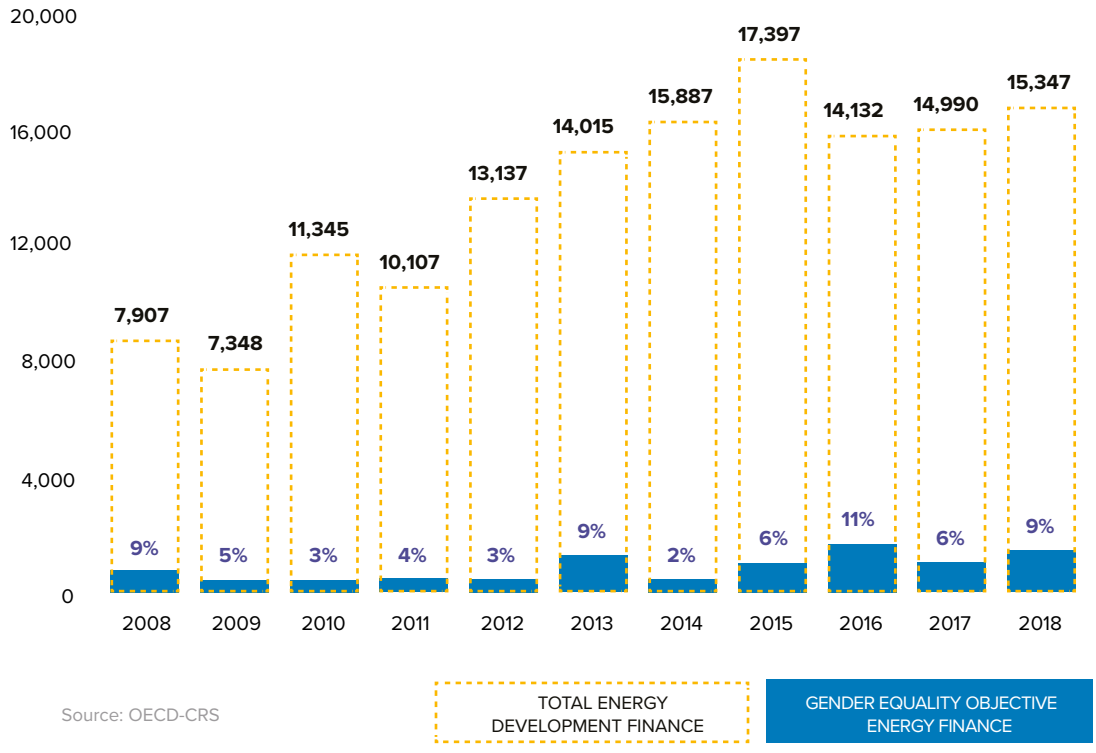
Box 1: Gender-based investment

Women and girls are acutely impacted by a lack of access to clean energy solutions. In the clean cooking sphere, the use of solid fuels in cooking leads to health concerns while activities related to collecting fuelwood can expose women and girls to less secure environments and represent time-consuming tasks that could otherwise be dedicated to education or other productive activities.[31]

Gender equality and the empowerment of all women and girls (SDG5) is inextricably linked to SDG7, yet, defining and measuring finance for gender-focused energy access projects presents challenges and is not widely documented.[32] Between 2008-18, SEforALL reports that the portion allocated to the energy sector with a gender equality objective has fluctuated between 2-11% of overall energy development finance – falling short of what is needed.

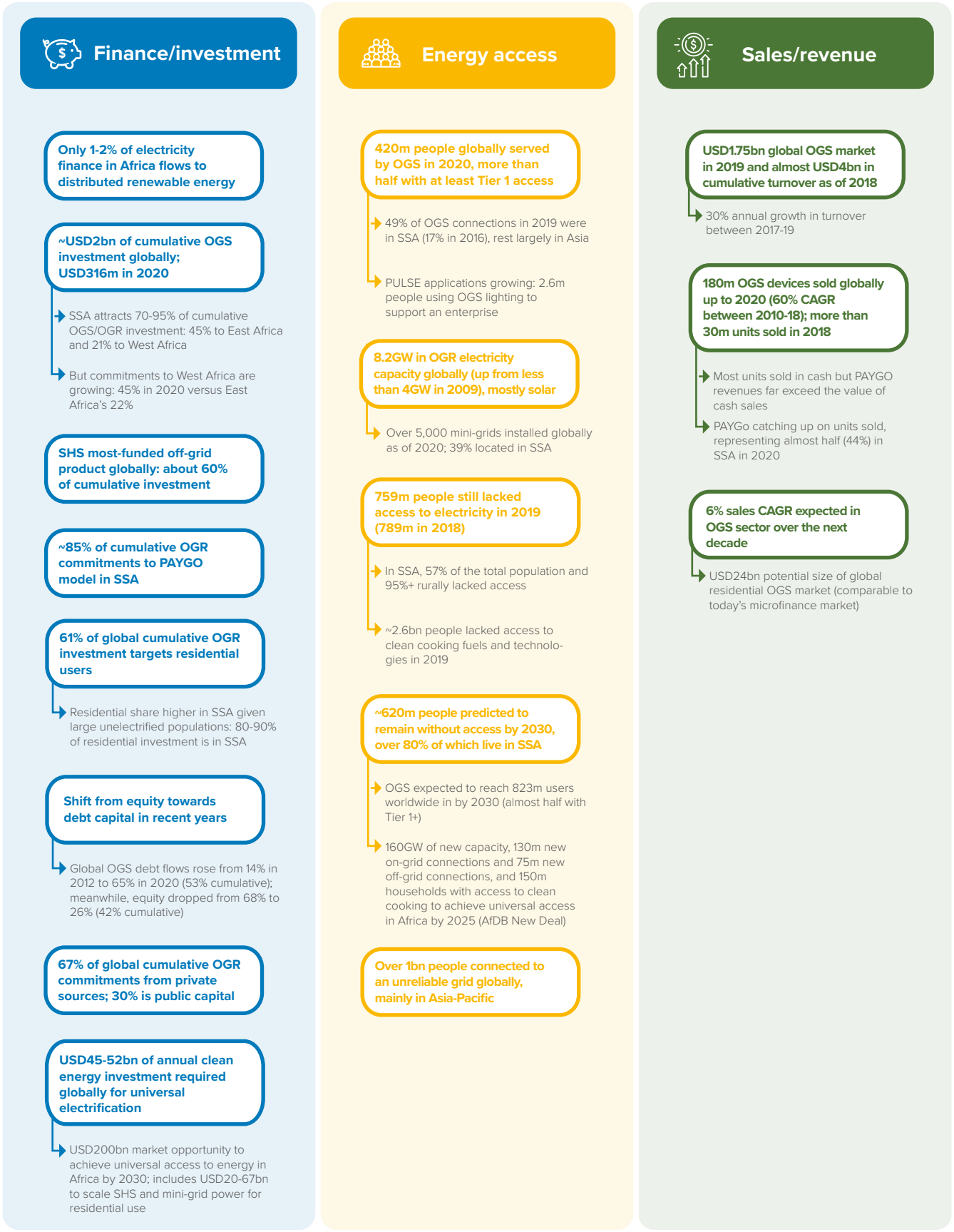
Gender-lens investment is a key ESG topic and British International Investment (the UK's development finance institution, formerly CDC Group) suggests that OGS and off-grid energy companies are important focal points for creating gender-based opportunities and gender-smart investing.[33] Several gender-focused development projects are in progress in SSA, East Asia and the Pacific, and some companies and investors are also promoting initiatives to directly address the issue.

Figure 4: Energy sector development finance with gender equality objective (USDm) and as % of total, 2008-18



Source: adapted from SEforAll et al., 2017. Energizing Finance. Policy Report.[34]

Figure 5: Market size and profile (headline figures): expanding market but vast potential remains



Note: Information on this page is covered in more detail in the appendix. Key sources include GOGLA and IRENA as well as World Bank/IFC, IEA and SEforAll (see appendix for more information).

4. Financing issues for distributed renewable energy

While investments in the DRE sector have grown considerably in the last decade, the financing landscape is yet to reach maturity (see market profile and sizing in appendix). Cumulative investment in OGS technologies, for example, stood at around USD2bn in 2020, while roughly USD35bn is required to improve access to electricity in low-income countries.[35, 36] In Africa, only 1-2% of electricity finance flows to DRE, and there is an estimated USD200bn market opportunity for investors to achieve universal energy access by 2030, a large part through distributed renewables.[37, 38]

Apart from still lacking in size, financing in this sector is also highly concentrated. The top ten OGS companies have attracted 87% of total funding globally, with most capital flowing to larger PAYGO companies.[39] According to GOGLA, close to 75% of all off-grid solar financing between January 2019 and August 2020 was committed to only three multinational companies, while just ten had soaked up 84% of investments in OGS by 2019.[40] A more recent analysis by the World Bank attributes 87% of early- and growth-stage investment awarded to just seven operators: BBOXX, d.light, Greenlight Planet, M-Kopa, Mobisol, Nova Lumos, and Off-grid Electric.[41] There is a similar trend in the mini-grids sector, with the top ten companies securing 77% of all investments.[42]

Nevertheless, there are signs of greater diversification. The top ten deals accounted for 68% of total investment in 2020, down from 90% a year earlier, and the figure for the top three deals also declined, from 56% to 41%. More companies received backing in 2020, too, with GOGLA reporting 78 beneficiaries, up from 49 in 2019; this included 46 businesses that banked support for the first time, versus only 20 a year earlier.

The IFC further notes evidence of increasing maturity, such as larger ticket sizes and a diversifying group of larger investors; IRENA states that the average ticket size for renewable energy investment almost tripled from just above USD1m before 2015 to nearly USD3m during 2015-19.[43] This suggests an increase in the size of individual businesses toward levels and volumes that increasingly attract the attention of professional investors. However, it could also reflect the market dominance of first-generation companies, particularly DESCOs operating in East Africa established by international founders.[44]

In general, financing large numbers of smaller-scale projects and businesses in developing countries is challenging and not unique to energy.[45] Beyond these omnipresent issues, there are many specific factors affecting growth in the financing of the DRE sector. To date, there is no model financing approach deemed most suitable based on differences in companies, project sizes, and risk appetites.[46] The relative maturity of each sub-sector also needs to be considered given varying stages of market development. Further, the types of finance deemed most appropriate depend on the size and maturity of each company within the DRE umbrella. Hence, a one-size-fits-all approach to financing is likely to be unsuccessful given the current stage of market maturity. Still, various forms of aggregation are seen as an emerging solution.[47]

The research conducted for this report uncovered several widespread issues creating a disconnect between the buy- and sell-sides. Disentangling the effects of each barrier on the financing of DRE in developing countries is a profoundly complex undertaking. Some barriers are standalone issues, while others cannot be considered in isolation due to their interconnectedness. To some extent, a combination of aggregation tools could overcome some of these financing barriers, but other issues will persist, which require upstream interventions such as regulatory frameworks.

4.1 General barriers

Broader consideration is required when assessing the obstacles to financing; are these challenges to financial aggregation and securitisation, general issues related to financing SMEs in developing countries, or specifically related to funding DRE?

To differentiate between these issues, this report refers to **general barriers** as challenges to SME financing in developing countries, versus **specific barriers** which prevent financial aggregation related to funding DRE. General barriers to financing are summarised in this section.

The different aggregation types (see section 5.1) can be mutually beneficial when scaling up investment opportunities; hence it is counterproductive to consider each separately. For instance, the aggregation of information can help improve transparency and understanding of credit risk for a bundled set of financial products (i.e., financial aggregation).

Financial aggregation may only partly contribute to overcoming these general barriers, and a holistic solution is likely to rely on complementary mechanisms to de-risk the investments. Nonetheless, these general barriers have implications for establishing a securitisation market and need to be considered. As detailed in section 7 of this report, some general barriers are further dissected to reveal barriers specific to financial aggregation.

Table 2: General barriers to finance of small-scale clean energy in developing countries

GENERAL BARRIERS TO FINANCE
Credit risk
Unfavourable credit terms
Access to suitable finance
Currency risk
Country risk
Sector-specific issues
High-cost business models
Tenor mismatch
Market fragmentation
Immature markets

4.1.1 Credit risk

Credit risk refers to the possibility of losses stemming from a borrower's inability or failure to make timely repayment of the loan principal and interest. The variety of factors that could lead to repayment failure is extensive and underpins the risk that lenders assume when extending credit, especially to small-scale projects in EM. These factors relate to the business model, enterprise type, target market, technology used, years in operation, managerial expertise, country of operation (specifically policy and political risk), overall economic prospects of the energy market, and the broader economy.

Woman charging phone thanks to solar panels
Photo credit: UNDP-Aurélia Rusek

Businesses are expected to assess risks and present this information to lenders and investors. Still, they often lack credit risk experience or the necessary expertise, structures, and processes to evaluate and manage these risks. Certain management teams may treat credit risk management as a technical exercise instead of an issue of broader culture and governance.[48] This issue is found in both businesses that service rural households through to large-scale operations in the C&I space. In some cases, mini-grids or C&I solar assets have additional counterparty risks tied to energy offtake contracts.

Box 2: SHS ownership models

Under the lease-to-own model, SHS recipients may experience a unit failure and in turn discontinue payment. The failure to repay can result in viable customers being blacklisted as uncreditworthy when in practice it is the fault of the company or business failing to deliver on expectations. By comparison, in the utility model – where the company maintains ownership – the provision of services is dissociated from ownership of the unit, creating a higher incentive to ensure service continuity.

These models are largely absent in SSA, where the norm is to operate via a lease-to-own system due to local regulations regarding ownership and market access. In India, Brazil and other developing LatAm countries, this has helped with payment reliability and ultimately built scale. Third-party ownership models may improve debt access via project aggregation, increased transaction sizes and ultimately securitisation.

Innovative means to mitigate credit risk are integrated into specific business models but may not be effective in practice. While non-payment can stem from either the inability or unwillingness of customers to pay, it may equally be a result of service failures, power-supply interruptions, or insufficient maintenance of service units, and it may be challenging to ascertain the actual cause of underperformance from a lender's perspective. In competitive markets, additional layers of credit risks can be created if companies relax credit requirements to increase sales or focus more on connecting new customers rather than retaining them.[49]

End-user credit risk is commonly cited as specific to lenders in the off-grid sector regardless of the funding source. These credit risks diminish potential investment returns and expose buy-side investors to additional uncertainty. Hence, clarity and understanding of the nature and extent of these residual credit risks and the underwriting of individual firms are necessary for financial aggregation. Aggregating receivables to finance smaller businesses and projects can reduce and diversify potential credit risk, but aggregation will not solve all problems.

Box 3: Remote shut-off technologies

The widely held belief that remote shut-off mechanisms can discontinue service to non-paying customers and reduce portfolio underperformance is misled. Remote shut-off by itself is not a credit risk management tool and the actions of a PAYGO company after a credit default event has occurred are even more important. In many cases, since the solar installation is within the customer's premises or private property, gaining access to the system to repossess is a major challenge – and even if they are able to repossess, a framework of resale into a secondary market and monetisation of repossessed property is also an important consideration.

4.1.2 Unfavourable credit terms

The general high-cost financing environment is commonly cited as a primary general barrier.[50] SMEs are often undercapitalised and lack scale and credit ratings, limiting debt opportunities.[51] In terms of local currency financing, these factors see banks extend only short-term loans with high collateral requirements and interest rates. In Rwanda, available bank loans to solar developers were quoted at rates of 18-20% interest p.a. with 24 months maturity and high cash collateral.[52]

Small-scale enterprises operating a B2C (business-to-customer) model have inherently lower debt capacity. Their revenues are generated from short-term contracts with low-income populations facing several risks, creating uncertain and unpredictable cash flows. Therefore, extending affordable financing is constrained by the reduced likelihood of businesses generating a return on investment. Lenders account for this by charging higher rates or by requesting additional security via collateral, which may be unavailable or costly to recover.

SMEs utilise local commercial bank loans, but these may not be on suitable terms or tenures.[53] Outside those businesses with an established brand, investment proposals hinge on a loss-making business model to a risky target market in a poorly understood sector. This proposition becomes particularly challenging once any grant or seed funding is exhausted. Some previous ventures have failed to deliver on expectations, further increasing lending restrictions and interest rates to the DRE sector.

As a result, SMEs resort to informal credit and microfinance options where funds like the African Enterprise Challenge Fund serve as intermediaries to direct capital into the space, alongside impact investors and technology-driven solutions such as peer-to-peer (P2P) lending.[54] While these are important initiatives, project-based funding can have performance-linked targets which may conflict with broader company objectives of generating *sustainable* growth.

Unfavourable credit terms lead to small-scale financing operations on-balance sheet, which interlocks business and project risks. This method increases accessibility to funding by providing larger amounts of collateral but is counterproductive to financial aggregation, which entails an off-balance sheet approach. Therefore, a new approach may be needed for financial aggregation to be feasible.

4.1.3 Access to suitable finance

Smaller developers typically have less market power when negotiating with financiers and can be burdened by unfavourable or inflexible debt structures.[55] Small-scale businesses operate with limited free cash flow; if there is a delay in the disbursement of finance, few have access to revolving lines of credit to cover the gap between signing contracts and accessing financing. Funding may also be unavailable when it is most needed – if a business performs well, finance is needed to grow; however, it can be difficult for enterprises to close equity or obtain loans when faced with challenges.

Beyond the scope of DRE businesses, numerous other small-scale enterprises are simultaneously competing for the same financing sources. Private investors state they are willing to provide senior debt. Still, few participants are eager to absorb lower-ranking debt or credit enhancements, resulting in higher amounts of equity being utilised to de-risk senior debt providers. There is a role for equity investors to inject more capital into DRE to open up opportunities for affordable debt, and having an appropriate capital stack is also essential to business longevity.

4.1.4 Currency risk

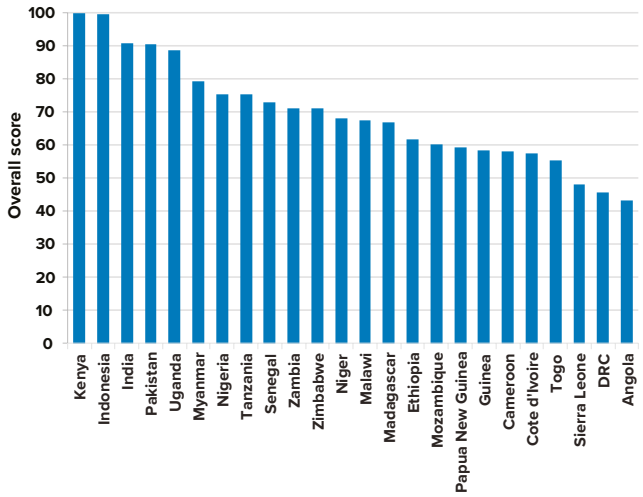
Barriers are created by currency mismatches when foreign capital is utilised to fund companies with local revenues. This issue is faced by all foreign investors funding EM projects – regardless of the investment method – and is considered a significant barrier.[56] It will apply to financial aggregation instruments targeting international finance since securitised vehicles issue instruments in foreign currencies while receivables are in local currency. No form of aggregation provides a unique solution to this universal barrier; hence the enablers to reduce currency risk will not differ from those used in other foreign-capital transactions to hedge these risks (i.e., investing in countries with a hard-currency peg, currency forwards, and swaps). Currency risk is further divided into foreign exchange (FX) risk and currency convertibility (see section 7 for further information).

4.1.5 Country risk

The ease of doing business and overall access to finance for small-scale enterprises varies depending on the country of operation. Subsidies, waivers, and uncertain tariff pricing are interventions that may be disjointed in certain countries, making multi-country expansion complex, costly, and at times, unviable. For those countries that present viable opportunities, approval processes and regulatory requirements vary, which ultimately harms successful business planning. The ability to attract finance to the respective markets depends on many market and country factors. Given that circumstances differ from country to country, the most realistic opportunities for financial aggregation may lie in those countries with more mature markets.

The PAYGO Market Attractiveness Index (MAI) provides insights on the prevailing country differences across 24 countries, of which 19 are in SSA and five in Asia and Oceania. The index is based on various leading factors that make a national market favourable or unfavourable for the development of energy services. Kenya, Uganda, and Tanzania rank highest among the 19 SSA countries included in the data.[57]

Figure 6: PAYGO Market Attractiveness Index (MAI) overall scores



Source: adapted from World Bank. 2021. PAYGo Market Attractiveness Index.[58]

Figure 7: PAYGO Market Attractiveness Index (MAI) pillar scores

SCORES ACROSS THE THREE PILLARS	Demand	Supply	Enabling Environment
Angola			
Cameroon			
DRC			
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			

Note: Overall score is a weighted average of the three main pillars scores: demand (20%), supply (50%) and enabling environment (30%). Dark blue = high score; light blue = average; orange = low. Higher score indicates better performance.

Source: adapted from World Bank. 2021. PAYGo Market Attractiveness Index.[59]

The PAYGO MAI is based on 67 relevant indicators to the development of PAYGO technologies and gives a high-level indication of the relative strengths in each country. Each of the three pillars – Demand, Supply, and Enabling Environment – indicate relevant indicators for financial aggregation:

- The indicators within the demand pillar relate to market size, ability to pay, and willingness to pay. Within SSA, Angola and Zambia were ranked low in this indicator, with high scores associated with Uganda, Kenya, Ethiopia, and Malawi.
- The indicators within the supply pillar relate to access to finance, operational considerations, market penetration, and human capital. Kenya scored highest and Sierra Leone lowest; however, the situation is different across the countries of operation. This pillar has a more considerable disparity in the absolute scores than the demand and enabling environment pillars.
- The indicators within the enabling environment pillar relate to information and communication technology (ICT), legal and regulatory, and willingness to pay factors. The Democratic Republic of Congo scores the lowest in this pillar, with Kenya highlighted as a leader in the region.

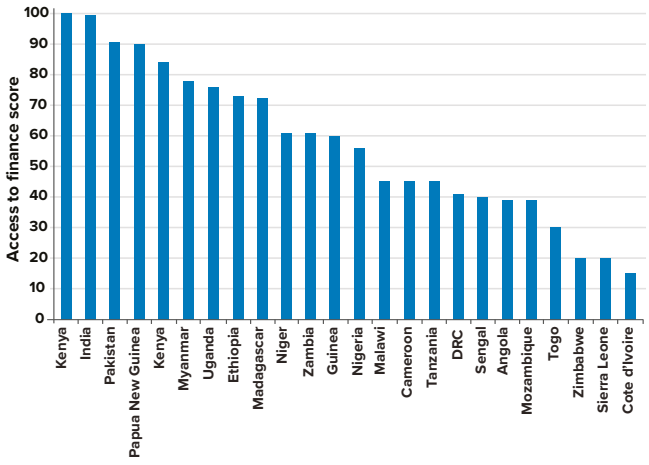
The accompanying report notes that 'potential market segments within index countries continue to grow.... the ongoing COVID-19 pandemic has impacted new PAYGO sales, while repayments have remained more or less stable in the short- term.'

Within the Supply pillar, Access to Finance is assessed and gives relevant insights on the relative ease of access to finance for PAYGO companies. The access to finance indicator is a normalised score based on:

1. Firms which don't identify access to finance as a major constraint (60%)
2. Affordability of financial services (10%)
3. Availability of early-stage equity (10%)
4. Financial markets - short term economic risk (10%)
5. Financial markets - long term economic risk (10%)

Within SSA, Uganda ranks as highest in terms of accessing finance, followed closely by Kenya – both these countries are active markets in the clean energy sector. Companies and projects still operate in lower-ranked countries, suggesting investment is influenced by broader considerations.

Figure 8: PAYGO Market Attractiveness Index (MAI) access to finance scores



Source: adapted from World Bank. 2021. PAYGo Market Attractiveness Index.[60]

4.1.6 Sector-specific issues

Under the umbrella of DRE and other small-scale, low carbon energy solutions, sector-specific barriers relate primarily to OGS, mini-grids, clean cooking, and other sub-sectors.[61] Disaggregating and analysing such barriers across these different sectors is beyond the scope of this report. Still, it is important to note that financiers consider sector-specific risk factors when making lending decisions.

For instance, within the OGS sector, businesses offering SHS typically source equipment overseas which are susceptible to supply chain issues and changing tariffs. SHS are faced with other risks compared to mini-grids, such as competition from cheaper generic products, which can erode consumer trust.[62] Similarly, mini-grids are viewed as a developing business model with hybrid financing needs related to long-term infrastructure projects and SMEs. Mini-grid suppliers incur higher costs when serving remote, rural populations where unclear regulations and changing tariffs combine with the potential arrival of the main grid to create an uncertain operating environment with limited means for cost recovery.

Further afield, clean cooking may need further technological advancements and public sector support to become commercially viable. At the same time, EVs require energy as a primary input along with supportive infrastructure (e.g., charging stations) for the sector to grow.

While DRE undergoes both a financial and business innovation phase, different business models are being trialled across various business structures within each sector in SSA. This represents a challenge for financial aggregation, which requires uniform and standardised receivables as a basis for transparency and modelling. To achieve this, businesses may need to converge towards an optimal business model for aggregation to become mainstream.[63]

4.1.7 High-cost business models

Ensuring sound unit economics – where the average revenue per user accounts for at least the entirety of the delivery costs – is pivotal to creating a scalable, long-term, viable investment opportunity. General commentary from several stakeholders suggests few examples where robust unit economics have coincided with growing or expanding companies. Even with enablers such as PAYGO and mobile money, reaching rural customers in remote areas, ensuring adequate last-mile delivery, and providing ongoing customer service are costly undertakings.

In the OGS sector, businesses can expand and diversify their target markets more readily, but incur high costs associated with supplying in remote areas, uncertain customer demand, and willingness and ability to pay. This can affect business viability which, in turn, brings uncertainty to financiers on the ability to recover costs and make investment returns.[64] For mini-grids globally, there are no proven business models that work everywhere due to differences in regulatory environment, geography, topography, culture, and demography.[65] In addition, mini-grids vary by ownership/operatorship, project size, customer target, and whether they are technology- or developer-focused.[66]

If the goal of clean energy expansion includes getting to the bottom of the pyramid, finance is imperative, particularly if customers struggle with their repayments. Grants, subsidies, seed equity, and concessional financing can help companies establish the necessary track record, address affordability issues and create conditions for attracting private finance.[67] Addressing these cost issues using appropriate finance is required before any type of financial aggregation can succeed.

Box 4: Winch energy: mini-grid financing platform

Based on sector experience in Sierra Leone, Benin, Mauritania, and Angola, London-based off-grid utility company Winch Energy partnered with NEoT Offgrid Africa (NOA) to close a USD16m project to install 49 PV mini-grids, plus portable batteries in Sierra Leone and Uganda – the largest mini-grid financing portfolio to date.[68,69]

The deal involves the creation of a new limited-recourse financing platform, Winch Energy IPP Holdings Limited WIPP.[70] The project launched in early 2021 and brings together several major players in the off-grid space, including a construction loan provided by SunFunder. A feature of the deal is an RBF mechanism extended by Uganda's Rural Electrification Agency, which includes subsidies provided by the UK's Foreign, Commonwealth & Development Office (FCDO) for projects in Sierra Leone with the German Ministry BMZ (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung) providing similar support in Ugandan locations alongside the EU. Project development support will be offered in Uganda by German development agency GIZ (the Deutsche Gesellschaft für Internationale Zusammenarbeit) with the equivalent service provided in Sierra Leone by the UN Office for Project Services.[71, 72]

In September 2021, FMO, the Dutch entrepreneurial development bank, arranged a syndicated facility where FMO (through the Access to Energy Fund) and the Renewable Energy Performance Platform (REPP) – managed by Camco Clean Energy (Camco) – will lend to WIPP the first tranche of approximately USD4m for the portfolio of mini-grids in Uganda and Sierra Leone. The second tranche of up to USD6m is also included in the facility to finance future projects. WIPP plans to expand to other countries with ambitions to reach some USD100m of operating projects in the next 24 months.[73] In addition to energy access, the developments are intended to create a pipeline of additional projects in both countries.[74] For instance, the project will also provide internet to the communities through partnerships with telecom operators in both countries.

This key development embodies collaboration between partners and a financing approach where risks are allocated to the appropriate financing entity. The structure appears different from other financing initiatives in the SHS sector, whereby the inclusion of the construction loan and development support would appear to be pivotal to enabling this type of mini-grid project. While no specific mentions of future financing plans are known, the limited recourse facility aggregates the financing needs across the 49 mini-grids, lending itself to securitisation opportunities and green bond issuances if the USD100m goal is achievable in the future.

Box 5: Mobisol

The restructuring and acquisition of Mobisol provide insight into the immensity of the challenge faced by for-profit enterprises delivering electricity to rural and impoverished communities in SSA. The company operated a vertically integrated SHS business model including manufacture, distribution, after-sales service, financing and credit, and successfully delivered solar electricity to 600,000 people in rural Africa using capital from private investors.[75]

In an immature market undergoing constant innovation and growth, some participants will inevitably fail as a part of the learning process. Practical learnings can come from Mobisol's insolvency and restructuring. Firstly, the perceived sector risk can lead to a reliance on venture capital and private equity, seeking high returns across a short time horizon. The Financial Times mentions that, after nine years in operation, Mobisol still financed their operations based on about two-thirds of equity and one-third in debt.[76] This drives up the cost of capital and leads to a conflict of interest to meet short-term targets while solving a long-term problem.[77]

Limited verifiable information is available on Mobisol's financial records. Mobisol's managing director stated that the company's plans to increase prices and sales volumes over time did not materialise due, in part, to the economic downturn in its markets of operation. According to an article published on NextBillion, the company may have failed to meet profit estimates partly due to several challenges faced across 2017-18, including natural disaster.[78] It suggests that the resultant insolvency was due to internal issues specific to Mobisol and not indicative of the overall industry.

A separate article in PV magazine hypothesises that, for Mobisol, two factors may have been at play; unrealistic expectations around achieving commercial viability in the short-term, while serving remote customers with limited ability to pay.[79] This highlights the need for adequate credit risk assessments that account for the actual risk profile of the customer base in times of financial stress.

The above descriptions echo several barriers highlighted in this report; grow-at-all-costs approach (business model risk), over-reliance on equity (inappropriate financing), and a natural disaster event (correlation risk). This example highlights a set of broader issues in the sector, where off-grid businesses strive for scalability at any cost to meet short-term investor needs in an environment absent of appropriate, affordable finance mechanisms, patient capital, and sufficient legislation.

4.1.8 Tenor mismatch

Debt investors and lenders are risk-averse by nature, and there is limited demand to lend for extended terms based on short-term receivables. Local commercial banks are essential intermediaries in managing this mismatch between short-term revenue sources and long-term lending. To achieve this, banks need clarity on the expected present value of future receivables. Lenders may be comfortable committing a 5–8-year loan tenor backed by 1–2-year receivables only if the originator has a strong track record proving the creditworthiness of the underlying assets and the ability to recycle repaid funds to finance more assets within the loan tenor. Otherwise, a 5–8-year loan tenor needs to be backed by 5-8 years' worth of receivables, which the predominant short-term contracts cannot guarantee.

The crowdfunding model provides a template for how aggregation could indirectly address this barrier. Instruments issued from a securitised vehicle could link small-scale businesses with relevant investor groups willing to provide the patient capital needed. This increased accessibility could crowd-in capital from pension funds, insurance companies, and other institutional investors with long-dated liabilities. If these instruments could incorporate carbon credits, D-RECs, climate finance, and other ESG-conscious tools, investors may be attracted to finance the sector as they are less concerned with immediate financial returns and value environmental and social impact.

4.1.9 Market fragmentation

The DRE sector is considerably more fragmented than the traditional utility sector.[80] This creates complexity when assessing small, complex companies operating different models across multiple markets. Overall, solar market fragmentation across numerous countries lead to sponsor risk, cited as a primary concern for many financiers.[81] Policy and market fragmentation further constrain financing, and investing in renewable electricity projects, impeding the ability to bundle assets into a uniform, transparent structure.[82] Investors also suffer from a fragmented approach to establishing SPVs that hinder securitisation. While financial aggregation would not directly address this issue, data aggregation coupled with standardisation could help create new transparency for distributed renewable projects. Without this, investments will continue in a fragmented manner on a business-by-business basis.[83]

4.1.10 Immature markets

Finally, there is a general lack of awareness around DRE business models and aggregation opportunities by financial market participants such as commercial banks, intermediaries, local credit rating agencies, etc. Being a comparatively new sector, lenders currently do not understand the solar space. They may not dedicate the time to learn the product or business model without external experts providing assurances. This leads to strict lending standards based on metrics from other industries applied to the clean energy sector.

Where there are no technical assistance partners involved in projects, entrepreneurs are routinely tasked with educating banks and investors to justify their business models. Further, there are only a few examples of wide-scale securitisation apart from a few one-to-one deals. The information shared by those who have successfully implemented SPV strategies is limited.

5. How can financial aggregation help unlock financing?

New financing mechanisms are required to address the urgent need for larger capital flows to finance energy access in developing countries. Financial aggregation, the focus of this report, is one such mechanism that can substantially expand investments into the sector, primarily in the form of debt. This section explains the key concepts and benefits of aggregation and securitisation, and then summarises their role in scaling up investment and the potential link to thematic bonds.

5.1 What is financial aggregation?

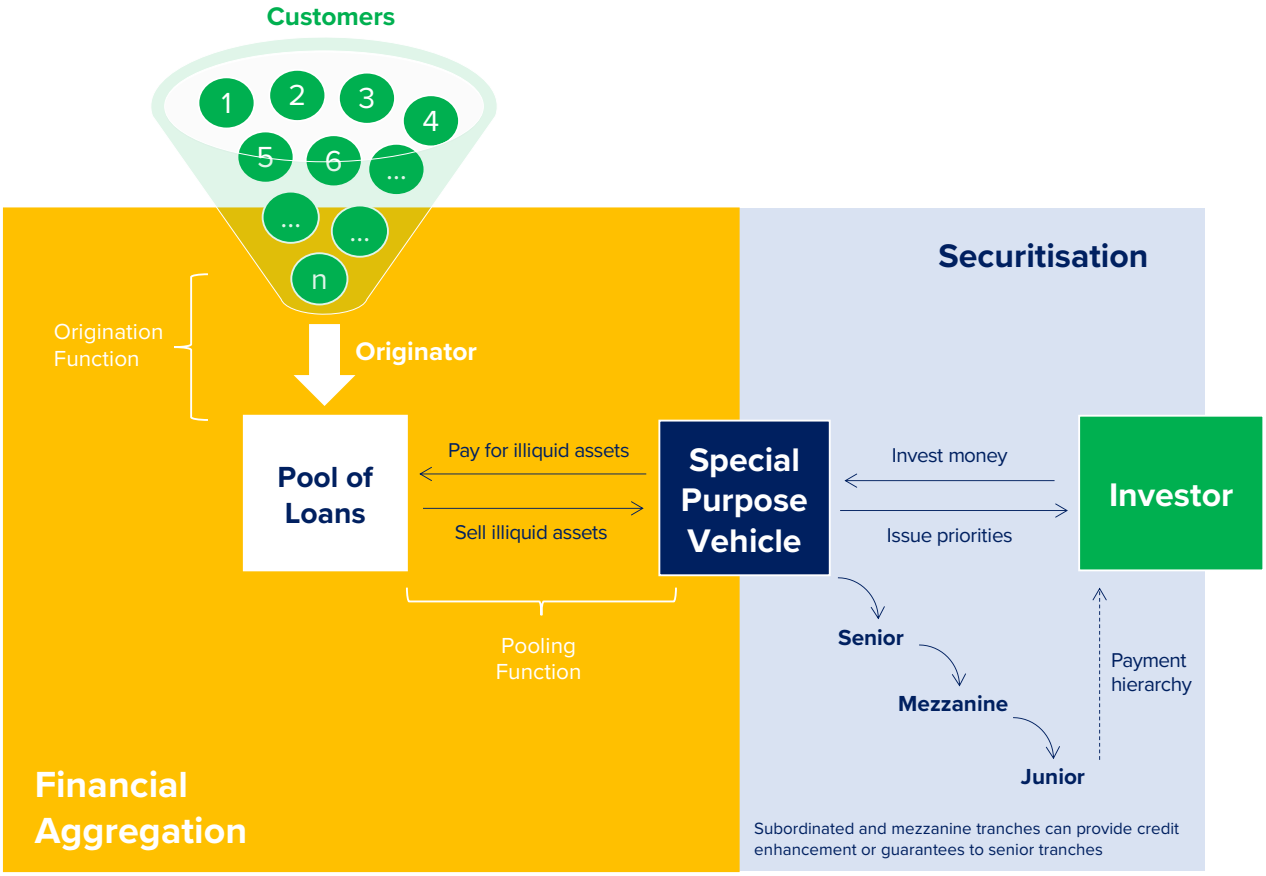
To create scale, small-sized projects or aspects of projects can be combined into a portfolio in a process known as bundling.[84] Larger-scale financing can then be provided across these bundled assets based on their future cash flows.

The Green Bank Network splits this process into two parts – aggregation and securitisation – with the former referring to the bundling of the small-scale energy assets and the latter the monetisation of these assets under different financing arrangements. The IIED expands further on these ideas by defining four aggregation categories:[85]

1. **Aggregating finance:** Combining multiple, smaller investment opportunities into a single vehicle or platform. The Cities Climate Finance Leadership Alliance report lists seven separate structures for market-based financial aggregation instruments, four of which could be directly applied in this instance (Global Thematic Funds; Corporate Green Bonds; City-Specific Green Funds; and Project-Specific and Other Revenue Bonds)[86]
2. **Aggregating demand:** Consolidating energy usage within communities or regions
3. **Aggregating enterprises or projects:** Creating a portfolio of enterprises or projects to be financed
4. **Aggregating information:** For example, via platforms that seek to improve access to finance for decentralised renewable energy enterprises by standardising the data that enterprises provide to investors: risk, returns, impact, and the creditworthiness of the target population

The various aggregation types can be mutually beneficial when scaling up investment opportunities. While each is relevant, financial aggregation and project aggregation remain the primary focus areas of this report.

Figure 9: Diagram of Financial Aggregation and Securitisation process



Source: adapted from Green Bank Network, 2019. Green Bank Insight: Aggregation and Securitization[87]

5.2 Leading benefits of financial aggregation for small-scale clean energy

The general barriers (presented in section 4.2) can impede access to finance, including financial aggregation mechanisms. On the other hand, the main stakeholders involved in financing DRE and other small-scale, low-carbon energy solutions can benefit from financial aggregation to address or counter these general barriers.

Firstly, financial aggregation can help reduce risk through diversification, thereby creating enhanced financing opportunities for enterprises. Secondly, investors also benefit from aggregated financing structures as these create scalable opportunities that justify transaction costs. Thirdly, governments can equally overcome other market barriers related to policy, tax, and regulation by creating a centralised platform to engage with investors.[88] More broadly, establishing this asset class within the DRE sector could provide a blueprint for similar developments in other SME-dominant sectors and industries contributing to the SDGs.

The leading benefits for the buy- and sell-side are listed below:

Buy-side benefits:

- **Risk diversification:** Achieved by funding multiple projects and companies with investment returns delinked from global market indices
- **Scale:** As the investment pool grows, ticket sizes increase and can attract larger investors
- **Lower transaction costs:** Increased process standardisation can eliminate costs associated with structuring, underwriting, and due diligence of individual companies
- **Transparency:** Collective analysis of anonymised consumer credit information combined with improved process standardisation, monitoring, and evaluation helps to understand asset risk and performance
- **Risk separation:** Securitised assets held in an SPV can be legally separated from the company, ensuring business-specific risks are isolated and do not impact debt repayments

Sell-side benefits:

- **Lower financing costs:** A combination of benefits can lower the cost of capital; as seen in other ABS markets, financing costs further decrease over time as the asset class grows
- **Growth:** Increased refinancing potential for individual projects using lower-cost capital
- **Increased access to new sources of finance:** Increased investor participation can encourage other market entrants. Securitisation can increase the pool of investors that might otherwise be out of reach, reducing the reliance on a single investment source
- **Appropriate finance:** Long-term financing needs can be matched with patient capital to promote business longevity over immediate 'growth-at-all-costs'

Box 6: The role of financial aggregation for small-scale clean energy

Securitisation enables companies and lenders to sell off existing financial assets to free up capacity for more business. It is the process through which an issuer creates financial instruments (asset-backed securities or ABS) backed by financial assets such as mortgages or lease receivables. The ABS bonds are sold to investors who receive a return drawn from the cash flows of the underlying assets.

By aggregating the funding into a common structure, securitisations enable institutional investors to finance small-scale assets and SME businesses.

A securitisation can be defined as green when the underlying cash flows relate to low-carbon assets or where the proceeds from the deal are earmarked to invest in low-carbon assets.

Transforming a pool of illiquid assets (typically thousands of separate ones) into tradable financial instruments (securities) can help drive financing of sustainability projects/assets if done correctly.[89] Hence, GSS securitisations can improve access to capital for companies and provide small-scale loans to projects and businesses associated with positive sustainability outcomes. The money raised from the sale of securitised products such as ABS can be used to create new loan portfolios. In addition, the aggregated loans and securitised pool can make sustainable deal sizes for bond market investors.

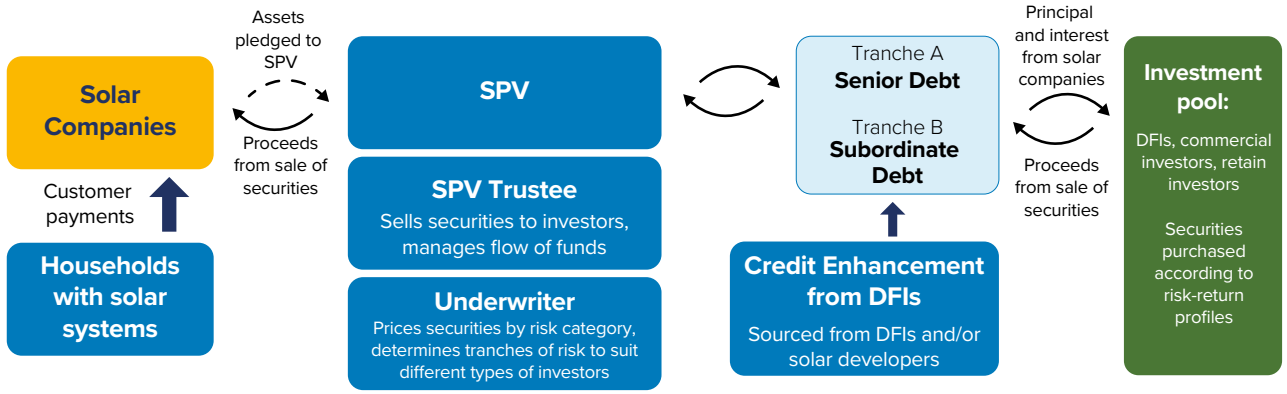
Excerpt from CBI's Green securitisation and the low-carbon transition report (Source: Green Securitisation - Unlocking finance for small-scale low-carbon projects, CBI 2018).

Box 7: Solar securitisation in Rwanda

The Development Bank of Rwanda is exploring solar securitisation targeting the large solar home companies via a proposed offering of approximately USD9m. Implementation involved designing a legal structure, creating the SPV, portfolio underwriting and the provisioning of credit ratings before the issuance and distribution take place.

This process reportedly involved a number of actors and processes to convene the team, establish the initial structure, value the portfolio, and secure the embedded credit enhancement.

Figure 10: Solar securitisation for Rwanda



Source: adapted from The Global Innovation Lab for Climate Finance. 2019. Solar Securitization for Rwanda, Lab Instrument Analysis.[90]

5.3 End goal of financial aggregation

Scaling up the DRE sector requires more prominent investors to allocate additional finance. As explained in the previous section, financial aggregation can package these small-scale financing needs into a portfolio from which marketable debt instruments can be issued. Given the additional positive benefits associated with the underlying investments, these debt instruments can be labelled as green, social or sustainability (GSS) bonds to funnel new sources of large-scale finance into the sector.

5.3.1 Global GSS market snapshot

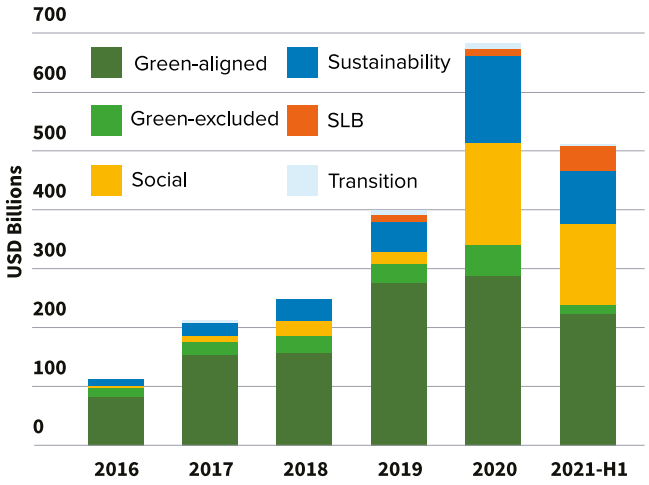
The thematic or labelled debt market, which comprises an expanding universe of GSS bonds/loans as well as sustainability-linked instruments, has grown considerably over the last decade.

At the end of June 2021, the sustainable debt market had reached USD2.1tn according to Climate Bonds data, and almost 10,000 instruments had been issued under GSS labels since 2006.[91] USD700bn worth of GSS instruments was issued in 2020, nearly double the prior year, which stood at USD358bn. The green debt market is the largest of the above segments, representing a cumulative USD1.3tn as of the end of H1 2021.[92] Climate Bonds forecasts suggest the first annual USD1tn in GSS (and potentially even green) issuance is in sight for 2022.

A cumulative USD4.6bn of green debt volume has originated from Africa, including USD406m aligned with the Climate Bonds Standard. So far, nine African nations have seen domestic issuers raise finance through green debt instruments, with South Africa (USD3bn), Egypt (USD750m) and Morocco (USD356m) being the top three countries.

The COVID-19 pandemic caught many off guard and impacted the issuance of all types of bonds globally towards the end of Q1 2020. However, the debt market proved to be a flexible source of finance to help with both the immediate impacts and longer-term recovery plans, which led to rapid growth in social and sustainability bond issuance.

Figure 11: Labelled issuance: five-year growth



Source: Sustainable Debt Market Summary H1 2021, CBI 2021[93]

5.3.2 Green bonds in small-scale clean energy

By nature, low-carbon energy is an eligible green activity under the Climate Bonds taxonomy. Still, the broad co-benefits generated by small-scale assets lend themselves to extensive social and sustainability bond applications, for example, by contributing to SDG 5 (e.g., reducing gender inequality) and SDG 8 (e.g., productive use).

While there have been increases in off-balance-sheet financing in the past few years, GSS instruments have yet to gain traction in the DRE sector. The World Bank expects that some companies will announce large off-balance-sheet deals within the next 24 months, which may stimulate securitisation alongside GSS bonds to attract new sources of capital.[94] This emerging evidence is promising, and some landmark structures are beginning to be implemented, linking small-scale financing needs, financial aggregation, and thematic bonds.

In December 2021, a report by Symbiotics Group, a market access platform for impact investing, announced a USD15m green bond transaction for Greenlight Planet Inc.[95] The 42-month bond proceeds go to financing supplier advances, inventory, and customer lease structures for PAYGO SHS via a secured loan facility. The bond was issued on Symbiotics' platform based in Luxembourg (Micro, Small & Medium Enterprises Bonds S.A.) under its Sustainable Bond Framework. The research conducted for this report suggests that this transaction is the first to use thematic bonds to finance real DRE in developing countries.

Instruments of this type can reduce some of the existing barriers to allow ESG-focused investors to finance DRE enterprises.[96] In turn, DRE projects, enterprises, and businesses could tap into the current demand for green bonds from investors with aligned investment mandates.

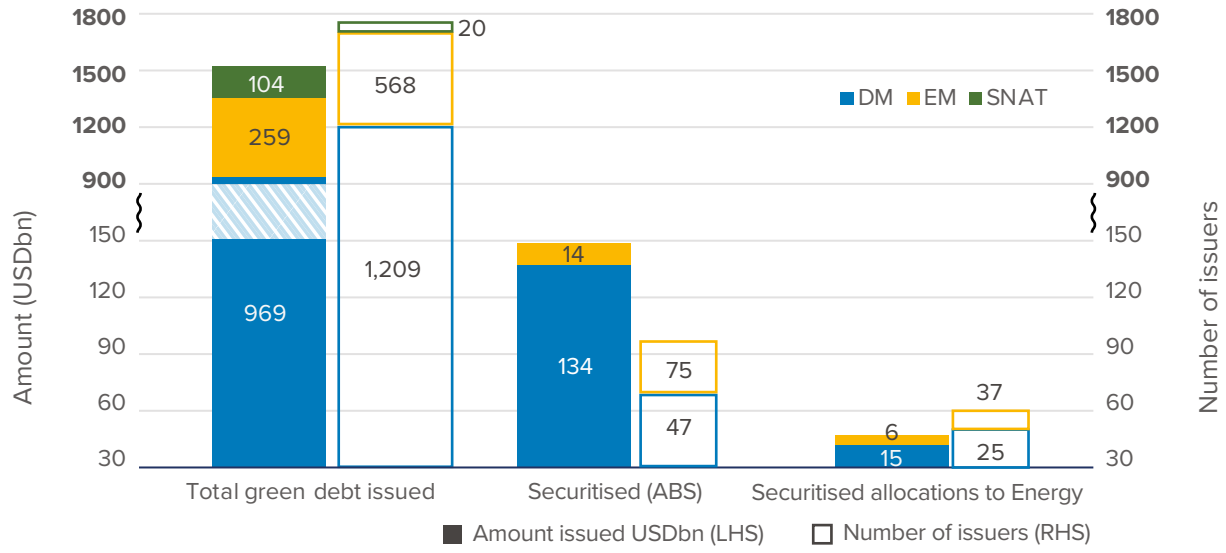
Box 8: Green securitisation for renewable energy

About 2% of cumulative green debt amounts (USD26bn) was issued under green securitisations as ABS partially or fully backed by renewable energy assets, with energy accounting for USD21bn (82%) – this stemmed from 121 deals from 62 different entities, over 90% of which came since 2017. Within the USD21bn of energy-backed ABS volume, the most common energy type by far was solar, predominantly loans for solar panels.

72% of the green energy ABS volume is from developed markets (DM), although EM contribute most of the issuers, mainly Chinese. The DM share is higher among solar ABS deals (about 90% by amount issued), highlighting the barriers preventing more EM solar assets from being securitised and financed by global capital markets.

Figure 12: Total green debt, securitised (ABS) debt, and securitised allocations to Energy (2007-2021 H1)

Amount issued USDbn (left) and number of issuers (right).



Source: Climate Bonds Initiative Green Bond Database (Sep. 2021).

DRE generation remains severely underfunded in the global green debt market

According to Climate Bonds' database, as of H1 2021 no ABS deals backed by DRE generation were found, and only four non-securitised bonds had such a component (all for distributed solar). Two interesting examples were issued by Brazilian companies, although neither are for residential purposes nor finance a large number of projects:

- **E1 Energia**, whose BRL150m (USD26m) deal targets 49 distributed solar projects, nine of which were under construction at the time of issuance and ranged in capacity from 0.3MW to 2.5MW. All seem to be for C&I applications.[97]
- **Athon Geração Distribuída** (a subsidiary of Athon Energia), which issued a BRL40m (USD11m) private placement to finance the construction and operation of six distributed mini solar systems, five supplying a telecoms company and the other to a publisher.

The global thematic debt market is far from reaching its full potential to finance DRE in EM. Green as well as social and sustainability bonds could be leveraged to this end. Addressing the barriers highlighted in this paper can unlock this potential by helping more companies access the market via receivables securitisation. Once the structure is proven, millions of projects households and SMEs could benefit, enabling a revolution in (clean) energy access.

To avoid greenwashing, the underlying loans in securitised products should be appropriately tagged as green. Historically this has presented some challenges such as identifying which assets in a lender's portfolio are green, standardising data and information to verify this, and creating a sufficient volume of loans to repackage in an ABS. The same is true for potential sustainability and social bond instruments.

As viewed from the buy-side lens, several key capital market developments represent meaningful progress towards potential green bond issuances for DRE in developing countries.

First green sukuk for renewable energy in Sudan

Green sukuk are Shari'ah compliant investments used to finance environmental projects. Recently, green sukuk have emerged, with a financially similar structure to a 'conventional' sukuk but where proceeds can only be used to fund environmentally-friendly projects.[98]

In 2021, two green sukuk transactions were identified related to renewable energy in SSA:

- Sanabel, a subsidiary of the Bank of Khartoum, launched an investment fund offering Sudan's first green Sukuk aimed at financing renewable energy for commercial use. According to its prospectus, the USD11.3m fund seeks to finance the production of 55MWh per day for industries such as agriculture and mining.[99]
- OneWattSolar (OWS), a digital solutions company built on a Blockchain platform to provide OGR energy, issued the first series of its USD24.4m green bond programme to deploy clean energy across SSA. The issuance was led by Comercio Partners and included a BBB-rated, seven-year green Sukuk of USD2.4m. This represents the first corporate green Sukuk in Africa and the first corporate green bond for an OGR energy project. Financial Sector Deepening Africa (FSD) — a UK-funded development agency strengthening financial markets in SSA — provided technical assistance in support of the deal.[100] The bond issuance was possible due to OWS's bankable business model and track record in Nigeria's renewable energy space and various partnerships with solar companies and installers across Nigeria.

The World Bank reports that green Sukuk can be used to address energy security, energy poverty, and environmental responsibility and leverage four forms of regional financial integration:[101]

1. Currency unions to foster regional integration to tackle climate change.
2. Regional exchanges to list green Sukuk, promoting credibility and transparency.
3. Regional/sub-regional multilateral development banks to implement green Sukuk programmes, such as the African Development Bank (AfDB) Green Bond Programme.
4. Subregional central banks which can promote the tradability of green Sukuk through preferential regulatory treatment and their qualification under international regulations such as Basel III.

Green bonds for renewable energy projects (Kazakhstan)

In 2020, the Damu Entrepreneurship Development Fund, a subsidiary of Baiterek Holding, successfully placed its first green bond to promote investment in renewable energy in Kazakhstan. Funds are intended for SMEs implementing green projects[102] via on-lending arrangements with second-tier banks and microfinance organisations at reduced rates.[103] The three-year deal carrying an 11.75% coupon was led by BCC Invest JSC, a subsidiary of Bank CenterCredit JSC.

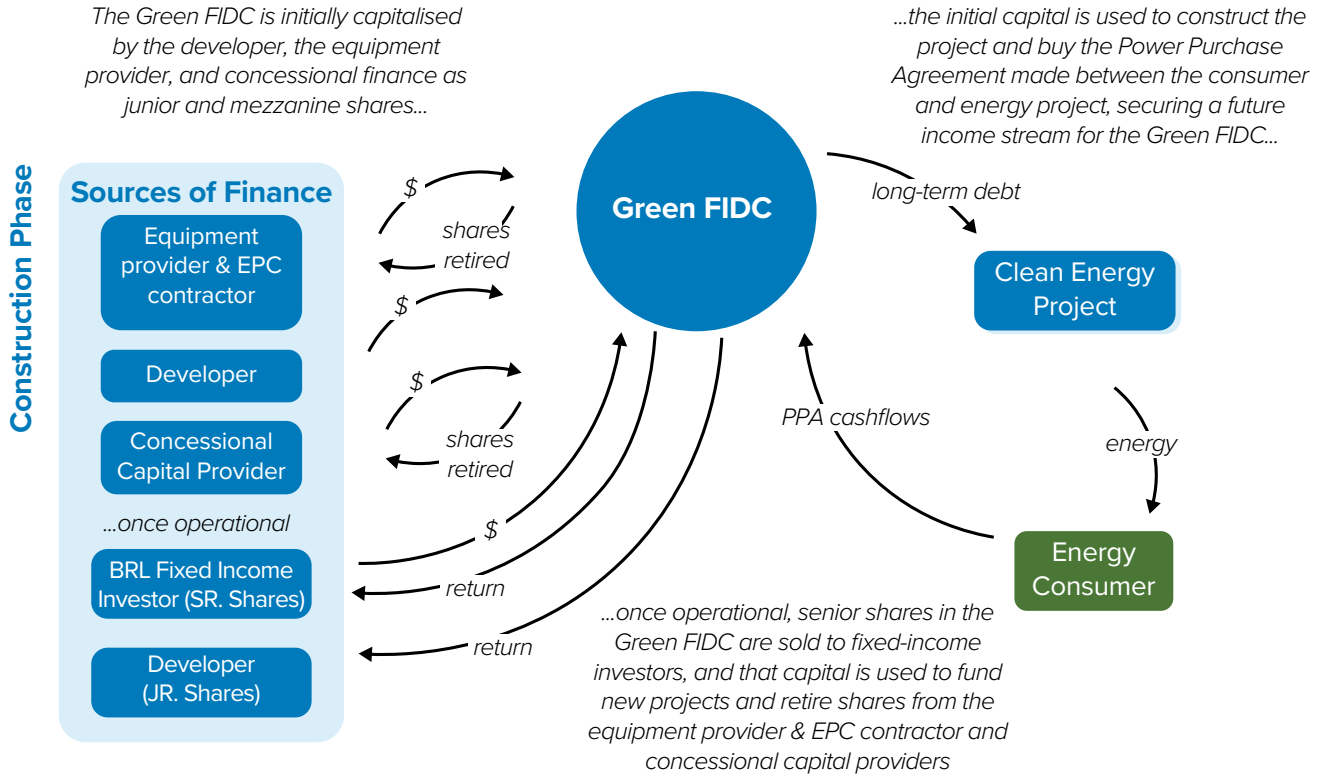
It was structured within the framework of an agreement with UNDP to reduce the risks of investing in renewable energy. UNDP provides technical support in selecting green projects and subsidises part of the funds green bond coupon rates. The instrument debuted in Kazakhstan under the De-risking Renewable Energy Investment (DREI) project implemented by the Ministry of Energy and supported by the UNDP with funding from the GEF.[104] The placement represented the first green bond listing to comply with the green principles in Astana International Exchange's (AIX) Green Bond Rules[105] based on the ICMA Green Bonds Principles and the Climate Bonds Initiative Standard.[106] This follows on from the Asian Development Bank's (ADB) issuance of the first green bond on the Kazakhstan Stock Exchange in late 2020 – a two-year, USD32.6m raise arranged by Kazakh-based merchant banking group Tengri Partners to finance climate change adaptation and mitigation projects in the country.[107]

Brazil's first FIDC and CRI issued as green bonds raise USD50m

Fundo de Investimento em Direitos Creditórios (FIDC, or Credit Rights Investment Fund in English) are regulated asset-backed securities specific to Brazil where receivables from multiple companies seeking to raise capital are securitised and traded. The Green FIDC builds on this concept by combining the FIDC regulatory frameworks, green certification criteria, the segregation of operational and financial risks, and a financial model tailored to the needs of renewable energy and energy efficiency projects.[108] The instrument initially provides finance for project construction and development and is refinanced via a share sale in the local capital markets once the project is operational.

The structure helps overcome key market barriers by integrating public and/or concessional financing to absorb development risks, thus protecting other public and private investors from these risks during the early stages. Further, the Green FIDC allows clean energy and energy efficiency projects to secure financing based on future cash flows from energy sales.[109] In April 2021, the first FIDC issued as a green bond was closed by Albion Capital and Órigo Energia via a USD35.8m issuance. The deal coincided with a close of Brazil's first Green CRI (Real Estate Receivables Certificate, a spinoff from the Green FIDC), which secured an additional USD14.3m raising a collective USD50m to finance Órigo's expansion in solar distributed generation.[110]

Figure 13: Green Receivables Fund (Green FIDC) structure



The Green FIDC builds on an existing financial structure in Brazil to provide lower-cost, long-term capital to renewable energy and energy efficiency projects.

Source: adapted from The Global Innovation Lab for Climate Finance. 2017. Green Receivables Fund (Green FIDC).[111]

Solar power Yemen UN-Hajar Hashem Abu Baker Alawi
Photo credit: UNDP Yemen

6. Current financial aggregation models in operation in the DRE sector

To date, there have been meaningful attempts within the DRE sector to establish a viable financial aggregation model. Many companies, programmes, and initiatives have executed transactions involving financial aggregation, securitisation, and other mechanisms.

From our research, limited funding has been raised via financial aggregation mechanisms in the sector, both in SSA and globally. Table 3 below lists a sample set of identified transactions, including a few with financial aggregation elements. These developments represent meaningful progress towards unlocking opportunities to tap into the green bond market.

From the information available on their respective amounts, the current size of the financial aggregation market for DRE in SSA (as of H1 2021) can be estimated at around USD400m.[115]

Almost all of this refers to the securitisation of OGS receivables, a substantial share to PAYGO companies. There are other examples of developments where larger-scale debt is being deployed within the sector. A separate 2020 report sponsored by GreenMax Capital Advisors and Energy4Impact lists 21 additional Specialised Off-Grid Debt Funds – some of which are related to the small-scale renewable sector but do not specifically make use of financial aggregation.[116]

Box 9: Primary types of financial aggregation strategies

Transactions can be viewed as falling into one of three SPV models, which we term 'originator-specific SPV', 'co-mingled SPV' and 'standardised SPV'.

- BBOXX (2015) – '**originator-specific**' SPV model. The BBOX transaction was a local-currency refinancing for KES50m (approximately USD500,000). BBOXX bundled 2,500 three-year customer contracts and created its own dedicated SPV for the transaction. This enabled the creation of asset-backed notes – named Distributed Energy Asset Receivables, or DEARs – with a maturity of 2.5 years and estimated to be 30% over-collateralised. The implied local currency (KES) interest rate was 21%. This transaction was the first ever securitisation, of any sort, registered with the Kenya securities exchange. The investor was Dutch impact investor Oikocredit. BBOXX was advised by Persistent Energy Capital.[112]

- SunFunder (2016) – '**co-mingled**' SPV model. SunFunder's model involves one overall SPV with the receivables of multiple originators co-mingled to offer investors a diversified portfolio. One SunFunder asset-backed product is the 'Structured Asset Financing Instrument' (SAFI). In May 2016, SunFunder announced a SAFI USD2m credit line to SolarNow in Uganda to provide working capital to acquire new customers. In October 2016, SunFunder announced the largest funding round yet for its SPV with USD50m from investors including OPIC and the Rockefeller Foundation.[113]

- Lendable (2016) – '**standardised SPV**' model. Lendable is an aggregation platform that works with multiple originators and investors. Unlike the SunFunder model, receivables of different companies are not co-mingled, but instead a single standardised SPV, each a separate legal entity, is established for each investor and portfolio. Ultimately Lendable envisages creating hundreds of these standardised SPVs, creating transparency and liquidity in the market. Lendable also has a risk analytics/modelling arm analysing each SPV to assess portfolio quality. In October 2016, Lendable announced its first receivables transaction in East Africa with a total value of USD600,000 for 500 leases, and a note maturity of 24 months. The interest rate was 14%. Investors included Deutsche Bank Foundation and Ceniarth.[114]

Table 3: Identified transactions relevant to the progression toward financial aggregation for small-scale, low-carbon energy

TYPE	YEAR	TITLE	RELEVANCE
SPV	2016	SunFunder announces first close of USD50m funding round for 'Beyond the Grid Solar Fund' SPV[117]	Anchor investors provide nearly USD21m to finance a pipeline of off-grid solar transactions, expand some of SunFunder's new financial products for the sector (including SAFI) for OGS companies and mobilise more commercial debt investors. The "Beyond the Grid Solar Fund" helps build credible evidence of the value of an SPV structure to facilitate debt finance for solar in Africa and Asia.
Technology development	2017	Lendable announces the first data-driven receivables transaction in East Africa[118]	Lendable secured KES56.65m (USD550,000) debt financing to provide PAYGO solar energy solutions using an innovative, data-driven receivables financing solution where capital is secured by future customer revenues from a high-quality portfolio of over 7,000 Raj Ushanga House (RUH) PAYGO solar customer contracts. This marks the first such financing by Lendable for a PAYGO energy company, using a data-driven approach to assess deal risk and avoid expensive structuring costs. The off-balance sheet structured debt financing accelerates scalable PAYGO solar power in Kenya and provides a template to create greater standardisation in the industry – future transactions could utilise the same Standard Receivable Financing structure.
PAYGO Receivables-financing facility	2017	SolarNow receives USD6m syndicated off-grid solar financing facility[119]	Investors SunFunder, Oikocredit, and responsAbility Investments announce a new syndicated receivables financing facility structured as a bankruptcy-remote SPV to enable SolarNow to deploy SHS to a broad section of Uganda's off-grid population by offering credit to end-users. The facility provides a valuable proof-of-concept for receivables financing within an SPV.
PAYGO Receivables-financing facility	2017	M-KOPA Solar announces USD80m of committed financing, including a USD55m local currency equivalent debt facility[120]	The local currency debt facility in Kenyan (KES) and Ugandan Shilling (UGX) is backed by M-KOPA customer receivables paid via mobile payment plans. The facility is designed to be utilised over the following three years to finance PAYGO solar installations in one million homes. It was the most significant commercial debt facility to date in the PAYGO off-grid energy sector and represents a scalable debt-based solution able to overcome currency mismatches.
Technology development	2018	Solaris Offgrid and Gaia Impact Fund partner together to fund the creation of a custom portfolio of SHS leases[121]	Solaris Offgrid uses real-time data and metrics to enhance credit underwriting criteria, project types, lease duration, and impact goals related to GOGLA's KPI Framework, enabling GAIA to isolate credit risks that match the fund's mandate. This marks one of the first occasions of a fintech utilising data to create transparency for off-grid energy projects and companies.
SPV	2018	Zola EDF mobilises a EUR24m local currency loan[122]	The African Development Bank approved a proposal to support Zola EDF (an SPV owned 50:50 by Off-Grid Electric and EDF) with a partial risk guarantee to mobilise a local currency loan worth approximately EUR24m equivalent, arranged by Société Générale and Crédit Agricole CIB. This presents an SPV solution with local currency offerings and may offer lessons for future attempts using a similar structure.
PAYGO receivables-financing facility	2019	PEG Africa raises USD25m equivalent in a multi-currency transaction[123]	PEG Africa raised USD25m equivalent in a multi-currency transaction (including USD, Ghanaian cedis, and CFA francs) led by UK CDC, including a USD15m equivalent receivables-backed facility. This presents a scalable receivables-backed solution that manages currency mismatches.

TYPE	YEAR	TITLE	RELEVANCE
Securitisation	2019	AfDB approves program to promote securitised financing of Distributed Solar Projects[124]	The DESCOs Financing Program promoted securitisation financing techniques to address finance access barriers for DESCOs while supporting their growth and expansion in existing and new markets. The program also facilitated local currency financing for DESCOs and provided local lenders with risk mitigation instruments to help them. The board approval followed the approval of a EUR50m guarantee facility and EUR6m technical assistance grant by the European Fund for Sustainable Development (part of the European External Investment Plan). The programme is actively involved in creating new ways to tackle existing barriers.
Securitisation	2019	Solar Securitisation Pilot for Rwanda[125]	An initiative to pool loans from multiple solar developers into tradable, asset-backed security, freeing up capital to expand the SHS market. While still under development, the proposed issuance was sized at USD9m and designed to enable the deployment of SHS for 175,000 households. At scale, the instrument can reach US100m in size in Rwanda alone, targeting 2m households, with the potential for future expansion to other East African countries with similar energy access and economic/institutional conditions. While only a pilot program, this may catalyse others to adopt financial aggregation and securitisation strategies in East Africa.
Technology development	2020	Cross boundary Energy Access (CBEA) uses Odyssey's asset management platform[126]	The first project financing facility for mini-grids is enabled via tracking and analysing the portfolio's performance of the underlying distributed energy assets. This represents a template for similar data collection, measurement, and monitoring that can be scaled for aggregation solutions in the mini-grid sector.
Securitisation	2020	NEoT Offgrid Africa launches the first receivables securitisation program for renewable energy projects in Africa[127]	NEoT Offgrid Africa (NOA) closed a receivables securitisation program with Zola Electricity Côte d'Ivoire (ZECI – a joint venture between EDF and Zola Electric) aimed at more than 100,000 SHS for households in Côte d'Ivoire, aiming to reach a portfolio worth EUR40m. This is claimed as the first investment platform to set up a receivable securitisation program to finance off-grid energy projects in Africa.
PAYGO receivables-financing facility	2021	Expansion of Brighter Life Kenya 1 Limited (BLK1), an off-balance sheet financing vehicle[128]	BLK1 is an off-balance sheet vehicle providing local currency impact finance for d.light's Kenyan PAYGO SHS business. Access to ongoing receivables funding provides the company with flexible working capital to finance its continued growth. It is intended as the first in a series of vehicles designed to provide d.light with continuing access to sustainable and affordable local currency receivables financing.
Green bonds	2021	Green bonds to finance DRE in developing countries[129]	Symbiotics Group announced a USD15m green bond transaction for Greenlight Planet Inc. The 42-month bond proceeds go to financing supplier advances, inventory, and customer lease structures for PAYGO SHS via a secured loan facility. The bond was issued on Symbiotics' platform based in Luxembourg (Micro, Small & Medium Enterprises Bonds S.A.) under its Sustainable Bond Framework. The research conducted for this report suggests that this transaction is the first to use thematic bonds to finance real DRE in developing countries.
PAYGO Receivables-financing facility	2022	Nithio FI secures catalytic investment from Shell Foundation to scale clean energy financing in Africa[130]	Nithio, the AI-enabled energy financing platform that directly finances clean energy companies in Africa, announced an investment from the Shell Foundation into its financing vehicle, Nithio FI. Nithio FI's lending is the data-powered engine that collects essential information, including consumer repayment data, to standardise credit risk assessments, inform due diligence, and enhance portfolio and impact monitoring.

7. Barriers specific to financial aggregation

Section 4.2 explored the general barriers to financing SMEs in developing countries. In this section, the focus is on barriers specific to financial aggregation. This report has taken a lens of sell-side and buy-side actors to assess these particular barriers. As the market has evolved, some of these barriers have diminished, and there are instances where practitioners have developed means to reduce them. Some specific barriers hold greater significance to particular DRE solutions or countries. This section aims not to consider the extent to which each barrier contributes to market inefficiencies but rather to highlight potential inhibitors to efficient aggregation.

Financial aggregation can take different forms and occur at multiple levels: on the balance sheet of a sell-side project developer; on the loan book of a primary buy-side domestic, commercial bank; and in more mature financial aggregation markets, via public securitisations from either project developers or financiers. Hence, the barriers associated with each form of financial aggregation vary depending on the approach taken. Each barrier hinders aggregation by either inhibiting the formation of a sufficient pipeline of investible projects or impacting the risk-return profile of small-scale clean energy projects.

The barriers identified and detailed in this section are based on consultations with various stakeholders across both the sell-side and buy-side (complete list included in appendix) and is reinforced further by the available literature. They represent the leading issues that need addressing if financial aggregation is to reach its potential to expand small-scale low-carbon energy.

Table 4: Financial aggregation barriers identified

BUY-SIDE BARRIERS	SELL-SIDE BARRIERS
Lack of track record	Support of domestic expertise
Transparency and data	Market sensitisation
Business risk	Deal/ ticket size
Correlation risk	
Structuring challenges	
Currency convertibility risk	
Foreign exchange (FX) rate risk	
Legal risk	
Exit strategy	

7.1 Limitations

Financial aggregation is complex, and the theoretical categorisation has limitations, such as some overlap between *sell-side* and *buy-side* distinctions. Nonetheless, while recognising these limitations, the sell-side and buy-side distinctions have value. In practice, many of these barriers are interrelated and cannot be considered in isolation, and their combined effect strongly influences investment decisions in the DRE market.

Other general barriers are evident in these markets but have been considered general issues related to foreign investment in developing countries, and several are discussed in section 4. For instance, political instability will affect prospects for financial aggregation in select countries but does not feature as a barrier due to its general nature. Country-specific regulations and legal, policy, and tax frameworks are largely omitted from this analysis but are also pivotal factors for enabling DRE. On the other hand, some barriers – like FX risk – could be considered 'general' issues for international finance but were deemed relevant for inclusion due to their direct implications for financial aggregation.

The lack of standardisation (e.g., contracts, assets, KPIs, etc.) could also be considered a barrier to further financing the DRE sector. However, ongoing market developments suggest that a lack of standardisation can be overcome by focusing on overcoming other barriers (e.g., lack of transparency, legal risk, etc.) that can pave the way for standardisation and its benefits to emerge – hence section 8.1.2 highlights standardisation as a potential enabler if other barriers are addressed. Similarly, rather than considering the lack of an investible pipeline of energy assets as a barrier, efforts to expand such pipelines are presented as a key enabler.

7.2 Buy-side barriers

In developing financial aggregation markets, the primary buy-side actors are mostly domestic commercial banks, impact investment funds, and non-bank financial intermediaries, including warehouse vehicles and platforms such as Lendable and Sunfunder. A broader buy-side ecosystem exists, including impact and mission-driven actors (asset managers, funds, foundations, family offices) and development institutions, who may provide first-loss guarantees and credit enhancement. Each lender has particular strengths and weaknesses regarding extending finance to the clean energy sector in SSA.[131]

Primary buy-side actors may, in turn, access different levels of buy-side actors, with banks refinancing their balance sheets and platforms accessing investors. As financial aggregation markets mature, these levels of buy-side investors evolve, with the most efficient markets accessing institutional investors via publicly placed bonds.

7.2.1 Lack of track record

A commonly cited issue surrounds a lack of information to adequately quantify the risk of a pool of aggregated DRE assets – a key requirement among risk-averse debt investors. In some cases, PAYGO companies extending long-term, flexible payments to customers may have some historical records but have not been in operation long enough to provide a complete picture of repayment cycles. This is often the case with new market entrants and start-up companies that fall within the umbrella of small-scale businesses. This creates inertia in allocating appropriate finance, with lenders imposing stringent lending requirements and borrowers lacking the means to fulfil them.

As a result, businesses are often forced to resort to a style of 'bootstrapping' through incremental equity raising or obtaining high-interest, short-term debt to fund initial business operations; this creates financial strain during initial phases and can initiate a vicious debt cycle detrimental to long-term financial health. The amount of available, well-priced long-term debt to fund the underlying idle assets with stable cashflows is insufficient to attract the typical investors interested in aggregated portfolios of DRE.

Other SMEs that integrate technology into their business model and have been in operation for 3-5 years may capture a wealth of data but lack the expertise or knowledge on how this can be utilised to analyse their customer base and indicate a viable track record. By comparison, larger-scale businesses operating for longer periods are likely to have more advanced capabilities to produce this information for lenders and thereby source finance on more attractive terms.

The U.S. International Development Finance Corporation (DFC – formerly the Development Credit Authority of USAID) lists insufficient track records as one of the leading challenges in the off-grid market.[132] All investors, not just those who are risk-averse, will demand performance history for any cash flow-based transaction such as securitisations. Hence, the availability of historical repayment patterns measuring portfolio performance builds investor confidence in projects and ultimately serves as a precursor to scaling up debt aggregation solutions.[133]

7.2.2 Transparency and data

Portfolio performance provides insights into how well a company executes its business plan and the overall expertise of management. When an expanding company pursues growth opportunities to serve new markets or populations, lenders need to understand the credit risk of current operations and future prospects. To achieve this, there is a need for transparency through high-quality, verified, real-time data to assess ongoing operations as well as assess potential opportunities.

This feature of credit risk management relies on effective and reliable management information systems (MIS) to provide data and quantify the risk in a pool of aggregated assets. Smaller enterprises are tasked with juggling future sales opportunities alongside current business operations and often fail to invest in the types of data collection or process automation often valued by lenders. When data is provided, it is often self-reported and unregulated.[134] Further, considering it is a lagging indicator, time delays between when the data is captured, analysed, and presented may reduce its relevance to lenders.

Centralised sources of consolidated data and information can help create standardised, measurable, and comparable metrics across the sector. Transparency around the credit portfolio quality of OGS companies is often unavailable (at least not publicly) given the frequent lack of audited financial statements holding credible information. These statements are critical inputs for creating industry-wide credit reference systems and rating agencies, which are notably absent in the market. Improvement in real-time data collection is fundamental to effective credit assessment and monitoring of receivables in a portfolio of assets.[135]

A 2020 paper from EnDev concluded that in Uganda, the exchange of credit information on customers is believed to encourage sustainable growth in the OGS sector while also accelerating the financial inclusion of solar customers.[136] These developments often rely on sufficient data privacy protections, which many international investors demand to be in place. While many countries in SSA have data privacy laws, their implementation is inconsistent.

Box 10: Nithio

Data-Driven Energy Access for Africa is an example of how data can trigger scalable financing of the DRE companies.[137] Piloted by Nithio in several African economies, the technology uses artificial intelligence for credit scoring to create loan pools that better match lender risk appetite and replaces physical assets with cash flow as collateral.[138] The platform aims to trigger scalable financing for DRE companies by assessing repayment capacities via machine learning algorithms to predict expected future cash flows.

By partnering with organisations such as Solaris Offgrid, Nithio aggregates and leverages multiple data sources to assess portfolio and energy user risk. Understanding these risks granularly enables Nithio to offer DRE companies financing directly via receivable warehousing financing. Nithio's lending arm, Nithio FI, aims to provide financing to more than 224,000 energy access products across the continent, including SHS and productive use appliances.[139]

In January 2022, Nithio FI secured catalytic investment from the Shell Foundation which joined existing investors, including US DFC, EDFI-ElectriFI, and FSD Africa Investments.[140] Nithio intends to support other investors and lenders interested in financing businesses under a similar arrangement. By 2030, Nithio estimates it will have facilitated 173.7 MW of clean energy, thus avoiding 5.42m metric tons of CO_2e emissions across SSA and could help NGOs and development finance institutions target less well-off communities.[141, 142]

Data is necessary to understand energy users' payment behaviour. Without this, the expected risk-return profile is unclear – particularly for PAYGO businesses that can function on flexible repayment terms and over indefinite horizons. The enablers section highlighted the importance of improved utilisation of existing data to provide additional visibility on customers' and businesses' financial flows.

By linking data aggregation with financial aggregation, Nithio aims to expand access to capital for DRE while reducing lending portfolio risk for investors.[143] This remains an example of how data and analysis can increase credit risk transparency across various businesses within an investment pool, eventually enabling securitisation.

7.2.3 Business risk

Challenges to the overall success and continuity of business operations are a general issue faced by all small-scale businesses in less developed markets. Ongoing growth and development have led to rapid innovation among business models and made the sector increasingly complex. This complexity leads to ambiguity and uncertainty when trying to understand the characteristics of a particular operation, which is vital for successful financial aggregation.

From the financier's perspective, assuming sponsor risk is highlighted as a primary concern, particularly in light of the overall fragmentation of the DRE market across different countries.[144] Investors overcome this by conducting lengthy due diligence, which is costly and resource-intensive. Despite best endeavours, operator failures can occur, and investors may still rely on the company itself to unwind the portfolio as there are few qualified service providers capable of intervening to ensure business continuity.

The critical reasons for operator failures under the PAYGO model have been insufficient appraisals of customer credit risk coupled with an acceptance of higher credit risk in expectation of higher returns. The likelihood of failure increases for operators where process automation is lacking and where heavy reliance on middle management and talent gaps exist. This is most visible in markets with a viable, creditworthy customer base that are becoming increasingly competitive and reaching the point of saturation.

The recent COVID-19 pandemic has been a challenging situation for most companies operating in this space, with certain businesses – often backed by solid capital bases, cash reserve capabilities, and established cashflows –faring better than others. However, this recent turmoil has reduced the available pool of originators and assets for aggregation in the near future.

Box 11: Effects of the COVID-19 pandemic

Despite continued interest in DRE in Africa, the sector experienced a decrease in external investment in the lead up to the pandemic and the trend has continued since. Access to capital is increasingly difficult, with investors becoming more risk-averse due to perceived uncertainty. Overall, stakeholder interviews indicated that while significant, the impacts as of mid-2021 were not devastating. The initial shock in 2020 was more subdued than predicted but the economic recovery in 2021 has perhaps not been as robust as envisaged, and negative effects will no doubt persist.

On the ground, the situation is highly country-specific and tied to the business itself. The PAYGO COVID Impact Monitor recorded that general sales growth slowed with lockdowns, which limited on-the-ground activities while international supply chain and other logistical costs increased along with lead times. Operators with existing government contracts to deliver a fixed number of installations faced challenges in meeting expectations, whereas those providing services to households saw an increase in utilisation during lockdowns.

During this time, many companies exercised greater discipline regarding use of capital but resorted to laying off staff and delaying expansion opportunities to reduce costs. The PAYGO COVID Impact Monitor showed liquidity (measured by assets convertible to cash in < 90 days / Total cost, and representing an inefficient use of capital), doubled from 51% prior to COVID in 2019 to 89% during COVID, with write-offs increasing for 75% of the firms surveyed during the same period.[145]

Consumers have proven resilient in the face of considerably challenging issues. Evidence indicates limited decreases in repayments compared to what was observed in other sectors, such as transportation. Overall collection rates remained stable between 2019 and 2021 although this varied across firms, with 50% experiencing collection rate declines. This suggests that the products are highly valued and the sector has solid underpinnings, serving an essential function in these markets.

7.2.4 Correlation risk

Pooling receivables from small-scale businesses within a single geography leads to correlated downside risk, such that economic disruptions affect the performance of all assets simultaneously. A report into PAYGO solar companies suggests that correlation risk is one of the key challenges for attracting capital to the sector from an investor perspective.[146] While financial aggregation can limit the concentration risk, widespread defaults can result if underlying businesses within an aggregation vehicle are clustered in a single customer segment, market, or region are broadly affected by a given event.

The breadth of factors that create economic turmoil in developing countries is vast, with natural disasters being a primary example. For instance, a widespread, prolonged drought would likely affect repayment and utilisation rates if the customers rely on agriculture as their primary income source. Floods or landslides can block access to particular regions for extended periods, affecting sales, servicing levels, and ongoing project development, potentially creating supply disruptions (particularly for mini-grids). Notably, the frequency and severity of these events will become increasingly common in the future due to the impact of climate change.

Few options are available to minimise or diversify correlated risks within a portfolio. Multi-originator aggregation transactions are complicated – even outside developing countries. Diversifying investments across countries and jurisdictions could spread these concentrated risks; however, this is not conducive to aggregation due to differences in policy, regulation, and legal protections. Limits could be applied within an aggregation facility, limiting the amount of finance available to the underlying companies looking to scale operations. Incorporating C&I operations – such as a local healthcare facility – as an anchor customer amongst a residential customer base can increase resilience to such risks and help to increase cash flow stability. While this type of approach holds promise, loans to C&I projects are likely to differ in tenor and amount to residential SHS loans, affecting standardisation.

As companies grow, they typically diversify revenue across products and geographies. Larger companies have additional tools to manage these risks, such as extended offtake agreements, which creates significant long-term revenue reliability and opportunities for long-term debt financing. The pooling effect from financial aggregation only serves to diversify uncorrelated risks. Therefore, small-scale businesses operating within a limited geography would typically absorb these risks, directly increasing their credit risk and impacting the investment return within a proposed aggregated finance arrangement.

7.2.5 Structuring challenges

To separate the pooled receivables from other business assets (and risks), it is necessary to create an off-balance sheet structure that enables securitisation. A recent default case, reported by a leading crowdfunding debt provider where the decline of one portfolio company created uncertainty for its other business operations, serves as a cautionary tale showing the potential effect of a failure to separate relevant assets.[147]

Establishing an SPV in the first instance can be lengthy and complicated, depending on the country. Domiciling the SPV in other developed markets can reduce the complicated setup process and incorporate suitable legal protections. Still, the associated costs are high for each SPV and typically disproportionate to current investment sizes. Further issues can also arise given that customers rely on operating companies to service their products and collect payments; if the operating company faces disruption, a suitable service provider may not be willing or able to fulfil the outstanding contracts on behalf of the SPV.[148]

These challenges directly impact prospects towards financial aggregation. Aside from being best practice, international investors will require sufficient legal protection and segregated vehicles to underpin each potential security issuance. A report into the DESCO sector notes that as the market grows, it will likely follow a similar path to other developed ABS markets that initially had many different offerings but converged towards a common standard over time.[149] This convergence is indicative of a maturing market that will see several barriers reduced through a mixture of market-based solutions and public-sector reforms. For now, an array of sector-specific challenges remains across the different technologies.

7.2.6 Currency convertibility risk

In certain jurisdictions, local currencies may not be convertible or local markets may restrict foreign capital inflows/outflows, limiting or impeding investment. Guarantees and assurance clauses around transferability and convertibility can be utilised to mitigate these issues but still face hurdles due to stringent local credit approval processes. Multilateral agreements and development bank support mechanisms – for example, the Currency Convertibility Fund backstopped by a contingent credit from the International Development Association (IDA) – may help address the risk at scale and increase foreign investor confidence.[150]

Box 12: NEoT / ZECI

NEoT Offgrid Africa (NOA) is reportedly the first investment platform to set up a receivables securitisation program to finance off-grid energy projects in Africa, focusing on SMEs, communities, and individuals seeking to diversify their energy supply sources.[151]

In March 2020, NOA launched a receivables securitisation programme to finance renewable energy projects in Africa with Zola Electricity Côte d'Ivoire (ZECI) – a company providing SHS to off-grid populations in Ivory Coast. ZECI is a joint venture of American company OGE (Off-grid electric), now ZOLA ELECTRIC, and the French Multinational EDF (Electricité de France).[152] The deal aims to equip more than 100,000 households with SHS in Côte d'Ivoire, mainly in rural and peri-urban areas, and reach a portfolio worth EUR40m.[153., 154]

Several financial players joined forces to support the company's development through the securitisation vehicle (NEoT CI), which uses blended finance comprising of:[155]

- An equity portion provided by NOA
- A senior loan in local currency of XAF11.8bn (about USD20m or EUR18m) granted by Société Générale Côte d'Ivoire (SGCI)
- Guarantees provided by the African Development Bank and Crédit Agricole CIB

The vehicle is owned by NEoT Off-Grid Africa, managed by NEoT Capital, and controlled by the infrastructure fund Meridiam, with Mitsubishi Corporation and EDF as co-shareholders. In addition to participating in the implementation and financing of the project, Grameen Crédit Agricole Foundation will also be in charge of monitoring the project's social and environmental performance.

Under this structure, NEoT CI purchases the SHS and the sale-on-credit contracts signed with the off-grid customers, which are paid via mobile money.[156] The securitisation programme sees NOA absorb the financial risks related to the 'rent-to-own' scheme whereby customers can become owners of the solar kits at the end of the rental period.[157] This arrangement enables ZECI to focus on commercialising and deploying clean energy supply solutions in rural areas in Côte d'Ivoire while strengthening its economic model.

More recently, NEoT has provided further support to the region's mini-grid sector, including Winch Energy (see Box: Winch Energy: Mini-grid financing platform).

As a first mover, NEoT may represent the beginning of broader market developments towards securitisation. There are a few notable features in their approach to market. Firstly, blended finance has been incorporated in establishing the programme, which allocates the risk layers to the relevant financing parties. Secondly, the challenges around the lease-to-own business model have been addressed directly, which was cited as one of the key business risks earlier in this report. Lastly, in the absence of a formal certification structure, Grameen Crédit Agricole Foundation has taken lead responsibility for measuring the positive social and environmental impacts stemming from the investments. These types of inclusions may represent important lessons for how to set up similar receivables securitisations for clean energy.

7.2.7 Foreign exchange (FX) rate risk

The U.S. DFC lists FX risk as the leading financing obstacle for international commercial lenders when investing in Africa, particularly in immature sectors.[158] Options for converting local currencies are available but incur disproportional costs relative to the investment size and drag on overall investment returns. For international lenders, the severity of this risk depends on the volatility of the local currency, but generally, frontier markets can have high currency volatility where large swings in exchange rates can occur over short periods.

Currency volatility can be managed by diverting capital to companies operating in countries with a hard-currency peg. An alternative is to utilise third-party hedging solutions. However, hedging costs for EM currencies are high and fail to provide a systemic answer at a global scale.[159] Another option is to pass these risks onto the customer by integrating period payment increases if a strong correlation between inflation and currency depreciation exists. However, this could have knock-on effects on other risks (e.g., business risk and repayment).

7.2.8 Legal risk

Some countries lack a supportive legal framework or standardisation of legal contracts, and not all jurisdictions have clear bankruptcy laws related to SPVs. Compounding this issue further, unclear legal procedures and timing for asset recovery may prove challenging and costly for lenders in the event of default. These issues are a fundamental impediment to issuing senior secured debt within an aggregation structure, which requires various legal agreements to close a transaction, with extensive input from local lawyers.

The need for standardised legal contracts and supportive legal frameworks would simplify general due diligence processes for international financiers and act as an essential building block for joint ventures to be created and potential bundling of assets across countries. In recognition of this, the Open Solar Contracts initiative was launched by IRENA and TWI to simplify and streamline legal procedures by focusing on six core elements: power purchase agreements, supply agreements, implementation agreements, installation agreements, O&M agreements, and financing term sheets.[160] Aggregation could leverage and adapt this vital work to overcome legal risk.

7.2.9 Exit strategy

While the primary focus of this report is on debt instruments leveraging financial aggregation, there is an intrinsic link between equity and debt financing. Start-up and early-stage companies need equity in their initial stages of growth before they make room for debt. The sector and underlying companies have experienced substantial growth recently, but this has not necessarily equated to profitability which has stymied venture capitalists and other initial impact investors from exiting their initial investments.

More broadly, local markets are immature with limited depth and secondary capital, while international markets deem the sector risky. This reduces liquidity and will act as a deterrent to other capital flows unless addressed. Financial aggregation can stimulate debt liquidity but will rely on a functional pathway for early-stage equity providers to recoup their investments – hence this barrier is relevant for extending both forms of capital.

7.3 Sell-side barriers

The sell-side can be understood as the supply of high-quality, credit-assessed, small-scale, low-carbon energy assets seeking debt capital. The primary sell-side actors are typically project originators or developers, such as DESCOs. A broader sell-side ecosystem exists, where project originators and developers are assisted by financial intermediaries such as investment banks and, where applicable, rating agencies.

The U.S. DFC categorises borrowers in this market according to the following segments:[161]

1. Local enterprises using cash transactions
2. Companies using the PAYGO platform
3. Project developers

The characteristics of the respective segments lend themselves to relative strengths and weaknesses in terms of accessing capital within the off-grid energy sector.

7.3.1 Support of domestic expertise

Despite local entrepreneurs often having a deeper understanding of the local market as well as occasionally superior business models, international groups typically have superior resources and connections to international financing sources. International private investors state willingness to support local enterprises and entrepreneurs but consistently allocate their capital to international companies. Based on GOGLA data, an estimated 75% of all off-grid energy financing was committed to three international companies between January 2019 and August 2020.[162] A World Bank study on early-stage financing in green sectors in SSA reinforces this trend: 53 out of 58 firms observed in the DESCO, mini-grid, renewable energy finance, and advanced systems and software subsectors originated by international founders.[163]

The capabilities of the respective groups are varied, with local founders operating at a comparative disadvantage. The perception that local entrepreneurs represent a higher risk adds an additional dimension to their challenges of obtaining finance. To correct this imbalance, programmes to support local energy entrepreneurs and technology providers are needed.[164] These can strengthen the DRE sector overall and help create an investible pipeline.

7.3.2 Market sensitisation

Local financiers and associated intermediaries often have limited experience and lack understanding of DRE business models; this creates uncertainty and increases contingency margins within lending rates. To counter this, businesses effectively incur the cost of sensitisation (or education), which may not be budgeted for by funders and detracts from their core business focus. While this disconnect deprives financiers of potential lending opportunities (and profits), the impacts are more acute for businesses and enterprises with few financing alternatives and call for better ongoing, structured dialogue between investors and industry.[165]

In the agriculture sector – another SME-dominant industry in developing countries – agri-loans are available for SME farmers. These products are typically offered through larger credit institutions and serviced by loan officers with sector-specific knowledge and expertise. Moreover, these bespoke credit facilities naturally aggregate small-scale businesses' financing needs, leading to eventual securitisation. Collective loan facilities subscribed to by many lenders/investors are standard practice in microfinance and enable funding to flow to the DRE sector, particularly for local companies. Within SSA, few examples were identified where local loans were explicitly created to finance the DRE sector.[166] Without DRE-specific loan products, financiers will continue to impose or adopt onerous requirements on businesses via lengthy, maladapted lending standards tailored to other industries like agriculture.

Further up the financing chain, aggregation and securitisation of receivables are only beginning to emerge as a possible financing solution in local markets, such that the associated concepts are relatively new. Building awareness around aggregation solutions will inevitably take time but is necessary before markets mature and widespread financial aggregation becomes viable.

7.3.3 Deal/ticket size

Investment opportunities in individual DRE companies lack scale, and investors face difficulties justifying the high costs, time, and resources required to execute a transaction.[167] Conversely, DRE businesses can only absorb a certain amount of finance before this becomes inefficient. Entrepreneurs with limited alternatives may agree to terms without the ability to negotiate, or companies may be forced to attain short-term, high-cost loans or private equity as a substitute. Accumulating inappropriate funding in the short-term can lead to long-term challenges for growth and expansion and directly affect a company's ongoing solvency.

There are evident signs that the DRE market is maturing, with individual investment sizes reaching levels and volumes that increasingly attract the attention of professional investors. This barrier can be further and directly overcome by aggregating the financing needs of multiple DRE companies.

8. What are the enablers?

The key enablers featured in this report represent the opportunities to advance both the supply and demand sides of financial aggregation transactions. The highest priority activities are heavily skewed to the supply side to increase data collection and standardisation to lower the risk margins on lending rates. Further, a pipeline of high-quality, transparency-driven investible assets is needed to integrate novel approaches (e.g., D-RECs) to attract climate finance and other ESG-focused investors.

These actions are considered vital next steps to progress aggregation. However, the key to unlocking this new asset class will also rely on innovative financing structures driven by the buy-side to improve the risk-reward profiles further. Combining these interventions lays a platform for connecting large-scale finance to small-scale businesses and establishing a liquid, functional capital market mechanism via financial aggregation.

In 2017, the Terrawatt Initiative summarised the collective action necessary to advance the aggregation and securitisation of small-scale assets (mainly via debt), with five areas prioritised:[168]

1. **Frameworks:** Governments need to set clear public policies and negotiate with businesses (public and private) and financiers (public and private) efficient business models supported by adequate regulatory frameworks
2. **Risk mutualisation:** Developed countries, development finance and climate finance institutions, insurers, reinsurers, and donors need to support the development of efficient and straightforward international, mutualised de-risking instruments
3. **Streamlined practices:** Stakeholders need to cut transaction costs radically by using fair and free contractual templates and applying standardised practices
4. **Aggregative tools:** Financiers need to develop aggregative financing techniques to be able to finance large portfolios of small-sized assets
5. **Digital processes:** Stakeholders need to secure asset data and transactions on a global, safe and cost-efficient digital platform

This report reinforces the importance of data, digitalisation, and standardisations (items 3 and 5) as primary factors to enable aggregation (item 4). Without question, regulatory frameworks (item 1) and de-risking instruments (item 2) are considered necessary accompaniments to the process. Yet, these have been considered secondary supporting mechanisms which can build on the primary factors.

8.1 Enablers of aggregation

Investment by the DRE sector, notably in the OGS industry, to build information systems capable of collecting new data points is helping to stimulate investment into the sector. Until recently, collecting industry-wide data was largely absent, but initiatives like PAYGO PERFORM are starting to collect data related to company operations, portfolio quality, and unit economics.

In the first instance, data on the financial performance of the underlying asset class is a means of measuring credit risk and counterparty risk to meet existing investor requirements. Secondly, collecting small-scale businesses' environmental and social impact data creates opportunities to channel new funding sources such as climate finance. Lastly, exploration is underway to assess the potential for this information to be leveraged in a predictive capacity to gauge the viability of future opportunities.

This holistic approach to data collection and aggregation can be an additional feature to attract a diverse range of investors at scale and unlock the potential of financial aggregation. As well as increasing transparency, it can also highlight the various co-benefits of investing in DRE.

8.1.1 Digital solutions

Digital aggregation offers cost-effective solutions to automate standardised and accessible information for stakeholders in the value chain. Digital platforms and decentralised power generation technologies hold considerable potential for households and productive uses, especially in rural and remote areas.[174] As well as increasing the accessibility of DRE, mobile payment platforms also establish digital payment records for customers. New technologies are now digitising customer receivables based on mobile money and PAYGO business models, along with smart technologies and other data-driven developments.

Data related to business financial flows creates transparency, a fundamental building block for investment decisions. When investors gain greater clarity around investment performance, they can make more informed decisions when allocating capital into the off-grid space, presenting opportunities for financial aggregation.

Digital solutions can drive scale, reduce costs, and reduce risk within the energy access value chain. These effects can be transformative for distributed energy business models when combined with rapid declines in renewable energy costs, increased energy efficiency, and battery technologies.[175]

Digital platforms operate two aggregation functions:[176]

- **Project aggregation:** Collects portfolio performance data from different projects, helping to move the industry towards quality and process standards as well as laying a foundation for other standardised KPIs. Investors and public assistance providers can then target investments and direct interventions towards a range of projects at reduced costs.
- **Financial aggregation:** Connects investors willing to allocate capital to companies, enabling these to innovate, build and grow. Currently, crowdfunding platforms targeting retail investors are operational and evolving to include institutional participants.[177] P2P business lending facilitates financing in exchange for bundled consumer loans into a single facility. It is a potential model for a debt fund subscribed to by multiple institutions and other large-scale investors.

TFE categorises four types of areas/applications — planning, platforms, operations, and payments — where digital solutions can be applied (see Figure 14 below) and how different stakeholders can utilise these in the energy access value chain (e.g., mini-grids, OGS, etc.).

Box 13: The distributor finance fund

The SIMA / Angaza Distributor Finance Fund (DFF) is a data-driven initiative aiming to unlock debt capital for clean energy distributors in developing markets. The Fund is financed by the Shell Foundation (co-funded by the UK Government, USAID, and Power Africa), the Skoll Foundation, and Ceniarth.[169]

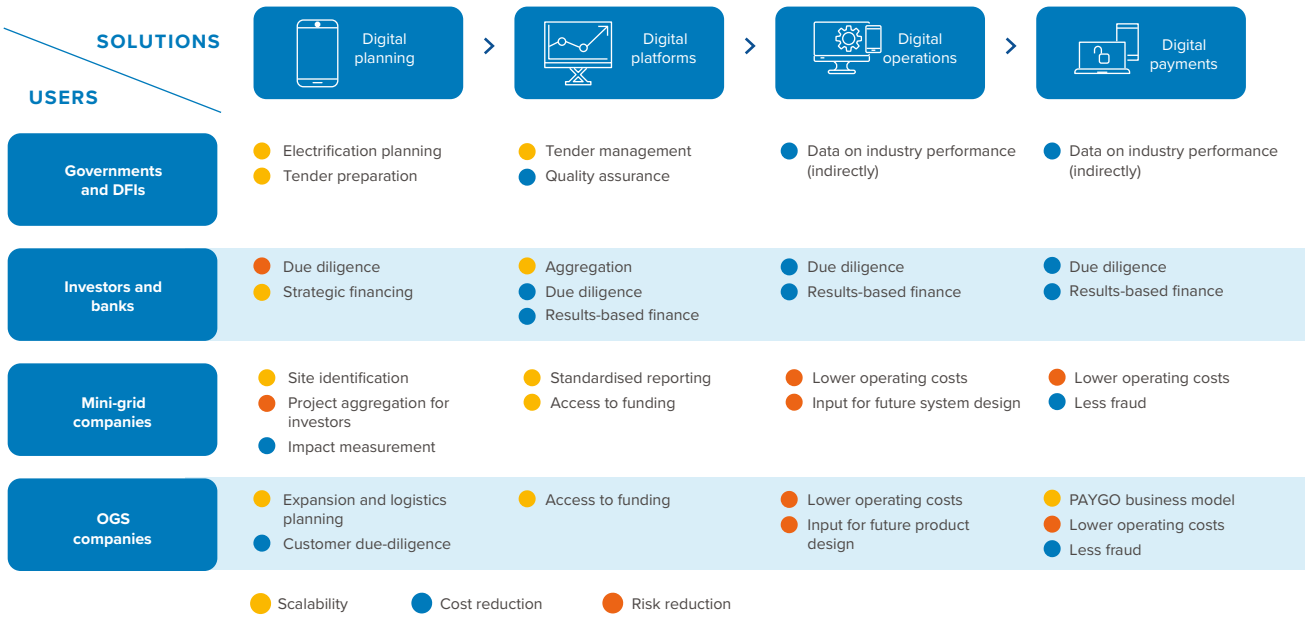
Through this arrangement, SIMA's underwriting expertise and deep sector knowledge are enhanced by data insights from Angaza distributors to assess eligibility for funding, reduce the duration and complexity of due diligence, and monitor and report on loans. By segmenting last-mile distributors (LMDs) based on their cash flows, asset quality, and other key operating metrics, the DFF targets high-potential borrowers and makes data-driven decisions based on verified financial data, alongside self-reported company information, to evaluate a potential borrower's underlying business performance and trends.[170]

The data also facilitates real-time monitoring, allowing the Fund to identify opportunities for additional support quickly. The Fund serves LMDs that specialise in reaching hard-to-serve customers with the debt facilities covering inventory expenses and include partial financial guarantees from product manufacturers. In parallel with financing, the Fund also provides value-added services to portfolio companies to support these objectives. By standardising data for assessing investment opportunities, the DFF will assist LMDs to better understand and improve on criteria that underpin lenders' decisions to enable lower lending rates.[171]

The mission to accelerate the growth of the off-grid sector is coupled with a focus on generating a greater positive impact on the lives of women by increasing women's participation in the sector and supporting companies that are founded or led by women, excel in employing and promoting women, or primarily serve female customers.[172] The DFF is anchored by loans to three last-mile solar distributors who have demonstrated strong sales growth while maintaining a quality PAYGO lending portfolio despite the challenges presented by the ongoing COVID-19 pandemic: Altech Group of the Democratic Republic of Congo; Deevabits Green Energy of Kenya; and Easy Solar of Sierra Leone and Liberia.[173]

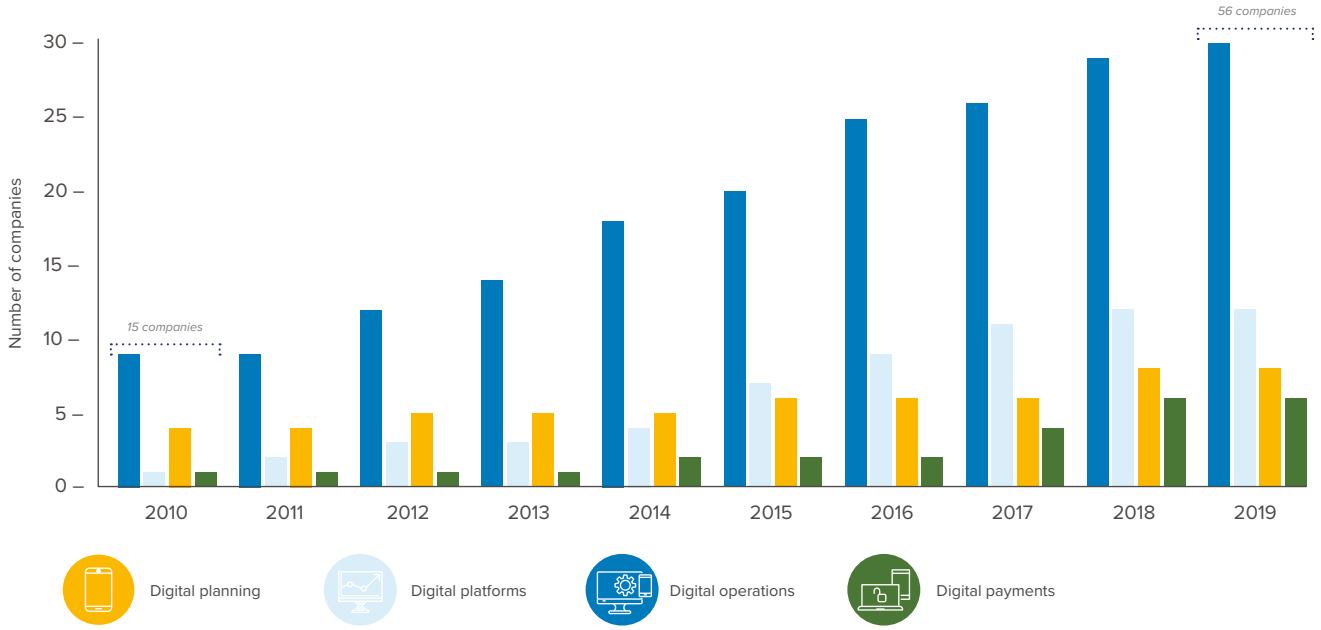
While only in its early stages, the DFF appears focused on utilising technology to help strengthen on-the-ground operations and reduce business risk. This capacity-building combined with data insights, digitalisation, standardisation, and centralised debt financing lends itself to scale and potential opportunities for financial aggregation in future. If new instruments such as D-RECs were incorporated to verify the positive social and environmental impacts, then any security backed by these business assets could be issued as thematic bonds.

Figure 14: Digital solutions across the energy access value chain



Source: adapted from TFE Energy GmbH. 2020. Energy Access, Data and Digital Solutions[178]

Figure 15: Number of digital solution specialists in the energy access market



Source: adapted fom TFE Energy GmbH. 2020. Energy Access, Data and Digital Solutions.[179]

Globally, the number of digital solution providers in the energy access space has grown considerably in the past decade, particularly in digital operations. TFE's analysis showed that 45 of the 56 digital solution specialist companies operating in the energy access market in 2019 (see Figure 15) were domiciled in developed markets instead of the developing markets they serve, which may present a missed opportunity to develop locally-sourced talent and capabilities.

There are several challenges faced in establishing these types of digital solutions. A consequence of operating in rural areas is that internet coverage can be limited, hindering real-time data transfer. This affects process automation and results in manual workarounds which may not be operationally scalable. Further, different projects will have additional capabilities and financing needs (e.g., capital type, ticket size). Hence the kind of platform, data points collected, KPIs, and metrics vary depending on the stage of development of any given project or company. Crucially, enabling regulation protecting both customers and investors is needed to support aggregation platforms.

Research and testing are underway on how data can be utilised within a standardised reporting framework to help create a comparable medium for standardised due diligence that can meet the needs of diverse stakeholders in the value chain. The creation of data contributes to further the development of customer credit ratings and standardised business KPIs. Evidence of how several data platforms help stimulate investments is included in many case studies featured in this report.

Box 14: Receivables finance platform

Solaris Offgrid have proposed building a Receivables Finance Platform to promote standardisation and transparency in financing. This is seen as necessary to create scalability and affordable, timely and predictable fundraising. The data-driven platform aims to extract transparent, coherent information to enable financial aggregation, reducing transaction costs and increasing affordable finance to smaller distributors. The aggregation facility purchases receivables from local PAYGO distributors, with the platform allowing investors to customise a portfolio of SHS leases for analysis and subsequent purchase. This structure aims to increase the supply of loans for PAYGO products with a focus on SHS while also streamlining financing for low-income households.

Portfolio performance based on a consolidated set of customer receivables and contracts can be assessed based on credit underwriting criteria, project types, lease duration, and impact goals. This information can then be evaluated based on the PAYGO PERFORM metrics created under the GOGLA KPI Framework. In addition, risks associated with distributor default and end-customers can be separated.

The solution is being developed via a partnership with First Growth Ventures, Pezesha and Pawame, to address specific barriers including:[180]

- **Data aggregation:** The technology allows PAYGO companies to transform their internal data into open data format such that they can participate in the receivable financing process.
- **Risk alignment:** Distributors can segment and pool leases into portfolios for investors to purchase directly.
- **Liquidity:** The platform can be configured to automatically purchase assets on a monthly basis, providing the distributor with liquidity and with customer repayments automatically credited to the investor.

More complex financing models such as revenue sharing, results-based finance, and gender-focused financing are being considered as a part of the project.

In 2018, Solaris Offgrid and Gaia Impact Fund announced a partnership to fund the creation of a custom portfolio of SHS leases using the Solaris PAYGO platform to define credit underwriting criteria, project types, lease duration, and impact goals related to GOGLA's KPI Framework. In 2021, an additional partnership between Solaris Offgrid and Nithio was announced to deliver advanced risk analytics for distributors of essential services in SSA to attract increased investment, including through Nithio FI.[181]

8.1.2 Standardisation

Pooling assets across a diverse set of business models, technologies, and countries is implausible without adequate transparency. Standardisation creates this transparency along with comparability and consistency across projects, companies, and geographies within the sector. Many publications specify key areas where standardisation can be applied, including:[182]

- Public tendering
- Tariff setting
- Ownership structures
- Feasibility studies
- Performance data and reporting
- Impact assessments
- Project evaluation and approval (potentially)
- Contractual agreements
- Underwriting
- Credit scoring guidelines
- Energy-financing products
- Consumer portfolio metrics
- Loan management systems
- Funding agreements

This list is considered a starting point for discussion and is unlikely to encapsulate all aspects where standardisation is possible. Combining these standards can address the existing ambiguity around each process, enhance the development of renewable project pipelines, reduce due diligence requirements, and lower transaction costs for investors.[183]

Standardisation has proven a key enabler for bundling smaller renewable energy projects in developed countries.[184] At present, centralised facilities for standardised documents are lacking; however, initiatives like 'Scaling Solar' and 'Open Solar Contracts' are working towards greater standardisation to accelerate energy investment.[185]

Carina Delgado is trained in solar energy at the Energy School for Women in Loreto, Peru
Photo credit: Jasmin Ramirez Romero-PNUD Peru-NAMAS

Key performance indicators (KPIs)

Expanding the scope and standardisation of operational data capture helps create industry-wide KPIs. These KPIs can inform investment decisions and finance-raising activities by measuring and verifying their performance. Sector-wide KPIs help with bundled receivables across different companies by creating transparent, comparable benchmarks to assess asset performance. These developments are at an early stage and are bound to improve over time. There is scope for these metrics to expand further; for instance, measuring gender equality within energy access projects can help monitor and evaluate financing targeting this objective.[187]

Recent advances by industry associations like GOGLA and AMDA are forming transparent benchmarks and comparability; for example, the collaboration between AMDA and Odyssey Energy Solutions in the mini-grid sector, where data is being collected to establish benchmarking KPIs.[188] This is complemented by a separate project focused on creating a quality assurance framework (QAF) developed by Power Africa in partnership with the US Department of Energy's National Renewable Energy Laboratory (NREL).[189] The PAYGO PERFORM initiative is another example of meaningful progress towards developing comprehensive metrics that financial aggregators can leverage.

Box 15: PAYGO PERFORM

The PAYGO Performance, Reporting, and Measurement (PERFORM) is a tripartite initiative of CGAP, Lighting Global, and GOGLA comprising investors (private and debt investors, local and international banks, and development finance institutions) working to develop a reporting framework and set of key performance indicators (KPIs) for the PAYGO solar industry, building on previous work to this end by Lighting Global and GOGLA.

Given a standard PAYGO model does not yet exist, conducting specific analysis of individual firms is still required. Understanding all the aspects of a PAYGO company is a considerable challenge for banks and other financiers. The metrics currently utilised are often borrowed from other industries (e.g., MFIs) even though they may be unsuitable in the OGS sector, failing to capture all the necessary information.

PAYGO PERFORM KPIs enable early benchmarking, trend analysis, and data-driven decision-making. This represents a collective, transparent, industry-led procUsess to standardise financial reporting and performance indicators for the industry. The indicators provide greater clarity on the risks present and help businesses manage and reduce risks over time, since better informed businesses can be more responsive to client needs, offer better service to their customers and, in turn, improve measurable business performance to attract additional investment.

Figure 16: PAYGO PERFORM KPIs

Source: adapted from CGAP. 2021. Webinar Presentation - Introducing the PAYGO PERFORM Key Performance Indicators.[186]

8.1.3 Investible pipeline

Data and digitalisation help deliver standardisation and KPIs, providing information for investors to isolate investible projects that match their desired risk-return profile. In terms of aggregating small-scale financing into a larger investment instrument, the flow of information and quantification of business metrics helps to streamline the process. However, a sufficient number of investible opportunities need to be generated and bundled collectively to create the ticket sizes demanded and justify the transaction costs incurred by investors.

Successful aggregation requires a pipeline of sufficient size, quality, and common characteristics.[190] In terms of financial aggregation, this is achieved via bundling finances on behalf of enterprises utilising a particular business model or technology. Creating a pipeline of uniform, investible projects, and SME assets is commonly cited by various practitioners as vital to aggregation. While pooling risks create both size and diversification, securitisation of the pooled investments is only possible if a sufficient number of suitable companies are willing to participate, alongside adequate governance by trustees and oversight from credit-rating agencies and regulation to allow for the formation of investment vehicles such as SPVs.

Finding adequate investible pipelines was viewed by many buy-side stakeholders as a key challenge. Existing investment screening involves manually searching for projects across different countries to ascertain investment knowledge, including time and expenses. As a result, investors are often delayed in executing transactions and are forced to take on more risk or accept more uncertainty than they are comfortable with. While the investment capital and projects are available, establishing a fluid pipeline connecting the two is not straightforward.

The degree of specific challenges varies depending on the stage of development for the underlying projects or companies. Small-scale companies may face capacity constraints to deliver on the investor demands necessary to create liquid, functional pipelines of opportunities. There are specific considerations; for mini-grids, local regulations often dictate what is achievable, and negotiations with investors are delinked from the regulatory processes that underpin project development. Nonetheless, this remains a crucial area for continued development for large-scale financial aggregation to become viable.

Box 16: Pipeline development for OGS companies

VentureBuilder (VB) is an example of a pipeline facility designed to support locally-owned and operated OGS enterprises struggling to raise funds from traditional early-stage investors.

The development company was launched in 2019 by Catalyst Off-Grid Advisors and Open Capital Advisors to deliver patient, early-stage equity capital and technical expertise to a number of local solar companies with strong management teams and deep knowledge in local markets.[191]

Combining PAYGO expertise, talent development, capital investment, and product partnerships are viewed as the keys to accelerate each partner's path to scale and crowd-in additional funding.

The challenges encountered during the pilot phase serve as important learnings for assessing the suitability of a business in the pipeline.[192]

Source: Venture Builder. 2021. Website.

Pipeline facilities unlock opportunities to identify promising initiatives and advance them towards financing opportunities by increasing information flow and enhancing market transparency and overall liquidity.[193] In certain instances, future receivables have been collateralised within warehouse facilities to unlock lending opportunities; however, the predominant model in place is closed-ended transactions specific to a particular business or operations. There is a need to create an open-ended revolving vehicle connecting multiple buy-side and sell-side actors. Pipelines of this nature can serve as the basis for other risk mitigation mechanisms such as concessional financing lines and potential new sources of finance from climate-first investors via carbon credits.

Investment platforms

IRENA's Sustainable Energy Marketplace channels public and private finance to meet market demand via a virtual platform.[194] The Marketplace currently provides 83 sustainable energy projects in SSA (translating into USD3.3bn worth of investment opportunities) and provides access to over 160 financing instruments, as well as over 130 service and technology providers.[195] Further support is extended through the provision of market data, specific regulations, and significant incentives. At present, only bilateral financial flows between financiers and relevant projects are facilitated, but there is potential for this type of platform to include a financial aggregation component.

Box 17: Climate Impact Payments Platform (CLIPP)

The arrival of digitalisation is seen as a key enabler capable of unlocking the next stage of financing solutions such as results-based finance (RBF). A2EI is trialling a global transaction platform for climate impact payments to radically reduce carbon emissions (SDG13 + SDG7). The RBF tool incentivises companies to reach unserved populations with OGS technologies by increasing energy access, reducing carbon emissions and increasing productivity. Under this arrangement, financing is automatically triggered only after the installation and performance of the product has been monitored.

Five OGS companies – Bboxx, Engie Mobisol, Victron, SunCulture and Lorentz Pumps – will test the platform for productive use appliances along with A2EI's own products. The trial will highlight which processes which benefit most from automation, digitisation and data gathering, and will demonstrate the climate impact of the products in real time. Donor funding will become more efficient under this structure and payments will be directed to projects which have delivered explicit, positive climate impacts.

Global platform: CLIPP aggregates funding from both the energy and climate space into a single centralised platform while being technologically- and jurisdictionally-agnostic

Value proposition for funders: efficient resource allocation while being able to monitor real-time progress and identify areas where additional funding is required

Value proposition for companies: qualified companies can simplify due diligence and reporting processes while simultaneously receiving quick fund disbursement by hitting impact targets

Digitised and automated: Tech-driven with low transaction costs

Impact-driven: Connects SDG7 & 13 by capturing data to track progress, assess impact and report insights to key stakeholders

Source: Open Capital and A2EI, 2021. Climate Impact Payments Platform (CLIPP).[196]

8.1.4 Sustainable finance

Sustainable finance is an alternative source of investment that aligns with the ambitions of the DRE sector. Establishing financial aggregation and securitisation could represent a meaningful market development to connect local businesses and projects with sustainable finance to achieve multiple SDGs. Currently, mobilising sustainable finance for clean energy investment is challenging due to the 'triple mismatch' conundrum neatly summarised by the UN (see box below).[197]

Box 18: Triple mismatch conundrum for sustainable finance

- A risk mismatch between the sources of funding available and the risk profile of sustainable energy investment.
- A mismatch in the location and scale of available sustainable finance (supply) in countries with well-developed financial markets and countries with high investment needs with relatively small asset sizes
- A mismatch of time horizons between available financing and the long-term nature of energy investment

Source: Theme report on finance and investment towards the achievement of SDG 7 and net-zero emissions, UN 2021.

These mismatches are amplified for small, locally-owned, and managed enterprises, developers, and projects in developing countries. A lack of expertise can lead to risk misperception, compounding the first mismatch despite superior local market knowledge. Secondly, local entrepreneurs often do not have the international networks or connections to link with foreign investors. The third mismatch is more pronounced given small-scale businesses have limited negotiating power when arranging the finance and are forced to agree to unfavourable loan terms.

To some extent, the enablers highlighted earlier in this report can tackle the first mismatch. Securitisation directly addresses the second mismatch by creating transparent, scalable market instruments. The third mismatch is overcome by extending the tenor of the securities and attracting patient capital with a sustainability mandate. Combining renewable energy certificates or carbon credits and financial aggregation could also enable local low-carbon markets to capitalise on the dramatic and accelerating move towards carbon neutrality and broader sustainability in international markets. At present, many sell-side actors may lack awareness of this potential.

Climate Finance and Renewable Energy Certificates (RECs)

Developing countries usually have a comparative advantage in supplying the global market with carbon credits and offer the possibility of providing lower-cost instruments to developed countries while creating additional revenue.[198] The substantial investment could materialise if the sector can establish a functional, standardised carbon credits market, for instance based on renewable energy certificates that quantify the impacts of smaller systems and facilitate their aggregation.

This solution relies upon a solid pipeline of projects that meet the needs of international carbon markets but also a certifiable mechanism that is globally recognised. At present, impact assessments are not unified under a global standard measurement that indicates which SDGs are being achieved and to what extent. Additional co-benefits created by these businesses can also attract broader thematic finance, provided the impacts can be quantified and certified. Financial aggregation can be complemented through carbon credits and renewable energy certificates.

Several actors have launched recent initiatives to crowd in climate finance and investment for DRE. An assessment commissioned by The Rockefeller Foundation and Shell Foundation recently estimated a USD200bn opportunity for climate-first funders to avoid 626m tonnes of CO_2 and deliver universal energy access in Africa by 2030.[199] In conjunction, the IKEA Foundation and The Rockefeller Foundation set up the Global Energy Alliance for People and Planet aimed at accelerating and scaling equitable energy transitions in low- and middle-income countries for one billion people with DRE from sources such as mini-grid and off-grid solutions.[200] Separately, new financing mechanisms are being explored via Distributed Renewable Energy Certificates (D-RECs) and Peace Renewable Energy Credits (P-RECs):

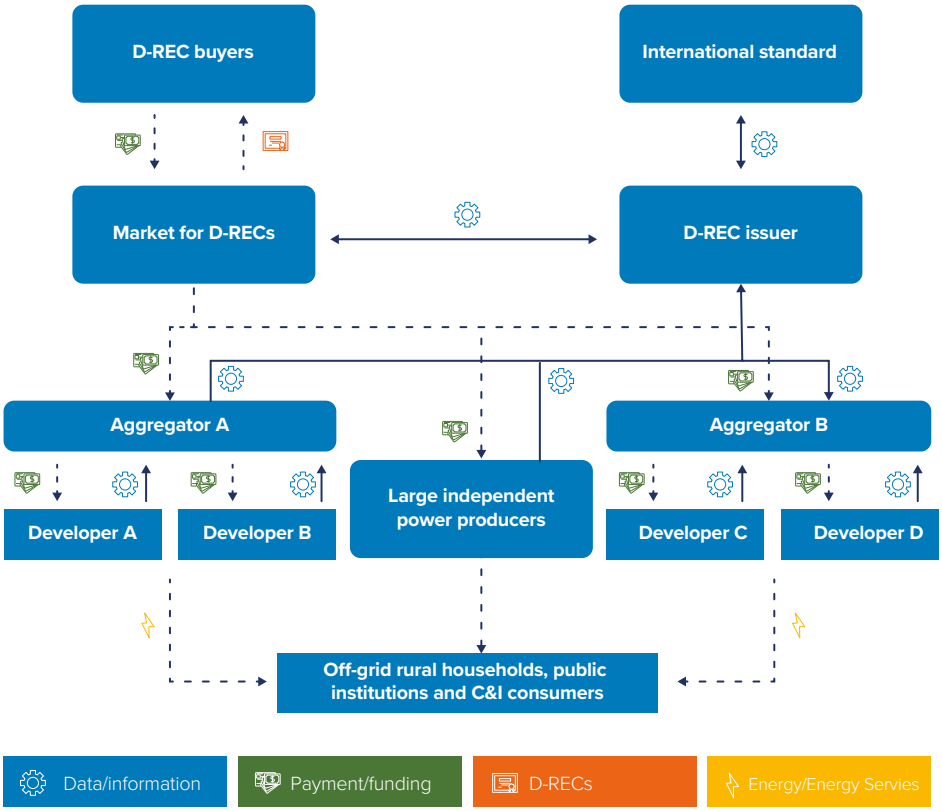
D-REC Initiative

A Distributed Renewable Energy Certificate or D-REC is a third-party-certified, verifiable, tradeable market instrument that can mobilise new sources of capital to support DRE deployment.[201] The D-REC Initiative's model is intended to catalyse commercial investments by aggregating digitally verified electricity generation data from DRE assets to issue D-RECs, which can be monetised. D-RECs are designed to overcome several challenges, for example, via:

- Long-term off-take agreements from D-REC buyers to account for uncertain project revenues
- New hard-currency revenues streams to overcome foreign exchange risks (see FX risk barriers)
- A D-REC platform to aggregate small systems and projects to minimise data aggregation costs
- Improved economics to lower project risk and attract domestic lending sources

An outline of the mechanics of D-RECs is shown in Figure 17.

Figure 17: Deconstruction of D-RECs



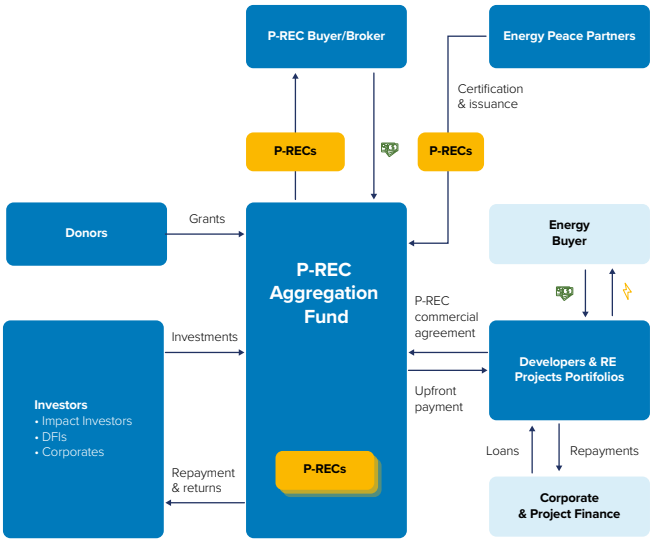
Source: adapted from D-REC Initiative. 2021. Homepage.[202]

P-REC Aggregation Fund

Peace Renewable Energy Credit (P-RECs) are a similar instrument to support new renewable energy projects in fragile, climate-vulnerable, and energy-deficit settings.[203] They provide a market-based financing solution for renewable energy projects in countries with political uncertainty and conflict risk. The P-REC Aggregation Fund will aggregate P-RECs and sell them to investors to provide upfront equity capital for a portfolio of renewable energy projects and developers in Africa and the Middle East.[204]

In 2020, Energy Peace Partners announced the first-ever purchase of P-RECs by Microsoft and Google from Nuru's solar mini-grid project in the Democratic Republic of the Congo.[205] The funds will directly finance the installation of streetlights in a recently electrified neighbourhood of Goma, the capital of North Kivu province.[206] Tenor issues are overcome by executing long-term contracts (up to ten years) to purchase P-RECs.

Figure 18: Deconstruction of P-RECs



Source: adapted from The Global Innovation Lab for Climate Finance. 2021. P-REC Aggregation Fund.[207]

Box 19: What's a P-REC?

- New category of energy attribute certificate (EAC) that supports emerging renewable energy projects in poorly electrified, fragile, and climate-vulnerable countries where renewable energy investment remains limited.
- I-REC with supplementary label from Energy Peace Partners certifying project co-benefits
  - » Represents 1 MWh of renewable energy generated, issued under the I-REC Standard
  - » Supports renewable energy projects that deliver social and economic co-benefits in the same community

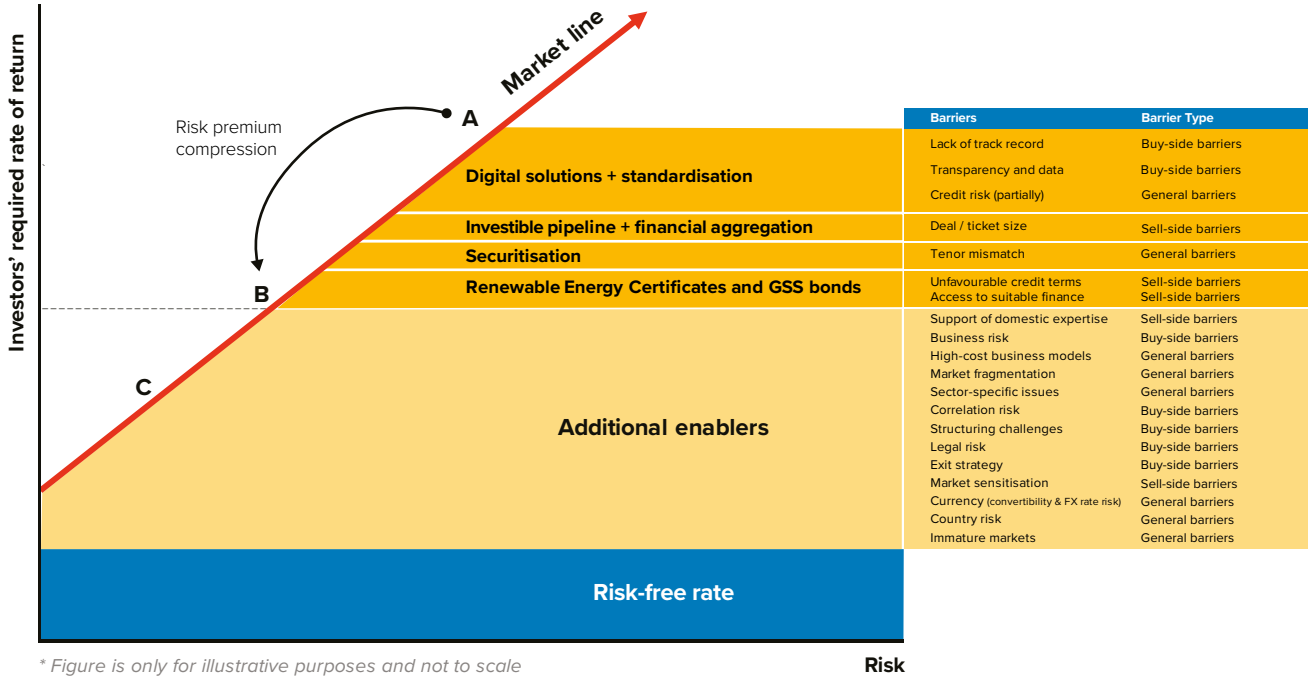
9. Linking barriers with enablers

The capital Asset Pricing Model (CAPM) can be adapted in the context of DRE and other small-scale, low-carbon energy solutions in developing countries and help conceptualise the connections between barriers, enablers, and financing rates (Figure 19). The graphical representation plots investment risk (x-axis) and investor's required rate of return (y-axis). A market line illustrates the minimum return investors expect for accepting the underlying investment risk.

The required rate of return is the primary driver of the high lending rates currently offered to the DRE sector. If there is any uncertainty around potential returns, lenders will incorporate additional contingency margins and higher lending rates.

By tackling some of the highlighted barriers with the proposed enablers, investors' required rate of return can be lowered. The net result would see the risk premium compressed and help the sector move from Point A to Point B on the market line. The graph also shows that while financial aggregation can combine with priority enablers to reduce lending rates, certain lending risks remain within the sector. Additional interventions are necessary for the DRE sector to move further down the line towards Point C, a theoretical point for the large-scale DRE sector.[208]

Figure 19: Barriers, enablers, and their contribution to the lending rate risk-premium



** Figure is only for illustrative purposes and not to scale*

Source: authors' compilation

The challenge at hand has been oversimplified in this model for illustration purposes; these barriers are inherently complex and interconnected. Further quantification of the financial benefits created by each enabler would represent a meaningful addition to this analysis. Nonetheless, there is emerging evidence of such enablers being implemented to increase financing opportunities.

Box 20: 3 key challenges and solutions

A lack of track record, transparency and data

» **Digital solutions and standardisation**

Digital solutions can improve data collection practices to help businesses establish a track record and measure the real-time performance of ongoing operations. Greater standardisation can establish industry-wide transparency via KPIs.

Deal/ticket sizes

» **Investible pipeline and financial aggregation**

Creating an investible pipeline helps establish a pool of receivables available for financial aggregation. This creates scale, which overcomes the existing issues around deal/ticket sizes.

Unfavourable credit terms and access to suitable finance

» **D-RECs and GSS bond issuances**

Once a pool of receivables is established, these assets can be securitised and complemented by novel instruments such as D-RECs to unlock opportunities for GSS bond issuances.

Box 21: Beyond the Grid Fund / Solar Energy Transformation Fund

Since 2013, SunFunder has established itself as a prominent distributed solar investor in SSA with experience across off-grid, mini-grid, C&I solar, telecom tower solarisation, productive use, and agri-solar investments to directly improve energy access for 8m people and mitigate 750,000 tons of CO_2e emissions annually.[209]
In 2017, SunFunder launched the USD47m Beyond the Grid Fund to finance loans to solar companies, support deployment of solar energy technology in off-grid and grid deficit communities and mitigate CO_2e emissions.[210]

With a primary focus on SSA, the fund sought to diversify investor types with exposure to the market and attract scalable funding solutions to solar companies. Types of financing provided by the fund included corporate loans for working capital and inventory, PAYGO receivables and structured finance, and project/construction finance. Standardised reporting metrics from GOGLA helped measure impact and showed that 4.5m people gained improved access to energy, and 412,000 tons of CO_2 emissions were mitigated annually due to SunFunder financing.

Private investors and foundations assumed more risk-tolerant positions, encouraging public financiers to create a blended finance arrangement. The fund was structured to meet the needs of both solar off-grid companies and debt investors across three tranches – senior debt, mezzanine debt, and junior debt. The Global Impact Investing Network details the fund's structure and lessons learned.

Table 5: Beyond the Grid Fund structure

Assets under management (AUM)	USD47m
Term	5-year fund
SDGs targeted	#7: Affordable and clean energy #8: Decent work and economic growth #11: Sustainable cities and communities #13: Climate action #17: Partnerships for the goals
Fund capitalisation	Three tranches Senior debt: DFIs, foundations, private investors Mezzanine debt: foundations, HNWIs, private investor Junior debt: foundations, private investors
Size of investments	Range: USD100,000 to USD5m
Return expectations	Range of 4-7%

Source: SunFunder Beyond the Grid Fund.[211]

In early 2021, the lessons learned from the Beyond the Grid Fund helped build the USD85m Solar Energy Transformation Fund, with the final close oversubscribed. The new fund aims to accelerate investment and impact over the coming years and expects to directly impact 2.8m people with improved access to clean energy and mitigate over 480,000 tons of CO_2 emissions annually.[212]

Lessons learned on fund structure:

- Funds should be tranched appropriately for various risk-return profiles and investor types.
- Concessionary or risk-tolerant capital providers can be essential to de-risking senior tranches for risk-averse investor types.
- Lack of catalytic capital: SunFunder's biggest constraint to expansion has been a relative lack of first-loss capital at necessary pricing levels to deliver an overall risk-profile attractive to more senior investors.

Lessons learned on the energy access market:

- Local capacity: SunFunder built Africa-based lending and credit teams. Its Nairobi office includes the COO, the CFO, investment officers, and financial analysts.
- Specialist expertise and lack of sectoral expertise.
- Speed: Lengthy due diligence processes at local banks and DFIs can be prohibitive.
- Flexible financing: from junior debt to short-term, small ticket regional deals, and local currency options.
- Structuring capacity: In-house counsel and a lending team with a range of structuring backgrounds.
- Long-term lender: SunFunder is a relationship-oriented business and does not seek to enter into loans on a single transaction-only basis.

The range of structuring features suggest that several barriers have been overcome:

- The term of the structure (5-years) represents a balance between the recipients of the funds and financiers; slightly shorter than the 7-8 years often requested by businesses, but longer than the 2-3 years loans often extended by local lenders.
- The investment allocations (USD100,000-5m) are sizes that companies can digest and are considerably lower than the minimum ticket sizes intimated during the stakeholder interviews conducted for this report.
- Standardised reporting metrics from GOGLA are incorporated to help measure the impact.
- The structure is underpinned by blended finance such that risks are allocated to the appropriate financing parties; this appears as a common feature in the other case studies cited in this report.

Lastly, the lessons documented mirror some of the existing barriers highlighted earlier in this report, namely the need for additional local capacities as well as flexible, long-term financing options. These are important to consider for future financial aggregation strategies.

10. Insights

Several systemic issues around the prevailing market dynamics are worth considering. To be successful, financial aggregation may need to be linked with other de-risking mechanisms such as concessional financing, guarantees, subsidies, or tax-exemptions, to name a few. Financial de-risking instruments and incentives can transfer investment risks to public actors, such as development banks, and are vital to reducing the cost of capital for small-scale renewable energy.[213] UNDP has previously suggested public sector interventions to reduce, transfer or compensate for early-stage market development risks before aggregation opportunities can be created in a more mature market.[214] The role of the public sector extends beyond financial incentives into other areas such as policy, legislation, and regulation – none of which has been the focus of this report.

At this early stage of market development, the creation of sophisticated finance should be coupled with additional technical assistance and capacity building for local enterprises. Given these companies collect payments from consumers, the financing arm of these companies are a quasi-financial institution. Therefore, many DRE enterprises deserve to be treated on par with other MFIs, which receive support to help develop capabilities within these enterprises related to organisational development, risk management, operational and financial self-sufficiency during their early phases. Equity investors, local commercial banks, and other financial intermediaries play a role here as they are often directly involved with local companies during their early stages.

Local sell-side actors see an abundance of opportunities available but need buy-side expertise to help develop their businesses and access superior financing options. In turn, the predominant issue for the buy-side is scale; various actors are actively executing deals but only in a limited size, suggesting that meaningful investment will only materialise if the current barriers are reduced. The inertia created by this problem is not simply affecting financing but also slowing electrification rates and preventing further progress towards the achievement of the SDGs. The disconnect can only be overcome via better collaboration between investors, financial intermediaries, and the DRE sector. A mutual appreciation of the challenges on each side of the financing equation is the first step towards enabling solutions.

On the buy-side, international private investors state their willingness to support local enterprises and entrepreneurs but consistently allocate their capital to foreign, larger enterprises. The analysis of financial flows into the sector supports this assertion. If investors are interested in creating impact, then there needs to be a greater acceptance that some of that impact will come instead of financial returns, not in addition to them. It seems highly unlikely that financial aggregation will change this trend or encourage foreign investors to absorb the greater perceived risks attached to local enterprises, at least until the market gains maturity. An important insight can be drawn from a number of the case studies where blended finance was needed to allocate risks to the most appropriate financing parties – this is likely to be an important feature in any proposed financial aggregation vehicle.

This raises further questions around which investors would take any subordinated debt tranche within any security based on financial aggregation. There is seemingly ample capital to allocate to senior debt tranches with less risk, but this capital cannot be allocated until finance is arranged for the first-loss layer. This is not a theoretical issue; a ‘relative lack of first-loss capital at necessary pricing levels to deliver an overall risk-profile attractive to more senior investors’ was cited as the biggest constraint to the BTG Fund expansion (see previous page).[215]

If international private investors are unwilling to assume these risks, the onus falls on development finance to take this risk layer. There are instances where DFIs have played a vital role; however, the ability for DFIs and other multilateral agencies to lend money to promote development is constrained by the importance of maintaining a solid credit rating.[216] As detailed in the market sizing section of this report (see market profile and sizing in appendix), DFIs have been the largest public capital providers, having committed USD400m, or 67% of total public investments into OGR; whether they have assumed first-loss risks is unclear.

These issues highlight the need for the enablers identified in this report. Increased data collection, digitalisation, and standardisation helps create transparency and reduce uncertainty around risks. In doing so, several layers of the existing risk premium are removed, which lowers financing costs for businesses and makes investment in the sector more attractive. Creating an investible pipeline is a second necessary action to create the scale and ticket sizes. These interventions, therefore, represent the priority action for financial aggregation.

DRE has the potential to lift millions of people out of energy poverty, create millions of jobs, help tackle and build resilience to climate change, and contribute to the achievement of the SDGs – however, while efforts have been made to set clear goals and improve coordination in the sector, energy access remains a complex and multifaceted issue. The various stakeholders in the sector have different measures of success and must often find a balance between competing and sometimes conflicting priorities.

For investors, this means finding the correct balance between maximising financial returns and environmental, sustainable, and social impact. For energy companies, it is a juggling act between growth versus profitability or commercial viability versus reaching social objectives.

While this may seem tangential to the topic of financial aggregation, these dynamics affect financing prospects across the sector.

For instance, evidence suggests that incentives remain skewed towards sales, 'growth-at-all-costs,' and financial returns. At the business end, a commission is often only earned on each sale even though there may be greater value created – for both the business and society – by making quality sales and providing adequate post-sales support. For financiers without specific earmarking of loans for clean energy projects, sales agents, loan officers, and branch staff lack incentives to prioritise and expand loan financing for the sector.

A continuation of this lack of clarity in objectives may lead to rapid growth in some parts but limit the sector's longevity, potentially creating conflicting incentives and slowing progress – particularly given the increasing need for measurable KPIs in sustainable investment and the growth of mechanisms such as results-based financing.

Perhaps it should be down to individual businesses, financing vehicles, or initiatives to define their objective(s), but if so, there needs to be more transparency and sharing of information across the sector and its many stakeholders so that viable instruments can be built to deliver on their intended purpose in a measurable and transparent manner.

UNDP Solar for Health Project Zimbabwe
Photo Credit: UNDP-Karin Schermbrucker for Slingshot

11. Conclusion

Unlocking financing opportunities using a sophisticated mechanism in a highly complex, fragmented sector housed within undeveloped capital markets is a challenging undertaking. There is a broad consensus from many buy- and sell-side actors that financial aggregation holds potential for small-scale renewable energy in developing countries. Yet, there are hardly any examples that have turned this potential into reality.

The DRE sector in developing countries is at an early stage. It may still be premature to consider financial aggregation a viable option in the vast majority of these markets. Nevertheless, ABS markets in developed countries experienced similar challenges but became an established asset class. Developing countries can leverage best practices from more developed markets to fast-track this financial innovation.

Except for reports published by IIED, few papers have delved into this topic in detail.[217] Michoud and Hafner have tried to conduct the deep-dive analysis necessary to definitively link financing barriers with solutions for clean energy access in sub-Saharan Africa.[218] As a result, there is limited evidence to verify the significance of each barrier or to quantify the extent to which each barrier restricts financial flows.

The enablers can help to address immediate issues preventing financial aggregation. Still, they do not reflect the full spectrum of potential enabling activities. The degree to which these interventions will lead to greater success will almost certainly rely on additional supporting factors.

Without question, the identified barriers and enablers only capture some of the material considerations that contribute to financial decisions. This report has invariably glossed over some key areas related to enabling environments (regulation, policy, legislation, to name a few) and the role of de-risking instruments. The implications of these market factors require a deep level of analysis on a country-by-country basis. In acknowledging this information gap, the Climate Aggregation Platform, plans to conduct further analysis via market assessments to highlight these critical aspects. Initially, an assessment will be undertaken in East Africa with further in-depth analysis in specific markets, including Uganda and Rwanda. This paper intends to update existing knowledge and outline the challenges at hand to spark further conversation on what is necessary for these financing solutions to progress further and to guide future work as part of the UNDP's CAP, the Sustainable Energy Hub, and its broader energy offer.

An unfortunate dichotomy is occurring where global sustainable finance is thriving, and the DRE sector in developing countries is growing rapidly – yet financing solutions in the latter fail to keep pace. Several developing countries have a population mass to drive energy demand, but the markets seem too underdeveloped to support the systems and frameworks necessary to make this innovative finance possible.

Overall, while there has been an increase in off-balance-sheet financing in the past few years, GSS instruments have yet to gain traction for the DRE sector.[219] There is emerging evidence of new structures linking small-scale financing needs, financial aggregation, and green bonds. It is clear the global thematic debt market is far from reaching its full potential to finance DRE, and other small-scale, low-carbon energy solutions in EM. Green as well as social and sustainability bonds could be leveraged to this end. Addressing the barriers highlighted in this paper can unlock this potential by helping more companies access the market via receivables securitisation.

Financial aggregation is widely considered a viable means to one day bridge this gap. As reflected by the case studies included in this report, there are encouraging signs that first-movers are innovating towards making such a solution possible, but the sector does not appear ready to embrace this type of approach – not wholly. Given this context and the prevailing general market issues, it may be too soon to view financial aggregation for DRE and other small-scale, low-carbon energy solutions as a viable option in many early-stage market's current stage, but the potential is undoubtedly there. The market can perhaps best be described by the idea of liminality and, in line with broader developments in sustainable finance, transition.

12. Further research

Multiple opportunities are available to build on the current research and the information compiled in this report. Our market sizing research suggests that, while sales and investment data is available for specific technologies and regions, more granularity on both a country- and sector-wide basis would provide additional insights into the evolving market dynamics. The analysis could then build on this information and uncover new insights on how financial aggregation could be applied within sub-sectors – particularly for businesses offering larger capacity products such as productive use appliances and C&I applications.

Further work on analysing the impact of each barrier and enabler would help isolate potential priority activities that are most effective in reducing the cost of capital. Likewise, greater research could further investigate the existing case studies; these cases have only been discussed at a high level and could benefit from more detailed information and ongoing monitoring as they progress. Following the lead of SunFunder in the BTG fund, the sector itself could benefit from further dissemination and reporting of the lessons learned when attempting to implement a financial aggregation strategy.

Currently, most deals related to DRE in developing countries involve one-to-one transactions with no material examples of wide-scale securitisation. A shift towards bundling and aggregation across businesses is unmistakable, but the size of current deals is small when compared to the scale needed to access the GSS bond market. When converting these ongoing developments into large-scale opportunities, additional challenges will likely be encountered.

An in-depth analysis could be conducted concerning regulation, policy, legislation, and other factors contributing to an enabling environment to outline country-specific strategies. The CAP's Market Development component plans to conduct a Regional Market Assessment for East Africa with in-depth assessments for Uganda and Rwanda under a unified Market Assessment Framework. This work will serve as a basis for developing action plans for Rwanda and Uganda.

Research examining the interaction between the various financing partners, tools, and instruments is warranted. In the first instance, a deeper dive is required into why DFIs, whose financing mandates are typically broad, aren't providing more upstream grants and equity capital to crowd in private debt. Their role is likely to be a complement to financial aggregation. Likewise, the use of other de-risking instruments (guarantees, etc.) is mentioned briefly throughout this report but could be further explored in the future.

Appendix

Glossary of terms[220]

TERM	DEFINITION
Green firm	Green firms are assumed to encapsulate a mix of business models operating across five green sectors: climate-smart agriculture, renewable energy, solid waste management, drinking water purification and management, and wastewater management. Subsectors include are solar home systems (SHS), mini-/micro-grids, community water purification, drip irrigation systems, online platforms for waste management, e-waste management, and industrial wastewater management.[221]
Green bonds	Bonds carrying a variant of the green label have been screened based on a set of process rules stipulated in Climate Bonds' Green Bond Database Methodology, summarised in the following overarching criteria:[222] • Deals must carry a variant of the green label, and • All net proceeds must verifiably (based on public disclosure) meet Climate Bonds' green definitions based on the Climate Bonds Taxonomy.[223] Only bonds with 100% of proceeds dedicated to green assets and projects aligned with the Climate Bonds Taxonomy are included in our Green Bond Database and figures. If there is insufficient information on allocations, a bond may be excluded.
Social and sustainability bonds	A comprehensive taxonomy or equivalent classification and screening system for debt instruments aiming to achieve positive social or sustainability outcomes has not yet been developed; as such, social and sustainability bonds are classified following the respective labels and categorised as follows: • Social: the label is exclusively related to social projects, e.g., Housing, Gender, Women, Health, Education, etc. • Sustainability: the label describes a combination of green and social projects, e.g., Sustainable, SDG, socially responsible investing (SRI), ESG, etc. The green project categories in these instruments are screened under the Climate Bonds Green Bond Database Methodology.
Use of proceeds (UoP)	The projects/assets/activities financed by the bond proceeds. In use-of-proceeds instruments such as GSS bonds, the proceeds are allocated to specific uses (e.g., renewable energy, climate mitigation/adaptation, health, education, etc.).
Climate Bonds Initiative Taxonomy	The Climate Bonds Taxonomy is a guide to climate-aligned assets and projects. It is a tool for issuers, investors, governments, and municipalities to help them understand the key investments that will deliver a low-carbon economy. The latest version of the taxonomy is available at: https://www.climatebonds.net/standard/taxonomy
Financial aggregation	The process in which multiple assets are bundled together and then receive financing, or refinancing, from investors based on their future cash flows.
Securitisation	The process of transforming a pool of illiquid assets (typically thousands of separate ones) into tradable financial instruments (securities).
Off-grid	The term 'off-grid' broadly refers to not using or depending on electricity provided through main grids and generated by main power infrastructure. Off-grid systems operate at smaller sizes than their centralised counterparts and often have (semi)-autonomous capabilities to satisfy electricity demand through local power generation.[224] The term 'off-grid systems' covers mini-grids (serving multiple customers) and stand-alone systems for individual appliances/users. Customers can be residential.
Distributed renewable energy (DRE)	Systems include power, cooking, heating, and cooling systems that generate and distribute services independently of any centralised system in urban and rural areas of the developing world.[225] DRE technologies include small-scale solar PV and stand-alone lighting systems; wind biodiesel generators; micro-and pico-hydro stations for electricity generation; and solar and biomass heating and cooling units and cooking devices. Many of these technologies provide productive or mechanical energy for commercial purposes. For this report, renewable energy-based micro- and mini-grids also qualify as DRE technologies.[226]
Off-grid solar (OGS) sector product segments	Broadly, the main OGS household product segments can be classified into three major categories differentiated by price and function: pico, solar home systems (SHS), and appliances. Pico-scale solar devices have the lowest cost of entry for most rural, low-income households. SHS, which can be designed for plug-and-play (PnP) or based on open-market components, provide multiple energy functions, such as powering appliances at increasingly higher price points. Finally, solar-powered appliances, which are energy-efficient and powered by direct current (DC), include both household appliances (such as televisions and refrigerators) and productive-use appliances (such as water pumps and agricultural cold storage). Overall, OGS products form the bulk of off-grid renewables (OGR), which can also include others such as hydro and biogas mini-grids.

TERM	DEFINITION
Pico products	Pico products include small, portable solar lanterns, flashlights, or lanterns designed to meet basic lighting needs as a direct replacement for kerosene lamps in a small household. These products are typically packaged either as a simple, one-light system with one LED light, an embedded 0.5–3.0 Watt-peak (Wp) solar panel, and an internal rechargeable lithium-ion (Li-ion) battery or as multi-light systems of up to three or four LED lights with a standalone solar panel rated up to 10 Wp and a rechargeable Li-ion battery. Some models include USB charging for mobile phones.
Solar home systems (SHS)	SHS have a solar panel rated 11 Wp or higher and include both home lighting systems and large systems which can power appliances. SHS refers to both plug-and-play and component-based systems unless specified. They offer a basic form of electricity and range in power capacity from a basic setup (two lights with phone charging) to upscaled versions that can accommodate appliances such as radio and TV. Over the long-term, access to these solutions will benefit from the ongoing development of photovoltaics (PV) and battery storage technologies to reduce the cost per kWh.
Mini-grids	A mini-grid is a set of small-scale electricity generators and possibly energy storage systems interconnected to a distribution network that supplies electricity to village-, town- or district-scale electrical distribution networks unable to operate independently from the national transmission grid. They range in size from a few kilowatts up to 10 megawatts. Smaller mini-grids are sometimes called "micro-grids" or "nano-grids".[227] Mini-grids provide larger amounts of electricity to recipients and lend themselves as an alternative technology to customers with higher electricity needs.
Clean cooking	Clean cooking includes electricity, gas, ethanol, solar, and the highest performing biomass stoves which meet emissions guidelines defined by the World Health Organization (WHO). The cookstoves enable efficient fuel use, low emissions, and safety.[228]
Productive use leveraging solar energy (PULSE)	Productive use leveraging solar energy (PULSE) is defined as any agricultural, commercial, or industrial activity that uses solar energy as a direct input to the production of goods or provision of services. PULSE enables or enhances income generation by households and microenterprises, often by mechanising commercial activities that would otherwise be performed manually or by providing additional hours of lighting to work that would otherwise be unavailable. These activities and lighting might also otherwise utilise non-renewable sources of energy, such as diesel generators or kerosene.
Potential market	The overall market of people (households and microenterprises) that either lack access to an electricity connection or have a poor-quality electricity connection forms the total potential customer base for OGS devices. This estimate includes customers that currently use OGS devices, as they represent a continued market for additional sales, replacements, and upgrades.
Addressable market	The share of the potential market that can be addressed by current OGS business models. By analysing the affordability of devices against the potential market, an estimate for the addressable market can be reached.
Pay-as-you-go (PAYGO)	PAYGO business models allow users to pay for their products via technology-enabled, embedded consumer financing. A PAYGO company will typically offer a solar product (predominantly SHS and multi-light pico devices) for which a customer makes a down payment, followed by regular payments for a term generally ranging from six months to eight years. Payments are usually made via mobile money, though alternative methods include scratch cards, mobile airtime, and cash. The counterpart to PAYGO models are direct cash-payment models. These types of operations are largely omitted from this report due to a lack of readily available information.
Distributed energy service companies (DESCOs)	Providers of off-grid electricity to households for lighting, appliances, and productive assets such as solar pumps[229]
First-generation companies	Companies founded in the early stages of the sector which have since dominated the market in terms of sales, geographical reach, and value of investments raised. They typically offer PAYGO and are vertically integrated or participate in multiple segments of the value chain, especially distribution, retail, and finance.
Second- and third-generation companies	Younger companies which followed first-generation companies and often focus on specific aspects of the value chain.

Stakeholder interviews conducted

The project team would like to extend thanks to all stakeholders who participated as a part of the interview stage of this project:

Table 6: List of stakeholder interviews conducted

ORGANISATIONS INTERVIEWED	
Alliance for Rural Electrification	Persistent
AMDA	SIMA Fund
Climate Policy Initiative	d.light
Distributed Power Africa	Engie Energy Access
KawiSafi Ventures	Ecoforge
Odyssey	Azuri Technologies
ResponsAbility	Solaris Offgrid
South Pole	REEEP
Angaza	SunCulture
Venture South	Baobab+
Acumen	SunFunder
Oolu Solar	Nithio
Positive Capital Partners	SEforALL
BFA Global	GreenMax Capital Advisors
Africa Minigrids Developers Association	Albion Investors
Catalyst Off-Grid	Shell Foundation
Oikocredit	IRENA
Kingo	Pollination Group
GOGLA	

Overview of small-scale, low-carbon energy solutions

Historically, on-grid connections have served as the least-cost pathway to increase electrification among non-rural populations; however, technological advancements are leading to off-grid systems – and mini-grids – becoming increasingly cost-effective solutions in rural areas.[230] For instance, the World Bank estimated that 490m people are served at least cost by 210,000 mini-grids, mostly solar-hybrids, requiring an investment of USD220bn.[231]

The full scope of small-scale, low-carbon energy solutions extends to several sub-sectors, not all of which will be detailed in this report. C&I and productive use applications are only mentioned briefly, while energy-efficient solutions for buildings, lighting, industrial and agricultural applications are outside the scope of this report. However, they could also benefit from its findings. Likewise, EVs and other transport applications (e.g., e-mobility) are beginning to emerge as low-carbon solutions to reduce transport-related CO_2 emissions and could fall within this umbrella but are omitted from this report owing to the lack of information available at the time of writing. Many of the findings may also be relevant for grid-connected solutions such as rooftop solar.

The off-grid sector includes companies, enterprises, projects that utilise technology to generate energy outside the main grid. In developing countries, several off-grid technologies use low-carbon processes to generate energy and fall within the small-scale category. The largest sub-sectors include:

Solar Home Systems (SHS)

Current solar home systems (SHS) already provide several services at greater convenience and lower cost than diesel.[232] Further, SHS avoid the long-range transmission costs and long lead times associated with grid connections, although depending on the population served, the costs associated with SHS can be higher than grid connections.

SHS are the dominant technology in the off-grid sector despite most companies failing to achieve profitability.[233] Between 2007 and 2019, the SHS market attracted around 60% of cumulative funding within the off-grid sector. The majority was sourced from private equity, venture capital, and infrastructure funds, followed by institutional investors (mainly foundations) and DFIs.[234]

Mini-grids

Mini-grids play an important role in increasing electrification rates but are less evolved and have attracted considerably less financing. These technologies range in size and generate larger amounts of energy compared to SHS; thus, they are particularly important for productive use appliances. Mini-grids provide a stable source of power with the potential to support households, medium-scale enterprises, and larger anchor customers such as health centres, telecom towers and schools.[235]

A further 50m people benefit from connections to mini-grids from around 20,000 projects – 1,500 of which are operational in Africa with a further 4,000 planned.[236] The African Development Bank (AfDB), among others, highlights several challenges faced by the sector that include:[237]

1. Gaps in policy and regulatory frameworks
2. Lack of proven business model(s)
3. Lack of market data and linkages
4. Lack of capacity of key stakeholder groups (public institutions, developers, and financial institutions)

The sector requires additional funding, but it is likely that the factors above are all contributing to the final challenge cited in the report: limited access to finance. Mini-grid business models are already undergoing significant improvements, with AMDA reporting that the average price per connection has halved and market entry costs have decreased by a third.[238] These improvements, alongside increasing understanding of mini-grid business models, will likely increase investment interest. UNDP's Africa Mini-grids Programme seeks to address some of these barriers.

Mini-grids face additional challenges concerning raising capital where understanding of the technology is lacking, and there is limited awareness of associated risks.[239] The sector encompasses a variety of nascent business models which incorporate characteristics of an infrastructure project mixed with an SME. The development of the mini-grid itself incurs high upfront capital expenditures and infrastructure risks. Once established, each mini-grid acts like a small-scale utility where ownership structure, management, and operational expertise can differ, contributing to the risk profile of the overall investment.[240]

To justify the capital costs associated with establishing the grid itself, it is necessary that a baseline energy consumption is met within the market served. Financing must consider these alongside broadly important factors such as regulatory compliance, customer demand, and tariffs that compound risks, such that a constant consumer base is required to amortise the capital costs and create a viable business opportunity.[241, 242]

Clean cooking

Clean cooking access is failing to keep pace with population growth across the African continent, with an estimated 750m to 890m people lacking access to clean solutions between 2010-18.[243] Solid fuels are used as a primary cooking need for 890m people, or 82% of Africa's population, killing more than 600,000 people each year and amounting to 600Mt in CO_2 emissions. By the end of 2019, only 4% of SSA had access to clean cooking solutions. Comprehensive, national-level clean cooking strategies are largely absent, and of those that exist, weak implementation and limited financing are leading to difficulties in achieving scalability.[244]

Funding dedicated to clean cooking is relatively low, mainly due to a lack of policy support for the industry and ongoing challenges for clean cooking companies setting affordable pricing while presenting attractive risk-return profiles to investors.[245] Several reports suggest that most countries in SSA lack comprehensive clean-cooking strategies, and stakeholders broadly agree that clean cooking technology is not commercially viable at this time. Given the stage of development, clean-cooking initiatives will still require significant public investment, and it is unlikely that financial aggregation will be a viable prospect in the near term.[246]

Box 22: Developments in clean cooking

The need for solutions in clean cooking has been recognised by the United Nations with the creation of the Clean Cooking Alliance and the establishment of the Venture Catalyst (VC) portfolio. The portfolio of 33 companies, operating mainly in Africa, is supported by the Clean Cooking Alliance's new Venture Catalyst programme, which currently includes biofuel, liquified petroleum gas (LPG) and biogas fuel distributors; pellet, ethanol, and char-briquette producers; and ethanol, gas, electric, and biomass stove manufacturers.[247] As part of the programme, the Clean Cooking Alliance has also launched the Spark+ Africa Fund, which aims to provide debt and equity financing to enterprises that manufacture, distribute and finance clean cooking solutions across SSA. Thus far, the African Development Bank (AfDB) and the European Commission collectively committed USD16m of the targeted USD50-70m.

Source: Clean Cooking Alliance. 2020. Clean Cooking Alliance Selects Portfolio Companies for Industry Acceleration Program.[248]

Market profile and sizing

A broad set of resources were surveyed in an attempt to size and profile the small-scale, low-carbon energy market. Global figures are included to give a wider appreciation of the landscape for developing markets, supplemented by information specific to SSA where available. Since most available data refer to OGR / OGS products, the focus is on this market. Overall, GOGLA and IRENA provide the most comprehensive and up-to-date statistics and were used the most.

Various market sizing approaches and indicators exist, which can broadly be split into (i) access/output and (ii) finance/investment. Given the main topic of this report, we start with an assessment of the financing landscape and follow with an overview of statistics related to energy access, sales, and capacity.

Both the current and potential size and profile of the market are assessed. How much of the latter can be addressed via instruments leveraging financial aggregation is not estimated. Still, the view of this report is that this could represent a very substantial share, far above current levels.

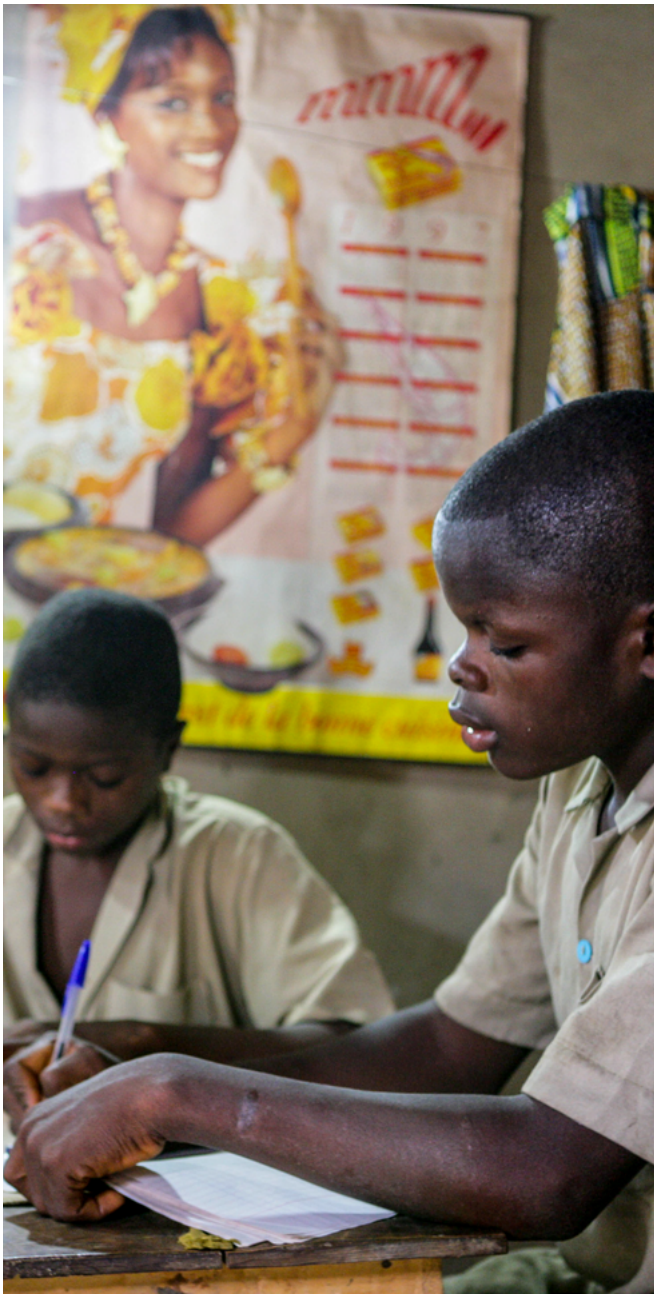


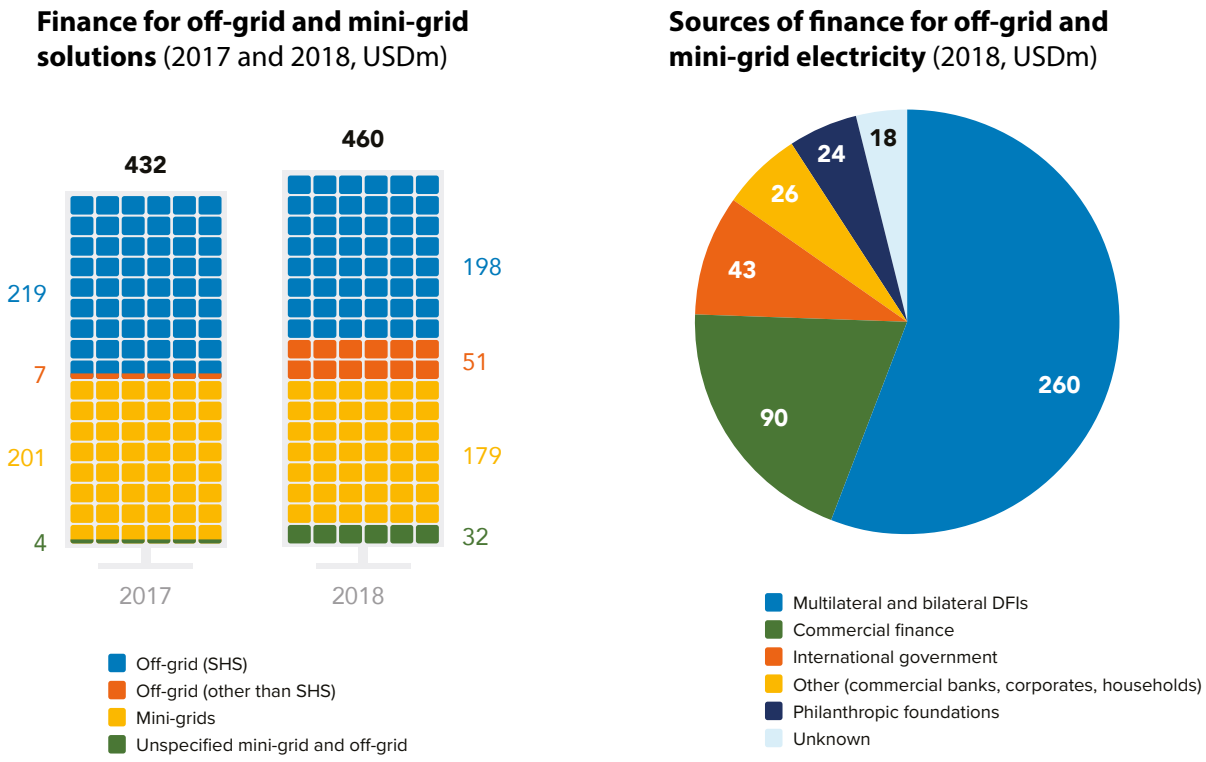
Photo credit: Schoolboys doing homework thanks to lighting from solar panels. UNDP Benin

Energy finance: growing yet imbalanced

Achieving SDG7 will require reaching currently unserved populations and helping those using Tier 0 products move up to Tier 1+ systems.[249] In the latest Energy Progress (Tracking SDG7) Report, the joint custodians estimate USD14bn in international energy finance flows to developing countries in 2018, down from the all-time-high of USD21.4bn in 2017.[250] The overall trend in public financial flows has been positive over the past decade, tripling during the 2010-18 period, but it masks some important distributional discrepancies, with financial commitments concentrated in a few countries and thus failing to reach many of those most in need of international support.[251]

The 46 least developed countries (LDCs) received a mere 20% of public financial flows over 2010-18 and a total of USD2.8bn in 2018 – a comparable level to 2017 but lower than in 2016 and 2015. SEforALL additionally reports that the 14 high-impact countries in SSA received less than 20% of total finance targeting residential access in the HICs in 2018, even though the region is home to 70% of the people without electricity access.[252] SHS received USD198m of the overall funding, followed by mini-grid solutions with USD179m.

Figure 20: Finance flows and source of finance for off-grid and mini-grid solutions

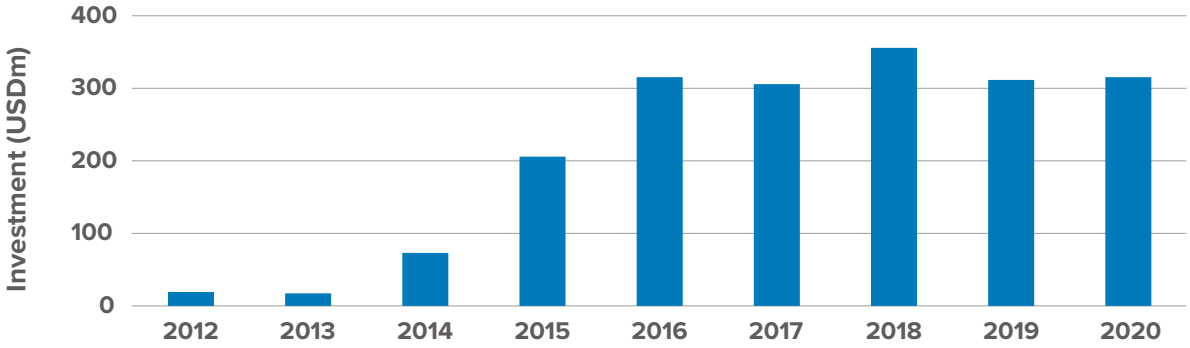


Note: Around USD32m were not allocated to either off-grid or mini-grids as it was unclear which one of two of the fundnig was for, or it financed a blend of the two. Figures on OGS investments include only publicy disclosed commitments tracked by GOGLA's Deal Investment Database and therefore represent a conservative view of the overall finance flowing into the sector.

Source: adapted from: SEforALL, 2020. Energizing Finance: Understanding the Landscape 2020.[253]

2020 OGS investment remains stable despite the pandemic

Figure 21: Global investment in OGS technologies



Source: GOGLA. 2020. GOGLA deal database: Investment Data.[254]

Cumulative OGS investment globally at the end of 2020 reached USD1.9bn according to GOGLA, having peaked at USD357m in 2018 before dropping to USD312m in 2019 and reaching a similar level in 2020 (USD316m).[255]

Other sources give slightly different but not far off estimates. Acumen reports USD1.4bn between 2012-18, which compares with GOGLA's USD1.3bn; IRENA cites USD2bn for the period up to 2019 versus GOGLA's USD1.6bn, although the former includes other OGR, namely hydro and biogas mini-grids.[256, 257]

Overall, OGS investment seems to have remained broadly stable despite the COVID-19 pandemic, although with 2020 as the latest year of data, it is too early to tell, and 2021 figures are needed to shed more light. Yet, despite the growth observed in OGR financing, it still represents a very small portion of the overall energy access financing landscape. In access-deficit countries, for example, USD85.8bn was committed for access to electricity and clean cooking during 2013-2017, yet OGR attracted less than 1% of the total.[258]

In Africa, Oil Change International finds that only about 1-2% of finance for electricity is currently flowing to DRE.[259] The majority of this flows from multinationals based in Europe or North America or is led by entrepreneurs from these regions, meaning profits are largely not remaining in Africa.

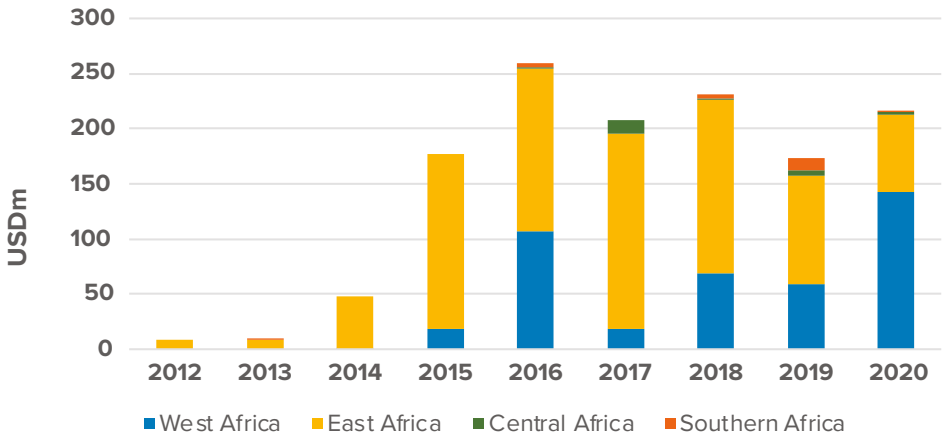
GOGLA further warns that many tracked 2020 transactions were legacies from 2019, and the fact that investments are highly concentrated – 75% of all commitments in 2020 went to the top 3 recipients – should be cause for concern.[260] This concentration underscores the urgent need to boost commitments to the sector and diversify them.

Box 23: SSA dominates – mainly East Africa but West is growing

SSA continues to capture the lion's share of global OGS investment, reaching 69% of both cumulative (2012-20) and 2020 investment according to GOGLA – plus part of a further USD459m of 'global' transactions that are not attributed to any single region. In its recent *Off-Grid Solar Investment Trends* report, GOGLA estimated that SSA attracted 95% of total investment between 2019 and August 2020, suggesting the region accounts for a high share of global transactions.[261, 262]

Among SSA, East Africa has captured 45% of global cumulative funding versus West Africa's 21% – **yet the pace of commitments to West Africa has increased substantially in recent years**, reaching 45% in 2020 while East Africa's dropped to a historical low of 22%.[263] 2020 marked the first year in which investment in West Africa (USD142m) exceeded that of its Eastern counterpart (USD70m).

Figure 22: Investment in off-grid solar technologies in Africa, by sub-region



Note: Africa also accounts for a large part of 'global' transactions (i.e., unspecified region), which are not shown.

Source: GOGLA. 2020. GOGLA deal database: Investment Data.[264]

IRENA paints a similar picture in terms of investment in OGR, which mostly comprise solar lights, SHS and solar mini-grids, but also include hydro and biogas mini-grids. SSA attracted at least 65% (USD1.3bn) of the near USD2bn in OGR investment between 2007-19.[265] This excludes USD389m targeting multiple countries / regions, a large part of which also seems to have been deployed in SSA.

Similar to GOGLA's OGS data, East Africa attracted the largest share (53%, or USD704m) of cumulative OGR investment in SSA, but West Africa has begun closing the financing gap in recent years. Four of the top five recipient countries in SSA were in East Africa – Tanzania, Rwanda, Kenya and Uganda – while Nigeria is the largest single recipient country, both in SSA and globally.[266]

SHS receive the bulk of investment, fuelled by PAYGO

SHS were the most-funded off-grid product globally, accounting for about 60% of cumulative investments during 2012-19.[267] A paper by Oil Change International adds that private finance for SHS has grown the fastest, increasing from less than USD10m in capital investment in 2012 to more than USD200m annually between 2016 and 2019.[268]

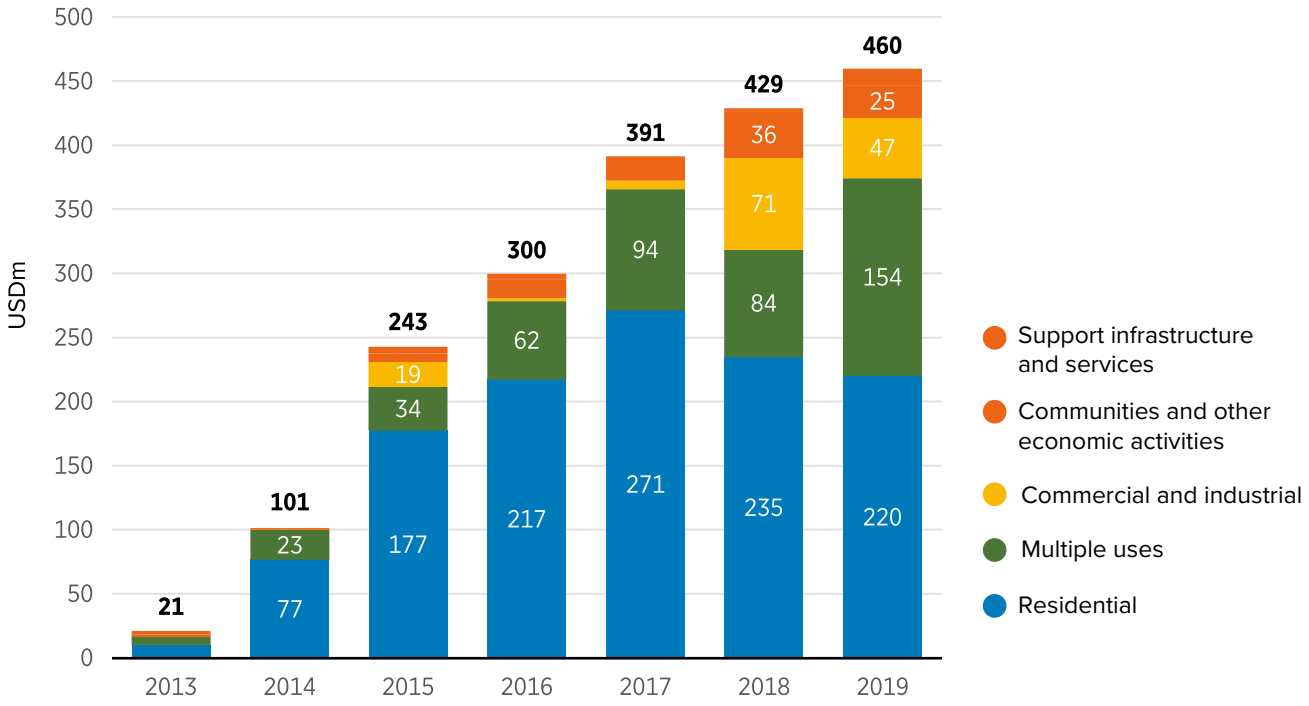
Within SHS, the high share represented by PAYGO models is well documented. IRENA finds that 83% of all cumulative commitments to OGR in SSA up to 2019 (USD1.5bn) went to PAYGO models. This is consistent with Lighting Global's estimate that 85% of all OGS funds raised were aimed at PAYGO companies, four of which accounted for 67% of the total investment.[269]

USAID claims SHS businesses received approximately USD1.3bn in funding between 2010-18, with 90% going to companies operating PAYGO financing models and 40% invested in businesses operating in East Africa.[270]

Residential uses most common but increasingly diversified

The majority of investment in OGR targets **residential users**. 61% of cumulative global investment up to 2019 (USD1.3bn) targeted this segment; the share is higher in SSA where off-grid residential use dominates given large unelectrified populations.[271] The subregion was responsible for at least 77% of investment in residential uses, a figure that is likely to be closer to 90% given an additional 13% directed to multiple regions, including Africa. 91% of the total off-grid investment for residential uses (USD1.1bn) was committed to SHS.

Figure 23: Annual commitments to OGR by user type, 2013-2019



Source: adapted from IRENA. 2020. Global Landscape of Renewable Energy Finance 2020.[272]

C&I uses were the second-highest, accounting for 8% (USD168m) of total investment. 2018 and 2019 saw unprecedented growth in commitments to C&I uses, with USD71m and USD47m invested respectively. SSA was again responsible for the majority (at least 63%) of cumulative investment, but unlike among residential uses, 77% financed micro- and mini-grids. SHS, solar lanterns, and solar refrigerators only contributed 14%, mostly providing energy access for small-scale businesses, such as barbershops and restaurants. Solar water pumps were responsible for 8%, predominantly for commercial and irrigation purposes.

Communities and other economic activities, such as streetlights and clean energy for hospitals and schools, represented 4% of global cumulative commitments. SSA accounted for the largest portion of this, with at least 66% of the global volume.

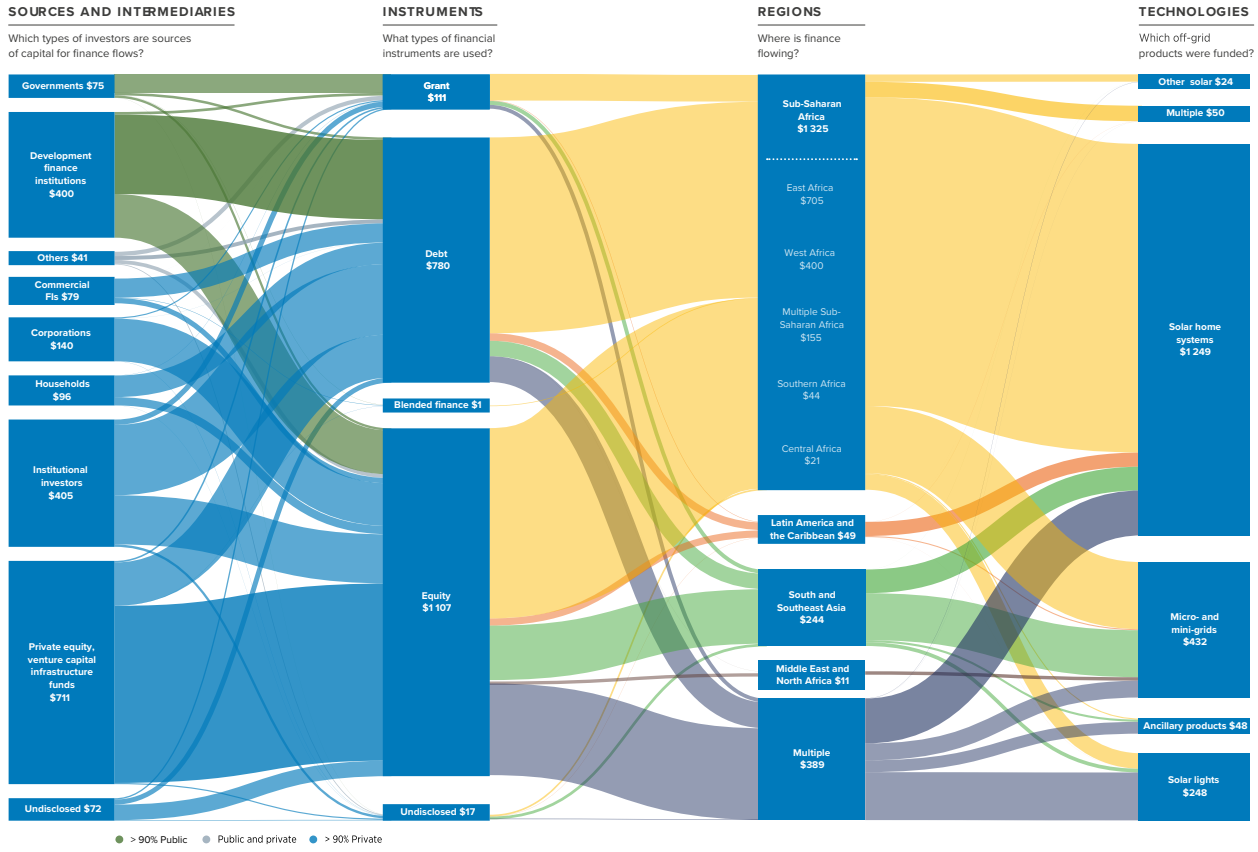
Finally, the 84% growth in commitments with **multiple purposes** in 2019, coupled with declines in all specific uses, may suggest an ongoing diversification of OGR energy investments with respect to specific energy uses.

Type of finance: debt growth outpacing equity

The profile of financial instruments and investors has changed as the global OGR sector has developed, becoming more diversified, as shown in IRENA's Sankey diagram (Figure 24). Compared to energy access projects overall, OGR have tended to be financed more with equity and less with debt instruments, especially in the market's earlier period.

The shift from equity towards debt capital in recent years indicates that off-grid energy has entered a new phase of maturity, which presents enhanced opportunities for capital market flows and financial aggregation.[273]

Figure 24: Landscape of OGR energy finance, 2007-2019



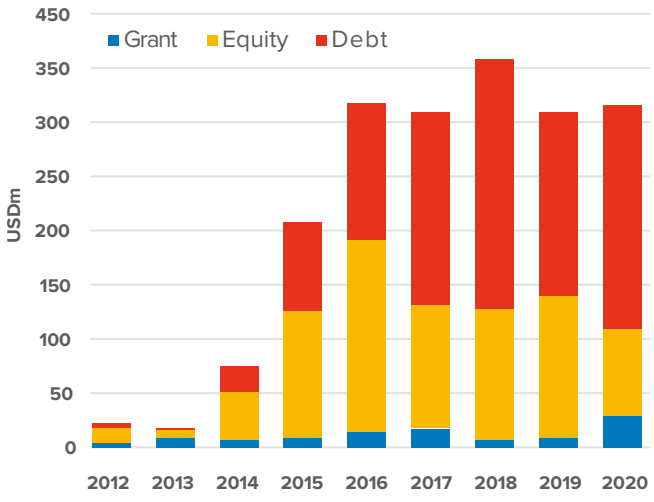
Note: Figures in USD million.

Source: IRENA. 2020. Global Landscape of Renewable Energy Finance 2020. IRENA analysis based on Wood Mackenzie (2020).[274]

Debt is instrumental to the growth of PAYGO solar companies because these require working capital to finance customer receivables. Over 60% of the total funding is estimated to finance consumer receivables, the rest being used for inventories and CAPEX.[275]

According to GOGLA, the share of global OGS debt flows rose from 14% in 2012 to 65% in 2020, accounting for 53% of the cumulative total; meanwhile, equity dropped from 68% to 26% (42% cumulatively). The equity-to-debt trend intensified in 2020, with debt flows remaining robust in the face of COVID-19 (+23% to USD206m) and equity commitments falling heavily (-39% to USD81m). Grant volumes have remained below 10% since 2014 after representing 18% and 38% in 2012 and 2013, respectively. The reductions in equity and grant funding affect next generation enterprises – particularly local companies – compared to established players, leading to further market dominance by the larger, top-tier companies, primarily in East Africa (see 'Highly concentrated financing' section below).

Figure 25: Financing blend in the OGS sector



Source: adapted from GOGLA. 2020. GOGLA deal database: Investment Data.[276]

The breakdown of SHS and mini-grid investment in SSA provided in the 2021 IEA paper paints a similar picture to the global OGS landscape, with debt increasing its share in the last five years to reach just over 60% of the total in 2020, versus 35% of equity (grants make up a low share).[277]

Box 24: Crowdfunding

Crowdfunding has become an increasingly important source of alternative finance for energy access, all of which seems to target EM (largely SSA) and investment in distributed renewables. An Energy4Impact report finds that about 90% of the overall USD59m invested through crowdfunding in 2019 was in the form of debt, 10% of which consists of P2P microlending and 90% P2P business lending; equity-, ICO-, reward- and donation-based crowdfunding follow respectively. The largest platform in 2019 was Trine, representing USD20m of the USD55m debt total.[278]

2020 crowdfunding volumes were projected to drop to around USD46m, with a slight drop in the share of debt. GOGLA notes that the level of crowdfunding investment was maintained in 2020, representing 10% of the total debt commitments to OGS and pointing to the consolidation of crowdfunding as a debt funding method in the sector.[279]

Source of finance: private finance growth reversed in 2020

According to IRENA, 67% of global cumulative commitments to OGR up to 2019 came from private investors and 30% from public capital providers. [280] The rest is attributed to a mix of public/private investment, along with undisclosed sources.

Overall, there is a limited number of active investors. The top 10 investors in the OGS space, consisting of both private and public organisations, contributed more than 60% (about USD1.1bn) of total investment in off-grid energy companies between 2010-18.[281] FMO, responsability, and SunFunder led the ranking.[282]

In 2019, the share of private finance – mainly private equity, venture capital and infrastructure funds, institutional investors, and corporations & business associations – rose to 78%, while public sources dropped to 20%. A continuing shift towards debt instruments, particularly coupled with aggregation mechanisms such as securitisation, is likely to further increase the appeal for private investors. In 2020, however, GOGLA data showed that government and DFI funding increased while private finance fell (albeit moderately), most likely due to the effects of COVID-19.[283]

DFIs have been the largest public capital providers, having committed USD400m, or 67% of total public investments into OGR. IRENA's data reveals USD208m of DFI funding in SSA was invested into OGS companies, close to half occurring in 2019-20. By contrast, the role of government agencies and intergovernmental institutions has declined significantly, from 21% of total investment in 2013 to only 2% in 2018 and 1% in 2019.

In SSA, the vast majority (85%) of investment in OGR originates from developed economies, while 12% comes from domestic/intra-regional and 3% from inter-regional developing economies.[284] While the priority is to increase investment in the sector, balancing finance flows in the medium- to long-term should also be pursued where possible.

Husband and wife under the solar lamp Cambodia Photo credit: Manuth Buth, UNDP Cambodia

Box 25: Early-stage investment in SSA green firms

A study tracking over 800 disclosed transactions associated with 157 green firms and involving 336 identifiable investors in SSA countries between 2006-17 indicated that 81% of investment capital in early- and growth-stage green firms in SSA went to the off-grid energy sector.[285]

The same study found that two-thirds of the investment was provided by impact investors, donors, foundations, and DFIs, with local investors accounting for only 13%.[286]

Table 7: Early-stage investment in green firms in SSA, by type of financier

	IMPACT INVESTORS	DONORS	FOUNDATIONS	DFIs	SUM
Number of investors	55	24	23	6	108 (44% of all investors)
Number of investments	161	112	62	15	350 (60% of all investment count)
Volume of investment	USD120m	USD77m	USD38m	USD45m	USD282m (63% of all investment volumes
Frequently used financing instrument	Equity (67%)	Grant (80%)	Grant (73%)	Debt (70%)	Debt (20%) Equity (33%) Grant (30%)
Frequently invested sector by volume	Off-grid energy (63%)	Off-grid energy (79%)	Off-grid energy (75%)	Off-grid energy (97%)	Off-grid energy (74%)
Note: Depending on the nature of the programme, government-funded programmes were categorised as either donors or DFIs.					

Source: adapted from World Bank. 2021. Early-Stage Financing in Green Sectors in Sub-Saharan Africa.[287]

Highly concentrated financing

The IFC observes that the sector shows signs of increasing maturity, such as larger ticket sizes and a diversifying group of large scale investors; IRENA states that the average ticket size for OGR investment almost tripled from just above USD1m before 2015 to nearly USD3m during 2015-19.[288] This indicates an increase in the size of individual businesses toward levels and volumes that increasingly attract the attention of professional investors, but it may also reflect the market dominance of first-generation companies, mainly DESCOs operating in East Africa established by international founders.[289]

The top ten OGS companies have attracted 87% of total funding globally, with most capital flowing to larger PAYGO companies.[290] According to GOGLA, close to 75% of all off-grid energy financing between January 2019 and August 2020 was committed to only three multinational companies, while just ten soaked up 84% of investments in SHS by 2019.[291] Largely these are established first-generation businesses, with Zola Electric, M-KOPA Solar and D-Light making up the top three.[292]

More recent analysis by the World Bank attributes 87% of early- and growth-stage investment awarded to just seven operators: BBOXX, d.light, Greenlight Planet, M-Kopa, Mobisol, Nova Lumos, and Off-grid Electric.[293] Some of the larger SHS businesses bundle their consumer receivables at a scale capable of attracting local currency debt financing to fund growth. In contrast, smaller companies tend to finance their operations through unsustainable levels of equity based on unrealistic growth targets.[294] Within mini-grids, ten companies secured 77% of all the funding available.[295]

These figures suggest that the industry is still building up a viable SME sector, important for the development of sustainable economies, to lessen unfavourable market concentration, and to build local resilience. As well as larger-scale capital flows to the sector, several initiatives support the development of local SMEs, and there are signs of increasing diversification. The top ten deals accounted for 68% of total investment in 2020, down from 90% a year earlier, and the figure for the top three deals also declined, from 56% to 41%. More companies received backing last year, too, with GOGLA reporting 78 beneficiaries, up from 49 in 2019; this included 46 businesses that banked support for the first time, versus only 20 a year earlier.

The average size of investments declined, from USD2.3m to USD1.62m, which could be either a good or bad sign, given the potentially smaller demands of seed investments. Data from GOGLA suggests that investment flows are beginning to expand beyond the traditional markets in Kenya and East Africa into West African nations.[296] These figures may indicate that several enabling factors are converging to build a more robust market and better investment opportunity in OGR.[297]

Investment potential/needs: tens of billions USD

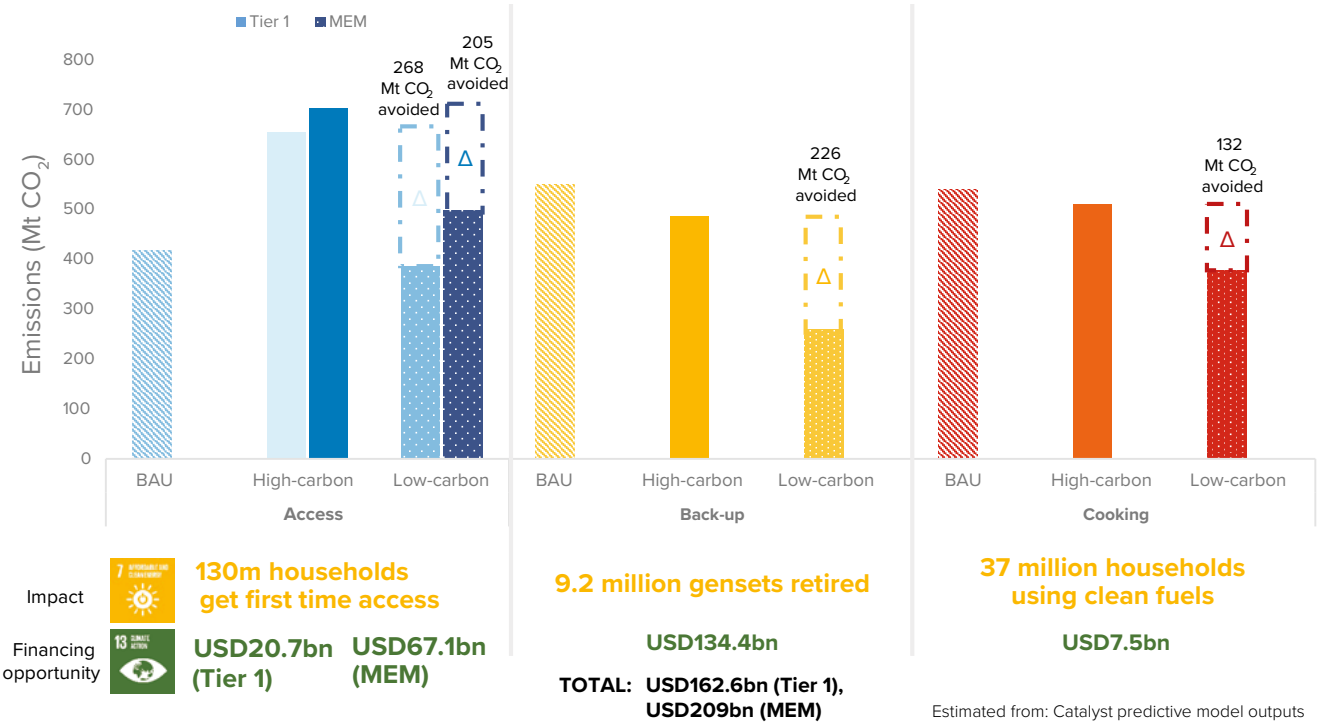
Estimates of the investment needed to reach universal energy access and the potential size of the OGS/OGR market vary, but there is consensus about the large and urgent need for finance to flow into the sector. UNDP set a 2025 milestone for annual investment in access to electricity to be increased to USD35bn and in access to clean cooking increased to USD25bn.[298] This investment level broadly aligns with IRENA estimates, among several other organisations, claiming that US45bn is needed.[299] The AfDB has estimated USD60-90bn as the annual investment required to deliver its New Deal goal of universal access in Africa, although the share of OGR is not disclosed.[300]

The Unlocking Climate Finance to Accelerate Energy Access in Africa report predicts that under a low-carbon scenario, there is a USD200bn market opportunity for climate-first investors to achieve universal access to energy in Africa by 2030.[301]

This includes USD20-67bn in funding to scale businesses providing SHS and mini-grid power for residential use, the lower end referring to capital needs of companies supplying Tier 1 products (of which about 25% for mini-grids) and the higher end to those providing larger systems (of which about 44% for mini-grids). Most, ranging between 50-60% depending on the product, is expected to come from debt instruments.

An additional USD130bn to increase the prevalence of affordable solar alternatives to diesel gensets, and a USD7.5bn injection to improve the affordability and availability of modern cooking options for low-income families are also required, as well as USD2.5bn in consumer subsidies specifically to achieve universal Tier 1 energy access (based on a 50% demand-side subsidy).

Figure 26: Different scenarios highlighting SDG 7 impacts and climate finance opportunities



Source: adapted from Catalyst Offgrid Energy Advisors, 2021. Unlocking Climate Finance to Accelerate Energy Access in Africa.[302]

Within the OGS sector, Lighting Global points to a global annual *external* investment need of USD1.7-2.2bn between 2020-24 to sustain the current market growth trajectory (projected to serve 823m users by 2030).[303] Of the total, about USD6.1-7.7bn would consist of external investment in OGS companies and USD0.5-3.4bn of public funding to bridge the affordability gap.

Other sources report considerably greater needs. The IEA states that achieving access goals in SSA alone requires an annual investment of >USD10bn (USD135bn in total) in SHS and mini-grids between 2020-30, at least a fortyfold increase versus 2018-20 levels of roughly USD300m.[304] In 2018, Shell Foundation referred to a total investment need of USD26bn, including almost USD1bn in grants, to finance the 298 first-, second-, and third-generation SHS energy companies estimated to be able to deliver energy throughout SSA.[305] USD11bn of this would be required for mini-grid and SHS investments in East Africa.

Finally, it is perhaps useful to note that the C&I solar market, albeit still small, also presents a large potential for targeted finance. According to a BNEF report, the financial sector has yet to take on a major role in providing funding for C&I solar systems. So far, most business customers have bought systems for cash without using third-party finance, and there are large opportunities for specialised financiers in the region to do more.[306] On-site solar power is cheaper than the electricity tariffs paid by C&I clients in seven of the 15 SSA markets studied.

Securitisation has the power to address a substantial share of the energy access gap. In 2019, the Global Innovation Lab for Climate Finance calculated that every USD10m in securitisation value (or another investment, for that matter) could reach 200,000 households based on a USD50 loan.[307] Using this assumption, servicing the 600m or so people in Africa that lack energy would require USD30bn.

OGR support expanding energy access

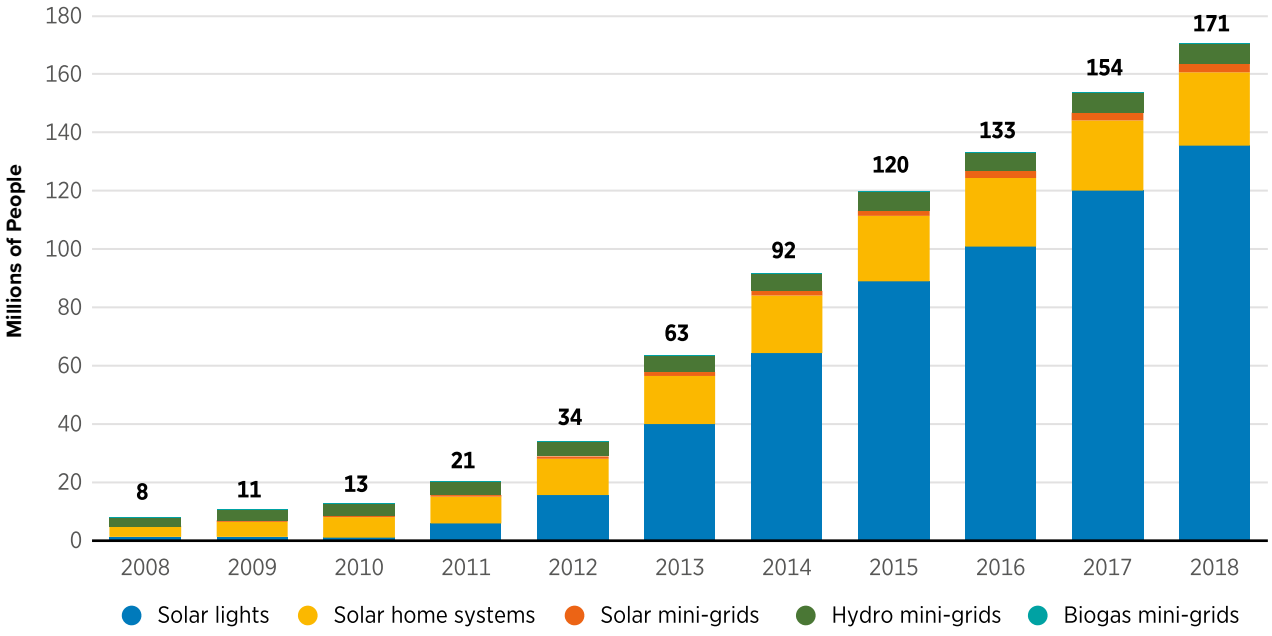
The global population with access to energy has risen consistently over the last few decades, albeit with regional variations.

Likewise, the number of people served by OGR has expanded significantly in the last decade, growing at a 38% CAGR between 2010-18 to reach over 170m people at the end of that period, according to IRENA.[308] Most of this is in the form of solar lights and concentrated in developing countries. The World Bank pointed to a slightly larger market, with OGS providing lighting and energy services to over 200m people worldwide in the same year.[309]

Achieving SDG7 will require not only reaching currently unserved populations but also helping those using Tier 0 products move up to Tier 1+ systems. IRENA estimated about 80% (136m) of the people served had access to Tier 0 solutions (i.e., pico products), while roughly 35m had access to Tier 1+, the minimum that counts as electricity access against globally agreed targets. Most of the latter accessed energy via SHS and solar mini-grids, with about 8m benefitting from hydro and under 1m biogas mini-grids.

More up-to-date statistics from Lighting Global's Off-Grid Solar report suggest the OGS market is now considerably larger and increasingly dominated by Tier+1. As of early 2020, 420m people were estimated to be served by OGS products globally, of which more than half had at least Tier 1 access.[310]

Figure 27: Population served by OGR solutions globally, 2008-2018



Source: adapted from: IRENA. 2020. Global Landscape of Renewable Energy Finance 2020.[311]

Box 26: Asia and Africa are the highest-growing regions

Asia and Africa account for the overwhelming majority of users. IRENA's data shows that 111m of the 171m people benefitting from OGR solutions at the end of 2018 were in Asia while over 50m were in Africa.[312, 313]

Within SSA, electricity access rates climbed from 33% in 2010 to 46% in 2019.[314] Advances in access rates outpaced population growth after 2010, although the trend reversed recently; between 2016-18, the number of people in the region lacking access remained stable. Despite this, the growth in the region's access to OGS solutions is notable. Only 17% of the total number of people connected to OGS solutions were in SSA in 2016, a figure which increased to 49% in 2019.

The growth in households served by OGS has been particularly driven by the rapid decline in technology costs and innovation in delivery and financing models, namely PAYGO systems. Sotiriou et al. (2018) estimate that the PAYGO model provided solar power to over 8m people in SSA between 2013-18, with IRENA also referring to 8m people having gained energy access with PAYGO models between 2015-20.[315, 316] This was concentrated in East Africa – GSMA estimated 730,000 units sold in the subregion versus only 30,000 in West Africa. However, reflecting increased investment in West Africa in recent years, one can expect the gap to have narrowed.

Revenue growth outpacing unit sales

Sales volumes have grown healthily but at a diminishing rate, to be expected in an expanding market. ESMAP reported over 130m OGS devices sold globally between 2010 and 2018, increasing at a c. 60% CAGR.[317] More recently, GOGLA estimated unit sales to grow 10% annually between 2017-19, with more than 30m OGS units sold worldwide in 2018 and 180m up to 2020.[318]

Product-wise, Lighting Global notes that SHS represented about 17% of unit sales as of the end of 2019, with pico solar products still dominating volumes.[319] The PAYGO business model, primarily used to finance SHS, has been increasing its market share noticeably, reaching 24% of unit sales in H1 2019 (20% in H1 2018). Sales volumes are also concentrated; by 2018, six companies – Azuri, BBOXX, d.light, Fenix, M-KOPA, and Zola (formerly Off-Grid Electric) – had sold 90% of the PAYGO SHS sold worldwide.[320]

Revenues have grown faster than unit sales in the OGS market – driven by the shift towards higher-priced and PAYGO-enabled products that provide higher levels of energy service.[321] Lighting Global indicates global turnover grew 30% annually between 2017-19 to reach a USD1.75bn market in 2019.[322] The World Bank put cumulative turnover at almost USD4bn in 2018.[323]

Unit sales are still dominated by cash and lighting products. Products purchased under the PAYGO model represent the bulk of revenue despite their lower volume versus cash sales. GOGLA data for H2 2020 shows 1.3m OGS lighting units sold on a cash basis in East Africa, amounting to USD31.8m, while the 876,000 units sold via PAYGO were worth a total of USD134m; in West Africa, 193,000 cash-based units were valued at USD4.7m, whereas the 242,000 PAYGO units sold for USD62m.[324]

Boy with solar lamp
Photo credit: UNDP Yemen

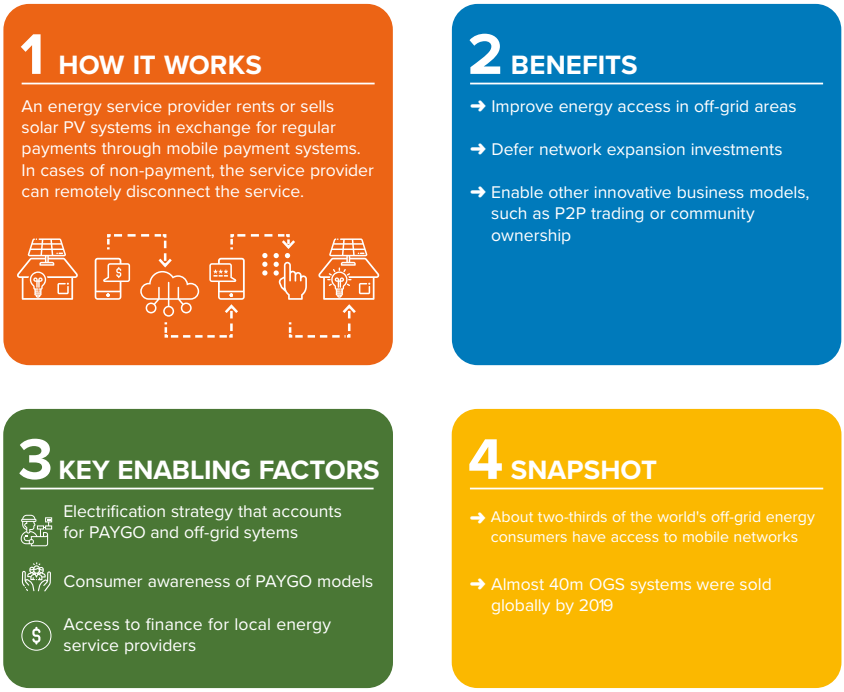
Box 27: Payment innovations via PAYGO technology

PAYGO financing has been a major enabler for OGR. Despite being more susceptible to certain risks compared to traditional lending, PAYGO technologies have excelled due to the widespread uptake of mobile money. Along with the increased opportunities presented by SHS, this technology has greatly increased electricity penetration in SSA.[325] 73% of total investment into green sectors in SSA flows through to the DESCO sector, which is dominated by PAYGO models.[326]

SHS unit economics have improved significantly over the last decade, yet last-mile distribution and the need for working capital still present challenges to most business models.[327] The underlying mechanics of PAYGO businesses mean that initially, costs associated with building and distributing solar PV systems are retrospectively financed by customer loans.[328]

PAYGO arrangements are typically based on small upfront payments and flexible repayment terms. Hence, business growth coincides with cost increases and notional loans outstanding, a dynamic requiring appropriate funding throughout this development stage. A report by IRENA notes that start-up companies fund mostly through equity and require less than USD1m for business planning process before progressing to an early-stage development phase typically seek USD3–5m in equity for the implementation of a pilot project and market entry. Expansion beyond this phase normally requires a mixture of debt and equity of between USD10m and USD20m. Further scale-up increases the proportion of debt finance to USD50-100m. Financial aggregation may open up opportunities for debt financing to be introduced earlier in this business development lifecycle.[329]

Figure 28: PAYGO model overview



Source: adapted from IRENA. 2020. Pay-As-You-Go Models Innovation Landscape Brief.[330]

GOGLA additionally estimated 68% of PAYGO revenues in 2017 among 3-10W products, 12% in the 11-50W range, and 20% >50W.[331] More recent data was not found, but the shift towards higher-priced products over the last few years – which may have been accentuated by the COVID-19 pandemic, with some market participants noting a trend of wealthier households obtaining more powerful systems during H1 2020 – is likely to have led to an increasing share in the more powerful ranges.

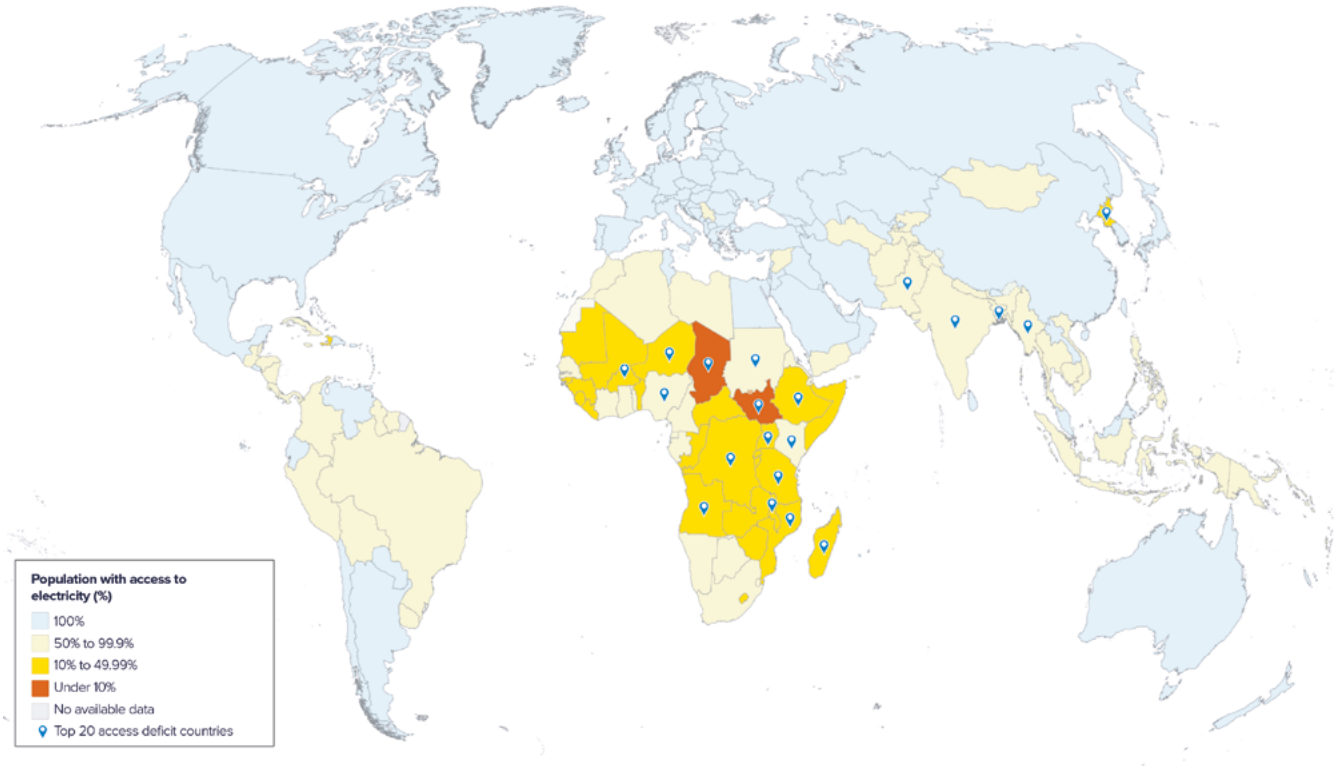
The number of people served by **PULSE applications** is also growing, although still small. As of H1 2020, GOGLA reported an estimated 2.6m people using OGS lighting products to support an enterprise (e.g., charging phones for a fee or operating a bar, restaurant, shop, or stall).[332] Lighting Global estimates dual-use PULSE appliances – used for residential and productive use, such as fans, TVs, and refrigerators – covering the range of OGS devices to form a global market of 38m users globally.[333] TVs can provide an income stream, with 12% of off-grid TV owners in East Africa showing television for a fee; refrigerators are primarily used by small businesses to sell cold goods and avoid food spoilage.

Potential market remains vast

While the customer base is considerably larger than ten years ago, the energy access deficit remains large – as does the potential for small-scale, low-carbon energy solutions to address it. An estimated 759m people globally lacked access to electricity in 2019, down from 789m in 2018.[334] According to the IEA, about 620m people were predicted to remain without access by 2030 under current and planned policies before the start of the COVID-19 crisis.[335] The majority (over 80%) live in SSA,[336] where 57% of the total population (about 120m households) and as much as 99% in rural areas of some countries lacked access at the end of 2018.

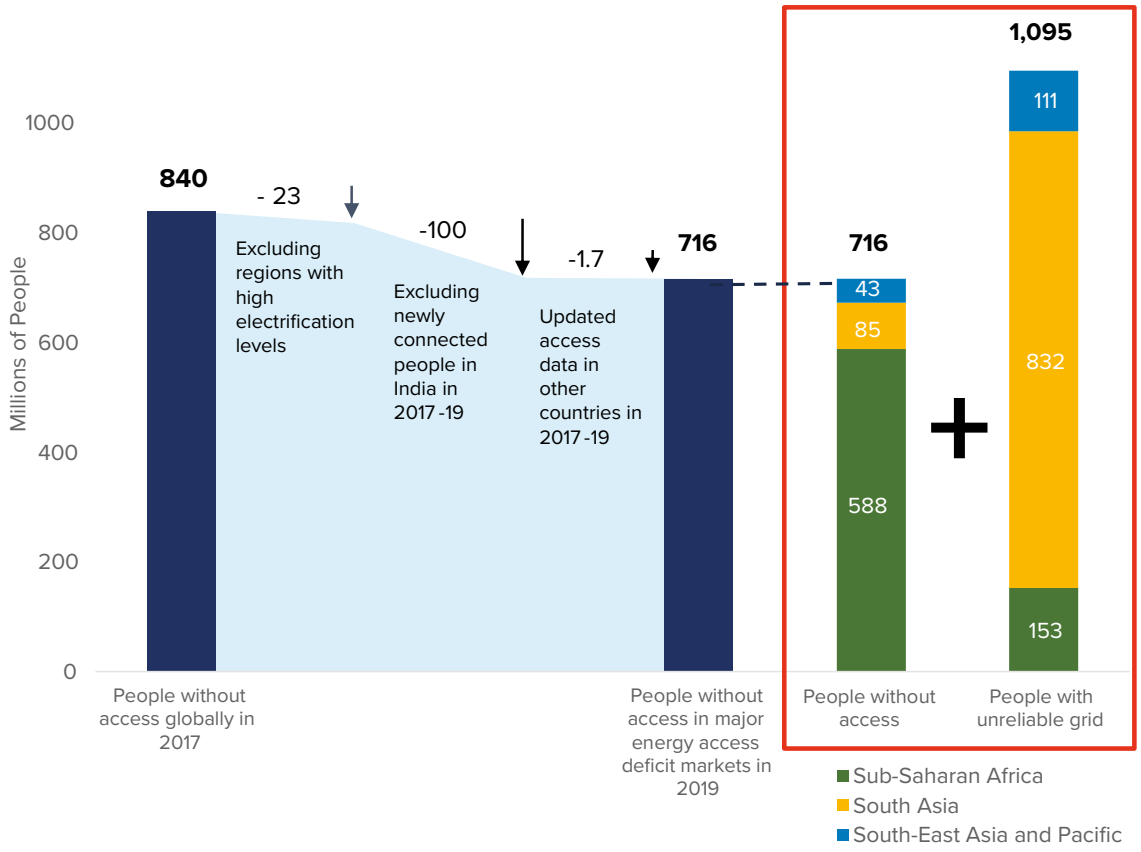
Further, over 1bn people are connected to an **unreliable grid** globally, of which 153m are in SSA and the rest in Asia-Pacific.[337] This presents additional potential, although only a subset of these people are real customers for OGS backup energy products. As a realistic benchmark of what could be reached in the next 5-10 years, Lighting Global estimates one in four people with an unreliable grid connection may also buy an OGS product, which would add a further 250m people globally (and roughly 40m in SSA applying the same assumption) to the potential OGS market.[338]

Figure 29: Share of population with access to electricity in 2019



Source: adapted from IEA. 2021. Tracking SDG7: The Energy Progress Report, 2021. Original source: World Bank 2021.[339]

Figure 30: Potential OGS market in sub-Saharan Africa and Asia–Pacific



Note: Not all people with unreliable grid are potential customers of OGS products (see previous page).
Source: adapted from GOGLA. 2020. Off-grid Solar Market Trends Report 2020.[340]

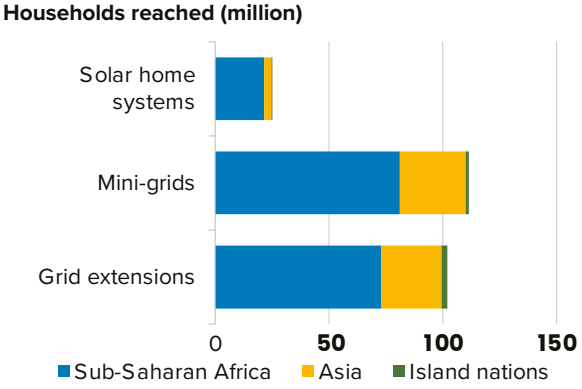
Public institutions, such as education and health facilities, represent another promising segment for OGS technologies. In 78 low- and middle-income countries, 59% of healthcare facilities lack access to reliable electricity, and in the Democratic Republic of Congo, the figure is just 9%.[341] Similarly, within education facilities, only 34% of primary schools in SSA and 52% in South Asia have access to electricity.

Overall, the OGS sector is expected to experience a sales CAGR of 6% over the next decade and reach 823m users worldwide by 2030, most of which currently lack access to electricity.[342] Of these, 389m are expected to have an OGS product providing Tier 1 service or above.[343]

With each household spending an average of USD200 per year on energy services, the market for companies offering OGS solutions for individuals is estimated at USD24bn annually.[344] Even with a more modest estimate of USD50-100 (broadly in line with the current average), the market could reach tens of billions USD over time, comparable in size to today's global microfinance markets. The potential is even larger when considering the impact of the PAYGO model in increasing reach by offering consumer finance.

Among technologies, SHS are likely to drive growth in the near future - especially in revenue given the continuing shift towards higher-value products - but mini-grids may play an increasingly important role.[345] The State of the Global Mini-grids Market Report 2020, a Mini-Grids Partnership report published by BloombergNEF and SEforALL, expects mini-grids to service more households than SHS under the universal access scenario.[346]

Figure 31: Technology use in universal access scenario (households reached)



Source: adapted from SEforALL on behalf of the Mini-Grids Partnership (MGP). 2020. State of the Global Mini-grids Market Report 2020.[347]

The primary goal of the AfDB's New Deal – to achieve universal electricity access by 2025 by leveraging clean and renewable energy solutions – will reportedly require providing a massive 160GW of new capacity, 130m new on-grid connections, and 75m new off-grid connections, as well as 150m households with access to clean cooking solutions.[348] The World Bank additionally estimated that over 140,000 mini-grids are needed in Africa alone to solve the electrification problem.[349]

PULSE applications remain largely untapped

While the OGS sector has primarily focused on consumptive energy use, industry and investors are shifting their attention to productive use appliances.[350] There is substantial untapped demand for products that offer a wider range of energy services, with the almost limitless applications in the PULSE segment presenting substantial growth opportunities.

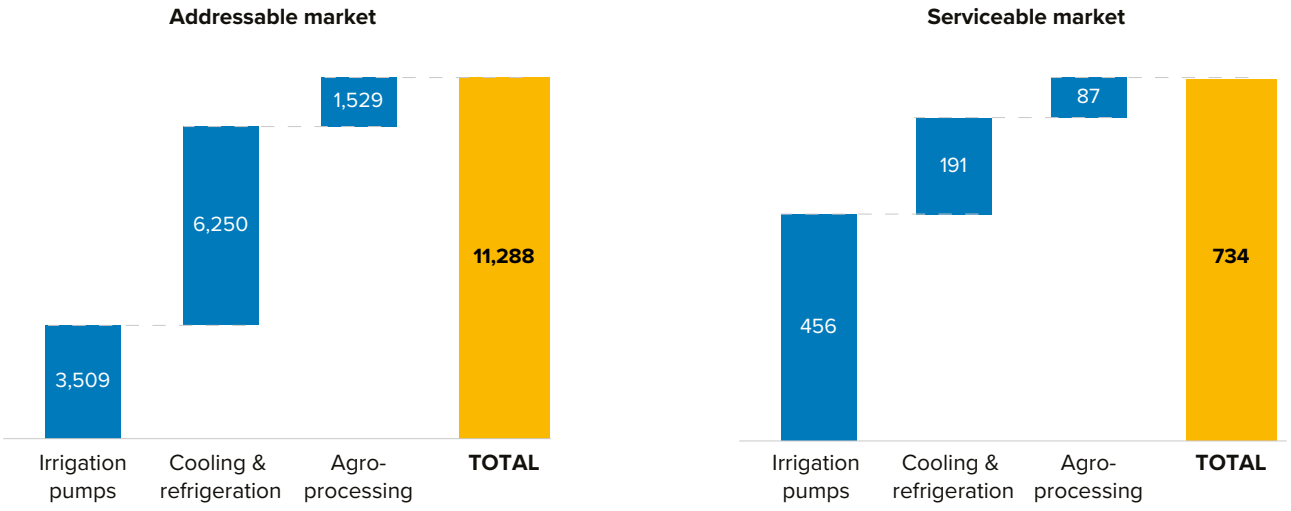
However, the IFC notes that uptake of PULSE products faces affordability constraints, and access to finance remains limited. Overall, the deployment of productive use technologies is likely to largely depend on the availability of consumer financing and long-term concessional debt and risk capital for innovators and enterprises. [351]

While these can be addressed through financial aggregation, the smaller size of the PULSE sector may require more time to grow before this becomes technically viable.

In 2017, the World Bank estimated off-grid solutions for TV, cooling, and refrigeration to represent a potential market opportunity of over USD4.7bn by 2020.[352] While a wide range of applications exists, the activity offering the broadest potential appears to be agriculture. Around 70m farms in Africa could leverage OGS for productive agricultural uses, such as irrigation pumps, agro- and livestock-related processing.[353]

The addressable agriculture market in SSA is estimated at USD11.3bn across three prominent use cases: irrigation, cooling & refrigeration, and agro-processing. Factoring in affordability constraints reduces the serviceable market size to USD734m, although this may be reduced further when accounting for the relative affordability of solar products versus traditional alternatives, which is not considered in these estimates.

Figure 32: Total addressable and serviceable market size (USDm) for PULSE in SSA



Source: adapted from Lighting Global. 2019. The Market Opportunity for Productive Use Leveraging Solar Energy (PULSE) in Sub-Saharan Africa.[354]

The potential SWP market exceeds 67m smallholder farmers worldwide; SSA is the largest, with more than 43m smallholder farmers currently lacking access to the main grid. Within agro-processing, Lighting Global puts the potential demand for solar mills and threshers at 940,000 units, given that 38% of a total 120m metric tonnes of produce is processed by smallholder farmers.[355]

Likewise, solar-powered cold storage solutions have broad potential, with 6.5m smallholder farmers in SSA alone active in sectors that would benefit from refrigeration.[356] Farmers working in the dairy and horticulture sectors, for instance, have no access to the grid and require cooling technologies, ranging from small cooling units for low volumes of dairy or horticultural produce to large walk-in storage facilities serving multiple smallholders.

Finally, there are also vast opportunities to deliver clean cooking globally, with approximately 2.6bn people as of 2019 lacking access to clean cooking fuels and technologies, down from 2.8bn in 2018 and 3bn in 2010.[357] The evolution has been weakest in SSA, where population growth between 2014-18 outstripped growth in access by an average of 18m people a year, leading to the region's access deficit rising by over 50% after 2000 to reach roughly 910m people in 2019. 2019 was the first year that more people without access to clean cooking methods resided in SSA than anywhere else, surpassing Central and Southern Asia, which housed the highest deficit up to 2018.[358]

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