GET.invest
Mobilising Renewable Energy Investments

Renewable Energy Market Segments in Sub-Saharan Africa: Outlook & Challenges

Working Paper (17 September 2021)

Disclaimer:

This is a living document, compiling experience and insights from the work of GET.invest. It aims at knowledge sharing and exchange, and at stimulating further discussion. The data and analysis presented in this report are drawn primarily from the experience of advisors of the GET.invest Finance Catalyst, which has advised companies and projects on how to secure financing since 2016. Thus, it is critical that the analysis and findings be understood in this context and not as an academic survey of the renewable energy investment market in sub-Saharan Africa, nor the multitude of financing instruments that support it.

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On behalf of
GET.invest is a European programme which supports investments in decentralised renewable energy projects. It is hosted on the multi-donor platform GET.pro (Global Energy Transformation Programme), and supported by the European Union, Germany, Sweden, the Netherlands, and Austria.

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Acronyms

AfDB	African Development Bank
AMDA	Africa Minigrid Developers Association
ARPU	Average Revenue Per User
BoP	Bottom of the Pyramid
BOT	Build-operate-transfer
C&I	Commercial & Industrial
CAC	Customer Acquisition Costs
CAPEX	Capital Expenditure
DESCO	Distributed Energy Services Company
DFI	Development Finance Institution
EPC	Energy Performance Contracting
GHG	Greenhouse Gas
ICS	Improved Cooking Stoves
IFRS	International Financial Reporting Standards
IPP	Independent Power Producer
IT	Information Technology
LPG	Liquefied Petroleum Gas
MDB	Multilateral Development Bank
Mtoe	Metric tons of oil equivalent
O&M	Operations & Maintenance
OGS	Off-grid solar
OPEX	Operating Expenses
P&L	Profit and Loss
PAR	Portfolio at Risk
PAYGo	Pay-as-you-go
PPA	Power Purchase Agreement
PV	Photovoltaic
RBF	Results-Based Financing
RE	Renewable energy

RECP	Renewable Energy Cooperation Programme
REIPPP	Renewable Energy Independent Power Producer Programme
REPP	Renewable Energy Performance Platform
SDG	Sustainable Development Goal
SEFA	Sustainable Energy Fund for Africa
SHS	Solar Home Systems
SMEs	Small and Medium-sized Enterprises
SPV	Special Purpose Vehicle
SSA	Sub-Saharan Africa
TA	Technical Assistance
UNFCCC	United Nations Framework Convention on Climate Change
VER	Voluntary Emissions Reductions

1 Introduction

1.1 Context & Purpose

GET.invest is a European programme that aims at mobilising investments in decentralised renewable energy projects. It is supported by the European Union, Germany, Sweden, the Netherlands, and Austria, hosted on the multi-donor platform GET.pro and implemented by GIZ, and. At the heart of the programme is an advisory facility, the GET.invest Finance Catalyst, that links renewable energy projects and companies with finance opportunities and vice versa, targeting small- and medium-scale renewable energy opportunities.

Since its inception in 2016 under GET.invest's predecessor, the Renewable Energy Cooperation Programme (RECP), the Finance Catalyst has supported more than 200 renewable energy projects and companies across sub-Saharan Africa and the Caribbean. Through this experience, the team has gained substantial insight into the challenges facing, and successes celebrated by, companies that are trying to deploy assets and services. In addition to experiencing the challenges alongside these developers, the Finance Catalyst's cross-cutting exposure has also highlighted common problems and potential solutions for addressing these challenges.

Thus, GET.invest's donors have requested analytical support, provided in this synthesis paper, that outlines market contours, challenges, gaps and solutions for the renewable energy market's underlying segments, derived primarily from the Finance Catalyst's experience advising projects and developers across these segments. In addition to addressing the state of each segment, the synthesis estimates the overall size of each segment in terms of current and future state by 2030. Furthermore, the paper analyses how each segment aligns with select Sustainable Development Goals (SDGs), which are critical to the development policy and financial planning process.

Access to Finance Advisory

The GET.invest Finance Catalyst provides on-demand advisory to get projects and businesses ready for finance and links them with financiers.

Figures from 2016 up until 09/2021, incl. the predecessor RECP

857 applications for support

207 projects and companies supported

100 clients in current portfolio

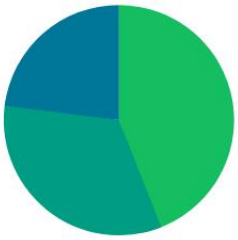
65 accepted by financier

36 financial close

more than 1 in 3 projects supported has been accepted by a financier

Breakdown by ticket size

- 5m-20m
- .....20m+
- 250k-5m

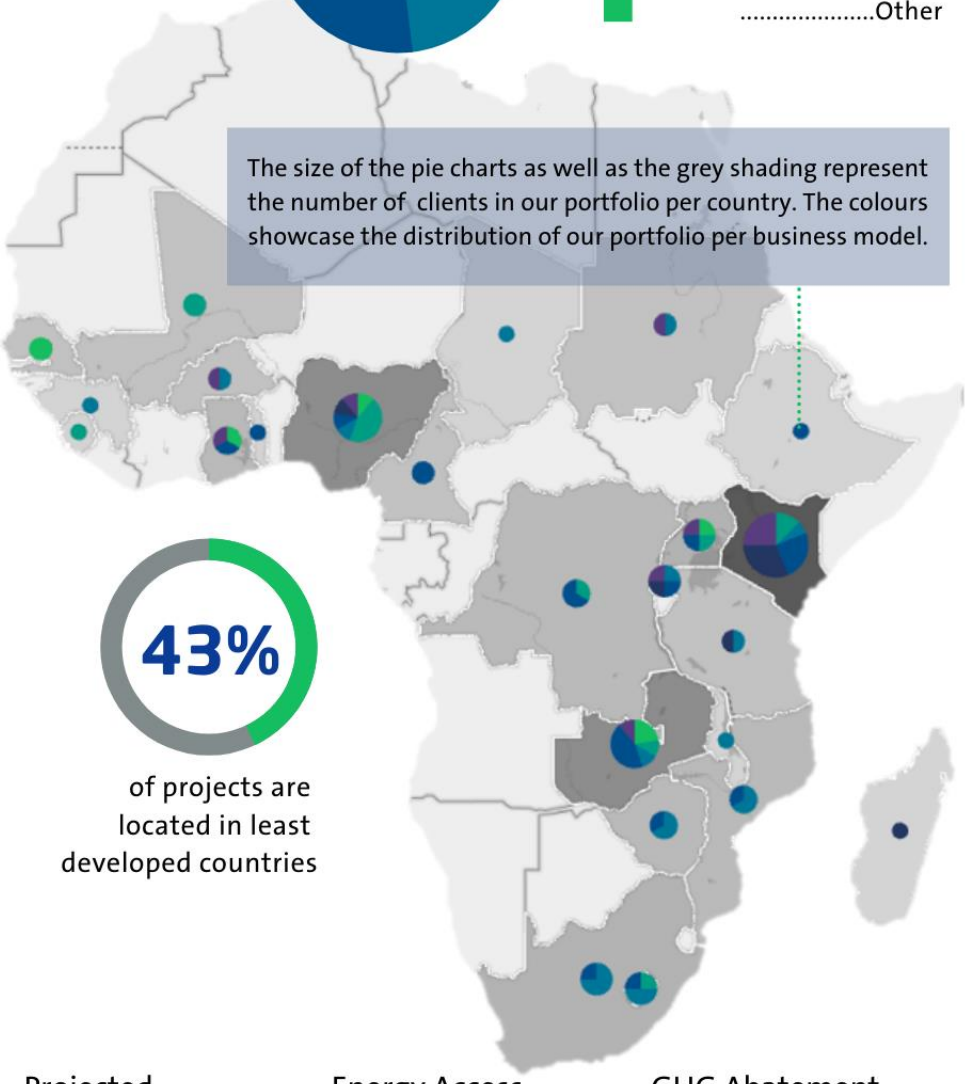


Our portfolio

Breakdown by business model

- .....IPP
- .....Mini-grids
- .....C&I
- .....SHS/OGS
- .....Clean Cooking
- .....Other

The size of the pie charts as well as the grey shading represent the number of clients in our portfolio per country. The colours showcase the distribution of our portfolio per business model.



of projects are located in least developed countries

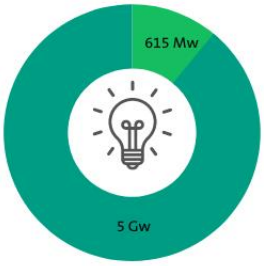
Our impact

Projected Investment Volume

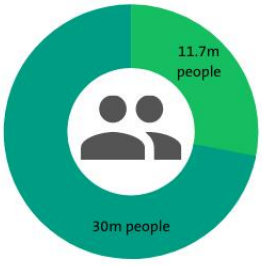
€ 1.2 billion

- EU energy targets for sub-Saharan Africa (2014-2020)
- Our projected impacts

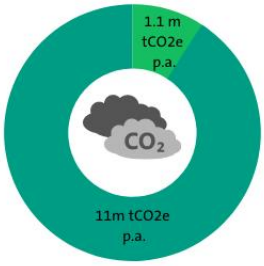
Projected Installed Capacity



Energy Access Potential



GHG Abatement Potential



Thus, this paper is based on the implementation experience of the programme as well as the professional experience and views of the individual contributing team members and advisors, and as such represents a synopsis of combined experience of several decades. A comprehensive literature review was deliberately not undertaken as the findings presented herein correspond with many publications and reports. Rather, this paper presents insights and opinions derived from the collective effort of over two dozen advisors and staff through five years of on-the-ground support to developers and projects throughout Africa.

We have also refrained from repeating the *raison d'etre* of GET.invest for each segment, i.e. the need to support (some of the, if not most) project developers and companies to prepare for and access funding. Indeed, solicited processes and other forms of standardisation can reduce and, in some cases, avoid this need altogether. But solicited processes are not applicable everywhere, and where they are, the need to support the structuring of investment capital and helping companies attain readiness for investment will persist. In addition, the support by GET.invest and other programmes helps the market to mature, such that new markets, business models and technologies emerge. Such new developments need again support to prepare for and access funding. We, therefore, believe that GET.invest continues to be highly relevant for the foreseeable future in all market segments and models, as well as for emerging topics such as hydrogen, storage, e-mobility etc., always with the objective of a) more deals in the pipeline and b) faster progress towards investment. However, in the interest of brevity, we have not repeated this for each chapter again.

1.2 Private Market Segments

The renewable energy market globally, and in sub-Saharan Africa, is diverse. Private projects and companies take a wide array of structures and approaches to doing business. However, these approaches can generally be organised into five different segments. The analysis presented in this paper uses the following archetypes to define each segment with a chapter dedicated to each one.

Table 1: Market Segments and Definitions

SEGMENT	DEFINITION
 **Independent Power Producers (IPPs)**	A private entity that owns and operates facilities to generate electric power for sale to utilities with no other distribution to other off-takers.[1] These may be purely privately held enterprises, cooperatives (such as rural solar or wind energy producers), or producers of energy through waste/secondary by-product processing (e.g. biomass and waste to energy).
 **Mini-grids**	A small-scale electric network that supplies electricity to a ring-fenced and often remote group of customers. They serve a limited number of consumers through a distribution grid that can operate in isolation from national electricity transmission networks. They can be fully renewable (e.g. solar with battery backup), partially renewable (e.g. solar with diesel backup) or entirely non-renewable (diesel genset).
 **Commercial & Industrial (C&I)**	A power generation facility where all energy is delivered directly to one or more industrial or commercial users for their own energy consumption. They can operate off-grid, or they can serve clients connected to the grid as an alternative (and sometimes cheaper) power source. The energy generation does not feed back to the grid in most cases (even if it substitutes grid consumption for its off-takers).
 **Solar Home Systems (SHS) / Off-grid (OGS)**	A stand-alone, small-scale energy system (typically solar, but sometimes wind or pico-hydro) that offers a cost-effective means of supplying power for lighting and appliances to remote off-grid households and productive users, or as a backup in urban areas. This segment includes companies that build and provide such units to consumers, as well as financing partners.
 **Clean Cooking**	Includes companies that provide cooking devices and non-charcoal fuels that lead to an increase in the environmental sustainability, "cleanliness" and long-term affordability of household cooking, based on one or more of the five indicators used by the Clean Cooking Alliance (thermal efficiency, CO emissions, fine particulates, safety and durability)[2].

1.3 Public Sector Context

The private players engaged in the energy sector are directly influenced, by varying degrees across the segments outlined above, by both regulatory regimes and the state of national utilities. While the focus of this paper is on the private market activity in each segment, there are some key issues at the public-sector level that must be considered in the context of energy sector growth, investment and

[1] Financial Catalyst's support to this segment is limited to those projects which have an installed capacity less than 20MW.

[2] Clean Cooking Alliance. "Voluntary Performance Targets." 2018.

stability. However, it is beyond the scope of this paper and the Finance Catalyst experience to suggest potential solutions for the macro-level challenges outlined in **Annex A** and summarised below:

- Wider economies and potential growth therein actually inhibit potential investment in African energy, with a handful of exceptions.
- Utilities play a central role in power sector investment, and they are often facing financial and technical challenges in executing complex procurement; nearly all utilities require substantial subsidisation and are not creditworthy as off-takers.
- Dynamic political cycles tend to exacerbate uncertainty in the power sector as procurement rules and procedures change with new administrations.

In much of sub-Saharan Africa, the need for grid-connected electricity demand is relatively small compared to other markets in the world, given the size of national economies. By international standards, the demand for power and the increase in demand for power on an absolute basis is limited, at least in the short and medium-term.

There is often the mistaken point made by many climate finance analysts that Africa represents a huge climate finance investment opportunity that exists because of the paucity of electrification. But low levels of electrification do not, in their own right, represent a commercial investment opportunity in the absence of demand AND the ability to pay. This is furthermore complicated by the relatively low potential for carbon revenue for clean electricity access because of benchmark methodologies. Clean cooking may have more opportunity in carbon revenue, however.

At a consumer level, many households do not own appliances that justify, or require a grid-grade electricity supply, nor do they have the ability to pay for it (as well as for the connection cost). It will take many years of well-distributed and sustained economic growth to raise purchasing power to a level where, for many millions of end-users, an electricity connection is an economically justified proposition. Moreover, increasing demand for grid power will almost entirely be driven by urban and peri-urban areas where the grid is relatively robust; this is also where the lion's share of economic activity and growth occurs, but where only a portion (sometimes minority) of the population resides. The shorter-term importance and relevance of grid-based electricity for development objectives differs strongly between centre and periphery, between urban and rural areas.

1.4 Methodology

1.4.1 Segment Approach

The main approach for synthesising each section of this report centred on primary research through internal consultations and input from the Finance Catalyst expert advisor team, composed of senior experts in various aspects of project preparation, financial structuring, and investor engagement across the five segments outlined above. Aside from wide quantitative statistics on segment size and future estimates, most evidence presented herein is primary source, on-the-ground reality for these segments. It is based on the experience in the team from supporting more than approximately 200 projects and reviewing over 800 applications since inception, as well as on the individual prior experience ranging from years to decades on related roles in the sector.

The initial input for each of the segments was provided by one or more advisors with particular exposure and experience, followed by internal review and follow-up consultations where required. This was then bolstered by quantitative research on market size, where available from external sources. Each section was then reviewed and edited by separate experts as well as the management team of the Finance Catalyst. The objective was to deliver a highly condensed analysis that clearly outlines potential solutions to address key barriers and market gaps. Case studies are presented to showcase some of the suggested solutions in practice.

1.4.2 Structure of this Paper

To inform the synthesis presented immediately following this section, each segment is presented as a standalone chapter. Each chapter follows a standard structure, which includes the following sections outlining the market conditions and growth potential over the next decade:

X.1. **General introduction** and key points about the market segment.
X.2. **Market assessment** data and observations on the current market structure, size and trends.
X.3. **Impact assessment** outlining current and future alignment with key SDGs (1, 5, 7, 8 and 13).

We would like to emphasise that the market and impact assessment is necessarily subjective: it is based on the views and experiences of the team of authors and contributors of combined decades of experience in the sector. The aim is to provide a realistic view of the varying impact of the different energy models on the different development objectives and to stimulate critical-constructive thinking as well as further discussion with and among readers.

The paper then presents key gaps identified through the Finance Catalyst's experience across one of three categories—policy, technical capacity and finance. Each challenge is presented in a standard format of description, following by one or more solutions that could be deployed to address the identified gap, in terms of the three following categories:

X.4. **Policy gaps** focusing on policy and regulatory issues where the public and private sectors interact (i.e. excluding the exclusively public-side challenges outlined above).
X.5. **Technical capacity gaps** outlining how technical capacity, for developers, suppliers and the project value chain, are insufficient for the segment.
X.6. **Finance gaps** outlining barriers that inhibit the necessary finance, as currently provided, from flowing into the segment.

The paper then concludes with an overall synthesis, which summarises the SDG relevance of each segment and presents some overall key considerations, which are drawn from the gaps and solutions discussed within each segment.

2 Synthesis

This section presents an overall synthesis of the analysis undertaken in the remainder of the report, drawing on data and information presented in each of the segment chapters. It presents a comparative summary on the potential impact against select SDGs, and in the context of overall estimated market size by 2030. It also presents a synthesis of key opportunities, drawn from the gaps and opportunities discussed in each segment chapter.

2.1 Comparative Impact

Each segment analysed in this paper has relative strengths and weaknesses in terms of its likely impact. This includes financial scale (i.e. potential market size by 2030) as well as alignment with select SDGs highlighted and discussed in each section. **Table 7** on the next page aggregates the data presented previously across all five key segments to give a sector-wide picture of potential impact opportunities.

Generally, all the segments have considerable impact alignment with the SDGs. However, C&I and clean cooking show the strongest alignment across the breadth of selected SDGs for this synthesis. Mini-grids come in a close second, and the three of them also represent the largest investment volumes needed to reach the respective SDGs by 2030.

Table 2: Comparative Relevance to SDGs (among segments, by 2030)[3]

	IPPs	Mini-grids	C&I	SHS/OGS	Cooking
Investment needed until 2030 (USD)	280 bn	93.1 bn	50 bn	6.6-11 bn	44 bn
1 NO POVERTY					
5 GENDER EQUALITY					
7 AFFORDABLE AND CLEAN ENERGY					
8 DECENT WORK AND ECONOMIC GROWTH					
9 INDUSTRY, INNOVATION AND INFRASTRUCTURE					
13 CLIMATE ACTION					

[3] Discussion on each segment's alignment to each SDG, now and in the future, is provided in section X.3 of each segment's chapter. This analysis is based on observations from the GET.invest Finance Catalyst as well as likely trends in each segment.

2.2 Key Opportunities

The table below highlights key opportunities in each segment, as well as overarching opportunities that apply broadly to all or most of the segments. It presents a summary of these key opportunities for each specific segment, and multiple segments, differentiated by near- and long-term time horizons.

Table 3: Near- and Long-term Opportunities[4]

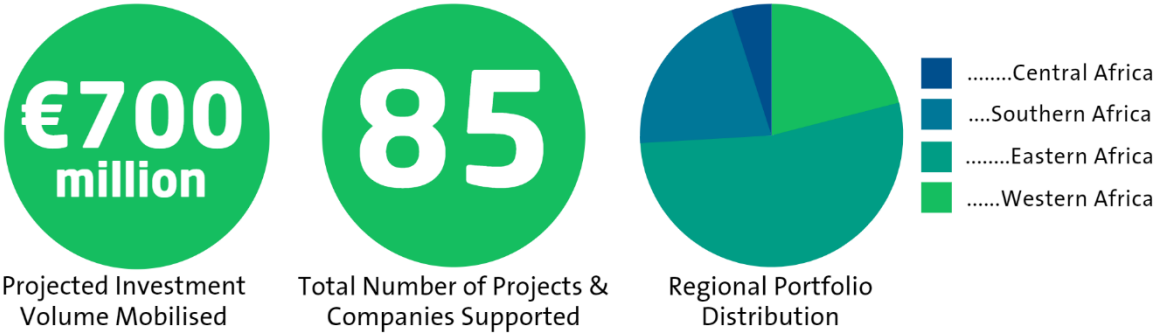
SEGMENT	NEAR-TERM OPPORTUNITIES	LONG-TERM OPPORTUNITIES
IPPs	— Establish or enhance existing IPP procurement processes nationally. — Provide additional capital to risk-seeking development capital platforms that revolve patient capital to developers. — Establish or scale up regulatory help desk. — Scale-up TA to reduce transmission losses.	— Harmonise regulatory standards and licensing for IPPs across SSA. — Structure faster, non-project finance and highly standardised debt auction modalities for smaller projects, with looser covenants than standard PPA language. — Scale-up connection subsidies for rural electrification and new connections — Upskill government on project finance and IPP negotiations.
Mini-grids	— Design smart subsidy schemes that bridge the gap to cost-reflective tariffs without undue market distortion. — Support established developers in acquiring and growing active portfolios through TA and concessional finance. — Deploy guarantees that mitigate targeted, high impact risks.	— Support standardisation of localised technology blends that support a modular approach, along with complementary financing structures that favour modular scale-up. — Standardise all subsidy programmes around a single process and engage financiers in the design and mechanisms to ensure they can be underwritten as project revenue.
C&I	— Develop and expand risk-mitigation/guarantee tools to address key payment and off-taker credit risks. — Develop a standardised private PPA template. — Provide capital to developers so that they can provide supplier finance.	— Roll out financial incentives or guarantees to off-takers that elongate tenors. — Provide TA to regulators, utilities and their stakeholders, in particular for underlying regulatory/licensing processes.

[4] Specific gaps and explanation of how each solution might address identified gaps is presented in sections X.4-X.6 in each of the segment chapters.

SEGMENT	NEAR-TERM OPPORTUNITIES	LONG-TERM OPPORTUNITIES
 SHS/ OGS	— Promote RBF grants (or recoverable grants) for de-risking OGS distributors, especially when they tackle rural and BoP/last-mile markets. — Promote convertible debt and (patient) equity funding especially for early-stage OGS distributors. — Portfolio guarantees and other risk mitigation instruments to leverage (local) currency debt finance for mature OGS companies.	— Encourage governments to maintain lean regulation/permitting while enhancing compliance to recognised OGS quality standards and certification. — Promote specialised debt finance instruments focused on the more mature (and large) securitised SHS PAYGo portfolios. — Support and promote standardisation of efficient electric appliances and productive use equipment to complement OGS offering (i.e. fridges, pumps, mills).
 Cooking	— Promote the wide adoption of quality standards for cookstoves and sustainable fuels. — Finance of RBF subsidy programmes that support distributors of high-efficiency cookstoves and innovative distribution models (i.e. PAYGo), or support end-user voucher subsidy programmes. — Promote convertible debt and (patient) equity funding especially for early-stage OGS distributors.	— Structure equity funding for clean cooking companies ready to scale up operations. — Support creation of innovative carbon + SDG impact finance instruments.

3 Independent Power Producers

Our Traction



3.1 General Introduction

The market for IPPs is relatively well developed in Africa, stemming from around three decades of concerted efforts by donors and investors to bring private capital into the energy sector in Africa through renewable technology deployment. Projects of various sizes, across a wide range of technologies, have been deployed. However, the segment is vastly over serviced in terms of available debt capital. The World Bank estimates the current market size—loosely defined as total annual disbursements—to be around USD 625 million for active investment opportunities in renewable energy IPPs throughout sub-Saharan Africa (SSA, excluding South Africa)[5].

Even at a leverage of 70%, that is a debt to equity ratio of 70%, this amounts to less than USD 450m debt to be provided by all the actors queued up to support these projects, incl. the World Bank, AfDB, European DFIs, commercial banks, and the other specialised debt facilities that are available across the market (including Chinese providers, local pension funds, Japanese Sogo Shoshas, sovereign funds and so on). Accordingly, unless underlying demand drastically increases (which is unlikely beyond slow marginal growth), IPP generation in Sub-Saharan Africa is unlikely to be able to absorb substantial amounts of additional funding in the next 5-10 years. Moreover, the MDBs, commercial banks and other sovereign backed debt providers will not meet their allocation targets in the medium term for debt into SSA renewables.

3.2 Market Assessment

In terms of IPPs selling to utilities, there is often a mismatch between investment in generation capacity, partially driven by donors' country preference, and actual current/projected demand in

[5] The World Bank. "Independent Power Projects in Sub-Saharan Africa." 1 April 2016.

certain countries and regions by way of cross-border trade. For example, in East Africa, "electricity surplus in the region stands at 878MW. The surplus power is projected to hit 3,430MW by 2025."[6] Ghana, in an attempt to address the acute shortfalls it was facing, contracted emergency power producers during the 2014 - 2017 period. However, the demand for electricity never materialised as estimated, due to tariff increases, insufficient increase in distribution infrastructure, and slow economic growth. As a result, there is substantial excess capacity: installed capacity according to the Energy Commission of Ghana is 5,083 MW, almost double the peak demand of 2,700 MW.[7] Of this excess, 2,300 MW has been contracted on a take-or-pay basis, meaning that the government is contractually obliged to spend money for excess capacity that is not being consumed. In contrast, there is unmet demand for additional generation capacity in southern Africa.

IPPs providing grid-based power generation will continue to be a pillar of sustainable power and energy sector development. De-carbonisation of existing assets and reduced reliance on fossil fuels for electricity is a feature of many countries' energy development plans. Most population centres, and especially industrial hubs, are supplied by electricity grids. However, IPPs alone have no direct influence on broadening energy access, as this is largely a function of new grid connections being provided by the utility to previously unserved customers. Since there is little evidence of substantial changes to these exogenous factors (**see 1.3**), it is expected that the slow growth of the IPP pipeline, especially for large-scale projects, will continue into the next decade.

Accordingly, the Finance Catalyst expects that the growth of this market will remain limited unless underlying conditions referred to in the introduction section change dramatically. The complexity of developing IPPs lead to extremely long development periods, and relatively low success rates. This has been and continues to be underestimated by many stakeholders.

The current structure of competitive procurement and long development cycles favours the experienced, large, well-capitalised, mostly international IPP developers who also have better technical resources. This has advantages in terms of scale and potentially low generation costs, but it also contributes to political frictions, misperceptions and reputational risks. National or donor initiatives to promote also less experienced and local developers could expand and diversify the number of developers, but they may come at some detriment to cost and process efficiency.

Absent any major change in overall grid access rates that would accelerate demand for additional installed capacity, the short- and medium-term organic growth of IPP opportunities will be in replacing fossil fuel assets (where national policy seeks to do so), as well as in reducing generation cost. Private, grid-connected storage, depending on cost and availability, may also be an area where growth is seen

[10] Muchira, Njiraini. "EA States Stuck with Excess Power after Building Billion-dollar Plants." The EastAfrican. 1 April 2019.
[7] Samuel Asumadu Sarkodie. "Lessons to be learnt from Ghana's excess electricity shambles." The Conversation. 5 August 2019.

for IPP-type procurement in the future. Another growth factor could, in the medium term, be e-mobility. This will require strategic orientation by national governments to be focused on energy transition, in line with the work being undertaken and the international level to ensure a “just transition” to cleaner energy.

These trends are further compounded by the rapidly dropping cost of self-generation and consumption, with or without storage, at the level of both industrial as well as private energy customers (see chapter 4). These aspects need to be taken into stronger consideration in realistic scenarios and planning for the development of this segment.

3.3 Impact Assessment

IPPs generally have relevance to SDGs that relate to economic growth, industrialisation and the deployment of sustainable, climate-friendly energy. However, their impact is largely hinged on the grid and the utility that manages it, as the IPPs themselves have little interface with the end-users of the electricity they produce. The underlying notion that modern energy is a precursor to economic growth and competitiveness means that IPP and private generation is highly relevant to some of the SDGs. The table on the next page presents the current and future relevance of IPPs to each of the six key SDGs, along with a brief commentary justifying each relevance grade.

Table 4: SDG Relevance of the IPP Segment

SDG	CURRENT RELEVANCE	FUTURE RELEVANCE	COMMENTARY
			**PRO:** Energy is a critical precursor to economic growth, and IPPs can provide substantial energy to the grid at scale. CON: Poverty impact entirely relies on grid expansion and tariff subsidisation, over which IPPs themselves have little direct control; benefit of IPPs (and cheaper power) is limited to grid-connected end users which may leave currently unserved populations further behind in economic development terms (target 1.4).
			**PRO:** IPP-generated electricity may support access to modern reproductive health services as well as other social services (target 5.6). **CON:** There is little other relevance to gender equality from IPPs.
			**PRO:** IPPs make a major contribution to increasing the percentage of renewables in installed capacity (target 2.7). IPPs generally deliver lower-cost energy than if managed and owned entirely by the utility due to the competitive market pricing and detailed contractual requirements. **CON:** While there are RE capacity impacts, IPPs have little direct influence on increasing access, as they are focused on generation and are not necessarily matched by equivalent connections.
			**PRO:** IPPs contribute directly to a more sustainable approach to economic development vis-à-vis fossil-based alternatives; this can, in turn, contribute to employment growth in grid-connected areas during construction. **CON**: Renewable IPPs often have a lower requirement for labour across the supply chain during operations (feedstock and O&M) when compared to fossil fuel alternatives or more decentralised approaches.
			**PRO:** IPPs directly enable sustainable and more resilient infrastructure, and more sustainable industrialisation through drastically reduced emissions at an industrial scale; pilot technology IPPs contribute to the commercialisation of these new technologies globally and through increased installed capacity, an ultimate and sometimes dramatic lowering of costs.
			**PRO:** Renewable Energy IPPs support the implementation of the UNFCCC through mitigation of energy sector emissions and enable leapfrogging of technology

3.4 Policy Gaps

Challenge: regulatory transparency and standardisation

IPP projects operate in a complex regulatory landscape. Land lease and generation licenses are often difficult and expensive to procure. Environmental and social impact assessment and planning can be cumbersome, especially given the disparity of regulatory standards between countries. Because the nature of project development in the IPP segment is risky, developing in a single country is not a feasible business approach; thus, navigating multiple, disparate regulatory environments with the added complexity of most financing coming from MDBs and DFIs makes financing a very cumbersome process.

- **Solution**: standardise (within a given country) procurement practices in the context of a central management/solicited approach, ideally through a dedicated office with all relevant modalities and capacities.

Challenge: responsibility, timing, and cost for grid connection

Regulation in many countries does not specify clearly enough the obligations of the IPP and the grid owner (utility) as to the costs, timing and ownership of the grid assets. Grid connection studies, agreement of entry point, the share of costs, and transfer of assets beyond the grid entry point (if funded by the IPP) are often delaying and complicating factors in finalising IPP projects. Often, the competency for rapid grid connection costings and assessment is also not available within the utility or is hampered by the finalisation of other grid investment plans.

- **Solution**: structure a TA facility to assist utilities in meeting their obligations to provide timely and high-quality grid connection information and costings to potential IPPs.

3.5 Technical Capacity Gaps

Challenge: legal and financial complexity occasioned by project finance structures

The requirements for full project finance (debt) compliant structuring are delaying projects considerably. From the land lease agreement to the PPA to inter-creditor loan agreements, thousands of pages need to be reviewed by multiple legal teams. As a result, the average developer can't keep sufficient legal knowledge in-house and instead must secure external legal advisory at a substantial cost.

Legal complexity is partially derived from financial engineering complexity. Many of the lenders insist on complex drafting of certain clauses which reduce the perceived risks upon project or counterpart failure, with the belief that these provide actual protection. In reality, the very few deals where default scenarios have become a threat have been settled without going to court. It might be argued that this is partly a result of the strength of the legal agreements. However, these clauses generate immense financial engineering and also legal complexity and thus drive up overall development cost and generate time delays.

- **Solution 1**: standardise legal structures and agreements embedded into procurement processes.
- **Solution 2**: provide an all-equity funding solution vehicle attached to a post-operational debt refinancing vehicle; this would accelerate initial construction financing and reduce the cost of financing by embedding refinancing at a lower cost of capital at an early stage in the operations of the IPP.

Challenge: long development timeframes, high risk/cost of failure

IPP project development, even after signing a PPA (which can take a considerable amount of time on its own) takes very long. The average time from signing a PPA to operation is approximately 4 years, a process which prior to the signing of the PPA also takes a significant number of years. With a secured PPA, much of the early development risks have already been mitigated. However, further investment by the developer at this stage is expensive, as it relies considerably on external advisory and technical services to validate against lender and regulatory requirements. The risk of project failure is lower than pre-PPA development, but the cost of failure is much higher.

The unfortunate reality is that most IPP projects fail. The vast majority of IPP projects that get initiated do not get completed at all, at great cost to all stakeholders, even after a PPA is secured. In many cases, this includes solicited processes. A considerable factor is the relatively higher expense of development at this stage for IPPs, and an unwillingness on the part of equity investors to develop the project further.

- **Solution 1:** see aforementioned solicited processes
- **Solution 2**: increase allocations to development stage at-risk project funding modalities.

Challenge: variations between RE technologies

There are considerable technical differences between renewable technologies. Solar PV is generally the fastest and least cumbersome, in part because of standardisation and ease of resource verification through meteorological and satellite data. Developing wind energy, however, takes considerably more time, given that wind is very location specific and the logistics of moving wind turbines into place can involve significant road infrastructure development. Geothermal is also highly location-specific; while demonstrating feasibility of a well head relies on shorter-term measurements, the investment required to drill test wells to even examine technical feasibility is very expensive. In geothermal for example, up to 50% of the total project cost can be incurred before construction.

A universal approach to supporting all technologies is therefore not helpful. Widely supporting RE across multiple technologies requires flexibility and the ability to adapt to each technology, as well as expertise in that underlying technology to provide meaningful support.

- **Solution 1**: establish a technology-specific solicitation mechanisms
- **Solution 2:** technology-differentiated risk-sharing mechanism to (partially) reimburse developers if post-PPA development investments do not yield a final project.

Challenge: efficiency, scale and domestic energy industry

The most cost-efficient IPP projects tend to be realised by large international project developers. Limited recourse project finance, especially through a competitive process, is a structure that heavily favours large corporates because of upfront development costs, performance guarantees required and the reliance on substantial balance sheets as a demonstration of capability.

Competitive procurement leads to the lowest end-user cost in IPP strategies. Again, large international developers will dominate these competitive procurement processes, due to knowledge, development funding, equity available and investor relationships.

Without substantial infusions of relatively cheap capital into local developers, as well as complementary TA, it is unlikely that policy interventions alone can change this reality. Looking forward, it is quite likely that the IPP market share held by large international companies continues to grow, while small, non-niche developers are edged out of the market. The tension between least-cost solutions and local development impacts is unlikely to be resolved. At the same time, there are considerable political pressures to ensure that the benefits from energy sector development and investment are not solely focused on non-domestic actors.

A shift in national policy towards a preference for local developers could expand and diversify the number of developers, but that may come at a detriment to cost efficiency and development time. This has to be carefully balanced with the tariff and timing expectations of the procuring government. Local developers cannot compete on a like for like basis with better capitalised and experienced international developers, and in cases where they do (such as has happened in South Africa), they often sell a portion of their equity to a larger developer prior to final bidding in order not to lose their development assets.

There are two areas where this might be addressed to promote local ownership and the creation of local developer expertise:

— **Solution**: procure small scale (under 5MW, for example) grid-connected IPPs in a separate and different window with complementary technical assistance. These will generally not attract the larger international players due to economies of scale not being realised and can provide an opportunity in a competitive procurement of more locally based national developers to participate. Streamlined and scale-appropriate tender processes should be considered.

3.6 Finance Gaps

Challenge: financiers (inherent) preference for large scale projects

IPPs tend to rely on project finance structures, as outlined above, for structuring the financing to build a new generation project. This has relatively high transaction costs versus other less complex (but rarely used in IPP context) financing structures, and it is not just the developers who face these high costs. Financiers also face relatively high transaction costs in appraising and managing project finance transactions. This creates a disincentive to undertake relatively small projects and instead puts the focus on maximum project size to achieve "economies of scale". This is true for both commercial investors and DFIs/MDBs.

- **Solution 1**: structure faster, non-project finance and highly standardised debt auction modalities for smaller projects, with looser covenants than standard PPA language.
- **Solution 2**: establish (or enhance) funding to existing developers to enable all-equity small IPP construction, ideally with a debt refinancing mechanism to reduce the cost of capital after commercialisation.

Challenge: paucity of development capital outside of balance sheets

Part of the financier preference for large scale projects derives from the fact that these projects are undertaken by better-capitalised companies that focus on economies of scale realised through more capital-intensive projects. Even at the large end of the spectrum, both endogenous and exogenous project development risks are many (and are compounded by the many challenges outlined above). Consequently, these companies largely self-finance project development since there are few other co-investors keen to take project development risk, except in the case of relatively large photovoltaic IPP projects (which are as close to standardised as we see in Africa).

Availability of development capital is even scarcer for smaller and niche projects. While it would not directly address regulatory issues, increased access to development capital would help to absorb some, but hardly all, of the development risk faced by IPP developers of all sizes. Many institutions have rolled out development capital through specialised funds and development platforms, but most of these structures still operate on commercial or near-commercial terms from the project developer's perspective—first loss or subordinate tranches help to catalyse more investment into the fund, but the terms of investment offered to investee projects are rarely impacted by the presence of a concessional investor.

- **Solution 1**: provide additional capital to risk-seeking development capital platforms that revolve patient capital to developers (particularly in less proven technologies or higher risk countries); examples include REPP, SEFA, InfraCo, DI Frontier, Climate Investor One, NAMA Facility **(see box 1)**.
- **Solution 2**: provide ringfenced or standalone funds to equity investors specifically for high risk, relatively low or zero return co-development for new technologies (globally unproven or first time in a given country) **(see box 2)**.

BOX 1. Case Study

OnePower

In 2017, OnePower was selected as the Preferred Bidder to build Lesotho's first utility-scale solar project, a 20MW PV facility in Mafeteng District called NEO 1. NEO 1 has received broad international support. Two key partners are the Sustainable Energy Fund for Africa (SEFA), a US $95-million multi-donor facility funded by the governments of Denmark, the United Kingdom, the United States and Italy and hosted by the Renewable Energy Department of the African Development Bank (AfDB); and the U.S. Trade and Development Agency (USTDA). The GET.invest Finance Catalyst helped OnePower to engage with SEFA and become one of its grantees.

SEFA and USTDA provided OnePower with grant funding for technical studies, legal assistance and environmental impact assessments, among other support. The SEFA and USTDA grants therefore significantly de-risked the project in its early stages and helped lower risk perception to potential partners and investors. Furthermore, these grants ultimately resulted in reduced tariff costs for the project and the local utility.

As OnePower is partnering with experienced equity players such as Scatec, a leading international developer of utility-scale projects, and Norfund, Norway's Development Finance Institution, as well as the Lesotho Government Pension Fund, its role as a small, local company would have been minor without grant funding. OnePower's ability to attract grant support for this project therefore helped secure its role in the development team and its position in the equity structure.

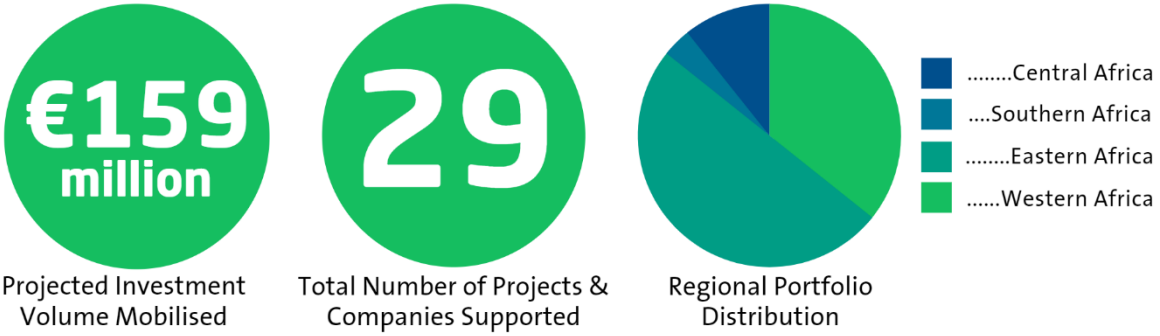
BOX 2. Case Study

SONGA Energy

In a joint venture with Virunga Power, SONGA is developing two run-of-river hydropower sites in south-central Burundi – a 1.65 MW plant on the Ruvyironza River and a 9 MW plant on the Mulembwe River. These projects will be some of the first private hydro installations in Burundi, with all electricity to be sold to the national utility, REGIDESO. SONGA Energy is also exploring the viability of local hydro-connected mini-grids and solar PV hybridisation and may consider some aspect of implementation of those components in the future. The feasibility studies and environmental impact studies for both projects were financed by a SEFA grant, which the GET.invest Finance Catalyst team helped SONGA secure. SONGA is the first to utilise SEFA funds for this kind of installation in Burundi. As one of the only development grant providers in the early stage IPP space, SEFA plays a catalytic role in development processes like SONGA's and OnePower's. We see a clear need for more grant providers of this kind.

4 Mini-grids

Our Traction



4.1 General Introduction

Generally, mini-grids are the next best alternative to grid connections in terms of power quality and quantity. They allow for the expansion of electricity access without expanding the main grid and can provide the same or better end-user experience in terms of voltage, continuity and reliability. As a business model, mini-grids rely on an overall operating structure that mirrors, albeit on a smaller scale, the IPP-utility-distributor model of both a private generation asset and a national utility. They can be better able to serve “productive uses” for power because they have a flexible power capacity to run standard AC appliances with an up-time sufficient to undertake value-added work and increase overall labour and capital efficiency for users (compared to solar home systems and other off-grid models).

4.2 Market Assessment

One trend we support is that many mini-grid developers are starting to take a portfolio-based approach to achieve scale and address the key operating risks of managing individual assets (each mini-grid being its own asset). Some mergers and acquisitions have led to consolidation, enabling potentially easier access to capital for some developers.

Driven by the desire to reduce the number of people without energy access in Africa, multiple funds and fund-like vehicles have been established, most at least partially funded by public or policy-mandated institutions (DFIs, philanthropies, MDBs, national investment agencies, etc.). Within these dedicated setups, we encourage a broader rethink of several of the aspects of remote/rural electrification projects and a rethink of the support systems currently being used.

However, our experience with developers confirms that there is yet to be a commercially viable mini-grid that does not require capital and operating grant support. Achieving scale through a single owner operating multiple grids (typically across a single country, but sometimes across multiple) marginally improves the need for subsidies, but developers still do not operate profitably without substantial grant support. This is in part because the mini-grid is a triple function business – they generate power (and manage backup generation and/or storage to ensure uptime), serve as the transmission manager and undertake all roles of a utility from rolling out new connections to billing clients. A major contributing factor is the poverty within the market being served.

The Africa Mini-grid Developer's Association (AMDA)[8] estimates the current market size is at around USD 7.5-8 million among its members, spanning 288 sites owned by its 28 developer members. However, given the over 500 million people currently unserved by modern electricity in Africa, there is substantial growth potential for this segment through 2030. SEforALL and BloombergNEF forecast investment need for African mini-grids at around USD 93.1 billion for the coming decade[9].

4.3 Impact Assessment

Because of their fundamental focus on providing access to electricity where it is currently unavailable, mini-grids are highly relevant to many of the SDGs. This is particularly true given that electricity is a critical precursor to economic empowerment and economic growth from both a livelihood and a competitiveness perspective. **Table 3** on the next page visualises the SDG relevance of the mini-grid segment.

[8] African Minigrid Developers Association. "Benchmarking Africa's Minigrids." 13 August 2020.
[9] Mini-Grids Partnerships, BloombergNEF & SEforALL. "State of the Global Mini-grids Market Report 2020." 1 July 2020.

Table 5: SDG Relevance of the Mini-grid Segment

SDG	CURRENT RELEVANCE	FUTURE RELEVANCE	COMMENTARY
			**PRO:** Energy is a critical precursor to economic growth – mini-grids provide access that is otherwise unavailable, incl for productive use and job creation. CON: Cost-reflective pricing is not feasible and, if charged might be considered usurious against average client household income level
			**PRO:** economic empowerment and income generation also available to female entrepreneurs, benefits of household electrification incl. for education
			**PRO:** mini-grids are likely to play an important role for energy access, esp. in areas that are uneconomical to electrify with the main grid; mini-grids have RE components (typically solar PV)
			**PRO:** Mini-grids enable decentralised economic productivity and localisation of value-added processing for some goods, either at industrial or household scale; they also contribute to employment enhancing household efficiency and enabling more options for income-generating activity at the household level.
			**PRO:** Mini-grids contribute to sustainable infrastructure development beyond the grid, increasing sustainable industrialisation especially outside of urban centres while increasing health and safety at the workplace when switching from traditional processes to electrified ones. CON: Mini-grids have an upward limit on efficiently supporting industrialisation, as capacity is relatively limited and distribution efficiency is constrained by voltage
			**PRO:** Mini-grids strengthen national resilience (through reliance on local resources) and adaptive capacity to climate change; they also support the implementation of the UNFCCC through mitigation of energy sector emissions CON: As long as diesel generation is the cheapest backup, mini-grids may be “dirtier” than other options; this will likely change as storage feasibility increases

4.4 Policy Gaps

Challenge: IPP-inherited regulatory treatment

While IPPs face their own challenges related to regulatory support and consistency, mini-grids have inherited much of the patchwork regulatory approach to IPPs as it relates to how they operate, and not entirely in a uniform manner even within countries. Specifically, many mini-grid operators are forced to register and comply with regulations applicable to their much larger IPP cousins. This adds substantial additional compliance and legal costs, typically to third parties, which further inflate underlying start-up (and sometimes operating) costs for mini-grids.

- **Solution 1**: support regulatory reform for tailored compliance and licensing requirements for mini-grids that is standardised and relatively affordable.
- **Solution 2**: deploy cost-sharing mechanisms (either through grants or in-kind support) to navigate licensing where reforms are not possible.

Challenge: cost-reflective tariff discussion

Many countries allow mini-grid operators to charge cost-reflective tariffs from a regulatory standpoint, but this makes prices in many cases not affordable to the households and businesses most mini-grid operators are trying to serve. Reliance on de-regulating end-user tariffs has little impact on enabling feasible projects unless it is coupled with access to subsidies. Generally, it is preferable to focus policy reform on reducing regulatory and licensing requirements imposed on mini-grids (per above) than to de-regulate price caps for end-user tariffs.

Most utilities in Africa benefit from some level of subsidy from the national budget. Though mini-grids are largely functioning as an extension beyond the existing grid (as an alternative to utilities adding more grid infrastructure), they are generally unable to access the operating subsidies that enable utilities to function. As noted previously, only two public utilities in sub-Saharan Africa are fully recovering operational and capital costs—the rest are benefiting from some level of subsidisation to make ends meet. Mini-grids typically operate with lower losses and better collection rates from end-users, but they still require subsidisation. Unfortunately, barriers to accessing national subsidies persist.

- **Solution**: based on least-cost rural electrification planning, design smart subsidy schemes that bridge the gap to cost-reflective tariffs without undue market distortion.

4.5 Technical Capacity Gaps

Challenge: operations and maintenance challenges

Localising expertise to ensure efficient operations and maintenance (O&M) is a major technical challenge facing most operators. By definition, mini-grids tend to operate in areas on the periphery of cities or beyond into rural areas, which are more challenging to access. Ensuring local on-call support and the expertise to ensure high-quality service remains a key challenge for operators. Even as they are able to build a portfolio of mini-grid assets, these companies typically need to manage O&M on a very localised basis.

- **Solution**: support local training and capacity building to ensure that a reliable and technically proficient O&M workforce is available.

Challenge: ensuring efficiency across multiple grids and eventual integration

As companies build portfolios of mini-grid assets and further consolidate/scale their operations, the question of how to best achieve efficiency is warranted. Depending on demographics and geography, it may be feasible to eventually consolidate disparate assets into a larger network. Similarly, eventual grid extension may be able to supplant the need for a mini-grid to generate its own power, converting it into strictly a distribution system.

- **Solution**: provide tailored analytical support to portfolio-oriented operators to examine potential technical/cost efficiencies from consolidating assets **(see box 3)**.

Challenge: technological complexity

Mini-grids typically utilise blended technology, relying on some combination of renewable, non-renewable and storage components to achieve adequate installed capacity and uptime. The blend of technology is typically less modular than a single technology, and thus requires over-designing systems with higher up-front capital costs and more complex maintenance requirements. In addition to this complexity, mini-grids are functioning as the utility and must build sufficient IT and/or mobile money infrastructure to ensure collections. All this must be serviced, from an operational cost perspective, principally by households that are relatively low consumption (2-20 kWh per month), as well as ideally anchor/productive clients. This is compounded by the need to provide reliable backup power when a renewable resource may only be intermittently available, either through diesel generators or more expensive storage alternatives.

- **Solution**: support standardisation of localised technology blends that support a modular approach, along with complementary financing structures that favour modular scale-up.

Challenge: disaggregation and fragmentation of asset operation

Mini-grids are, by definition, spread across areas that are geographically isolated. They are also operating on their own "islands," since it is more economically feasible to operate them separately than build out interconnection infrastructure among them. Developers and operators are discovering the advantage of taking a portfolio-based approach, not least because of risk mitigation compared to

operating a single or very few grids. However, the ability of operators to aggregate mini-grid portfolios largely depends on their access to suitable corporate finance and equity.

- **Solution**: support established developers in acquiring and growing active portfolios through TA, as well as corporate loans and/or equity, with more focus on blended/concessional finance.

Challenge: specifications and design around "productive use" anchor clients

One thematic approach often favoured by donors is around anchor "productive use" clients. Once the mini-grid is in existence, an application for grant support for a specific productive use business model can be made and often is successful. Water pumping, agricultural processing and refrigeration are most often identified as anchor uses. In practice, these projects are entirely bespeaking around the needs of the anchor client (including at times configuration of the product use appliances). It would be preferable if productive use support could be weaved into the mini-grid application upfront, as the existing anchor client is most likely already using a form of continual electricity provision (diesel generators).

- **Solution 1**: provide tailored TA and/or financial support to offset the design and/or construction cost of productive use assets as part of a larger mini-grid financing package.
- **Solution 2**: support pilot studies and -projects of various productive use applications to identify generic elements that can become an integral part of every village mini-grid for example community refrigerators, milk chilling equipment, electric mills, internet services, and others.

4.6 Finance Gaps

Challenge: multi-business risk exposure

Due to their structural nature as generation, distribution and collection businesses, mini-grids face a multitude of risks that are often only partially borne by a commercial entity or with sovereign backstopping in the case of a public entity. Due to the breadth of commercial and non-commercial risks, access to finance for mini-grid developers is limited to those financiers with above-average risk tolerance. This also contributes to their reliance on grants and subsidies to offset the relatively high cost of debt. This even causes the equity cost of capital to be too high for all but the most impact-minded investor (or policy-driven, as is the case with DFIs). Yet, despite these risks, finance providers insist on using costly risk mitigation strategies copied from the IPP world. While the same entity often builds, maintains and operates the mini-grid asset and collects revenues from customers, the financiers insist on disaggregating the risks by using EPC and O&M contracts, complex capital structures and results-based grants.

- **Solution 1**: deploy guarantees that mitigate targeted, high impact risks to dissuade financiers from using limited recourse finance risk mitigation measures **(see box 4)**.

— **Solution 2**: support the establishment of a mini-grid asset company[10] that buys existing assets from or jointly develops new assets with multiple mini-grids and pays developers to operate through O&M contracts, with suitable risks allocated to each party (potentially underpinned by performance guarantees to scale up access to third-party finance).

Challenge: fragmented subsidy availability

Mini-grid developers and operators are well aware of the variety of special results-based and other subsidy programmes operating across sub-Saharan Africa. So much so that the timing and announcement of a grant programme will drive mini-grid expansion. However, the lack of coordination between these facilities makes successfully securing them challenging for the developers. Financiers know this, resulting in particularly results-based subsidies not being underwritten by lenders as a reliable source of revenue. Standardisation, simplification and coordination with lenders for external subsidy programmes are essential to making a meaningful impact on the subsidies' effectiveness in improving access to more capital for developers and operators.

— **Solution 1**: standardise all subsidy programmes around a single or a small number of processes, and engage financiers in the design and mechanisms to ensure they can be underwritten as project revenue.
— **Solution 2**: design or enhance support to a mixed subsidy scheme to provide structured investment grants, results-based grants and/or equity convertible grants as mini-grid developers mature.

BOX 3. Case Study

KUDURA POWER EAST AFRICA LTD.

KUDURA, which means "the power to change" in Swahili, is one of the larger green mini-grid operations in Kenya and has been operating since 2011. They mix energy access with productive use and deploy a Patented containerised dual-purpose water and energy provision system with their mini-grids. Under the umbrella of holding company RVE.SOL (an investor/developer), KUDURA represents a portfolio-based approach driven by the pursuit of larger scale. This scale is being pursued under the notion that a larger portfolio of individual mini-grids is more economical and closer to commercial viability than a single mini-grid or small portfolio. Centralised functions like maintenance, finance, billing, etc. are shared across the portfolio of mini-grids, including KUDURA and other acquired mini-grids/portfolios across countries. This enables better portfolio performance information and diversifies underlying risk. Subject to securing the right blend of finance and access to key subsidies/RBFs, this "mergers and acquisitions" approach to reaching scale is showing substantial progress towards the commercial success of mini-grid operations without foregoing the critical development impacts of rural electrification and last-mile access. The GET.invest Finance Catalyst helped KUDURA identify financiers and provided knowledge of potential site counties.

[10] CrossBoundary Energy is currently piloting this approach, and it could be a good partner to consider for this solution.

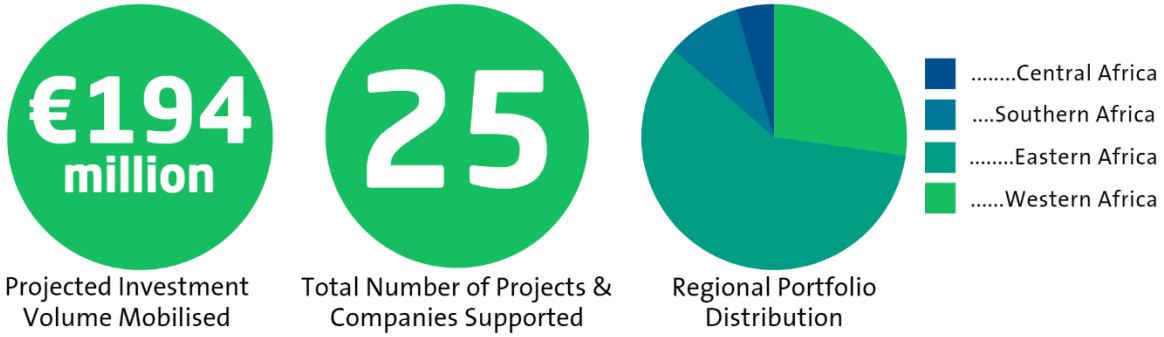
BOX 4. Case Study

SustainSolar

SustainSolar builds and sells containerised solar generating units for use primarily by mini-grid operators. Their units serve as a cost-competitive alternative to bespoke construction of panels, inverters and batteries. To further enhance the appeal of their units, SustainSolar is setting up an Asset Company (AssetCo) that will provide containerised units to mini-grid operators on a lease-to-own basis rather than a straight purchase. This will allow the cost of construction to be ploughed into operating expenses and paid over time instead of as an upfront capital cost. To adequately fund the AssetCo, the GET.invest Finance Catalyst is supporting SustainSolar in identifying and engaging with key investors and guarantee/insurance providers to provide a sufficient capital base and mitigate key underlying credit and operating risks of the model. Few guarantee providers are able to accommodate such a niche structure for the mini-grid market, and additional guarantors could help enhance the sophistication of this nascent market instrument.

5 Commercial & Industrial (C&I)

Our Traction



5.1 General Introduction

C&I projects are a steadily growing segment that is seeing new entrants from both downscaling utility-scale developers and upscaling EPCs. The entry by utility-scale developers is largely reflective of the saturation of the IPP market and other challenges, as documented in the IPP chapter above. C&I projects are business-to-business transactions and thus are not characterised by the challenges facing IPPs when dealing with utilities as off-takers.

Because of their relative efficiency in the regulatory process, and because they are typically installed for creditworthy off-takers and clients, C&I projects are the most viable and most commercial segment of those analysed in this document. Growth is slightly constrained by the capacity and availability of technical skills, but developers and clients are adapting, particularly as technologies like solar and storage are becoming more standardised.

5.2 Market Assessment

The C&I market has massive growth potential. Bloomberg estimated in 2019 that the current market is around USD 41.2 million,[11] and it would be reasonable to expect market growth over the next ten years to reach at least USD 50 billion. As the segment matures, developers will move into (or expand on existing inroads in) suburban retail power provision, incl. to residential users. A substantial portion of the current market is composed of international project developers serving large-scale industrial clients with MW-size projects, while smaller domestically rooted developers are installing smaller kW-scale projects.

[11] BloombergNEF, responsibility & Global Climate Partnership Fund. "Solar for Businesses in Sub-Saharan Africa." 24 January 2019.

However, especially as large and medium scale businesses turn to C&I as a way to ensure power availability and stability, the segment will directly compete with state-owned utilities for clients. These trends will likely incite a political response to the segment, which may impact its ability to grow. This is especially true as regulatory standards are applied to various sizes of C&I projects.

Tax implications for the end-user business also play a key role in the realisation of growth, as currently, energy-intensive companies are typically not interested in C&I because of tax considerations. From a typical accounting perspective, a power source held outside a company's own balance sheet (i.e. in an SPV) that enters into a long-term dedicated sales arrangement with the company is considered at a minimum a contingent liability for the company and at worst a lease arrangement, creating substantial balance sheet liabilities. So, producing your own power, however constructed, reduces the customers' ability to invest money in their core business. This is less of a barrier for SMEs, or shopping centres, but a big hurdle for energy-intensive users (like mines or heavy manufacturing).

However, it is important to appreciate the market pressure generated by continuously falling (in particular solar) generation as well as storage costs. Rarely is a successful African company only attached to the grid. Most have diesel generators to ensure that they always have power. Diesel is expensive, but diesel is an expense and can be claimed as such. The C&I hurdle to overcome is to replace a seemingly short-term expense, whose impact is on the P&L with a long-term obligation impacting the balance sheet. Any positive changes in the tax treatment of "own generation" would immediately lead to sector growth.

5.3 Impact Assessment

C&I is most common as a substitute or alternative to grid power. While it is certainly enhancing the quality and sustainability of power (vs. diesel genset backups), affordability largely depends on the technology and regulatory requirements. It is also the segment that is closely aligned with the notion of "productive use," where a project is expressly constructed to serve an economic or income-generating activity such as industrial processing, agricultural processing, refrigeration or pumping/irrigation. These projects, if properly structured, can have a profound impact on localised economic development and competitiveness.

Table 6: SDG Relevance of the C&I Segment

SDG	CURRENT RELEVANCE	FUTURE RELEVANCE	COMMENTARY
			**PRO:** C&I tied to productive uses can drastically enhance economic development at a very local level, provided it is tied to substantial training and maintenance. C&I can also increase local resilience to some disasters by decentralising power production.
			**PRO:** Clinic-level C&I can expand access and reduce costs for modern reproductive health services. CON: Gender impact of C&I depends almost entirely on the business function of the off-taker, and the developer has almost no influence on gender outcomes.
			**PRO:** C&I is very likely to replace diesel gensets and/or mixed grid energy with fully renewable energy over time given the high irradiation levels in Africa. Large scale C&I projects (in the mining and manufacturing sectors) that incorporate community electrification may escape Section 16 IFRS treatment and augment energy access numbers. CON: C&I is most likely to be rolled out, even as the segment grows, in already grid-connected areas, so it may not meaningfully contribute to addressing the access gap.
			**PRO:** C&I directly contributes to economic diversification and upgraded capacity for economic activity, which also contributes to stable employment even in urban and peri-urban contexts. C&I also plays a big role in sustainable eco-tourism, as it's the most sustainable way to power off-grid and remote lodges, hotels, etc. (Target 8.9)
			**PRO:** Especially in productive use contexts, C&I directly increases the sustainability of industrialisation and contributes to increased resiliency through decentralising power generation. CON: Wide-spread adoption of C&I robs the already insolvent utilities of their most lucrative customers and further reduces their ability to fulfil the ascribed mandate.
			**PRO:** C&I strengthens national resilience (through reliance on local resources) and adaptive capacity to climate change. Wherever diesel or fossil-based grid power is replaced, it also contributes to climate change mitigation.

5.4 Policy Gaps

Challenge: cooperating and interfacing with utilities

In more mature markets, C&I projects do not require direct physical proximity to a client. Rather, a grid-connected client can purchase captive power from a relatively distant producer via the grid, known as wheeling, where the utility serves as basically an intermediary "toll road" for a private power purchase. Though common in mature markets, wheeling is either non-existent or very challenging from a licensing perspective where it is available in GET.invest' countries of operations. Another regulatory tool particularly suitable for C&I is net-metering (where surplus power can be transferred onto the grid for payment by the utility to the producer), or similar arrangements that allow for C&I generators to interact with the grid and operator to make use of excess generation. However, net-metering as a formal policy only exists in a small handful of African, Caribbean and Pacific countries. Viable solutions will need to also reflect valid utility interests and concerns.

- **Solution 1**: provide TA to regulators, utilities and their stakeholders, in particular for underlying regulatory/licensing processes, to enable wide-spread wheeling agreements as well as supporting a net-metering policy.
- **Solution 2**: develop a standardised private PPA template with wheeling terms embedded.

Challenge: withholding tax on dividends and interest

These taxes create a major disincentive to domestic investment in many African countries. For example, they stand at 20% in Zambia and 10% in Lesotho. While not specific to C&I, they have a direct negative impact on the availability of hard currency for local investment. Mining companies, for example, tend to process elsewhere to sidestep this tax as unrefined ore is relatively low value; the same offshoring of value addition is not possible for C&I. This is also a significant issue for IPPs and mini-grids.

- **Solution 1**: advocate for non-application of tax for renewable C&I projects nationally and across the continent.
- **Solution 2**: support restructuring of developers with tax optimised holding structures (**see below**).

5.5 Technical Capacity Gaps

Challenge: contracting variation

Each project is highly tailored and specific, particularly when considering larger projects. These are also centred on a private PPA between the developer and the off-taker, and occasionally have provision of energy to the immediate vicinity (especially in peri-urban and rural contexts). In all cases, developers have to be quite adept in how to negotiate and structure these agreements to ensure that risks are adequately managed. One key constraint is the duration of these private PPAs: they are often relatively short-term because the off-taker believes that the grid will eventually be cheaper, available

(for off-grid contexts) or sufficiently stable. This compounds uncertainty and has implications on finance availability.

- **Solution 1**: develop and expand risk-mitigation/guarantee tools to address key payment and off-taker credit risks.
- **Solution 2**: enhance capacity (through training) of medium and small C&I developers on contract negotiation and PPA terms.

Challenge: efficient corporate structures for developers

Increasing competitiveness of renewable C&I against fossil fuels will require not only falling technology costs for renewable generation and storage versus diesel (which is already happening), but also some innovation on the part of the companies providing C&I solutions at scale. Already, some companies have shifted to a segmented structure where a holding company manages two subsidiaries that independently develop/install and then long-term manage C&I assets on behalf of clients. Furthermore, decreasing the capital intensiveness of C&I can be achieved through various forms of supplier/balance sheet financing and/or leasing structures offered by the developers. Generally, the market should be nurtured toward maturity through more nuanced business structures now that some lessons can be learned, and growth potential can be more readily quantified by each company.

- **Solution 1**: support conversion of proven developers to holding company structures to optimise capital and business structure **(see box 5)**.
- **Solution 2**: provide capital direct to C&I developers so that they can provide supplier finance to potential customers as an alternative to third-party finance **(see box 6)**.

5.6 Finance Gaps

Challenge: limited to clients with strong balance sheets

Established companies with strong balance sheets are the primary clients for C&I developers. This is for two reasons: they have relatively stable and well-documented power usage/expenses, and they are more reliable as paying clients for a captive power system. With declining technology costs and competition within the C&I segment, these companies are benefitting from substantially lower power costs before the application of taxes (**see above**). However, this results in two main issues. First, C&I's growth is limited to a relatively small client pool in most countries if strong balance sheets are the main criteria. Second, utilities will lose at least part, if not all, of the revenue they generate from their largest and best clients as C&I scales up.

- **Solution 1**: deploy off-taker guarantees designed to enable C&I developers to engage clients with less dependency on balance sheet record.
- **Solution 2**: advocate and build out wheeling (technical) and net-metering capacity as a way for utilities to retain some revenue from distributing C&I power.

Challenge: PPA and financing tenor mismatch

Most C&I customers retain the belief that grid power will become cheaper and more reliable over time, or, if they are off-grid, that they will eventually be able to access the grid. Therefore, it is very common for the term of C&I projects to be relatively short, nominally less than ten years. This is not a major constraint for relatively small SME or shopping centre projects with lower peak power outputs, but it remains a constraint in larger C&I projects. Debt cannot be repaid fully during these shorter durations making short PPAs non-viable for developers.

— **Solution**: roll out financial incentives or guarantees to off-takers that elongate tenors (i.e. a price match or cost offset guarantee if utility power becomes available cheaper after ten years, paired with covenants in the PPA that limit tariff increases over time).

BOX 5. Case Study

Starsight Premier Energy Group (SPEG)

SPEG is an East Africa focused JV between Starsight Energy and Premier Solar Group. SPEG offers solar PV solutions to C&I clients in Kenya, Uganda, Tanzania, and Rwanda. Each country has or will have a Devco and Assetco, allowing clients to benefit from a "one stop shop" approach to having a solar PV system installed, financed and thereafter professionally maintained, all by in house teams. Premier Solar Solutions, the Devco in Kenya, has been operational since 2017 and has so far installed 16 projects, totalling over 8 MWp, and is on track to have installed a further 13 projects in 2022 taking its total installed capacity to over 20 MWp. Starsight Premier Energy Services, the Assetco in Kenya, was set up in 2021 and has currently financed US$ 5.4m of projects and is on track to have financed a total of US$ 11.7m of projects by the end of 2022 . Similar Devcos & Assetcos are being set up in Uganda in Q1 2022 & in Rwanda / Tanzania in 2023. The GET.invest Finance Catalyst supported Premier Solar Group in the equity raise that ultimately led to the formation of the JV and is currently supporting SPEG with its 1st debt raise for the Asssetco businesses.

BOX 6. Case Study

Direct capital provision **to C&I developers**

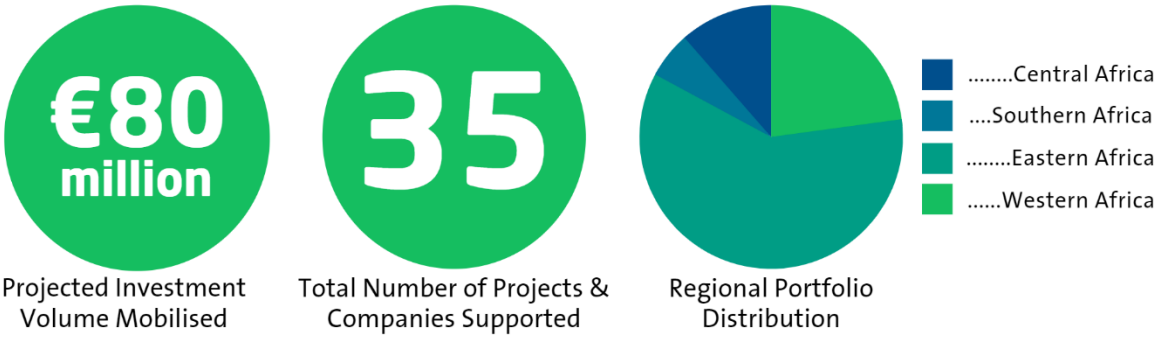
Captive C&I projects are generally relatively small in capacity compared to on-grid traditional PV projects, with C&I capacities ranging from 100Kw to 2, 3, 5MW. As such, the structure generally recommended is bundling in portfolios under a dedicated SPV with its own funding. Mostly development, construction, and monitoring require local understanding of the market and local partner developers to take this on. The funding, therefore, needs to be provided by specialist Funds/Asset management Holdco's benefiting likely of international DFI/Venture Funds for risk finance. As projects are realised and proven successful, operations are realised refinanced with DFIs, long term funding is expected. The funding and underlying PSA or Lease arrangement will be long term. Critical risks to be considered are assessing the required load profile, credit

risk profile of the client, forex risk, EandS aspects with the end-user, and close monitoring of payment behaviour.

Relevant specialist strategic investors in this field within the GET.invest Finance Catalyst network, working with local selected development partners that could be mentioned without being exhaustive are Crossboundary, Empower NewEnergy, Solarise, ResponsAbility, Starsight, Ecoligo (also crowdfunding platform), and Total-Eren. The GET.invest Finance Catalyst helps C&I clients improve their financial model to raise the interest of these actors.

6 Solar Home Systems (SHS)/Off-grid Solar (OGS)

Our Traction



6.1 General Introduction

The off-grid direct to consumer market is primarily composed of Solar Home Systems (SHS). Other off-grid systems, such as standalone solar water pumping, are encompassed in the segment as well. However, this chapter focuses on SHS as the primary focus within the broader segment. However, it is important to appreciate that within the broader off-grid solar segment, there are other important business models focusing on the distribution of solar-powered productive use equipment (i.e. small solar water pumps, small electric mills, fishing lights, etc.). Another emerging segment is larger, i.e. multiple 100w or even KW-range, systems for small commercial users (i.e. modular cold storage) or larger residential customers. Since these are emerging models, and the experience of GET.invest and the Finance Catalyst with them is limited, they are not included in this analysis.

The SHS segment delivers basic electricity access to households and small businesses in both rural and peri-urban contexts, with limited power needs. These units are typically 12v or less, and they are principally oriented towards lighting and mobile phone charging. Larger units that can run small 12/24v appliances like refrigerators, radio and TV, internet hotspots, small tools, and also multiple phone charging are available, but these are typically used by small businesses and middle-income households.

The segment is quite broad because of the wide variety of unit sizes, storage capacity and linked services. Some SHS companies bundle power units with lighting, appliances, or other services like mobile internet. The proliferation of Pay-as-you-go (PAYGo) schemes, possible on the foundation of mobile money platforms, has availed many companies to business models as an alternative to outright purchase. This lowers the initial investment burden for both households and small businesses, thereby enabling much more growth than would be possible through a strict asset financing model.

6.2 Market Assessment

The OGS market is relatively well established already and is showing signs of continued growth. Recent estimates put the market size at around USD 400 million[12]. To achieve universal access, the OGS sector would require USD 6.6-11 billion in additional financing.[13] There are a few larger international players that are most commonly component or whole unit manufacturers. These larger players are more likely to provide bundled or more "technologically driven" units that provide more than just lighting and phone charging. However, the majority of SHS companies are local entities with established distribution markets and commission-based agent sales networks and strategies. Partnerships between international producers and local distributors (who may even do some on-shore assembly) leverage the strengths of each, if the partnership is well formulated. In fact, some operators (especially the larger players) are vertically integrated, but a horizontal specialisation on "last mile distribution", associated with IT solutions for PAYGo platforms and sales network management, is emerging as an effective way to secure customer services and cost-efficient way to distribute products.

6.3 Impact Assessment

The impacts of SHS are in particular social in nature and to an extent also economic. Modern lighting and phone charging (the principal activities enabled by SHS) greatly enhance the quality of life[14] and some aspects of modern service access, but their contribution to productive uses is necessarily limited.

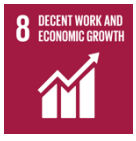
That said, it is important to appreciate several aspects:

- the range of energy needs provided by SHS corresponds with the needs of large segments of the population for the foreseeable future.
- SHS can be an entry point for end-users without prior access to electricity, thus being a steppingstone towards SHS upgrades.
- the SHS segment is also innovating, and in combination with the falling cost of storage, is likely to remain viable for the foreseeable future for millions of users.

In a broader view, when looking at the SHS sector, the data collected during the re-payment period over PAYGo platforms represent a strong opportunity in the area of "access to finance" by generating often the first-time-ever credit history of end-users. Access to finance is ultimately contributing to small entrepreneurship, economic development and female empowerment.

[12] World Bank Lighting Global Program, GOGLA & Energy Sector Management Assistance Program (ESMAP). "Off-Grid Solar Market Trends Report 2020." March 2020.
[13] Ibid.
[14] For example, see GOGLA's recent report on livelihood impacts of SHS titled "Powering Opportunity in South Asia: From Work to Well-being, the Important Role of Small Scale Solar."

Table 7: SDG Relevance of the SHS/Off-grid Segment

SDG	CURRENT RELEVANCE	FUTURE RELEVANCE	COMMENTARY
			**PRO:** SHS/OGS, especially as solar and storage technologies become cheaper, can displace more expensive and less healthy lighting alternatives (e.g. kerosene, non-rechargeable batteries and generators for some small businesses), increasing household savings; SHS can also enable more stable access to mobile money and mobile banking services through more regular in-house charging of mobile phones, and enable basic household income generation. Systems are likely to become bigger with time CON: small SHS cannot serve economic activity with higher power needs, especially compared to alternative power sources like mini-grids or grid access.
			**PRO:** SHS can empower women and girls through lighting access and mobile charging at home, increasing their contact to health services, financial services, security and education; SHS for clinics can increase the quality and availability of reproductive health services; SHS also contribute to women's ability to open household-based businesses that are otherwise impossible
			**PRO:** SHS are, by definition, 100% renewable and provide electricity access to currently unserved households and businesses (as they cannot be grid-connected due to voltage difference); thus, they contribute greatly to providing modern energy access (albeit at a limited generative capacity) to unserved households; pricing for SHS is also much more affordable to most of these rural and peri-urban households than other alternatives, and they offer PAYGo options that better suit the financial activities of these households
			**PRO:** SHS, as it grows, will contribute to substantial growth in peri-urban and rural employment through installation, service and management of SHS companies and their assets. SHS also contributes to energy access for micro/household enterprises, which make up around 80% of employment in sub-Saharan Africa CON: Especially compared to other segments, SHS have limited contribution to industrial or commercial activity with larger power needs

SDG	CURRENT RELEVANCE	FUTURE RELEVANCE	COMMENTARY
			**PRO:** SHS can increase access to financial services via greater access to mobile phone charging, thereby increasing reliability of mobile money and mobile banking. Financial inclusion can be also improved by the creation of a "credit history" for all end-users that pay on credit via a PAYGo platform CON: Though they may serve as a springboard into greater demand for energy, SHS themselves do not have the capacity to substantially contribute to industrial growth and infrastructure expansion.
			**PRO:** SHS in certain contexts (e.g. clinics) have a limited but positive influence on national resilience (through reliance on local resources) and adaptive capacity to climate change CON: The overall impact of SHS on national emissions is quite low, as households as the target clients are not heavy emitters for non-cooking energy activities

6.4 Policy Gaps

Challenge: inadequate definition (and enforcement) of quality standards

The rapid proliferation of SHS has come with almost no regulatory oversight in the segment. While this has enabled rapid growth, it has also resulted in a flood of low-quality components and parts alongside relatively no consumer protection or recourse for end users. VeraSol has entered this space as a third-party quality assurance agency, though it is not universally recognised yet. In addition, there is a lack of quality standards for services, nor are there clear mechanisms to ensure consumer protection in the provision of these services. These lacking quality standards are a serious threat to the sustainability of the segment, with potential adverse effects for the reputation of SHS caused by the poor quality of products and services in relation to SHS.

- **Solution 1**: support the adoption as well as effective enforcement of VeraSol standards, ideally enforced across multiple countries, for SHS components, systems and service, for instance, conditioning a regime of local fiscal incentives (import duty and/or VAT waivers/reductions) to the existence of an internationally recognised quality standard certificate.
- **Solution 2**: enhance consumer protection through the establishment of multi-stakeholder task forces, or industry associations and oversight groups.
- **Solution 3**: condition financial support to SHS companies to only those who are both VeraSol (or equivalent internationally recognised quality standard) compliant and demonstrate a commitment to consumer protection (i.e. as done in current donor initiatives such as Beyond the Grid Fund for Africa).

Challenge: import taxes on components and pre-assembled units

Import tariffs are generally applied to SHS components and pre-assembled units. Navigating import tariff regimes can be cumbersome, and port seizure or delayed delivery of components are common experiences especially for smaller local SHS companies and other new entrants. These tariffs also create an inflated cost to end-users as most are passed through, thereby increasing the barrier to access particularly for rural households and businesses (which already face high last-mile costs, **see below**).

- **Solution 1**: create tax rebates or results-based reimbursement mechanisms especially for new entrants that meet certain quality standards.
- **Solution 2**: advocate for import tariff waivers for certified SHS systems.

Challenge: enabling policy and strategies are mostly unformulated

Broadly speaking, SHS is proliferating because of the demand for the service. As noted above, there is basically no policy environment established for enabling the sustainable growth of this market segment. Rural electrification strategies tend to focus mainly on solutions with higher generative capacity (grid extension or, in some cases, mini-grids), but they often leave aside SHS as not within the remit of rural electrification. And often, when the rural electrification agencies do include SHS-based electrification targets or initiatives, they risk imposing centralised approaches (i.e. public tenders for SHS installation at no cost for end-users), or in general a highly subsidised public sector approach to a segment that could rely effectively on professional private sector distributors. Governing this SHS market effectively means providing quality standard policies, simple licensing based on minimum quality service requirements, improved access to local currency finance, and, where possible, fiscal incentives (**see above**). This menu of policy measures is much more appreciated by quality distributors than complicated to obtain and market price distorting subsidies. Improved coordination and communication amongst key stakeholders could greatly enhance the sustainability of growth achieved in the segment.

- **Solution 1**: provide TA to planning and policymaking to ensure adequate and informed inclusion of SHS in rural electrification planning, and drafting of market enabling policies.
- **Solution 2**: foster "multi-stakeholder" consultation groups in the SHS segment, comprising ministries, financiers (especially microfinance institutions) and SHS industry associations (i.e. the Off-Grid Task Force established in Zambia).

6.5 Technical Capacity Gaps

Challenge: human capital & technical capacity constraints of local and smaller distributors

The formal SHS market is currently dominated by a relatively small number of large companies. The rest of the market comprises a multitude of smaller actors, many of which provide products and services that fall short of quality requirements. However, these actors have particularly strong impact potential, in terms of local job creation, leaving no one behind and reaching the "last mile", gender

empowerment etc. These actors need specific support, by targeted capacity development in conjunction with tailored financial support.

- **Solution 1**: tailor TA to training and professionalising management and staff, and deploy seed capital (various options, in particular patient equity, convertible finance).
- **Solution 2**: provide TA to local governments to ease labour policies and the mobility of professionals across the Sub-Saharan region, supporting the creation and cross-fertilisation of new professional talent in the SHS/OGS market.

Challenge: integration and dedicated support to productive use

While social impacts of SHS are quite high, economic impacts tend to be more limited because of the added utility of the generative capacity of most SHS which only provide lighting and small device charging. While this is already highly relevant for many small business activities, a recent innovation, though nascent, shows that more value-adding appliances and tools can be run on SHS systems. An increasing number of SHS distributors are indeed widening their offering, to include simple/affordable smartphones, and small electric tools for income generation activities (i.e. barber razors, sewing machines).

However, the added complexity of innovation, production and distribution of appliances on top of SHS systems is a substantial leap for most SHS companies: beyond the challenge of a product offering with higher pricing, when the additional appliances are not simple "plug-in" types (i.e. smartphones), their proper sale and after-sale service embeds much more complexity and potentially higher average CAC (customer acquisition costs). As put recently by an interviewed large SHS distributor, for instance, the sale of solar pumps needs to be tailored to the end-user and is a much more "knowledge-intensive" sale than the largely standardised sale of an SHS.

- **Solution**: build out donor TA and RBF programmes to promote strategic alliances between SHS distributors and the emerging set of specialised solar efficient appliances makers/distributors, to enhance know-how transfer and horizontal integration **(see box 7)**.

6.6 Finance Gaps

Challenge: impact (energy access) is positively correlated with distribution costs

Currently, many SHS are deployed in areas where they are either the most appropriate or the cheapest option, compared with alternatives, which in many instances also includes unreliable and expensive grid connections. However, SHS are most impactful where they serve "last mile" households and communities – those which are going to be the very last to be connected to any grid, if ever. Reaching these communities with reliable distribution and maintenance services is significantly more expensive than other less remote areas, even for SHS companies. In addition, the PAYGo terms for these remote communities may need to be with longer tenors and/or more flexible payment schedules, also contributing to higher distribution costs. Distribution and maintenance costs for high impact tend to be underestimated by companies and financiers alike.

- **Solution 1**: structure operating capital support with concessional terms applied for qualified "last mile" customer portfolios.
- **Solution 2**: structure working capital facilities with tenors that are aligned with the cash conversion cycles of PAYGo distributors: i.e. not only 2-3 year inventory financing terms but > 3 years tenors that include an appreciation on the long lead times, logistics, PAYGo tenors and necessity of re-scheduling for end-users under risk of default/repossession.
- **Solution 3**: craft RBF programmes to motivate and support established SHS distributors to serve the more remote rural districts and in general the BoP end-users with entry-level SHSs, since the marginal distribution cost for SHSs is higher in all these cases.

Challenge: substantial reliance on rent-to-own terms (PAYGo)

Most business models in the off-grid market are rent-to-own, based on sales at consumer credit terms, with PAYGo platforms or in partnership with MFIs acting as finance providers. While this has implications for the funding situation for PAYGo companies (as further outline below in the Finance Gaps section), this also triggers a wide range of aspects to be considered from a regulatory perspective. PAYGo companies are acting similar to financial institutions, collecting customer payment data, charging financing costs, implementing collection processes in case of non-payment and others. Indeed, some SHS PAYGo distributors are now offering financial inclusion products or simply rewards to good (on-time) SHS payment behaviour, such as access to school micro-loans. All this holds both strong development potential as well as high risks on both the company and customer side.

- **Solution 1**: provide technical assistance support to facilitate deeper partnerships between PAYGo operators and mobile money providers.
- **Solution 2**: link access to energy activities to access to finance activities, using personal credit data from PAYGo payment. For this, support establishment of Credit Reference Bureaus and linking the PAYGo sector to the Credit Reference System **(see box 8)**.
- **Solution 3**: develop responsible finance principles, consumer protection regulation and data protection standards to protect PAYGo customers from unfair practices.

Challenge: underwriting and pricing end-user creditworthiness

While SHS has relatively low CAPEX requirements, these companies face relatively high OPEX requirements to ensure sufficient inventory for new sales and serve asset fleets in the field. Working capital, and access to appropriate financing instruments for it, is therefore critical to their success and growth.

Those companies offering PAYGo products face an even higher constraint in accessing viable options for working capital, in large part because of portfolio risk: PAYGo companies carry high amounts of receivables and thus need to control the quality of their sales Portfolio at Risk (PAR). PAR for these PAYGo models tends to be higher than what would be considered financeable for commercial banks on the continent.

Furthermore, the tenor of the limited options is short-term, and these companies require longer-term tenor (up to 3.5 years) to adequately match the leasing cycle of their products. Early-stage and smaller

companies are especially limited in their access to usable capital, and success largely hinders on securing grants since most investment is going into large companies.

- **Solution 1**: scale-up support to SHS-oriented RBF facilities.
- **Solution 2**: expand grant (or convertible/reimbursable grant) availability to early-stage companies as a way to furnish critical working capital.
- **Solution 3**: contribute to capitalise impact financing instruments that are able to offer the much-needed convertible debt and equity to SHS distributors in the early stage growth phase.
- **Solution 4**: deploy tailored portfolio guarantees that address the margin in realistic PAR to bank requirements in order to enable bank lending in the sector.
- **Solution 5**: scale-up green lines of credit with built-in risk mitigation/guarantees for local banks specifically tailored to the portfolio structures of SHS companies.

Challenge: lack of receivables-based finance options for established companies

As mentioned above, PAYGo focused SHS company assets consist principally of a large portfolio of receivables. In this model, the end-user is effectively provided credit by the SHS company until the rent-to-own agreement is fully paid. As these portfolios mature, and their risk profile is better understood and predictable, they should become a financeable asset. The first experiment with asset-backed financing of SHS PAYGo distributors in Africa happened in 2015[15].

In a developed country, or even other markets in SSA, a company with a portfolio of relatively reliable receivables would be able to leverage this portfolio, without substantial collateral, to access working capital from a lender. The lender would discount the total amount of receivables at some rate based on the average risk (usually Portfolio at Risk at some day-count of delinquency, like 30 or 90 days).

The working capital raised would be used to support increased inventory, sales, service and potentially broaden the product line offered by a company. However, in part due to company management acumen and part to the relative immaturity of the segment (and poor understanding of banks about the underlying portfolio risk characteristics), SHS companies generally are not able to borrow against receivables from local financial institutions. They need to leverage these portfolios to grow and increase overall inventories and scale-up.

- **Solution 1**: together with European DFI, contribute to crafting debt finance instruments focused on the more mature (and large) securitised SHS PAYGo portfolios.

[15] In December 2015, the first asset securitisation was completed by a distributed energy services company (DESCO). A special purpose vehicle subsidiary of BBOXX Ltd. issued asset-backed notes –named Distributed Energy Asset Receivables, or DEARs–secured by approximately 2,500 customer installment sales contracts. The contracts represented the unpaid portion of the purchase price of BBOXX's solar home systems sold to customers living without electricity in Kenya. Oikocredit International, a global impact investor, purchased the Kenyan shilling denominated notes for KES 52,000,000. (see: https://persistent.energy/wp-content/uploads/2018/11/Securitization.pdf)

— **Solution 2**: expand equity investment in SHS companies with proven track records, especially through existing initiatives and platforms **(see box 8)**.
— **Solution 3**: expand DFI debt platforms tailored to the SHS segment, particularly focused on alleviating collateral requirements.

BOX 7. Case Study

Koolboks & OVO Solar

Koolboks & OVO Solar are two GET.invest Finance Catalyst clients that are startup off-grid appliance companies. Koolboks produces a high-performance solar fridge with a built-in thermal battery. This battery replaces the need for a more complex and lower efficiency electric battery. OVO Solar produces a modular solar-powered smart egg incubator that drastically improves hatch results for chicken eggs. Both companies' products operate on PAYGo basis, and both are primarily planning to sell products through SHS distributors and similar companies. The main challenge to growth is securing and financing sales of their products to distribution partners in SSA countries; neither company has sufficient capital to provide supplier finance to facilitate meaningful order volumes, and virtually no distributors have enough cash on hand to acquire reasonable quantities of product on an up-front cost. Sales on commission by the distributors are also unfeasible due to construction, shipping and delivery delays. Trade finance products are technically available to support these two companies, but their relatively short lifespan and notionally high-risk clients make most export credit providers unable to support on a risk/cost basis. Thus, a critical and unmet financing gap exists to support the wholesale transaction between these niche appliance producers, like Koolboks and OVO Solar, and their distributor clients in key countries.

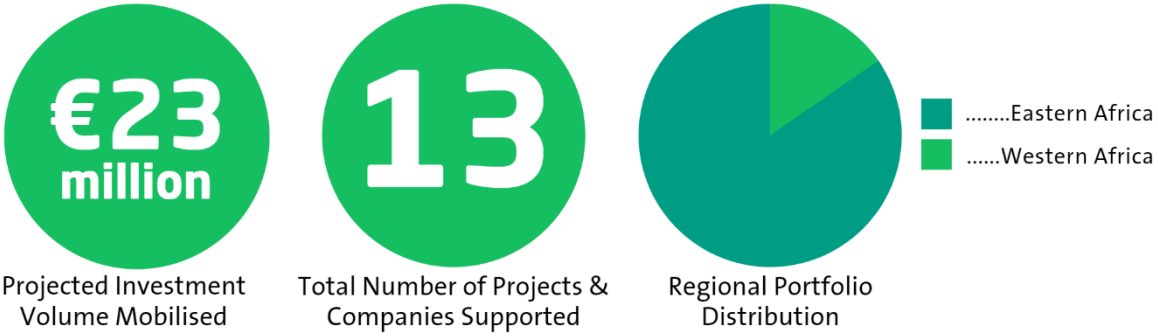
BOX 8. Case Study

Qotto

Through a single proprietary platform, Qotto provides access to three services: energy, internet, and finance. Where legacy utilities operators cannot deploy large infrastructures that costs millions of USD, Qotto deploys and operates decentralised nano-infrastructure that cost less than 1000 USD and provide these three essential services, thanks to its in-house team of 70 salespeople and 70 after-sales technicians. Qotto currently operates in West Africa and UEMOA French-speaking countries, such as Benin and Burkina Faso. Qotto has built an operation with a annual turnover exceeding €1m with €7.5m external financing, €2m of which is debt based on receivables. Qotto is discussing with multiple financiers for a €10m debt/equity financing round. The GET.invest Finance Catalyst is providing advisory services to Qotto in the development of their financial model, drafting presentation documents, approaching investors and negotiating financial close.

7 Clean Cooking

Our Traction



7.1 General Introduction

The clean cooking segment is in fast development in sub-Saharan Africa, as pilot activities led by the non-profit sector, or local government, have paved the way for local and international private sector players in an emerging market. While highly fragmented structures, incl. informal actors and local improved cookstove manufacturers or builders will continue to play an important role, the time has come for clean cooking to tap into investment funding for scaling up and acceleration of impacts.

Invariably, the main competitive advantage of clean fuel and cooking solutions rests on its potential to substitute for more expensive charcoal fuel in urban settings and usually "freely" (but with substantial physical effort) accessible firewood in rural settings, the most widely used traditional fuels[16] [17]. If clean cooking solutions cannot compete on price terms with traditional biomass, it is not commercially viable, and thus cannot contribute to modern energy access at scale. Secondary and often lauded benefits of clean cooking include reduced emissions, improved household air quality, reduction of deforestation and improved gender outcomes from more efficient fuel access (compared with gathering biomass in the most extreme example). In particular, the aspect of rapid deforestation is of crucial importance for the future of the continent, since forest cover is deeply linked with key issues such as soil erosion and degradation, as well as water supply, making an indirect impact on food production as well.

[16] Lambe, F., Jürisoo, M., Wanjiru, H., and Senyagwa, J., "Bringing clean, safe, affordable cooking energy to households across Africa: an agenda for action." 28 October 2015.
[17] PBL Netherlands Environmental Assessment Agency. "Towards universal access to clean cooking solutions in Sub-Saharan Africa: An integrated assessment of the cost, health and environmental implications of policies and targets" 2018.

7.2 Market Assessment

Traditional biomass sources are hugely prevalent across the continent, accounting for nearly half of the final energy consumption[18]. In 2018, total primary energy demand for biomass equalled 371 Mtoe in Africa[23]. With regards to the costs of traditional fuels, the typical charcoal price range in sub-Saharan African cities is $0.2-0.5/kg. Taking the example of Nairobi ($0.49/kg), consumers roughly pay $27/month to cook with charcoal.[19] Cooking is a daily, universal need and even urban households maintain high demand for charcoal-based cooking. In 2018, the number of people without access to clean cooking was around 900 million in SSA.[20] Although charcoal markets are often informal and un-regulated, prices tend to increase in general (as seen for example during Covid-19 early months), and more so when the value chain needs to reach out to urban consumers. Thus, the market potential is huge, and it includes both urban and rural households. However, it is important to note that in many rural settings, households cook with firewood rather than charcoal[21], thus the affordability of the modern cooking solutions needs to be well addressed by clean cooking companies (i.e. via PAYGo integration).

According to the Clean Cooking Alliance, the total investment in clean cooking in 2019 equalled around USD 70 million[22]. To achieve universal access to modern energy cooking services, SEforALL estimates the annual funding required to be nearly USD 4.4[23].

Traditionally, clean cooking solutions revolved around more efficient firewood and/or charcoal Improved Cooking Stoves (ICS), which allows a saving of fuelwood or charcoal in a range of 20-70%.[24] This focus is now changing to include cleaner and high-performance fuels (i.e. pellet, liquid biofuels), more efficient bio-gasifier stoves, and deployment of electric cooking where possible. The efficiency is determined by the type of stove and user practice. Cash sale business models are the norm for the more basic ICS companies, and sometimes short-term consumer credit is extended. This part of the clean cooking segment tends to be made of artisans and could be targeted for financial inclusion programmes delivered through MFIs and financial cooperatives. These players typically lack business management and acumen skills that are addressed by programmes such as EnDev, among others. In

[18] International Energy Agency (IEA), "Africa Energy Outlook 2019" 2019.
[19] Energy Sector Management Assistance Program (ESMAP), Modern Energy Cooking Services (MECS) & World Bank Group. "Cooking with Electricity: A Cost Perspective." 21 September 2020.
[20] Ibid.
[21] Lambe, F., Jürisoo, M., Wanjiru, H., and Senyagwa, J., "Bringing clean, safe, affordable cooking energy to households across Africa: an agenda for action." 28 October 2015.
[22] Clean Cooking Alliance. "Clean Cooking Industry Snapshot 2021." 19 March 2021.
[23] SEforALL. "New SEforALL Research Shows Urgent Investment Needed to Achieve Universal Energy Access by 2030." 29 October 2019.
[24] Urmee, Tania & Gyamfi, Samual. "A review of improved Cookstove technologies and programs." Renewable and Sustainable Energy Reviews. May 2014.

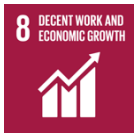
addition to stoves targeting households, there is a segment supplying “institutional” stoves for businesses (i.e. restaurants, schools, prisons, etc.).

Over the past few years, the segment has shown rapid shifts from fragmented, semi-formal entrepreneurial approaches and mainly grants-assisted non-profit or public driven initiatives to an entrepreneurial presence across most countries. Experimentation of new business models is taking place as well as deployment of a spectrum of solutions: from basic Improved Cooking Stoves (ICS) models to higher efficiency solutions, including solar-powered bio-gasifier stoves, ethanol stoves, biogas-based solutions, LPG stoves and electric pressure cookers. Some of the more advanced business models integrate into the high-efficiency cookstove a PAYGo functionality: addressing at the same time affordability for end-users and reliability of credit sales (i.e. the stove stops functioning when end-users are late in payments). Moreover, the high-efficiency bio-gasifier cookstove products, thanks to the solar panel/battery, integrate basic lighting and phone charging capability. Cooking fuels are also distributed similarly across a spectrum.

7.3 Impact Assessment

Most of this segment’s impact alignment is principally due to the sheer size of the access gap to modern cooking equipment and fuels: if universal access to clean cooking is achieved in the next decade, the impact will resonate across many of the SDGs, with the opposite holding true as well. Almost a billion people in Africa will see improvements in both social and economic outcomes due to accessing these critical, daily-use enhancements associated with access to clean cooking.

Table 8: SDG Relevance of the Clean Cooking Segment

SDG	CURRENT RELEVANCE	FUTURE RELEVANCE	COMMENTARY
			**PRO:** Any reduction in a high-frequency cost for poor households will make a substantial difference in freeing up scarce resources; cleaner cookstoves and fuels with lower costs will reduce poverty CON: Modern cookstoves may require more upfront investment, which has proven to be a challenging undertaking for poor households
			**PRO:** Modern cooking has a demonstrated impact on gender empowerment, reducing the substantial burden of fuel gathering on women and girls; they also substantially improve indoor air quality which is most often experienced by women and girls.
			**PRO:** Access to modern cooking is a critical part of universal energy access; modern cooking is an essential component of achieving SDG7, and they are the only way to do it by 2030 (since electricity-based cooking appliances would not be universally achievable by then)
			**PRO:** Modern cooking promotes resource efficiency, even among those low technology ICS that more efficiently burn biomass; local manufacturing of bio-fuels and manufacturing or assembly of components is driving economic growth, as well as downstream value chains for cookstoves and fuels will likely create jobs and economic opportunity
			CON: Modern cooking has little direct influence on sustainable infrastructure development, and are more secondary beneficiaries of more sustainable infrastructure (i.e. transportation systems increase access to cleaner cooking fuels, not vice versa)
			**PRO:** Modern cooking strengthens national resilience (through reliance on local resources) and adaptive capacity to climate change due to avoiding ecosystem degradation) ; they also significantly support the implementation of the UNFCCC through mitigation of energy sector emissions, and they reduce pressure on natural forest resources (the preservation of which both reduces emissions and retains carbon sinks)

7.4 Policy Gaps

Challenge: inadequate adoption and enforcement of quality standards

Much like SHS, the clean cookstove and fuel segment spans a huge range of quality when it comes to products and the availability of fuels. Because of the essential nature of cooking, any negative experiences (or second-hand information thereof) drastically reduces trust in new cooking methods. The near-total absence of clear standards and consumer protection in the segment, therefore, allows for low-quality products to disrupt organic growth and keeps demand latent. The apparent similarity between high- and low-quality stoves compound the perniciousness of low-quality products on consumer willingness to change behaviour.

- **Solution 1**: support the creation and adoption of minimum standards (ideally through a multi-stakeholder consultative body), ideally enforced across multiple countries, for clean cooking solutions components, systems and services.
- **Solution 2**: enhance consumer protection through the establishment of multi-stakeholder or industry associations and oversight groups.

Challenge: tax treatment of stoves and fuel

Mostly in the case of cookstoves, but also the case of some fuels, the segment is faced with steep import taxes for internationally sourced components and wholly assembled units. This is especially true for higher technology stoves, such as those that have secondary or associated benefits like electricity production.

- **Solution 1**: create tax rebates or results-based reimbursement mechanisms especially for new entrants that meet certain quality standards.
- **Solution 2**: advocate for import tax waivers for certified cookstove systems and potentially some fuel types.

Challenge: loose charcoal and forest resource regulation and enforcement

Loose regulations on charcoal and illegal forestry activities make them seem cheaper than clean cooking solutions by avoiding regulatory compliance costs. If the charcoal market remains largely a grey market, tax and license-compliant cookstove and fuel companies will struggle to compete.

- **Solution**: advocate for enhanced regulation and enforcement of forest resources and charcoal production as part of policy-based lending and other sovereign financial support.

7.5 Technical Capacity Gaps

Challenge: consumer preferences and behaviour change

As alluded to above, cooking is a mainstay activity for every household. Making changes to this means basic survival is very high risk – if something goes wrong, a family goes hungry. This risk is compounded when considering more advanced cookstoves, which often cost equivalent to multiple months of income for families (but are frequently grant subsidised or financed over a longer period).

— **Solution 1**: undertake robust consumer education campaigns about the economics and long-term savings of clean cooking and especially how to differentiate between high- and low-quality products.
— **Solution 2**: provide incentives (incl. grants) directly to early adopters of innovative, certified cookstoves to offset any potential hiccups in adoption, expectations or actual performance.

7.6 Finance Gaps

Challenge: last-mile sales and distribution

Another similarity of cookstoves and fuels to SHS is the increasing expense to deliver last-mile services to rural and remote households. These contexts are where social, gender, economic and environmental benefits are most profound, but they are the most challenging to reach. This is especially true for clean fuels, which require regular delivery to be perceived as a reliable alternative to biomass.

— **Solution**: structure operating capital support with concessional terms applied for qualified "last mile" customer portfolios.

Challenge: absence of working capital

Just like SHS, both cookstoves and fuel are fundamentally OPEX-intensive businesses. Fuels occasionally also require substantial CAPEX investment (e.g. pelletizers or distillation), but they are also highly reliant on regular availability of working capital to succeed. There is again a paucity of working capital finance available for the segment, which severely constrains growth.

— **Solution 1**: scale-up support to clean cooking-oriented RBF facilities.
— **Solution 2**: expand grant (or convertible/reimbursable grant) availability to growth companies as a way to furnish critical working capital **(see box 9)**.
— **Solution 3**: expand equity investment in clean cookstove/fuel companies with proven track records, especially through existing initiatives and platforms.

Challenge: cookstove cost for households

Compared to the status quo, a new cookstove appliance is typically equivalent to at least a few months of income for the average target household in most cases. Even when behaviour change occurs, the ability to pay becomes a serious secondary impediment. Some companies cross-subsidise stoves with fuel sales, but this reduces consumption cost competitiveness against biomass. However, this complicates the business model and can chew up precious capital in inventory of both stove components and inputs for fuel production. Like the SHS market, some companies are experimenting with consumer finance through rent-to-own and even PAYGo approaches, but these are far from the norm. Partnerships with microfinance institutions to break up the burden of paying for a stove are one option used across a number of countries, but this further increases the total cost of acquisition through typically high microfinance interest rates on top of stove base cost.

- **Solution 1**: deploy subsidies to partly offset the cost of stoves (ideally results-based) so that companies can focus on competitively pricing clean fuels **(see box 9)**.
- **Solution 2**: deploy concessional lines of credit to MFIs with clear pass-through benefits to end consumers.

Challenge: untapped impact bond and carbon revenue alternatives

Because of its high impact and verifiable carbon offsets, clean cooking and fuel are a reasonable segment to explore impact bonds and carbon revenue sources. Especially as the sector moves towards the integration of PAYGo functionality, and the resulting cookstove usage data collection, it is foreseeable that some SDG impacts could be measured and monitored, as well as the GHG emission reductions. It is generally feasible, albeit time-consuming and expensive, for a clean cooking project to secure carbon revenues as long as they can demonstrate a minimum of 10-15,000 VERs per year. However, impact bonds are mainly untested sources of capital for the segment and carbon offsets present the challenge of high transaction costs and lengthy processes. Companies working in this segment are predominantly small and local which requires support approaches tailored to their needs and capacities.

- **Solution 1**: lead the creation of an impact bond for clean cooking access **(see box 10)**.
- **Solution 2**: expand existing platform services to advise on carbon-based revenue registration and generation (at low/no cost) to support cookstove and fuel companies.

BOX 9. Case Study

PowerSpot

PowerSpot operates in western Kenya with two main business lines: the first is household and institutional cookstoves that burn pellets and generate 12/24v power through a transducer in their chimneys. The second is in the production of pellets that are principally made from sugar refining waste known as bagasse. Bagasse, until a recent regulatory change from the Kenyan Environmental Management Authority, was burned in the fields and created a substantial amount of water and air pollution in the process.

PowerSpot's stoves are sold below cost, which is made up over time in the sale of pellets to each stove owner. This enables households to acquire relatively high- tech stoves through a lower up-front coss. Cross-subsidisation by pellets is feasible even with pellets selling at a per-calorie cost that is cheaper than locally available charcoal. However, due to cross-subsidisation, PowerSpot's growth is largely constrained by sales and production capacity of pellets, which directly enable to construction and sales of more stoves.

Critically, PowerSpot's pellets have recently attracted agricultural and industrial heat clients as an alternative to expensive LPG or diesel-electric heating. Among others, PowerSpot has secured as clients food processing, powder coating, tea drying and other industrial processors. Between stove clients and these new industrial clients, PowerSpot's current pellet production capacity has reached its limits, and it unable to meet demand across both client groups. PowerSpot is currently fundraising to build up to three more pelletizing factories to meet current demand. If capital would be readily available to expand pelletizing operations, this growing demand would be a positive development. PowerSpot's bagasse-based pellets

would then serve both household cooking fuel demands and more GHG intensive industrial processing clients as a substitute for both LPG and diesel.

However, even with high demand, the absence of long-term offtake agreements creates a predicament for potential financiers—even with a solid business model and proven sales history, growth is contingent on short-term and even one-off retail purchase agreements for pellets. Thus, PowerSpot is, with the support of the Finance Catalyst, targeting the support of blended finance and some grant support to facilitate the transaction and mitigate risks. However, precious little capital is available in this space, especially under a corporate structure where a new pelletizing plant represents a substantial cost compared to the existing balance sheet.

Even with high demand, the absence of long-term offtake agreements and the cross-subsidisation model for stove use creates a predicament for potential financiers—even with a solid business model and proven sales history, growth is contingent on short-term and even one-off retail purchase agreements for pellets. Thus, PowerSpot is, with the support of the Finance Catalyst, targeting the support of blended finance and some grant support to facilitate the transaction and mitigate risks. However, precious little capital is available in this space, especially under a corporate structure where a new pelletizing plant represents a substantial cost compared to the existing balance sheet.

BOX 10. Case Study

Emerging Cooking Solutions

Emerging Cooking Solutions (trading as Supamoto) is a leading PAYGo energy service provider in Zambia, currently expanding into Mozambique and Malawi markets. Clean cooking is its core business, with modern pellet manufacturing and over 12,000 high-efficiency biomass stoves distributed. SupaMoto has also sold over 20,000 certified solar home systems. The imported Tier 4 Mimi Moto stove has proved successful and is already distributed at scale, together with pellet fuel.

Today, SupaMoto is making the switch to their own design – the SupaMoto-stove, which is set to disrupt the clean cooking market, with its performance and IoT innovations. In addition to demonstrating the highest level of efficiency (54% Thermal Efficiency and highest level - Tier 5 – on 3 out of 4 measurements for emissions, at the Aprovechio Research Center), which further reduces households expenditure for traditional fuels (i.e. charcoal), PAYGo technology is integrated into the SupaMoto-stove, to turn off the fan in case the user does not purchase SupaMoto's pellets. At the same time, ample cooking data, time and record of fan speed and GPS location is sent via a built-in SIM card to a cloud-based application.

While raising early-stage equity or convertible debt remains a challenge and a priority, this innovation allows monitoring of usage data, thus enabling Supamoto to explore alternative financing structures, such as high-quality carbon offsets and impact bonds associated with the clean cooking access impacts in terms of the Sustainable Development Goals, i.e. on gender and health. Recent third party assessment of carbon offset potential indicate that carbon revenues associated with the distribution of SupaMoto-stove and pellets will become the a key driver for funding growth, as well as for fueling new alliances in new African markets in a B2B distribution perspective. The GET.invest Finance Catalyst helps SupaMoto with identifying equity

partners, carbon finance partners, financial modelling and business structuring, in addition to cookstove industry expertise.