Standard Microgrid mini-grid in Zambia

Open Sourcing Infrastructure Finance for Mini-Grids

CROSSBOUNDARY ENERGY ACCESS

December 2020

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CBEA Foreword

This document 'open sources' the approach we and our partners developed to invest long-term, low cost infrastructure capital into mini-grids in Africa, and what we have learnt from implementing the approach in practice.

We are excited to share the work we have done with Ceniarth, Rockefeller Foundation, the Renewable Energy Performance Platform (REPP), PowerGen Renewable Energy, and Standard Microgrid. We are grateful for those who have directly supported it – Shell Foundation, UK aid, and DOEN Foundation. Finally, we are grateful for those who have partnered with us on it – Norton Rose Fulbright, Foley Hoag and Camco Clean Energy.

We also want to recognize upfront that there are at least four good reasons why we might have chosen not to publish this paper.

First, we know that open sourcing CBEA's documents will help create competing financing facilities. But we believe the competition this poses to CBEA's own future growth is far outweighed by the potential to accelerate progress towards the goal we share with our competitors of delivering affordable and reliable power for all by 2030.

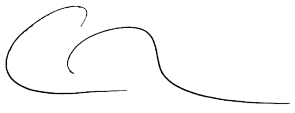
Second, we are aware that an uncharitable reader may interpret this paper as us claiming we invented project finance. We certainly did not. And we certainly do not believe we did! But we do think that we have created valuable intellectual property in adapting traditional project finance for the distributed nature of mini-grid assets. We are excited to share that knowledge.

Third, this paper might imply project finance is the only way to finance mini-grids at scale and that we've solved mini-grid financing. We do not believe that. We do believe that unlocking project finance for mini-grids is an important innovation. But we also believe that it is just one innovation of many that will be required for mini-grids to fulfil their potential.

Finally, we might give the impression that finance is the last or most important piece of the mini-grid puzzle. It is not. We know that finance doesn't exist in a vacuum. It is only possible for finance to make an impact because there are developers to build and operate mini-grids, governments who pass innovative regulation for mini-grids, and donors who bridge the sector to scale. We hope open sourcing our approach to our particular part of the puzzle will help the rest of the sector to achieve our shared goal.

Stepping back, we did not believe any of these were good reasons to not share this knowledge. We hope you agree.

Matt Tilleard
Managing Partner
CrossBoundary Group



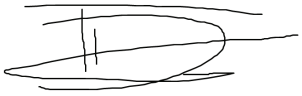
Gabriel Davies
Head of Energy Access
CrossBoundary Group

PowerGen Foreword

This document 'open sources' the project finance approach that PowerGen has implemented along with CBEA and our other partners. At PowerGen, we are incredibly thankful for the significant amount of time and resources CBEA and its partners spend on trying to solve 'mini-grid financing', an issue that continues to plague the sector. Through our collaboration, we have been able to develop our understanding of how to fund our projects and it has helped us to raise funding with other investors.

Our approach probably still has many flaws, but we are convinced this is the way forward. For the sector to meaningfully improve energy access, it needs significant investment. The only way to make that happen is to match our projects with the right type of capital, and that means finding an approach that unlocks infrastructure capital. However, as mini-grids are not traditional infrastructure we know it will take many iterations to get this approach right. We hope that sharing this is a good step that others can add to and improve on.

Aaron Cheng
President
PowerGen



Tobias Dekkers
Head of Capital Raising
PowerGen

Acknowledgements

We are grateful to the industry experts we have been fortunate to have worked with over the last three years. This approach would not have been possible without the expertise, support, and grit of the teams from Ceniarth, Camco Clean Energy, Foley Hoag, Norton Rose Fulbright, PowerGen Renewable Energy, the Renewable Energy Performance Platform (REPP), Rockefeller Foundation, Shell Foundation, Standard Microgrid, and UK aid.

We are furthermore grateful to the following peer reviewers whose insight, expertise, and attention to detail significantly improved this from previous draft versions. Thank you.

This paper focuses on allocating mini-grid risks through project finance contracts. However, as we state in section III.3, project finance reduces many mini-grid risks, but market risks, regulatory risks, government contractual risk, and political risks, remain. As many reviewers noted, mitigating these risks is as important as the risks we aim to mitigate through project finance structure contracts. While we are working to incorporate de-risking mechanisms and tools into our own investments to address these risks, we believe there are others who are already covering these issues much better than we can. We hope that future iterations of this open source project will include more on de-risking mechanisms. For now, we encourage readers to look out for work by AMDA on regulatory regimes in Africa, the Wood Makenzie report *Evaluating minigrid policies for rural electrification*, and the IFC's Scaling Mini-Grid program.

Furthermore, we want to reiterate that project finance is not the only way of bringing infrastructure capital into the mini-grid sector. We have been encouraged to hear from investors of alternative structures and hope that these can be included in future iterations of this open source project.

Peer Reviewers	Organization
Aaron Cheng	PowerGen Renewable Energy
Abiodun Olusegun Aina	International Finance Corporation
Alix Graham	InfraCo Africa
Arnaud Schalk	ProparCo
Ben Attia	Wood Makenzie
Ben Hugues	CamCo Clean Energy
Benedikt Lenders	PowerCorner ENGIE
Brian Somers	Standard Microgrid
Caleb Cunningham	Standard Microgrid
Caroline Eboumbou	Rockefeller Foundation
Daniel Kitwa	Africa Minigrid Developers Association
Emma Miller	Shell Foundation
Emily McAteer	Odyssey Energy Solutions
Greg Neichin	Ceniarth
Guilhem Dupuy	Gaia Impact Fund
Harry Guinness	Lions Head Global Partners
Hugh Bowring	CamCo Clean Energy

Ikenna Emehelu	Norton Rose Fulbright
Imme Rindt	Ceniarth
Jaikishin Asnani	International Finance Corporation
James Doree	Lions Head Global Partners
James Todd	Oikocredit
Lauren Cochran	Blue Haven Initiative
Leslie Labruto	Acumen
Leva Indriunaite	CamCo Clean Energy
Marius Groenenberg	Triodos Investment Management
Mark Barnett	Foley Hoag
Mathilde Girard	CDC Group
Mathilde Sirbu	Gaia Impact Fund
Maxwell Tenney	Foley Hoag
Michael Feldner	GET. Invest
Michelle de Rijk	DOEN Foundation
Nico Tyabji	Sunfunder
Olúwatóyìn Emmanuel-Olubake	Acumen
Rajen Ranchhoojee	CrossBoundary Group
Roxana Ignat	FMO
Sebastian Deschler	CrossBoundary Group
Sho Tsunoda	PowerGen Renewable Energy
Steven Hunt	Foreign, Commonwealth & Development Office
Tobias Dekkers	PowerGen Renewable Energy
Vince Knowles	Ceniarth
William Hall	N-Ellipsis
Yann Tanvez	International Finance Corporation

CBEA's open source initiative is led by Matt Tilleard, Gabriel Davies, Humphrey Wireko, Annette Mumbi, and Marlynie Moodley.

Executive Summary

We are open sourcing our investment approach for mini-grids to accelerate universal energy access in Africa

Time is running out to achieve universal energy access in Africa. Mini-grids have a critical role to play in bridging the gap. They are the least-cost method to bring electricity to over 260 million people in Africa[i]. The mini-grid sector is ready to scale and meet that challenge. But it needs *a new model of financing that allows infrastructure capital to flow into the underlying assets.*

CBEA and our partners Ceniarth, Camco Clean Energy, DOEN Foundation, Foley Hoag, Norton Rose Fulbright, PowerGen Renewable Energy, the Renewable Energy Performance Platform (REPP), Rockefeller Foundation, Shell Foundation, Standard Microgrid, and UK aid have developed an approach to allow this transformative shift in financing. But to achieve this transformation, this approach needs to be adopted widely.

CBEA PARTNERS

Shell Foundation | camco CLEAN ENERGY | PowerGen | ceniarth | ISM | STICHTING DOEN

The ROCKEFELLER FOUNDATION | REPP Renewable Energy Performance Platform | NORTON ROSE FULBRIGHT | FOLEY HOAG LLP | UKaid from the British people

Therefore, we believe "open sourcing" our approach will help accelerate universal access to electricity in Africa. We are sharing a set of tools that we co-developed with our partners to unlock access to the $1 trillion global infrastructure capital market[ii] that mini-grids need to scale.

We believe project finance unlocks the capital mini-grids need to scale. Mini-grids are infrastructure and they need long-term, low-cost capital just like other infrastructure assets. But mini-grids have been difficult to invest in as infrastructure assets. Project finance can address this. Moreover, bringing infrastructure capital into the mini-grid sector also allows developers to raise corporate financing.

We are sharing these four core components of our project finance approach for mini-grids:

1. First, term sheets for the **project contracts** that are critical to aligning incentives between Owner and Operator. We will be publishing the template term sheets on 15th February 2021.
2. Second, a **bankable project finance model,** showing the conservative assumptions required to secure long-term debt. We will be publishing the template financial model on 15th February 2021.
3. Third, what we have learnt about the **on-the-ground realities** that make implementing our structure in rural Africa challenging - contained in this document.
4. And finally, an overview of the **market and regulatory risks** that remain, even when using project finance - contained in this document.

We recognize that financing is just one innovation of many that will be required for mini-grids to fulfil their potential. However, we believe it is an important one, and we are excited by the many potential iterations and improvements on our model. We are open sourcing our model so others can use and improve on it. We believe we can converge on financing solutions to achieve SDG7, if we act swiftly, and if we act together.

PowerGen's Rakota mini-grid in Nigeria

1 Time is running out to achieve SDG7 in Africa. Mini-grids have a critical role to play, but are not yet attracting the capital they need

1. There are less than 10 years left to achieve SDG7 in Africa

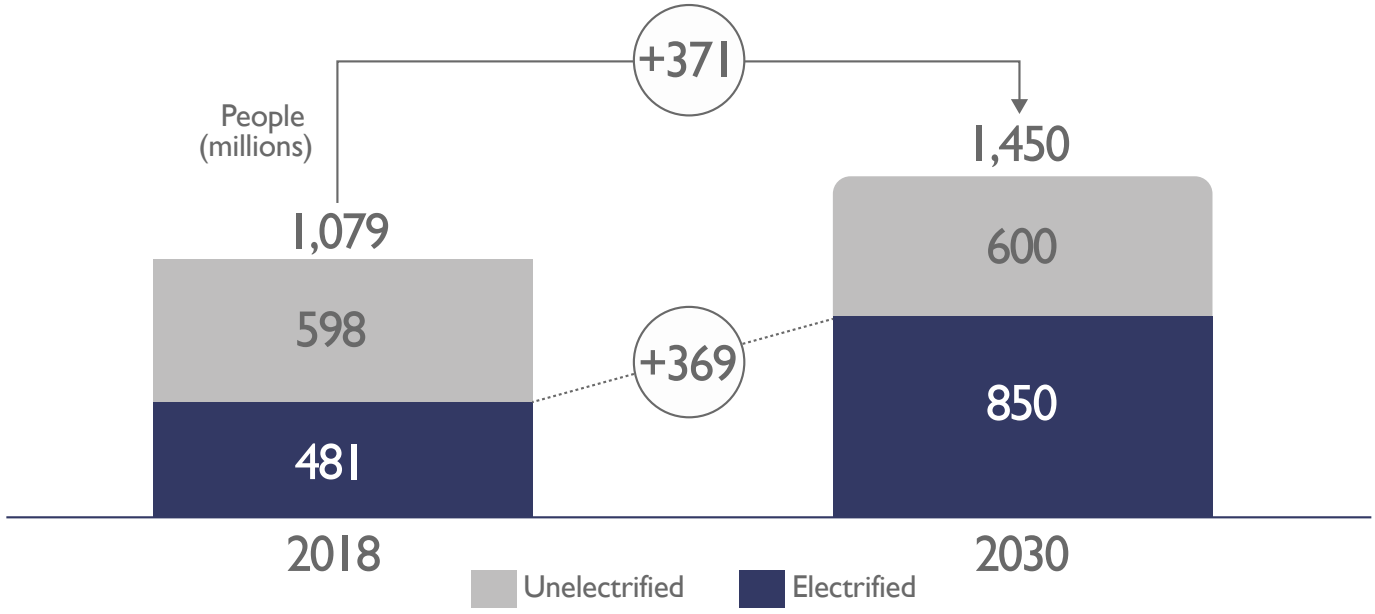
Time is running out to achieve SDG7 in Africa. There are less than 10 years left to achieve universal energy access by 2030. To date, the continent has relied largely on electrification through the main grid, which is responsible for 96% of the 481 million people with power in sub-Saharan Africa. But relying on the main grid has left 600 million people on the continent without power. And if we do not change our approach, we will never reach universal access by 2030.

At current rates, the International Energy Agency (IEA) forecasts that the number of people in sub-Saharan Africa without power – 600 million – will remain the same in 2030 as it is today[iii]. The increase in electrification will be matched by the growth in the off-grid population.

2. Mini-grids are the least cost option for over 260 million people in Africa

Mini-grids have an essential role to play in achieving universal electrification and delivering on SDG7. Today, mini-grids are already cheaper than main grid extensions for *at least* 100 million of the 618 million Africans living off-grid[iv]. And the building blocks of mini-grids are getting cheaper. A recent World Bank report[v] found that mini-grid capital costs in Africa have declined by over 50% in the last 8 years, as "the costs of key mini grid components, such as solar panels, inverters, batteries, and smart meters, have decreased by 62%–85% as a result of innovations and economies of scale in utility-scale solar projects, the booming rooftop solar industry, and the growing electric vehicle market". The International Energy Agency (IEA) forecasts that as mini-grids continue to fall in cost, they will be the least cost option for 264 million people in Africa by 2030[vi].

Exhibit 1: 600 million people will not have access to electricity in Africa in 2030. The 369 million people who will gain access is slightly outpaced by the expected population growth



3. Mini-grids are ready to scale in Africa, but are not yet attracting the capital they need

Support for mini-grids from governments, donors, investors, and utilities is gaining momentum. In June 2019, a group of investors with more than US$2 billion under management, released a public position paper[vii] stating "we believe mini-grids have a role to play in achieving universal electrification, and we have the types of capital needed for mini-grid financing". Representatives from 10 African governments - Côte d'Ivoire, Ghana, Kenya, Liberia, Nigeria, Zambia, Uganda, Zimbabwe, Tanzania, and Cameroon – echoed that call and appealed[viii] to governments, international donors and the private sector "to commit the capital required to de-risk the mini-grids sector and to do so in collaboration with international and domestic financial institutions".

Existing developers are growing, building more sites, and entering more countries. The Africa Mini-Grid Developers Association (AMDA) has grown from 7 developers at its launch in 2018, to 34 developers across the continent. PowerGen, the world's largest private sector developer with over 100 mini-grids on the continent, acquired Rafiki Power in 2019[ix], signalling the first signs of consolidation in the market. Global energy IPPs, such as Akuo Energy[x], international utility companies, such as Engie, established solar home system providers, such as BBOXX[xi], and leading telecom tower operators, such as Sagemcom[xii], have all entered the African mini-grid market. Large mini-grid programs with public funding support have launched in countries such as Benin ($40 million from MCC), Sierra Leone ($44 million from FCDO, Nigeria ($150 million from the World Bank), Zambia ($28 million from the EU), and the DRC ($39 million from the FCDO and $147 million from the World Bank).

However, despite the momentum in the sector, mini-grid companies have only managed to raise $350 million in equity over the last 8 years[xiii]. This is less than 0.1% of the $187 billion of public and private capital the IEA forecasts[xiv] needs to be mobilized into the mini-grid sector to achieve universal energy access by 2030.

II Project finance unlocks the capital mini-grids need to scale

1. Mini-grids are infrastructure. They need long-term, low-cost capital like other infrastructure assets

Infrastructure forms the basic physical systems of a nation - transportation, communication, water and power. And as the World Bank notes[xv], "Infrastructure development lies at the nexus of economic growth, productive investment, job creation, and poverty reduction."

Mini-grids are infrastructure. They have been that nexus for hundreds of millions of people, powering grain mills, irrigation pumps, and light industry throughout the history of rural electrification, from the USA in the early 1900s, rural China in the 1980s and 1990s, Cambodia in the early 2000s, and in countries like Indonesia and Mali today.

Two core features of infrastructure assets dictate what they need from the public and private sector:

1. Private Sector

Infrastructure assets require high upfront investment and generate steady returns over a long time period of 10–20+ years. This means infrastructure needs long-term, low cost capital, which in turn means reducing risk as much as possible, for as long as possible.

2. Public Sector

Infrastructure assets deliver services that are vital to a country's economic prosperity. Governments will intervene with regulation and subsidized funding to ensure critical infrastructure gets built and maintained.

As infrastructure assets, mini-grids need long-term, low-cost capital from the private sector, and regulatory and subsidy support from the public sector.

2. But mini-grids have been difficult to invest in as infrastructure assets

Mini-grids have not yet begun to seriously scale across Africa. Currently, most of the private capital supporting the growth of the sector is venture capital. But to scale, mini-grids need to unlock infrastructure capital from the natural long-term holders of infrastructure assets: pension funds, infrastructure funds, and insurance funds. Rural mini-grids' typical payback period is around 7-10 years and will only deliver double digit returns on a 15-20 year horizon. Like bridges, wind farms, and roads, mini-grids are infrastructure assets that need long-term, low cost capital, and long-term de-risked regulatory frameworks.

Project finance is often used to achieve this. Project financing fixes the risks and cash flows over a project's lifetime in order to bring risk levels down to match the long-term, low cost financing the projects require. Reliable, low risk cash flows are the objective. As far as possible, revenues and costs are therefore fixed through long-term contracts. Where not possible, revenues and costs are structured to be as predictable as possible.

"The construction and tolling of the Henri Konan Bédié Bridge in Abidjan, Côte d'Ivoire, offers a best-practice example" of infrastructure project finance at work in Africa, according to BCG and AFC in their 2017 report, *Infrastructure Financing in Sub-Saharan Africa: Best Practices From Ten Years In The Field*[xvi] .

Exhibit 2: Henri Konan Bédié Bridge in Côte d'Ivoire and Ighombwe mini-grid in Tanzania – not as different as they first appear

Henri Konan Bédié Bridge in Côte d'Ivoire

PowerGen's Ighombwe mini-grid in Tanzania

ii.Project finance unlocks the capital mini-grids need to scale

The table below sets out the three core features that infrastructure project finance typically requires from *investors*, how that was achieved in a case study on the Henri Konan Bédié Bridge, and why those requirements have been challenging for mini-grids in Africa.
A bridge is not the typical comparison for mini-grids. However, we believe it's a better mental model for investors and governments than the classic analogies comparing mini-grid financing to the aggregation of retail solar leases in the US, or a grid-connected solar park with a PPA. Mini-grids are much closer to a utility infrastructure play, and need the same kind of regulatory and financing approach. For example, most mini-grids do not have contracted cash flows *and never will*. They largely achieve cash flow certainty through the utility model: customer exclusivity and good customer service.

Exhibit 3: Investors aim to reduce risk as much as possible, for as long as possible

Infrastructure project finance requirement	Case study: how the Henri Konan Bédié Bridge achieved this	Challenge for mini-grids in Africa
1. Ring fencing the assets Project finance aims to reduce the amount of risk investors are exposed to. This is typically achieved by carefully isolating the investment of debt and/or equity to a specific set of assets and the long-term cash flows they are expected to generate. All government licenses, contracts, and physical assets are typically held in a standalone company.	The project sponsor Socoprim, a subsidiary of Bouygues, a French industrial group, formed a public limited company for the sole purpose of entering into the concession, obtaining government licenses, and developing and owning the bridge itself.	Up until now, mini-grids were typically built on developers' balance sheets. Investors cannot just invest in a specific set of assets, as they would then be exposed to all the other risks (upside and downside) that a company faces e.g. development risk, activities in other countries, different business lines, corporate overheads, etc.
2. Long-term fixed contracts Project finance fixes as many of the revenues, costs, and liabilities over the lifetime of the project as possible. By fixing the cash flows through long-term contracts over the term of the financing, it is possible to create an investment with very reliable cash flows, reducing risk and justifying the low-cost financing for the duration of the investment.	The government of Côte d'Ivoire and the holding company entered into a concession agreement with a 30-year operation period and clear mechanisms to determine how costs and revenues develop over time, after which the bridge will become government property.	Mini-grids do not sell power to large governments. They typically sell to retail consumers who are receiving electricity for the first time, which makes it difficult to fix or even predict revenues. Fixing other mini-grid costs and risks through long-term contracts is also challenging, as a lot is still unknown about how mini-grid development and operation will evolve over the long-term.
3. Scale The process of fixing and allocating all the revenues, costs, and risks over 10-20 years is an extremely time and labour-intensive process. The high fixed transaction costs to establish contracts, SPVs, and financing arrangements only work at scale.	The total investment in the Henri Konan Bédié Bridge is $365m.	Individual mini-grids are typically $200k-$500k in CapEx. Portfolios of 30+ mini-grids are therefore still well below the minimum $5m-$10m ticket size that can justify the fixed transaction costs.

Standard Microgrid mini-grid in Zambia

ii.Project finance unlocks the capital mini-grids need to scale

The table below sets out the three core features that infrastructure project finance requires from *governments,* how that was achieved in a case study on the Henri Konan Bédié Bridge, and why those requirements have been challenging for mini-grids in Africa

Exhibit 4: Governments aim to provide regulatory certainty for investors, and to ensure infrastructure reaches those who cannot afford it

Infrastructure project finance requirement	Case study: how the Henri Konan Bédié Bridge achieved this	Challenge for mini-grids in Africa
1. Customer exclusivity Investors cannot justify long-term investments if their customer revenues are at risk to a competitor.	Additional bridges can only be built with another government concession – a private company cannot start building a bridge next to the Henri Konan Bédié Bridge without lengthy approval and consultation.	Only some markets have regulation that addresses the arrival of the main grid. Mini-grids need regulation that allows for integration with and compensation from the main grid. Privately owned mini-grids often operate in a competitive environment with the utility.
2. Regulated pricing Prices are typically regulated so customers are protected, while infrastructure owners have long-term visibility on achieving a regulated return.	Bridge tolls are subject to regulation on how much they can increase each year to protect customers, while also ensuring the bridge owners achieve their regulated return. The Government publishes the tolls in an official gazette.	Mini-grid tariffs need to be cost-reflective or cross-subsidized to attract private investment, and have mechanisms to protect customers from increases. However, only some markets in Africa have well-regulated mini-grid tariffs.
3. Subsidy and/or Guarantees Infrastructure projects often deliver a public good. Where they serve people who cannot afford the full cost, governments will provide subsidies, guarantees, or low cost financing to bridge the affordability gap.	To improve the investment case, the government made two additions to the original concession agreement: a sizable subsidy of 50 billion CFA francs (approximately $81M), and a minimum revenue guarantee during the loan repayment period.	Rural households and businesses typically cannot afford the full cost to service them. Traditionally, the development of rural distribution grid infrastructure has been financed by the public sector. The World Bank estimates that main grid connections typically receive an average subsidy of ~$800 per connection. Mini-grids typically require less subsidy ($400 - $900 per connection), but few markets provide a mini-grid subsidy.

CBEA was established to address the challenges facing infrastructure investors for mini-grids in Africa. We focus on the markets with the most supportive government policy and regulations for long-term mini-grid investments. As section IV.3 shows, additional risks remain, such as change in law, FX devaluation and convertibility.

3. CBEA's project finance approach has three distinctive features that addresses these challenges: Isolate, Allocate and Aggregate

CBEA was launched in January 2019[xvii] as Africa's first project finance facility for mini-grids. The fund aims to unlock access to the $1 trillion global infrastructure capital market, by bringing in the long-term, low cost capital that mini-grids needs to scale, and to provide first-time, grid quality power to rural households and businesses in Africa.

We invest long-term equity and debt through a project finance structure to purchase mini-grid projects. In other words, 'we buy mini-grids'. Our approach to investing in mini-grids has three distinctive features: Isolate, Allocate, and Aggregate. These are directly linked to the three principles of project financing infrastructure outlined above:

1. Isolate: directly owns mini-grid assets and their customer revenues;

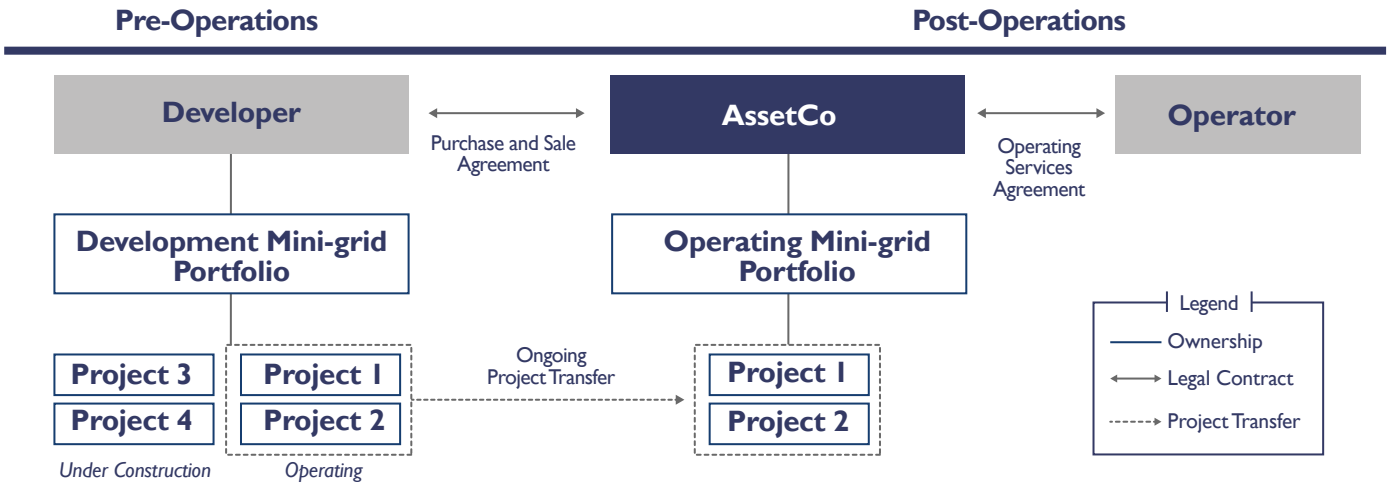
2. Allocate: all revenues, costs, and risks are allocated through long-term contracts, and;

3. Aggregate: aggregate mini-grids into portfolios, and portfolios into a much larger facility.

We ring fence the mini-grid assets by transferring them from the balance sheet of the company that develops and builds the mini-grid (the Developer). Once constructed, the mini-grids are transferred to a company created specifically to hold the assets – an Asset Company (the AssetCo). All contracts, permits, and equipment are owned by the AssetCo and we own 100% of the AssetCo. As far as possible, the revenues, risks, and costs are fixed and allocated through long-term contracts between the AssetCo, Developer, and Operator (the company that operates and maintains the mini-grids once purchased by the AssetCo). Where aspects of the business model cannot be fixed, such as customer consumption, the risks are clearly allocated between the parties.

ii.Project finance unlocks the capital mini-grids need to scale

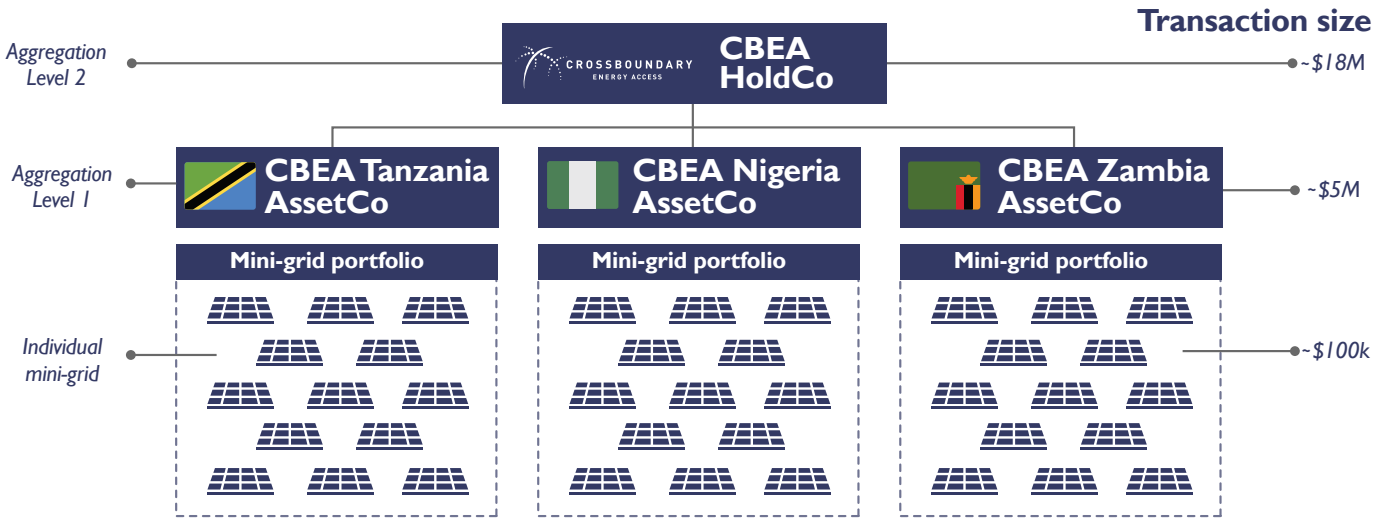
Exhibit 5: Overview - Assets are transferred from the Developer to the AssetCo



The above figure shows how the AssetCo, Developer, and Operator execute the proposed structure. Once a mini-grid has been built and is operating in accordance with standards agreed to by both parties in the Purchase and Sale Agreement **(PSA),** it is sold to the AssetCo. The AssetCo then pays the Operator to operate and maintain the grid as stipulated in the Operating Services Agreement **(OSA).** So far the Developer and the Operator are always the same company. However, in the future, we expect to see some companies choosing to specialize in either development or operations, and differen t companies taking on the role of Developer and Operator, as selected through competitive bidding.

To achieve scale, CBEA aggregated multiple AssetCos into a single investment platform – a HoldCo - that is large enough to raise equity and mezzanine debt from investors.

Exhibit 6: CBEA uses two levels of aggregation to create large transaction sizes and diversify risk



By structuring its mini-grid investments on these three principles - Isolate, Allocate and Aggregate – CBEA has been able to raise long-term infrastructure capital on 10+ year tenors.

Exhibit 7: CBEA structures its mini-grid investments so they satisfy the three features that infrastructure investors require

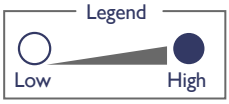
Infrastructure requirement	How CBEA's structure achieves this for mini-grids in Africa
1. Ring fencing the assets	Isolate: The AssetCo holds and isolates all the project assets - customer contracts, land leases, permits, physical equipment, IP rights – and nothing else. If the operator walks away or goes bankrupt, the assets remain with the AssetCo, and a replacement can be found for the long-term operating contract.
2. Long-term fixed contracts with incentives	Allocate: Risks and costs prior to commissioning and sale are allocated through the Purchase and Sale Agreement (PSA), and risks and costs after commissioning and sale are allocated through a long-term Operating Services Agreement (OSA).
3. Scale	Aggregate: Aggregating projects into AssetCo's, and AssetCo's into a financing platform creates the scale needed.

CBEA's first transaction[xviii] on this basis was with PowerGen Renewable Energy and the Renewable Energy Performance Platform (REPP) in Tanzania. CBEA committed $5.5m to purchase 60 mini-grids as PowerGen constructs them, after which PowerGen steps into a long-term OSA. CBEA's pilot fund is aggregating this transaction with two further transactions to commit a total of $18M in committed capital.

4. Bringing infrastructure capital into the mini-grid sector also allows developers to raise corporate financing

The difficulties in raising infrastructure capital explains why mini-grid developers have struggled in general to raise any kind of financing. The three phases in the life of an infrastructure project have different risk levels and timelines.

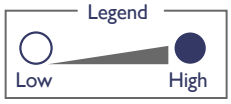
Exhibit 8: The activities to move infrastructure forward decrease in risk from development to operations



	Development	Construction	Operations
Activities	Strategy, head office setup, R&D, surveying, permitting	Procurement, transport, building, contracting, commissioning	Repairs, maintenance, revenue collection, customer service
Risk			
Tenor	 1-5 Years	 6-18 Months	 15+ Years

Each phase requires capital tailored to the risk and tenor. There is no single type of finance that is well-suited to all 3 phases for mini-grids.

Exhibit 9: Development, construction, and operations each have specific types of capital that match their risk-return profiles

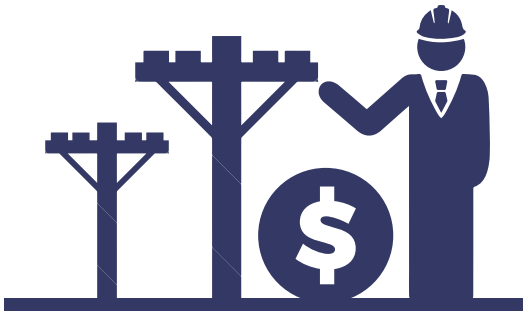


	Development	Construction	Operations
Ideal Capital	VC, growth equity	Construction finance	Construction finance
Blended Return	25-35%	15-20%	10-15%
Tenor	1-5 Years	6-18 Months	15+ Years

However, infrastructure capital has been difficult for most mini-grid companies to find for the reasons outlined above. Without a foreseeable exit, construction financiers have not been able to consider investing in mini-grids. Developers have therefore had little choice but to fund all activities – regardless of risk and tenor – from one bucket of finance.

CBEA's approach aims to solve this. When there is a clear mechanism for recycling capital on commissioning, mini-grids can raise construction finance and developers can focus on what they do best – develop, build and operate mini-grids. When developers can focus on developing, building, and operating mini-grids, they can be more effective in running their business and improving their business model. This means developers can deliver on the risk/return requirements of a VC or PE investor.

The tables above represent a simplified picture of infrastructure financing. Construction and Operations may be combined in the future as mini-grid companies develop a track record of constructing projects to time and budget, and some investors will only view the Operations phase of mini-grids as lower risk once they see mini-grids with 10+ years of good operating data.



When developers can focus on developing, building, and operating mini-grids, they can be more effective in running their business and improving their business model

III CBEA is sharing the core components of our project finance approach for mini-grids

"…the investment gap in infrastructure is not the result of a shortage of capital. Real long-term interest rates are low, there is ample supply of long-term finance, interest by the private sector is high, and the benefits are obvious."
G20 taskforce on increasing infrastructure finance, 2017[xix]

The throttle on capital flowing into mini-grids is the same as it is for infrastructure in general. It is a lack of bankable projects, not a lack of available capital. Our approach to structuring bankable mini-grid projects has allowed us to raise long-term, low cost equity and debt. It is only one step in the right direction, and we believe that by sharing the core components of that approach, we can support others to take that step too. More importantly, it will enable others to build on our approach, iterating and improving on our initial model to create more bankable projects and attract more capital to the sector.

To this end we are sharing:

1. The term sheets for the project contracts that are critical to allocating risks and aligning incentives between Owner and Operator.
2. A bankable project finance model, showing the conservative assumptions required to secure long-term debt.
3. An evaluation of the risks, including the market and regulatory risks that a project finance structure cannot mitigate by itself.
4. What we have learnt about the on-the-ground realities that make implementing project finance on mini-grids in rural Africa challenging, and how to mitigate them.

The section below covers these four components in more detail. The term sheets for the project contracts in (1) and the underlying financial model in (2) will be shared separately in the first quarter of 2021.

1. Mini-grid project financing contracts must go beyond standard approaches to allocating risks between Owner and Operator

A standard project financing approach requires that all revenues, costs, and risks are allocated between the parties through long-term contracts.

As outlined above, we achieve this through two contracts:

Purchase and Sale Agreement (PSA)

This governs everything pre-commissioning, including the purchase of the grids,

Operating Services Agreement (OSA)

This governs everything post-commissioning and post-purchase.

A hair salon customer enjoying power from a PowerGen mini-grid in Tanzania

iii. CBEA is sharing the core components of our project finance approach for mini-grids

Exhibit 10: All activities, costs, risks, and revenues are allocated between the Developer and Owner through the PSA, and the Operator and Owner through the OSA

Topics covered by the PSA	Topics covered by the OSA
Project Standards • Project Sourcing • Licensing • Commissioning • Land • Technical Standards • Subsidy Programs *Acquisition* • Project Sourcing • Exclusivity • Determination of Purchase Price - Cash - Profit share • Customer Acquisition • Workmanship Warranties • Transfer of Projects • Conditions Precedent • Force Majeure *Policies* • Insurance • Intellectual Property • Environment, Social, and Corporate Governance • AML and Anti-Bribery • Health and Safety	*Fees and contracting* • Determination of Operating Fee - Fixed for Services in Scope - Revenue Share - Out of Scope • Termination Rights *Operations & Maintenance (O&M)* • Operations • Maintenance • Diesel Usage • Critical Spare Parts • Major Capital Replacement • Generation Expansion • Mini-Grid Distribution Network Extension *Customers* • Customer Service • Mini-grid Manager Training • Demand Stimulation • Tariffs • Customer Payment Collection *Reporting and Standards* • Ongoing Licensing • Warranty Claims • Uptime Guarantees • Standards of Performance • KPIs • Monitoring *Policies* • Insurance • Intellectual Property • Environment, Social, and Corporate Governance • AML and Anti-Bribery • Health and Safety

The topics above are not unique to the mini-grid sector. The allocation of these kinds of risks, costs, and revenues have many precedents in adjacent sectors such as utility-scale solar, or the telecom tower industry. CBEA is sharing term sheets for the PSA and OSA that will show that the treatment of these topics is as 'standard' as possible. In general, we've tried to follow project financing precedents. However, together with PowerGen and Standard Microgrid, we identified specific challenges to project financing mini-grids in rural Africa that require innovative contracting approaches:

1. Limited revenue track record:

Revenue forecasts play a central role in the long-term investment thesis, but privately owned and operated rural mini-grids have a limited track record. PowerGen's portfolio in Tanzania had 3 years of operating history when CBEA closed its investment in their pipeline in July 2019 - well below CBEA's 15+ year investment horizon. Most mini-grid markets will have even less operating track record.

2. Revenue growth required:

Unlike a utility-scale solar project selling power to the grid, the mini-grid investment thesis is based on the assumption that customers will steadily grow their consumption. Revenue growth is an essential part of the business model, but it's difficult to contractually guarantee.

3. Limited or no long-term off-takers:

Mini-grid customers are typically rural households and small business customers with no long-term contractual obligation to buy power from the mini-grid.

4. Multiple remote rural sites:

Rural mini-grid sites can be over 12 hours' drive away from the country headquarters. A round trip to a site can take 2 days and cost $1,000. A portfolio of many of these types of assets means centralized decision-making by a remote asset owner on O&M and customer management is inefficient, slow, and complex.

5. Small size of individual mini-grids:

Individual mini-grids are typically $100k-$500k in CapEx. Designing, diligencing, and approving investments in projects at that scale can soon become a significant proportion of the value of the project.

6. No clear point of financial close:

Mini-grid portfolios are typically built on a rolling basis, with development and licensing overlapping with procurement and construction across projects.

CBEA, PowerGen and Standard Microgrid, believe the sustainable long-term solution to these challenges is to align incentives as far as possible. The projects benefit when both parties act as if they owned the grids, and developers/operators are empowered to make decisions like owners. Devolving decision-making to Operators and their field teams also captures the huge value and knowledge that sits much closer to the customer. At its core, the mini-grid sector is a customer business. And no one knows the customers better than the teams on the ground.

iii. CBEA is sharing the core components of our project finance approach for mini-grids

Exhibit 11: Challenges to project financing mini-grids in rural Africa require innovative contracting approaches

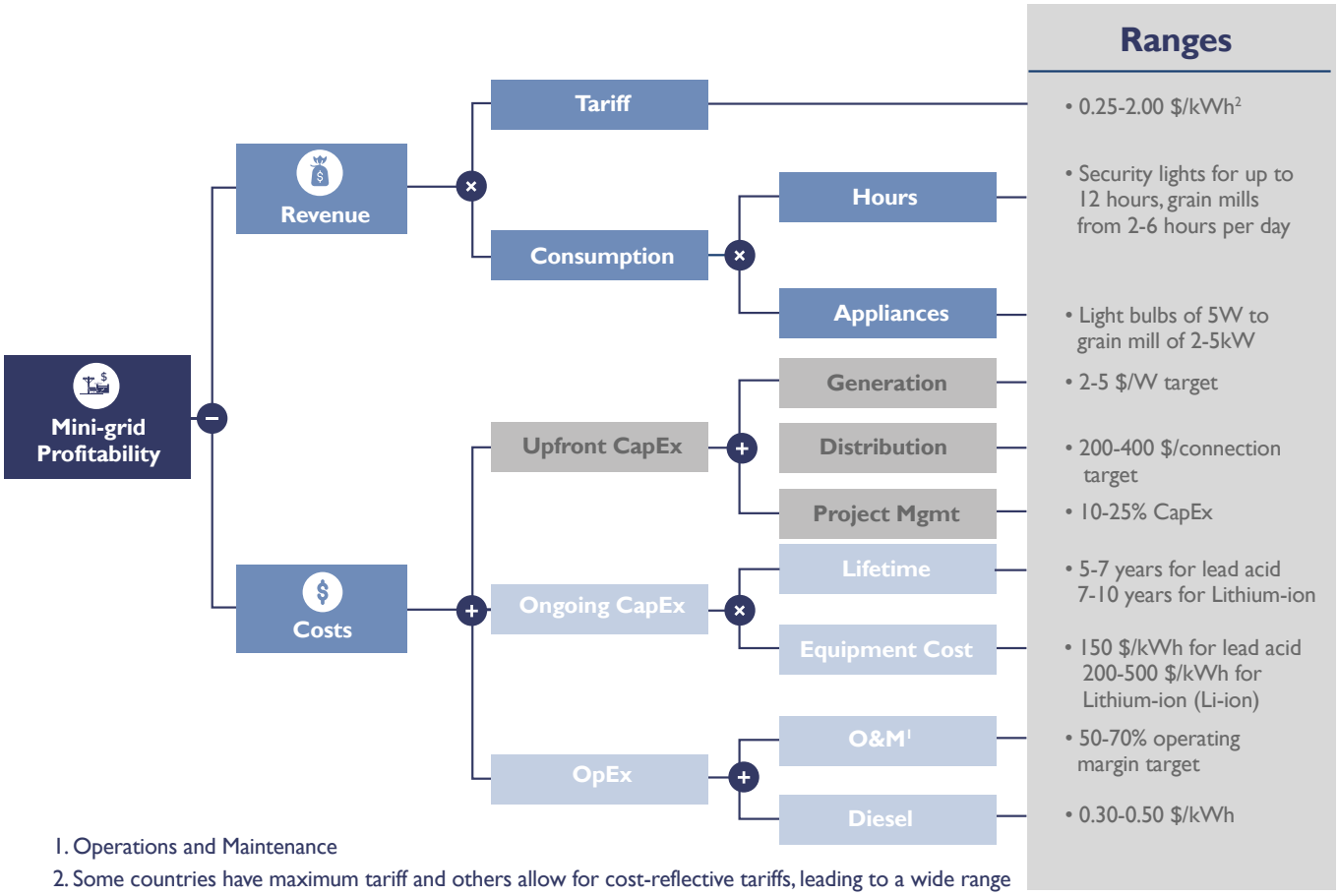
Challenge	Contract	CBEA contracting solution
1. Limited revenue track record	PSA	Average Revenue Per User (ARPU) threshold: before purchase, Developers must demonstrate actual ARPU at a low, but fixed proportion of forecast project revenues to ensure viability of connections installed. Developer premium paid as a share of distributions: on the sale of grids to the AssetCo, developers are paid cash for the CapEx. The developer premium is paid in the form of a share of the distributions from AssetCo. The developers therefore profit when they've developed sites and acquired customers that perform well over the long-term.
2. Revenue growth required	OSA	Variable Operating Fee: part of the Operator fee is in the form of a revenue share for revenue above a target ARPU forecast. This incentivizes the Operator to systematically drive increases in consumption and revenue by customers with demand stimulation activities. This should be in addition to a minimum operating fee for core grid O&M.
3. Limited or no long-term off-takers	OSA	Uptime guarantee at customer level: in the absence of a contractual obligation to buy power, the only way to ensure power sales is through customer satisfaction. Under the OSA, Operators guarantee a power uptime percentage at the customer level, measured at the smart meter. The Operator incurs penalties for every percentage point below the uptime guarantee threshold.
4. Multiple remote rural sites	OSA	Devolved O&M decision-making: operations, maintenance, and customer service decision-making is pushed down as close to the team on the ground as possible, rather than on centralized basis by a remote asset owner. The OSA gives the Operator unusual flexibility on when O&M is performed and how customer issues are resolved. Incentives are aligned through the uptime guarantee. If there are serious issues affecting power uptime i.e. half the inverters are down, the Operator is heavily incentivized to fix it to avoid losing their operating fee. For less serious issues, Operator has the flexibility to optimize trips to site to resolve them at least-cost.
5. Small size of individual mini-grids	PSA	Mini-grids are designed, diligenced and approved at a portfolio-level: CBEA diligences and approves a Project Standards Book that sets out the standards on which all mini-grids will be delivered to. Mini-grids are purchased on a 'no-objection' basis on submission of evidence that they satisfy the criteria in the Project Standards Book. This streamlines the diligence and approval process.
6. No clear point of financial close	PSA	Mini-grids are purchased on a rolling basis: CBEA commits to buying mini-grids on a quarterly rolling basis as batches of mini-grids reach commissioning. This means developers can recycle capital for each batch of completed mini-grids, rather than waiting for the entire portfolio to be completed.

Critical to enforcing these contracts, is an effective asset monitoring platform that can integrate data feeds from the inverter, mobile money aggregators, smart meters, and the developer's own operating platform. CBEA has developed an operating platform with Odyssey Energy Solutions that allows a lean team to monitor the performance of these remote assets from a central location.

2. A bankable project finance model requires conservative assumptions to secure long term low-cost debt

The mini-grid business model is driven by a few key value drivers, as the simplified business model driver tree below illustrates.

Exhibit 12: Mini-grid profitability depends on a few key value drivers

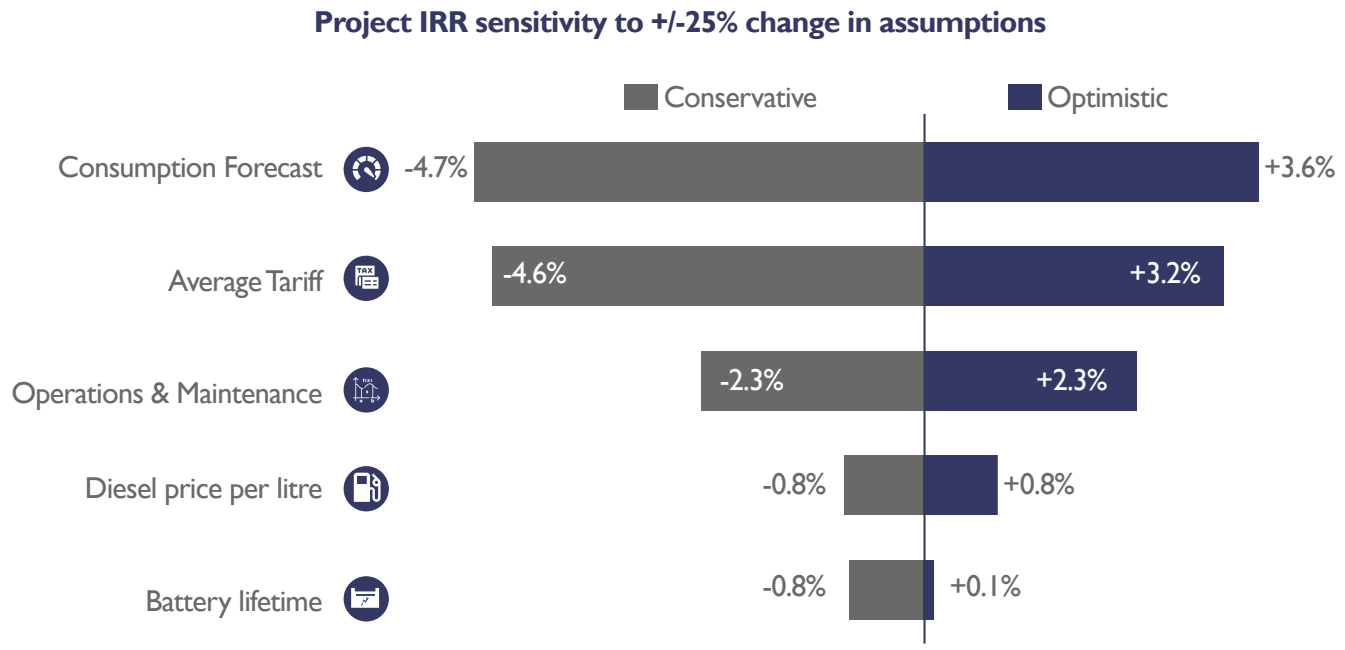


1. Operations and Maintenance
2. Some countries have maximum tariff and others allow for cost-reflective tariffs, leading to a wide range

Running a scenario analysis on the observed ranges for a few variables shows how sensitive mini-grid returns are to these drivers.

iii. CBEA is sharing the core components of our project finance approach for mini-grids

Exhibit 13: Sensitivity analysis shows that returns are highly sensitive to certain assumptions



Small variations in key assumptions have significant impacts on cash flows and project returns. A bankable project will therefore need to either:

1. Fix variables through long-term contracts, for example, fixing O&M costs for the lifetime of the financing, or;

2. Show it can service debt on a financial model set to conservative assumptions for variables that cannot be contractually fixed, for example, the price of diesel, consumption forecasts, etc.

In addition, infrastructure investors - especially lenders - may choose a slightly lower return to reduce risk. For example, lenders may require the project to pay extra for more comprehensive insurance, or pay more for batteries that have a longer and more protective warranty. One of the challenges for mini-grids, is that mini-grids projects are often structured from the perspective of developers or governments/donors. This can lead to projects which are not bankable for infrastructure investors as the table below outlines.

A technician testing one of Standard Microgrid's mini-grids in Zambia

iii. CBEA is sharing the core components of our project finance approach for mini-grids

Exhibit 14: Developers, investors, governments, and donors can take different approaches to key business model drivers

Assumption	Developer approach	Long-term infrastructure investor	Government/Donor
Consumption	Incentivized to make higher consumption forecasts, as this leads to higher valuations, and higher developer premium.	Will take a conservative long-term view as the project needs to service its debt. Projects have significant risk of default if consumption is lower than expected.	May be incentivized to believe in higher consumption forecasts, as that means projects can hit regulated returns at lower tariffs for customers, and with less subsidy.
Tariff	Will need a cost-reflective or cross-subsidized tariff, while seeking opportunities to lower wherever possible, given how sensitive customers are to price.	Largely the same as for Developer.	May allow for cost-reflective tariffs, but are under strong pressure from customers to reduce tariffs to the same level as the grid, which are generally not cost-reflective in Africa. Cross-subsidy programs are available, but only to public utility run mini-grids.
CapEx and grid sizing	Sizes generation and distribution capacity to service the near-term consumption forecasts. This minimizes the amount of Developer's balance sheet tied up in upfront CapEx.	Sizes grids based on the term and availability of financing. Project debt for mini-grids typically has an initial 1–2 years availability period where capital investments are funded by a significant portion of low-cost debt. Later expansions are financed out of equity cash flows which are more expensive, or requires additional finance to be raised. Project financiers may therefore favor sizing grids to meet consumption for the term of the financing.	Variable
Diesel	Diesel can help reduce CapEx investment in solar and batteries by providing flexible power that can be used when it's cloudy, or there are demand spikes (e.g. on market days).	Aims to minimize diesel use even when beneficial from a simple project returns perspective. If diesel is a major line item in the cash waterfall, then investors are exposed to significant risk of oil prices over the 10–15 year investment period. Preference is to use low cost capital to invest in more solar and batteries upfront.	Donors typically put heavy pressure or outright restrictions on diesel for climate change reasons.

Assumption	Developer approach	Long-term infrastructure investor	Government/Donor
OpEx	This is the greatest unknown for mini-grid operators who are still scaling their businesses. Will seek flexibility in operating contracts to match their actual costs.	Aims to lock operating and maintenance costs as much as possible, as this is a major cost paid out at the top of the cash waterfall.	Inclined to believe low operating cost forecasts and push operators to state low operating costs in order to minimize tariffs
CapEx – choice of battery	To date, most Developers have chosen lead acid batteries as they have a much cheaper upfront cost. However, lead acid batteries typically come with warranties of only 1–3 years. Many developers are now switching over to Lithium Ion (Li-ion).	Even if lifetime cost is slightly higher, investors may prefer to pay for the longer warranties (8–10 years) and operational simplicity of Li-ion and lower environmental liability.	Preference for batteries with lowest environmental impact.
Insurance	Higher risk tolerance and the need to preserve cash means developers may operate with minimal coverage.	Investors will look for comprehensive cover, especially to ensure projects can make quarterly debt payments, for example, including cover that makes provision for flooding, etc.	N/A

CBEA is sharing a bankable financial model and model guide with the flexibility to evaluate a project's ability to service debt and deliver equity returns under hundreds of combinations of these critical assumptions. This can be a valuable tool for both developers and investors to understand the viability of a mini-grid portfolio, and the key drivers of profitability. They can then use the model to make decisions on how to best structure a bankable mini-grid portfolio that can attract infrastructure finance.

3. Project finance reduces many mini-grid risks, but market and regulatory risks remain

CBEA classifies risks into four categories: 1. Business model, 2. Financing, 3. Regulatory, 4. Developer/Operator. The risk matrix below evaluates risks as either low (green), medium (yellow), or high (red).

Exhibit 15: CBEA's project finance structure mitigates risks in green. Yellow and red risks remain

Risk Category	Risk Type	CBEA Mitigation	External Mitigation
Business Model	Construction	Invest at fixed price on commissioning	N/A
	Operation	Penalties in Operating contract for poor grid reliability	Insurance
	Customer	Operator upside sharing for customer revenues	Insurance
Financing	Subsidy	Invest on commissioning when subsidy secured	Engage donors and government on subsidy design
	Private Capital	Raise large tickets at tthe holding company level	N/A
	FX	Assume ongoing currency depreciation	Local currency debt, affordable FX hedging
Regulatory	Tariff & Permiting	Commit capital once tariff and permits secured	Engage government on mini-grid tariff and permitting
	Grid Encroachment	Target markets with grid integration regulation	Engage utility/government to coordinate grid expansion
	Tax	Invest with conservative view on tax exemptions	Engage government/tax authority on exemptions
Developer/ Operator	Incentive Alignment	Profit sharing and revenue share	N/A
	Performance	Standards contractually enforced	N/A
	Termination	Operating contract is a standalone commercial contract	N/A

PowerGen's Rakota minigrid in Nigeria

iii. CBEA is sharing the core components of our project finance approach for mini-grids

Mitigating three of the four 'red' high-level risks mainly lies in the hands of governments and donors. The sector has seen otherwise bankable projects put at risk when governments have changed import duties on solar equipment or mandated non-cost reflective tariffs, or donor-funded main grid extension programs have overlapped with mini-grid concessions.

Governments such as Nigeria have also tried to do the reverse – put in place regulation that creates bankable projects by addressing some of the key regulatory risks. Programs such as the World Bank Group's Scaling Mini-Grid initiative are also critical. They provide governments with best practice guidance on bankable contracts/regulations and risk mitigation support. Political risk insurance from institutions such as the Multilateral Investment Guarantee Agency (MIGA) also offers investors "a tool…to mitigate and manage risks arising from the adverse actions—or inactions—of governments"[xx].

Like most infrastructure investors, CBEA's finance is in hard currency. However, as mini-grids sell power to retail customers, revenues are in local currency. CBEA's approach to FX risk is to:

1. Invest in countries where regulations allow for tariff adjustments in response to FX changes.

2. Build FX depreciation into the base case financial model.

3. Invest in a basket of countries to diversify currency risk.

However, mini-grids will be able to attract far more infrastructure investors with more comprehensive FX hedging solutions. CBEA is exploring the following options: hedging with MFX or similar solutions, borrowing in local currency, insurance, or proxy hedging.

4. On-the-ground realities create challenges for implementing this project finance structure

CBEA and PowerGen have learnt many lessons about the practical challenges of implementing this structure on rural mini-grids. The table below outlines some of these challenges from the developer's perspective, and possible mitigations.

Exhibit 16: Investors can mitigate some of the practical challenges of implementing project finance on rural mini-grids

Issue	Developer Perspective	Potential Mitigation
Asset transfer friction	Transferring contracts and government licenses in these markets can be a lengthy and costly process.	Instead of being conditions precedent to investment, make certain contracts and licenses conditions subsequent to investment, dependent on lender approval. See next section for potential structural changes.
Construction Finance	CBEA's long-term take-out does unlock construction finance. However, raising additional construction finance can be a lengthy and costly process for the developer.	Create standardized construction finance facilities that developers can quickly access. Purchase mini-grids on a rolling basis to minimize the construction finance required at any one time. See next section for potential structural changes.
Developer premium not paid upfront	Paying developer's profit purely in the form of a share of long-term cash flows puts pressure on the amount of working capital they need to retain on their balance sheet.	As developers prove their grids deliver the expected returns, shift some or all of profit share upfront.
Documentation	Mini-grids have hundreds of documents, many in hard copy only.	Sign up customers electronically and use a data room. CBEA uses Odyssey Energy Solutions to do this. Standardize the assets and reporting as far as possible.
Assets are remote and complex	Hard to monitor operator and enforce contracts with many small, remote, and complex assets.	Aim to automate as much of the contract as possible in an asset monitoring platform like Odyssey Energy Solutions.

The following section outlines more fundamental changes in structure and approach that address some of the challenges above.

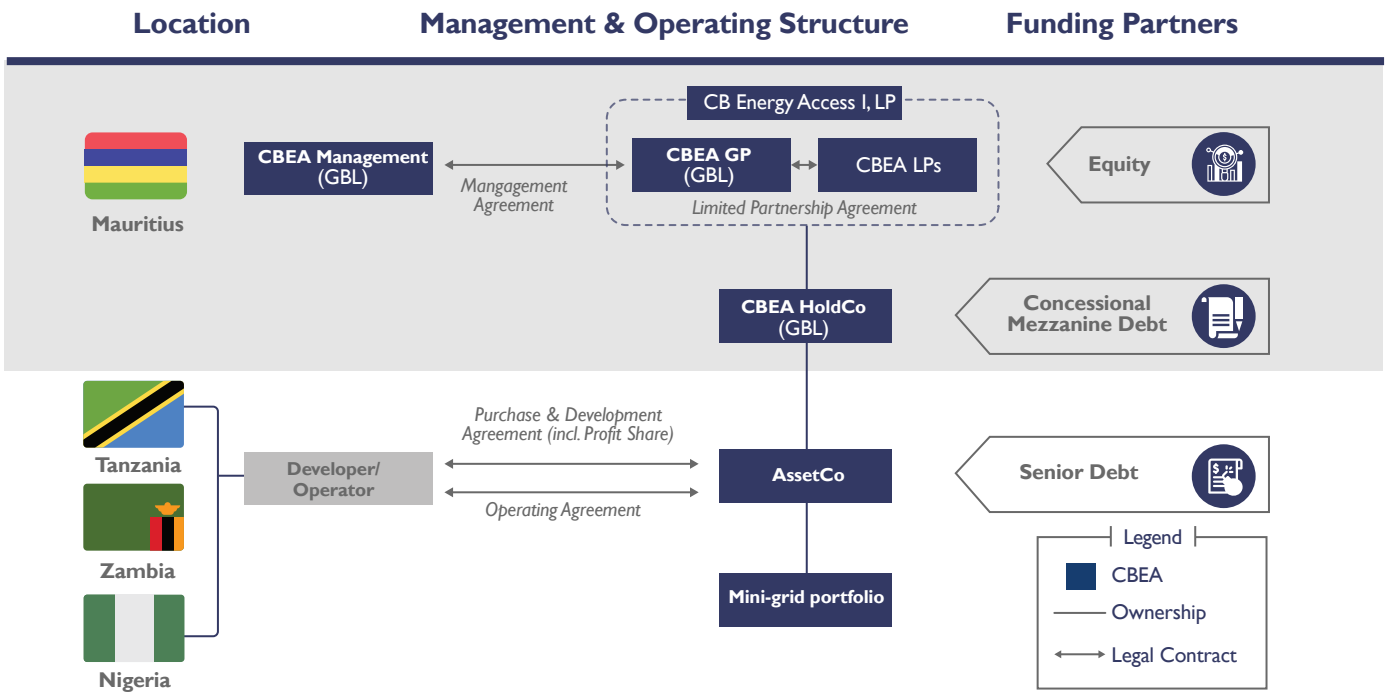
IV We see many potential iterations and improvements on the model

CBEA's approach to structuring bankable mini-grid projects has allowed us to raise long-term, low cost equity and debt. However, it is only one step in the right direction. CBEA and PowerGen see many potential iterations and improvements to our initial model to create more bankable projects and attract more capital to the sector.

1. Raising senior debt at a Holding Company level could reduce transaction costs

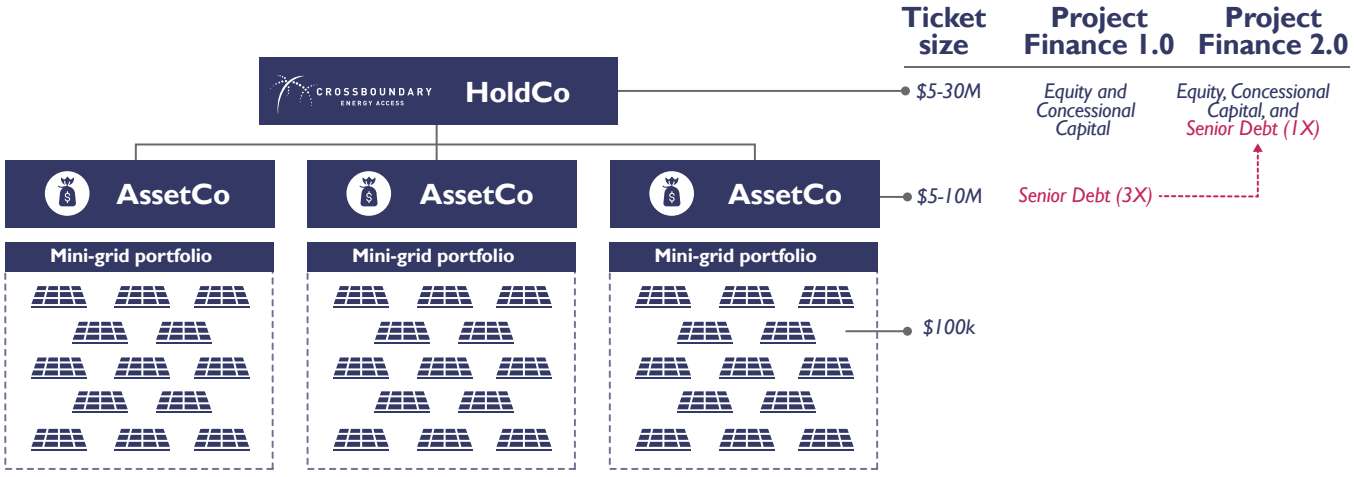
To achieve scale, CBEA aggregated multiple AssetCo's into a single investment platform - a HoldCo - that is large enough to raise equity and mezzanine debt from investors. The fixed transactions costs for the equity and mezzanine were spread across a larger asset pool, accounting for a smaller proportion of the total investment. Senior debt was raised on an AssetCo by AssetCo basis, in-country.

Exhibit 17: Project Finance 1.0. CBEA-I raised equity and mezzanine debt at a holding company level in Mauritius to increase the ticket sizes. Senior debt was raised on an AssetCo basis in-country



One iteration to this structure is to raise senior debt at a holding company level. Under a multi-country HoldCo structure, a single senior debt facility agreement is negotiated once. The transactions costs for raising senior debt does not scale linearly with project size. The transaction costs for a $60M deal are not 10x the transactions costs for a $6M deal. CBEA's internal and external transaction costs for the senior debt in Tanzania were a relatively significant proportion of the $3M debt facility.

Exhibit 18: Project Finance 2.0. Raising senior debt at a HoldCo increases the ticket size from $5-10M to $15-30M and reduces the transaction costs – which for large DFIs can be over $500k per transaction



Working on a $30M debt ticket is forecast to increase transaction costs to $500k. This reduces the proportion of fixed transaction costs to a more sustainable level – only 1.6% of the $30M debt facility and provides risk diversification for the lenders.

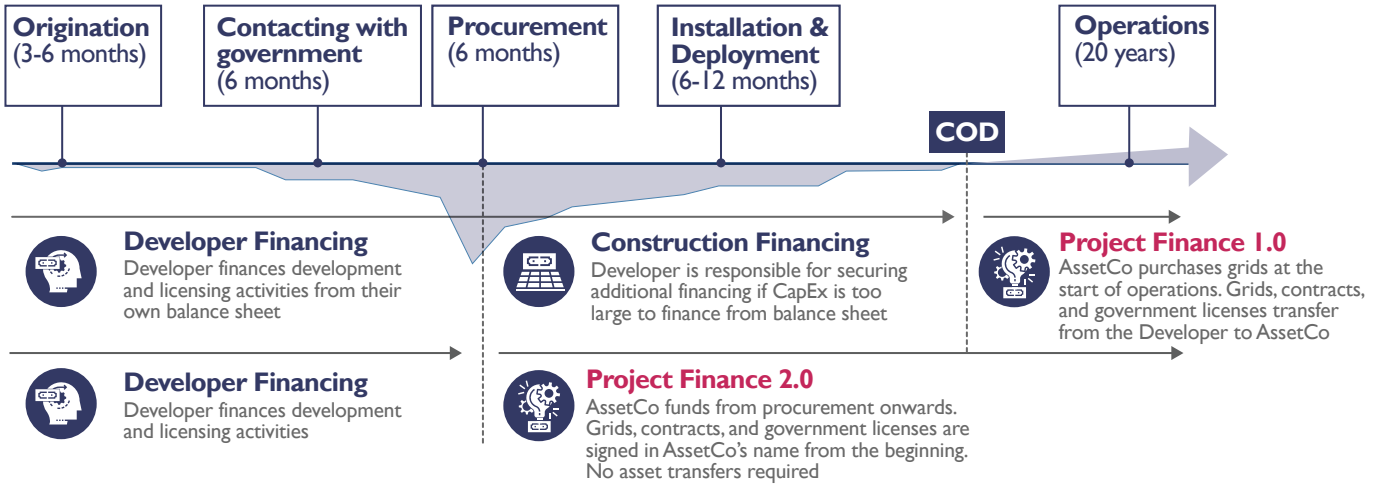
2. Investing from procurement onwards could eliminate the costs of raising additional construction finance and transferring assets

CBEA-I purchases grids only once they reach operations, transferring the assets from the Developer to the AssetCo in-country. However, PowerGen highlighted that purchasing and transferring operating assets can add cost and time for developers. This is due to the friction of transferring contracts and government licenses, and the additional work to raise construction finance. Beyond the mitigants suggested above, one structural solution PowerGen proposed is for all grids, contracts, and government licenses to be under the AssetCo from the beginning, and for the Owner to fund, from procurement onwards. This would avoid the need for asset transfers, or additional construction finance to be raised.

This is the approach that InfraCo Africa adopted for its investment in Sierra Leone with PowerGen. A project company, Off-grid Power was formed to develop, construct, commission - as well as own and operate - a portfolio of solar, battery, diesel hybrid mini-grids serving up to 12,500 customers across the southern and eastern half of Sierra Leone[xxi].

iv. We see many potential iterations and improvements on the model

Exhibit 19: PowerGen developed a project timeline and cash flow visualization that shows how a project financier could come in earlier in the mini-grid lifecycle



However, this brings its own challenges. The Owner takes on a much stronger governance and oversight role during development and construction, and must resource their team accordingly, or the Developer offers a full EPC wrap and takes the risk on development and licensing.

3. Regearing throughout the lifetime of a mini-grid portfolio could optimize use of capital

Mini-grids are infrastructure. But they have two big differences from a typical renewable energy infrastructure project like a solar farm with a long-term power purchase agreement (PPA). These differences mean that regular re-financing of the debt is likely required to optimise long-term equity returns.

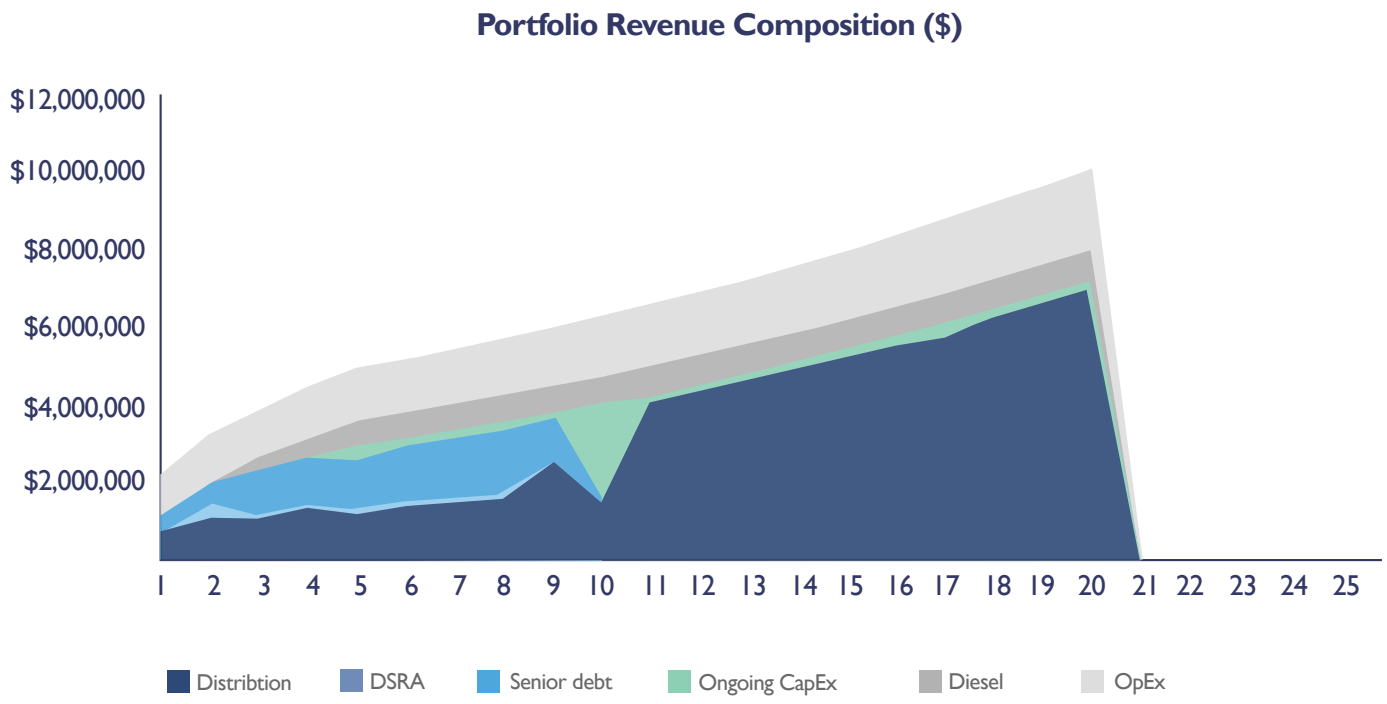
Exhibit 20: Mini-grids have different cash flow profiles to solar farms due to their revenue growth and ongoing CapEx needs

Infrastructure Asset	Revenue Growth	Ongoing CapEx
Solar farm with long-term PPA	Low or no growth in the amount of power sold. Only revenue growth will be in any allowed escalations in tariff.	Ongoing CapEx limited to replacement of minor capital items.
Mini-grid portfolio	Relatively high growth forecasts as first-time rural households and businesses use increasingly more electricity.	Large capital investments required through the lifetime of the project. Replacement of batteries can equal 10% of the initial capital investment, and grid expansions up to 30% or more.

Mini-grid portfolios are therefore more like ports, which have a strong growth story and ongoing investment obligations and opportunities. Port operators, like mini-grid operators, take a much more active role in driving revenue by offering more value to customers. Ports often target revenue growth at a 2x index to GDP growth. Even markets with slower growth like the EU can therefore expect revenue growth of 4% a year. To deliver the increase in demand, port owners will regularly invest in expansions and upgrades to the port infrastructure. This combination of revenue growth and ongoing CapEx means a single tranche of long-term debt at the beginning of the project is unlikely to optimize equity returns.

iv. We see many potential iterations and improvements on the model

Exhibit 21 Project Finance 1.0: The breakdown of revenue shows that a typical mini-grid portfolio can expect strong revenue growth of 2% a year and significant capital investments required over its lifetime



The graph above shows the breakdown of revenue for a sample mini-grid portfolio of 30,000 connections. The portfolio has been financed by a combination senior debt and equity. The light blue represents the senior debt being repaid over the first 10 years. The light green represents the ongoing CapEx requirements: expanding generating capacity to serve the growing consumption, and the replacement of batteries and inverters expected in year 10. The levered equity IRR is 11%.

Equity returns can be further optimized by 1. releasing equity as revenue growth is achieved and 2. maintaining a lower weighted average cost of capital (WACC) for any ongoing investments. This is how private port operators optimize their financing.

Exhibit 22: DP World, one of the owners of the Port of Maputo in Mozambique, regularly refinances to maintain a Debt/EBITDA ratio of 2.5x to 4x

The port of Maputo in Mozambique

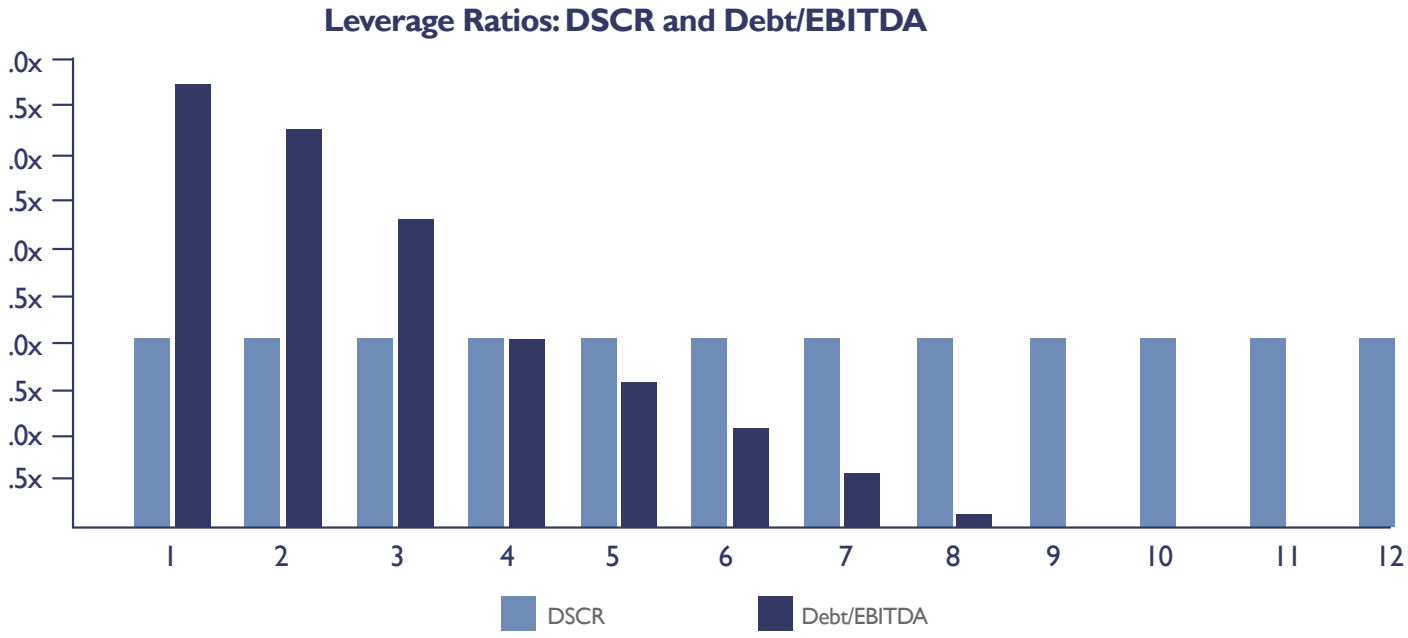
iv. We see many potential iterations and improvements on the model

A good example of a private port operator in Africa, is the port of Maputo in Mozambique[xxii]. The port is managed by the Maputo Port Development Company (MPDC), a Mozambican-registered joint venture. One of the joint venture partners in MPDC is Dubai Ports World (DP World). DP World manages a portfolio of 80 operating marine and inland terminals globally[xxiii]. DP World regularly refinances to optimize its use of debt. For example, in 2018 DP World raised $3.3bn of new long-term finance to raise its Debt/EBITDA ratio from 2.5x to 2.8x, and its net debt/equity ratio from 53% to 65%[xxiv]. We recognize the limitations to this analogy. The $3.3bn was not only for the port of Maputo, and DP World is a very large, investment grade sponsor and not all of its project level debt may be non-recourse. However, we believe it's a useful, if not perfect model to compare against.

Project finance debt is often 'sculpted'. Sculpting means the principal and interest payments are set to be the same proportion, or ratio, in every year of the Cash Flow Available For Debt Service (CFADS). This helps match the size of the debt payments to the cash flows. For mini-grids this means sculpted principal payments steadily increase over time as revenue grows, except for years where major CapEx replacement is expected. Payments are calculated and set in a financial model according to the Debt Service Coverage Ratio (DSCR) metric. Debt payments calculated on a DSCR of 2.0x means that in every year, the principal and interest due will be the expected cash flows available for debt service divided by 2.0.

However, as the graph below shows, the revenue growth and ongoing capital needs of mini-grids means that even well sculpted debt soon falls below optimal levels from a Debt to EBITDA perspective.

Exhibit 23 Project Finance 1.0: High revenue growth means that even with well sculpted debt, the portfolio is under-leveraged after year 5. Debt/EBITDA drops to 2x below typical infrastructure levels by year 5

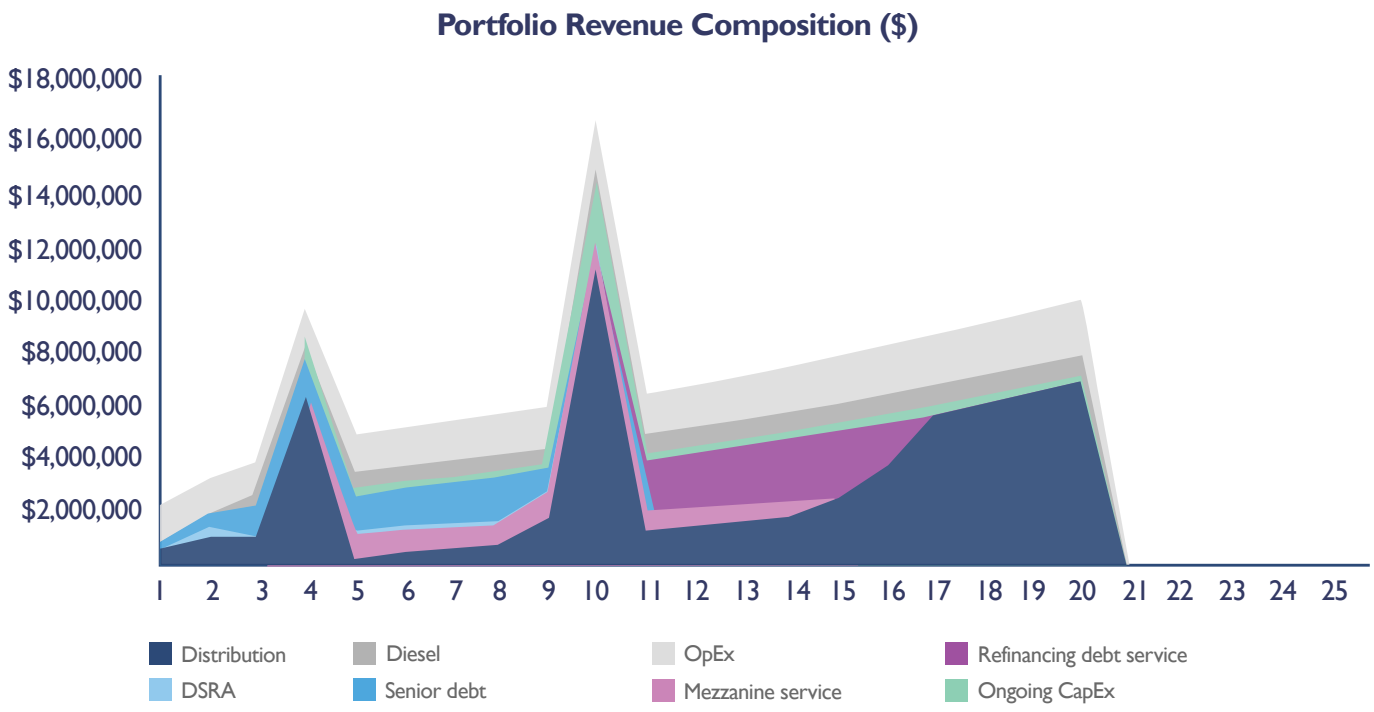


EBITDA is a close proxy to cash flow available for debt service. For a given year, Debt/EBITDA is the ratio between the amount of debt outstanding, divided by EBITDA. When the ratio is low i.e. below 2-3x, it means the project is generating a lot of cash relative to the amount of debt it is holding on its balance sheet. The portfolio has additional capacity to borrow through refinancing existing debt, or layering in additional subordinated debt.

PowerGen's Rakota mini-grid in Nigeria

iv. We see many potential iterations and improvements on the model

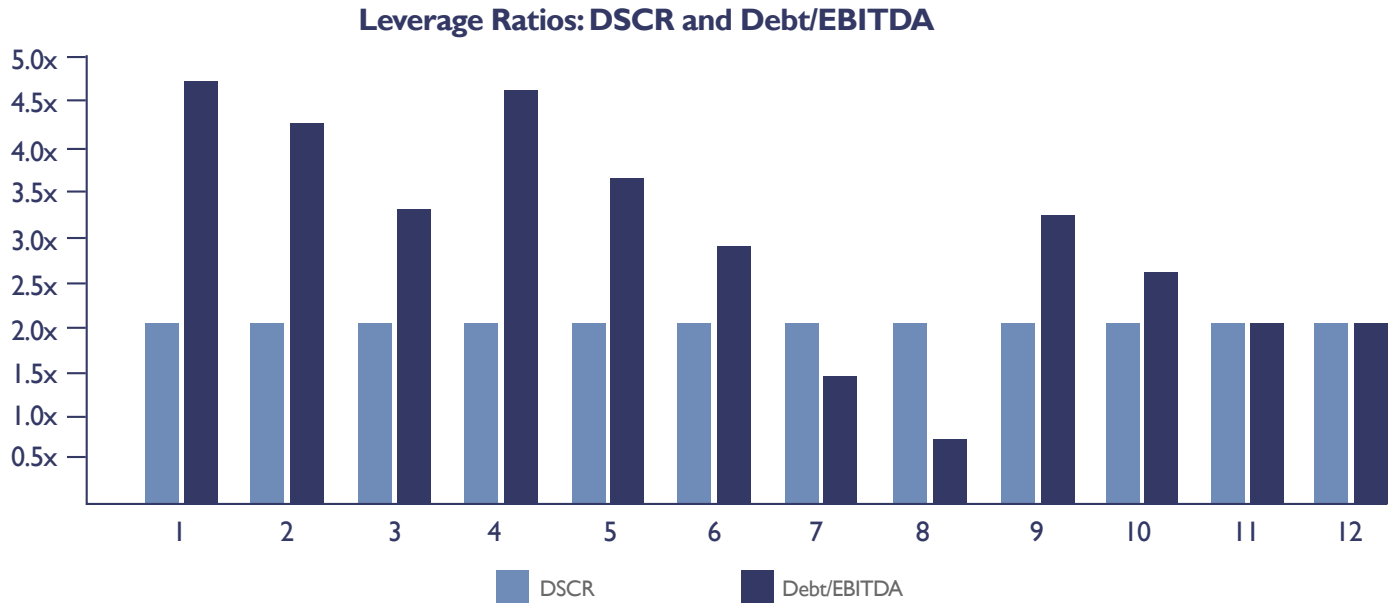
Exhibit 24 Project Finance 2.0: Regearing throughout the lifetime of the portfolio releases equity as revenues grows



The graph above shows the same mini-grid portfolio, but with two debt financings: a mezzanine debt financing in year 5 (lilac) and then a refinancing of the senior debt year 10 (purple). The two spikes show the impact of the refinancing on cash flows. Both re-financings allow for a significant release of cash to equity (navy blue).

These re-financings allow for cash to be released to equity earlier because the portfolio was underleveraged – it was not optimizing its use of debt. The graph below shows that re-financing helps keep the Debt/EBITDA ratios within optimal 2x–4.5x levels for infrastructure assets. The consistent and growing revenue allows the project to be refinanced, with some debt replacing equity. The risk-bearing initial equity investors are provided with a partial return of capital.

Exhibit 25 Project Finance 2.0: Regearing throughout the lifetime of the portfolio returns leverage ratios to optimal levels – typically above 2x on Debt/EBITDA



Most importantly, the regearing has increased the equity IRR by 4 percentage points from 11% on a single debt tranche, to 15% with regearing in year 5 and year 10 respectively.

While it can optimize equity returns, refinancing does come with significant risks, and the transaction costs and complexity may only make sense at the Holding Company level. Owners have no guarantee on what terms they will be able to refinance 5 or 10 years into the future. Investors should be comfortable investing on downside cases where refinancing is not possible, or only possible at less favourable terms.

4. Long-term financing at scale does not just unlock infrastructure capital. It could allow for radical and innovative improvements to the mini-grid business model

Aggregating mini-grids into project finance platforms will unlock access to the long-term, low-cost infrastructure capital the sector needs. However, the scale and tenor of the financing can do more than that. It could also allow for radical and innovative improvements to the underlying business model. Improving the mini-grid business model is critical for the mini-grid sector to a) bring power to the poorest and hardest-to-reach customers and b) reduce the volume of public subsidy required to achieve universal electrification.

Long-term financing can be combined with mini-grids' long-term customer relationships in two ways.

1. Invest upfront in connections

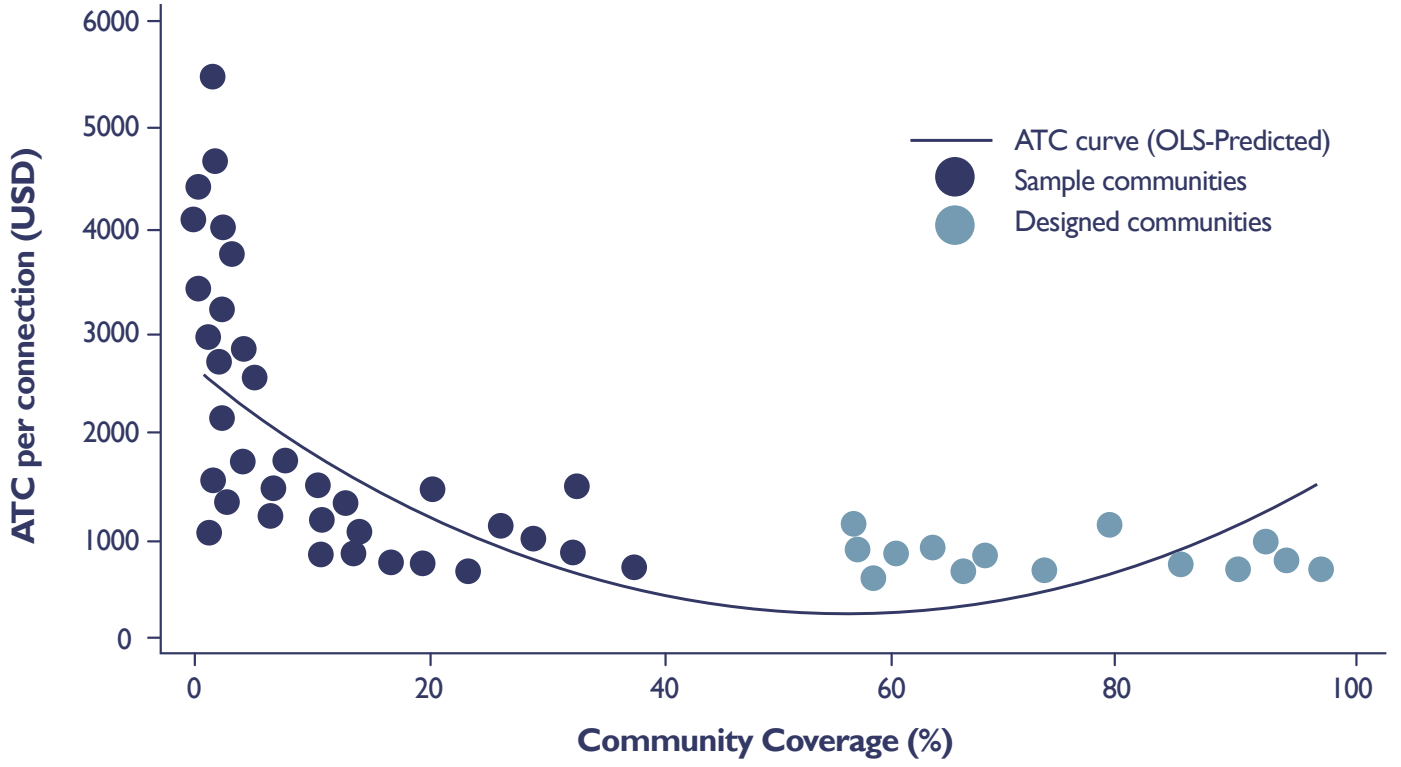
Combining long-term financing with mini-grids' long-term customer relationships could allow mini-grids to capture the best of both worlds from their two adjacent sectors: main grid electric utilities and solar home systems.

First, rural mini-grid businesses are essentially electric utilities. They engage in the generation and distribution of electricity for sale to retail customers. In a well-regulated market, a mini-grid can expect to serve its surrounding customers for a very long period of time - typically up to 15-25 years. Like main-grid utilities, mini-grids can therefore take a long-term view in investing in infrastructure for its potential pool of customers.

Typically, most mini-grid developers build their distribution networks reactively. Beyond the main trunk lines, the grid is expanded as customers pay the upfront connection fees. As customers see poles go up and their neighbours benefit from the power, confidence typically grows, and more customers will request connection. This can involve multiple trips to remote rural sites as grids double in size over their first 12-18 months. This approach makes sense for developers trying to conserve precious balance sheet capital for guaranteed customers. However, over a 12-18 month period out of a 15+ year investment period, it's extremely likely that most customers will want to be connected. It therefore makes sense for a long-term infrastructure investor to invest in the distribution infrastructure proactively ahead of customer interest. As found for main grid utilities, this can reduce the cost per connection as there will be reduced logistical costs arising from multiple trips to site, and the costs are spread over more customers. Customers may also be more likely to sign-up immediately if their connection is already in place and they just need to pay the connection fee.

Mini-grid technician in PowerGen's Nairobi workshop

Exhibit 26: A study by UC Berkeley found that the average total cost (ATC) per connection for the main grid public utility in Kenya (KPLC) decreased in line with the % of customers connected up to around 60% coverage[xxv]

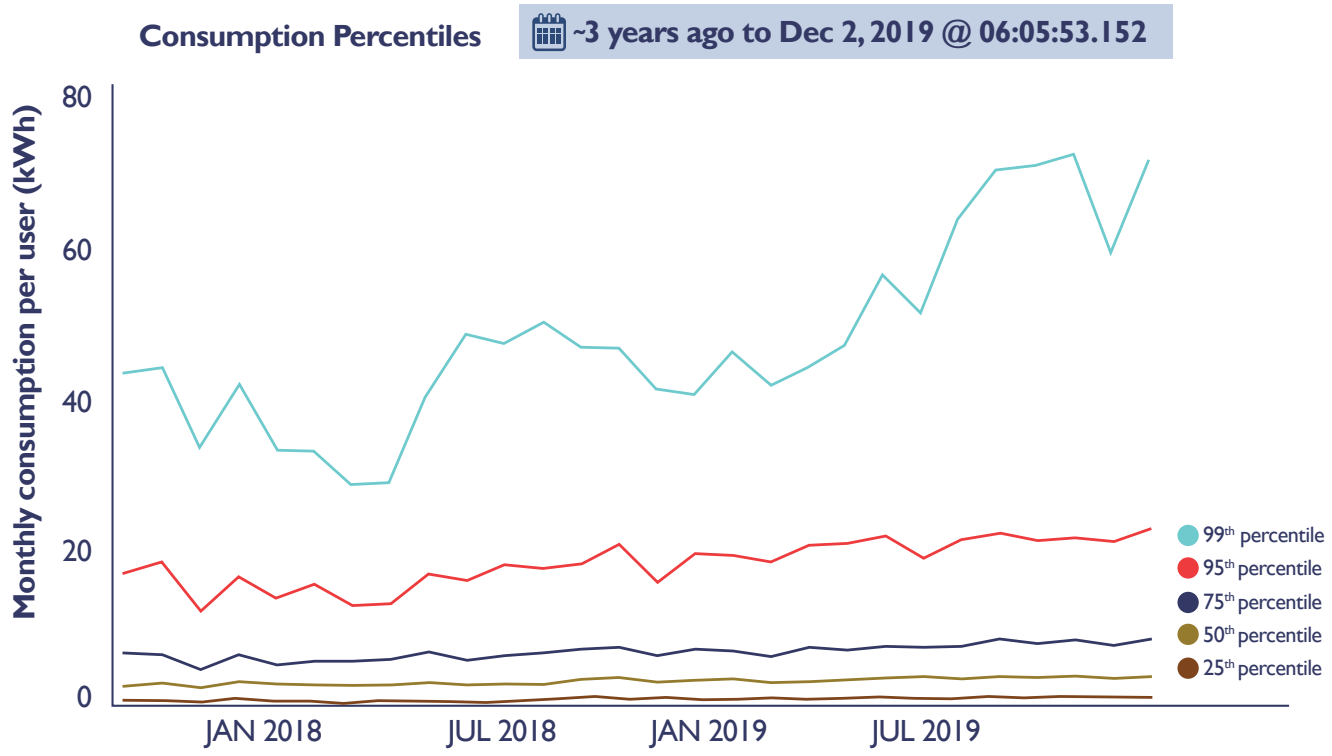


2. Include appliances in mini-grid CapEx

Second, mini-grids could adopt the approach taken by solar home system (SHS) companies and include appliances in their CapEx. Currently, a mini-grid asset starts with the solar panels and ends at the smart meter. A SHS starts at the same place - the solar panels - but ends one step further. SHS always include an appliance - from lights, to televisions, or even small fridges.

Adding productive use appliances like grain mills, machine tools etc, would increase the CapEx of a mini-grid by 5-10%, but could increase the revenues by 10–30%.

Exhibit 27: An extract from CBEA's Odyssey asset monitoring platform shows that consumption growth is driven by the large productive use customers - the 95th and 99th percentiles



There are numerous questions around the operational and contractual complexity to make this work, but the business case for an infrastructure investor to use their low-cost capital to invest in a revenue enhancing asset is compelling. In Benin, PowerGen and Sunkofa will trial this approach at scale. The precedent for using low-cost capital to finance appliances can be found at the very beginning of rural electrification. In 1934, the United States government established the Electric Home and Farm Authority (EHFA), and the Federal Housing Administration (FHA)[xxvi]. The EHFA provided low-cost and long-term financing services to consumers who bought, tested and labelled appliances. In 1945, private electrical utilities, commercial banks, and savings and loans associations rapidly adopted FHA[xxvi] style mortgage lending plans. The private utility, Consolidated Edison of New York, arranged financing for "all essential operating equipment" for homeowners. Operating equipment included appliances such as ventilation and exhaust fans, refrigerators, washing machines, irons, clothes dryers, combination heating, cooling, and water heating[xxvii]. The innovation in Africa is that private financiers and private utilities make that first leap to providing low-cost financing in the absence of a public program, given public capital is a finite and scarce resource.

Financing at scale allows for bulk procurement and major cost reduction

A final and obvious benefit for a financing platform that aggregates mini-grids to a much greater scale than a single portfolio or single developer could achieve on their own is the ability to bulk procure components and achieve economies of scale. While all the innovations above are being tested by developers and operators in the sector, more evidence is required to determine their impact on the business model. We raise these here as some of the many innovations that we continue to explore, and hope others will too.

V Conclusion: we are open sourcing our approach to mini-grid financing so others can improve on it

1. Mini-grids can attract the long-term infrastructure capital the sector needs if developers, investors, donors, and governments adapt their approach

To achieve SDG7, the IEA forecasts mini-grids are the least cost solution to bring power to 264 million people. To attract the $187 billion in capital required to achieve that, all mini-grids' key stakeholders are required to adapt their approach: developers, investors, donors, and governments. We set out below the recommendations we believe are necessary for long-term, low-cost capital to flow into the sector at scale. We separate them into Existential and Accelerators. If a market doesn't follow the Existential recommendations, we believe it is impossible for private infrastructure investors to invest in mini-grids in that market. Accelerator recommendations are recommendations that stakeholders can adopt to accelerate the flow of infrastructure capital into a market.

Exhibit 28: Recommendations for mini-grid key stakeholders to adapt their approach: Developers, Investors, Donors, and Governments

Existential	Donors	Mini-grid subsidy programs should double down on a few markets and commit to minimum programs of $100m+ for 5+ years. Entering a new market is extremely costly and timely.
		Mini-grid subsidy programs should seek formal endorsement from AMDA members and private investors committing to provide the required mini-grid pipeline and matching private capital needed.
	Governments	Government regulation must allow for certainty on long-term cost-reflective tariffs through clear, transparent and stable adjustment mechanisms, with appropriate subsidy if tariffs are set below cost-recovery levels. We recommend tariffs are subsidy neutral, whereby subsidies are sourced through reallocations of less effective subsidies where possible. Togo's reallocation of some of its kerosene subsidy to solar home systems in 2019 through the 'CIZO Cheque' is a relevant example[xxviii]. Explicit, appropriately compensated integration mechanism between main grid and mini-grids so that the main grid can benefit from the existing distribution network, and grid arrival is not value destructive for private mini-grid owners/operators.
	DFIs/Donor-Funded Lenders	DFIs and other donor-funded lenders adapt their project finance approach to the mini-grid business model, as REPP did. Examples to consider include: • There is no PPA, so no direct agreement with the offtaker. Direct agreements with EPC/O&M are important. • There is no take-or-pay, so a lender must make a view on revenue forecasts and apply more conservative debt sizing ratios. • Generally, a large portfolio of mini-grids are built over a long period of time, so availability and grace periods need to be stretched out longer than usual. • Revenue ramp-up develops over time, so sculpted debt repayment is important.

	Developers	Collaborate through AMDA on best practice to reduce costs through innovation, scale, and learning by doing. Increase availability of market data and benchmarks. AMDA's *Benchmarking Africa's Minigrids* report was a major first step. Sector-wide data on consumption trends is something that investors could rely on when assessing projects.
Accelerator	Governments	All government licensing (environmental, tariff, distribution) should be done on a portfolio basis.
	Donors	R&D funding for mini-grids should focus on converting every diesel-based appliance currently running in rural Africa to an electric version that works for solar mini-grids. As the IFC put it in their 2019 PULSE Report, "Solar powered agro-processing units do not currently match diesel units in terms of performance at any scale."
	Developers	Developers with less than 10 mini-grids should seek partnerships with large-scale operators such as other larger mini-grid developers, SHS companies, and telco tower operators. The path to operating a mini-grid business at scale is long. Equally, market entry even for experienced operators without a local partner is costly and lengthy. This has worked well in Benin, where two tender winners were partners on this basis: PowerGen and Sunkofa, and AKUO and Power-On.

2. We are open sourcing our model so others can improve on it. We can converge on financing solutions to achieve SDG7 if we act swiftly, and if we act together.

We know that open sourcing CBEA's documents will help create competing financing facilities. However, the competition this poses to our own future growth is far outweighed by the potential to achieve the goals we share with our partners: delivering affordable and reliable power for all by 2030. We also do not believe we have found the only way to finance mini-grids at scale. We share these documents on the understanding that these are versions 1.0 of mini-grid project financing. Together with our partners, we are already seeing potential opportunities to improve and iterate, and we are sure other investors and developers will do the same. There are many organizations with capabilities and resources that we do not have. As these organizations develop ways of financing mini-grids, we encourage them to also share their approaches with the sector.

References

[i]Energy Access Outlook 2017, World Energy Outlook Special Report. International Energy Agency (IEA)

[ii]Global infrastructure investment: The role of private capital in the delivery of essential assets and services. Commissioned by the Global Infrastructure Investor Association and prepared jointly with PwC

[iii]Energy Access Outlook 2017, World Energy Outlook Special Report. International Energy Agency (IEA)

[iv]CrossBoundary research: https://www.greentechmedia.com/articles/read minigrids-are-the-cheapest-way-to-electrify-100-million-africans-today.

[v]ESMAP. 2019. Mini Grids for Half a Billion People: Market Outlook and Handbook for Decision Makers. Executive Summary. Energy Sector Management Assistance Program (ESMAP) Technical Report 014/19. Washington, DC: World Bank.

[vi]Energy Access Outlook 2017, World Energy Outlook Special Report. International Energy Agency (IEA)

[vii]Unlocking Private Capital for Mini-Grids in Africa. https://www.powerforall.org/news-media/press-releases leading-investors-strongly-encourage-donors-provide-more-effective-support-mini-grids-africa

[viii]African Mini-Grids Community of Practice Meeting Berlin, Germany Communiqué. https://africaledspartnership.org/2019/06/13/ african-mini-grids-community-of-practice-meeting-berlin-germany-communique/

[ix]https://nextbillion.net/news/press-release-pan-african-micro-utility-powergen-acquires-rafiki-power-e-on-off-grid-solutions-from-e-on/

[x]http://www.club-er.org/news-events/opportunities-767.html

[xi]https://www.bboxx.com/news/tomorrows-connected-community-bboxx-unveils-vision-community-future-developing-world/
[xii]https://www.norfund.no/lighting-up-madagaskar/

[xiii]Wood Mackenzie – Power & Renewables Global Off-Grid Renewables Investment Datahub

[xiv]Energy Access Outlook 2017, World Energy Outlook Special Report. International Energy Agency (IEA)

[xv]https://www.worldbank.org/en/topic/financialsector/brief/infrastructure-finance

[xvi]Infrastructure Financing in Sub-Saharan Africa: Best Practices From Ten Years In The Field, BCG and AFC, 2017

[xvii]https://www.crossboundary.com/crossboundary-mini-grid-facility-announces-first-close-with-the-rockefeller-foundation-and-ceniarth/

[xviii]https://www.forbes.com/sites/jamesellsmoor/2019/07/17/mini-grids-are-ready-to-change-the-world-again

[xix]https://blogs.worldbank.org/ppps/preparing-bankable-infrastructure-projects

[xx]https://www.miga.org/political-risk-insurance

[xxi]https://infracoafrica.com/project/sierra-leone-mini-grid-project/

[xxii]Humphreys, Martin, Aiga Stokenberga, Matias Herrera Dappe, Atsushi Iimi, and Olivier Hartmann. 2019. Port Development and Competition in East and Southern Africa: Prospects and Challenges. International Development in Focus. Washington, DC: World Bank. doi:10.1596/978-1-4648-1410-5 License: Creative Commons Attribution CC BY 3.0 IGO
https://dpworld.ae/about-us/about-dp-world/

[xxiii]DP World Announces Robust Financial Results. Reported revenue growth of 20% in 2018. Dubai, United Arab Emirates, 14 March 2019.

[xxiv]Lee, Kenneth, Edward Miguel, and Catherine Wolfram. (2020). "Experimental Evidence on the Economics of Rural Electrification", Journal of Political Economy, 128(4): 1523-1565.

[xxv]Short- and Long-Run Impacts of Rural Electrification: Evidence from the Historical Rollout of the U.S. Power Grid Joshua Lewis (University of Montreal) Edson Severnini (Carnegie Mellon University and IZA)

[xxvi]Tobey, Ronald C. Technology as Freedom: The New Deal and the Electrical Modernization of the American Home. Berkeley: University of California Press, c1996 1996. http://ark.cdlib.org/ark:/13030/ft5v19n9w0/

[xxvii]https://www.esi-africa.com/industry-sectors/future-energy/togolese-government-approves-innovative-solar-subsidy/

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