OPEN SOURCING INFRASTRUCTURE INVESTING FOR MINI-GRIDS

CrossBoundary Energy Access (CBEA). August 2020

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I EXECUTIVE SUMMARY: WE ARE OPEN SOURCING OUR INVESTMENT APPROACH FOR MINI-GRIDS TO ACCELERATE UNIVERSAL ENERGY ACCESS IN AFRICA

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

We are open sourcing our investment approach for mini-grids to accelerate universal energy access in Africa. Time is running out to achieve SDG7 in Africa. Mini-grids have a critical role to play in bridging the gap. At current costs, they are the least-cost method to bring electricity to up to 290 million people. 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, PowerGen Renewable Energy, the Renewable Energy Performance Platform, Rockefeller Foundation, Shell Foundation, UKaid, Norton Rose Fulbright, and Foley Hoag, have developed an approach to allow this transformative shift in financing. But to achieve this transformation, this approach needs to be adopted widely.

Therefore we believe “Open Sourcing” CBEA’s approach will help accelerate universal access to electricity in Africa. To that end, 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 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 like other infrastructure assets. But mini-grids have been difficult to invest in as infrastructure assets.

We believe project finance approach addresses this. Moreover, bringing infrastructure capital into the mini-grid sector also allows developers to raise corporate financing. CBEA is sharing the core components of our project finance approach for mini-grids. First, the project contracts that are critical to aligning incentives between Owner and Operator. Second, a bankable project finance model, showing the conservative assumptions required to secure long-term debt. Third, what we’ve learnt about the on-the-ground realities that make implementing our structure in rural Africa challenging. And finally, the market and regulatory risks that remain even when using project finance.

We are excited by the many potential iterations and improvements on our model. For example, investing from procurement onwards could eliminate costs and delay of assets transfers. Re-gearing throughout the lifetime of a mini-grid portfolio could optimize use of capital. Combining long-term finance with mini-grids’ long-term customer relationships could allow for radical and innovative improvements to the business of electrification.

We are very aware that we can’t scale mini-grid project finance alone. We need your help. We are open sourcing our model so others can improve upon it. We believe we can converge on financing solutions to achieve SDG7 more quickly if we act together.

CBEA PARTNERS

Shell Foundation | PowerGen Renewable Energy | ceniarth | The Rockefeller Foundation | REPP Renewable Energy Performance Platform | Norton Rose Fulbright | Foley Hoag LLP | UKaid from the British people

II TIME IS RUNNING OUT TO ACHIEVE SDG7 IN AFRICA. MINI-GRIDS HAVE A CRITICAL ROLE TO PLAY, BUT AREN'T YET ATTRACTING THE CAPITAL THEY NEED

1. TIME IS RUNNING OUT TO ACHIEVE SDG7 IN AFRICA

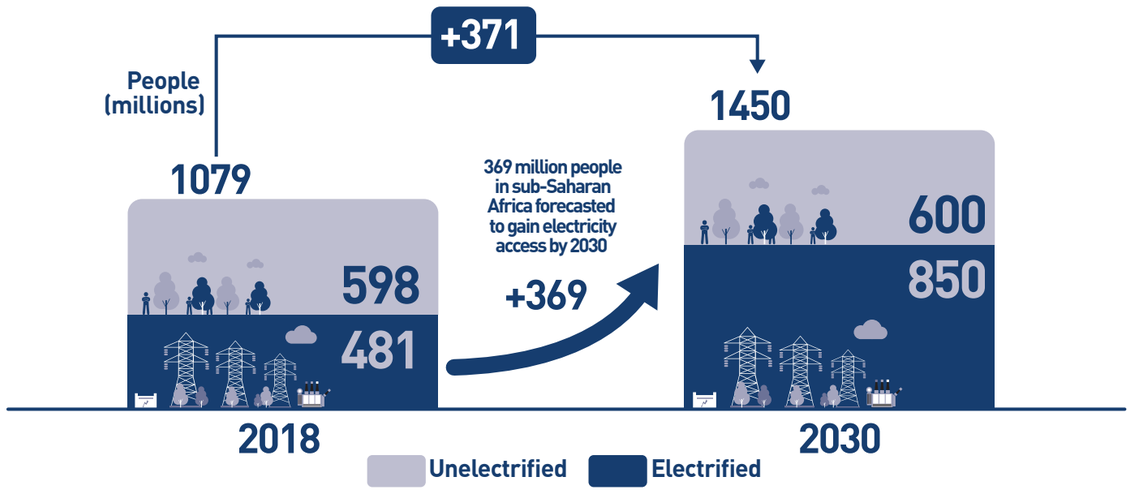
There are less than 10 years left to achieve universal energy access in Africa. To date, the continent has relied largely on electrification through the main grid, which is responsible for 96% of the 481 million people with power in sub-Saharan Africa. But relying on the main grid has left 600 million people on the continent without power. And if we don't 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. The increase in electrification will be matched by the growth in the off-grid population.

2. MINI-GRIDS HAVE A CRITICAL ROLE TO PLAY AS THE LEAST COST OPTION FOR UP TO 290 MILLION PEOPLE

Mini-grids have an essential role to play in achieving universal electrification and delivering on SDG 7. Today, mini-grids are already cheaper than main grid extensions for at least 100 million of the 618 million Africans living off-grid. And the building blocks of mini-grids are getting cheaper. A recent World Bank report 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 290 million people globally by 2030.

Exhibit X: The 369 million people in sub-Saharan Africa forecasted to gain electricity access by 2030 – a 77% increase from 2018 – is slightly outpaced by expected population growth



3. MINI-GRIDS ARE READY TO SCALE IN AFRICA, BUT AREN'T 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 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 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 28 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, signalling the first signs of consolidation in the market. Global energy IPPs, such as Akuo Energy, international utility companies, such as Engie, established solar home system providers, such as BBOXX, and leading telecom tower operators, such as SagemCom, have all entered the African mini-grid market. Large mini-grid subsidy programs have launched in countries such as Benin ($40 million from MCC), Sierra Leone ($44 million from DFID), Nigeria ($150 million from the World Bank), Zambia ($28 million from the EU), and the DRC ($39 million from DFID and $147 million from the World Bank).

However, despite the momentum in the sector, mini-grid developers have only managed to raise $180 million over the last 8 years. This is less than 0.1% of the $187 billion of public and private capital the IEA forecasts needs to be mobilized into the mini-grid sector to achieve universal energy access by 2030.

III PROJECT FINANCE UNLOCKS THE CAPITAL MINI-GRIDS NEED TO SCALE

1. MINI-GRIDS ARE INFRASTRUCTURE AND THEY NEED LONG-TERM LOW COST CAPITAL LIKE OTHER INFRASTRUCTURE ASSETS

Infrastructure forms the basic physical systems of a nation—transportation, communication, water, power. And as the World Bank notes "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 inflation-linked returns over a long time period of 10 – 20+ years. This means infrastructure needs long-term, low cost capital. This 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 subsidised 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 haven't yet begun to seriously scale across Africa. Currently, most of the 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. Mini-grids' typical payback period is around 8 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 and need long-term, low cost capital, and long-term de-risked regulatory frameworks.

This is typically only possible through project finance. Project financing is where investors ring fence a specific set of project assets and fix the risks and cashflows over a project's lifetime in order to bring risk levels down to match the long-term, low cost financing the projects require. 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.

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

III. PROJECT FINANCE UNLOCKS THE CAPITAL MINI-GRIDS NEED TO SCALE

The table below set out the three core features that infrastructure project finance 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.

Exhibit X: 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 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, government licenses, and develop and own the bridge itself.	Mini-grids are typically built on developer's balance sheets. Investors can't just invest in a specific set of assets, they're exposed to all the other risks (upside and downside) that a company faces e.g. 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 possi ble. By fixing the cashflows through long-term contracts over the term of the financing, it's possible to create an investment with very reliable cashflows, reducing risk and just fying 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 costs and revenues develop over time, after which the bridge will become government property.	Mini-grids do not sell power to large governments. They 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 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 ~$100,000 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.

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 X: Governments aim to provide regulatory certainty for investors, and ensure infrastructure reaches those who can't 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 can't justify long-term invest ments 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.
2. Regulated pricing - prices are typically tightly regulated so cus tomers are protected, while infra structure 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 to attract private investment, but have mechanisms to protect customers from increases. However, only some markets in Africa have well-regulated mini-grid tariffs.
3. Subsidy – infrastructure projects often deliver a public good. Where they serve people who cannot afford the full cost, governments will pro vide subsidies 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 $81million), and a minimum revenue guarantee during the loan repayment period.	Rural households and businesses cannot typically afford the full cost to connect them. 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. CBEA focuses on the markets with the most supportive government policy and regulations for long-term mini-grid investments.

3. CBEA'S PROJECT FINANCE APPROACH ADDRESSES THIS: ISOLATE, ALLOCATE, AND AGGREGATE

CBEA was launched in January 2019 as Africa's first project finance facility for mini-grids. The fund aims to unlocks access to the $1 trillion global infrastructure capital market, bringing in the long-term, low cost capital that mini-grids need to scale and provide first-time, grid quality power rural households and businesses in Africa.
CBEA invests long-term equity and debt through a project finance structure to purchase mini-grid projects. In other words, 'we buy mini-grids'. CBEA's 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.

CBEA ring fences 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 transfer 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 CBEA owns 100% of the AssetCo. The revenues, risks, and costs are 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).

The above figure shows how the AssetCo, Developer, and Operator execute the proposed structure. Once a 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). At this early stage of the sector, it's important to CBEA that the same company that builds the mini-grids, is the company that operates the grid. So the Developer and the Operator are currently always the same company.
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 X: Overview: Assets are transferred from Developer to the AssetCo

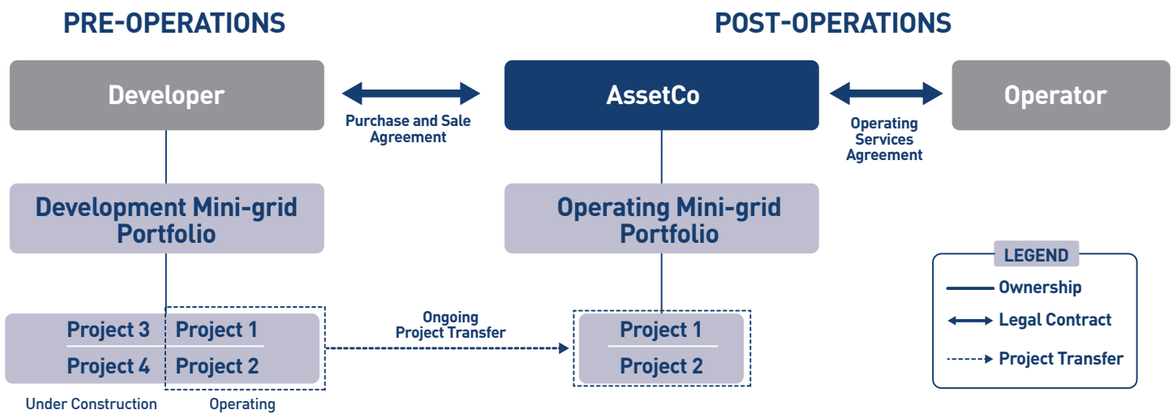
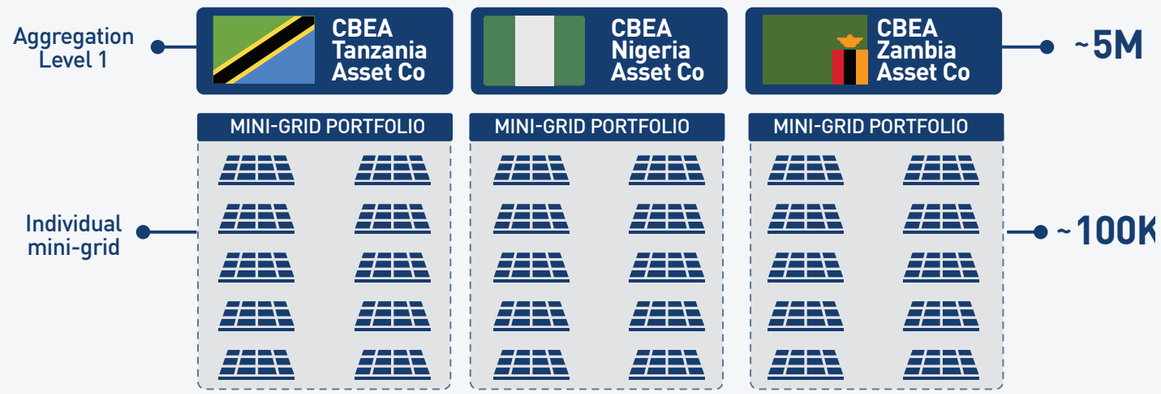


Exhibit X: CBEA uses two levels of aggregation to create large transaction sizes and diversify risk



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

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

INFRASTRUCTURE REQUIREMENT	HOW CBEA'S STRUCTURE ACHIEVES IT 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 pre-commissioning and sale are allocated through the Purchase and Sale Agreement (PSA), and risks and costs post-commissioning and sale are allocated through a long-term Operating Services Agreement (OSA).
2. Scale	**Aggregate:** Aggregating projects into AssetCos, and AssetCos into a financing platform creates the scale needed.

CBEA's first transaction 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 X: The activities to move infrastructure forward decrease in risk from development to operations

TIVITIES TO MOVE NFRASTRUCTURE FORWARD DECREASE IN RISK FROM DEVELOPMENT TO OPERATIONS	DEVELOPMENT	CONSTRUCTION	OPERATING
ACTIVITIES	Stragety, head office setup, R&D, surveying, permitting	Procurement, transport, building, contracting, commissioning	Repairs, maintenance, revenue collection, customer service
RISK	●	◑	◔
TENOR	◑ 1-5 Years	◔ 6-8 Months	● 15+ Years

LEGEND: LOW ○ ● HIGH

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

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

DEVELOPMENT, CONSTRUCTION, ND OPERATIONS EACH HAVE SPECIFIC TYPES OF CAPITAL AT MATCHTHEIR RISK-RETURN PROFILES	DEVELOPMENT	CONSTRUCTION	OPERATING
IDEAL CAPITAL	VC, growth equity	Construction finance	Infrastructure capital
BLENDED RETURN	● 25-35%	◑ 15-25%	◔ 10-15%
TENOR	◑ 1-5 Years	◔ 6-18 Months	● 15+ Years

LEGEND: LOW ○ ● HIGH

However, infrastructure capital has been difficult for most mini-grid companies to find for the reasons outlined above. Without a foreseeable takeout, construction financiers haven't 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 are more effective in running their business and improving their business model.

IV | 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*

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. CBEA's 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, but we believe that by sharing the core components of that approach, we can support others to take that step. More importantly, it allows 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've 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 also be shared separately.

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, CBEA achieves this through two contracts:

1. **Purchase and Sale Agreement (PSA):** this governs everything pre-commissioning and the purchase of the grids.
2. **Operating Services Agreement (OSA):** this governs everything post-commissioning and post-purchase.

Exhibit X: 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
Exclusivity Determination of Purchase Price · Cash · Profit share Project Sourcing Licensing Environment, Social, Corporate Governance AML and Anti-Bribery Customer Acquisition Land Technical Standards Workmanship Warranties Commissioning Transfer of Projects Insurance Subsidy Programs Intellectual Property Conditions Precedent Force Majeure	Determination of Operating Fee · Fixed for Services in Scope · Revenue Share · Out of Scope Operations Maintenance Diesel Usage Environment, Social, Corporate Governance AML and Anti-Bribery Tariffs Customer service Mini-grid manager training Critical Spare Parts Major Capital Replacement Customer Payment Collection Generation Expansion Mini-Grid Distribution Network Extension Demand Stimulation Standards of Performance Uptime Guarantees KPIs Monitoring Reporting Ongoing licensing Termination Rights Warranty Claims Insurance

IV. CBEA IS SHARING THE CORE COMPONENTS OF OUR PROJECT FINANCE APPROACH FOR MINI-GRIDS

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 'vanilla' as possible. In general, we've tried to follow project financing precedents. However, there are 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 data.

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 there is no way to contractually guarantee it.

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 ~$100,000 in Capex. Designing, diligencing, and approving investments in projects at that scale can soon become a significant proportion of the value of the project.

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

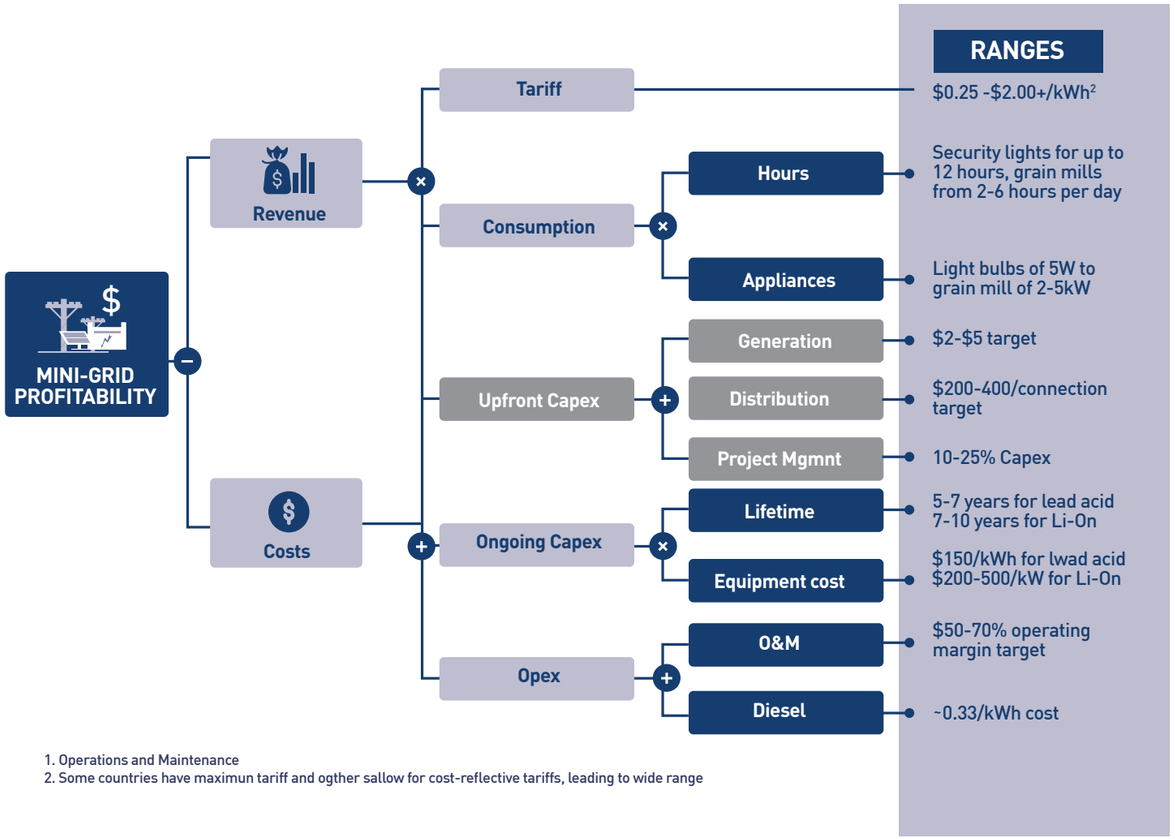
CHALLENGE	CONTRACT	CBEA CONTRACTING SOLUTION
1. Limited revenue track record	**PSA**	**ARPU threshold:** Before purchase, Developers must demonstrate actual Average Revenue Per User (ARPU) at a specific proportion of forecast project revenues to ensure viability of connections installed **Developer premium 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.
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 % 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.

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.

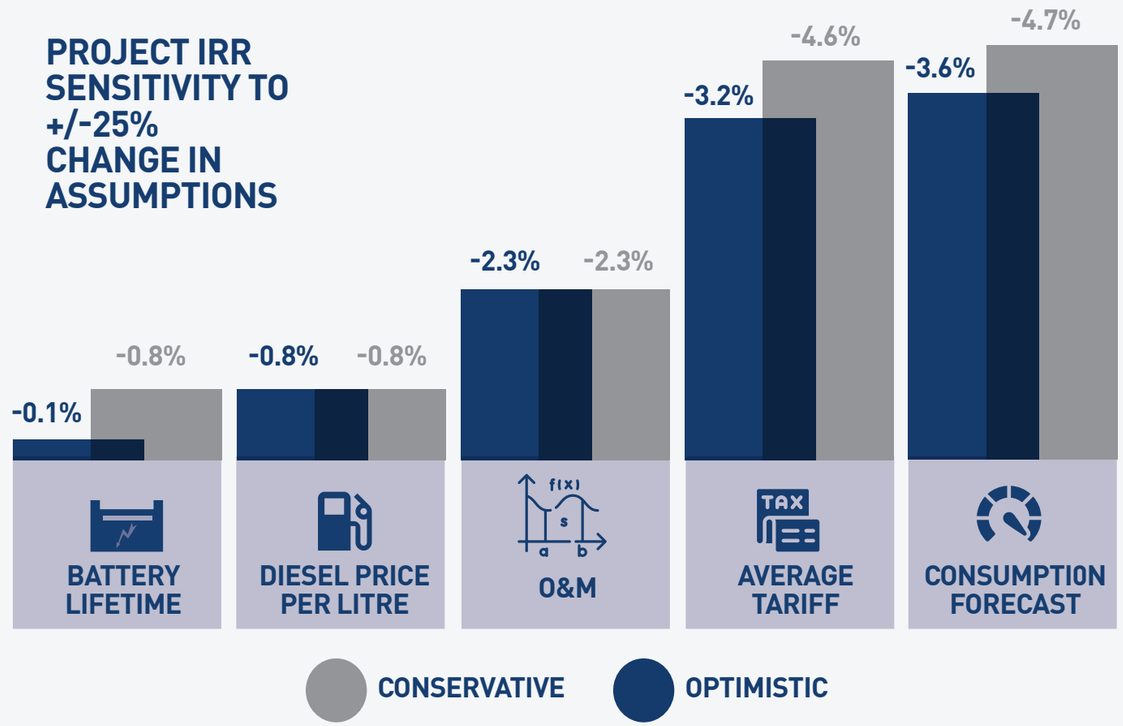
Exhibit X: Mini-grid profitability depends on a few key value drivers



1. Operations and Maintenance
2. Some countries have maximun tariff and ogther sallow for cost-reflective tariffs, leading to wide range

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

Exhibit X: 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 e.g. 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 can't be contractually fixed e.g. 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 better 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.

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

ASSUMPTION	DEVELOPER APPROACH	LONG-TERM INFRASTRUCTURE INVESTOR	GOVERNOR/DONOR
Consumption	May be 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 tariff, while seeking opportunities to lower wherever possible given how sensitive customers are to price	Largely same as developer.	Will typically allow for cost reflective tariffs, but are under strong pressure from customers to reduce tariffs to the same level as the grid. These are generally not cost- reflective in Africa
Capex and grid sizing	Will size generation and distribution capacity to service the near-term consumption forecasts. This minimizes the amount of developers' balance sheet that gets tied up in upfront capex.	Will size grids based on the term and availability of financing. Project financing will typically have an initial 1-2 years availability period where capital investments are funded by a significant portion of low-cost debt. Expansions later on are financed out of equity cash flows which are much more expensive, or require 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 cost 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).	Will aim 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.
Apex	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.	Will aim 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 not switching over to Lithium Ion (Li-On).	Even if lifetime cost is slightly higher, investors may prefer to pay for the longer warranties (8 – 10 years) and operational simplicity of Li-On and lower environmental liability.	Preference for batteries with lowest environmental impact.
Insurance	Higher risk tolerance and need to preserve cash means developers may operate with minimal coverage.	Investors will pay for comprehensive cover, especially to ensure projects can make quarterly debt payments even in the event of 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 buckets risks into four types: **1)** Business model, **2)** Financing, **3)** Regulatory, and **4)** Developer/Operator. The risk matrix below evaluates risks as either low (green), medium (yellow), or high (red).

IV. CBEA IS SHARING THE CORE COMPONENTS OF OUR PROJECT FINANCE APPROACH FOR MINI-GRIDS

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

RISK KBUCKET	RISK TYPE	CBEA MITIGATION	EXTERNAL MITIGATION
Business Model	Construction	Invest at fixed price on commissioning	N/A
	Operation	Penalties in op contract for poor grid reliability	Insurance
	Customer	Operator upside sharing for customer revenues	Insurance
Financing	Subsidy	Invest on commissioningn when subsidy secured	Engage donors and gov on subsidy design
	Private Capital	Raise large tikets at tthe holding company level	N/A
	FX	Assume ongoing depreciation	Local currency debt, affordable FX hedging
Regulatory	Tariff & Permiting	Commit capital once tarifff and permits secured	Engage gov on mini-grid tariff and permitting
	Risk Encroachment	Target markets with grid integration regulation	Engage utility/gov to coordinate grid expansion
	Tax	Invest with conservative view on tax excemptions	Engage gov/tax authority on excemptions
Developer/ Operator	Incentive alignment	Profit sharing and revenue share	N/A
	Performance	Standards contractually enforced	N/A
	Termination	Ops contraacts is standalone commerciala contract	N/A

Mitigating three of the four 'red' high-level risks largely lies in the hands of the 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.

This is why programs such as the World Bank Group's Scaling Mini-Grid initiative are so important. They provide governments with guidance on bankable regulations and risk mitigation support.

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, and

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

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

ISSUE	DEVELOPER PERSPECTIVE	MITIGATION
Asset transfer friction	Transferring contracts and government licenses in these markets can be a lengthy and costly process.	Instead of being conditions precedents to investment, make certain contracts and licenses conditions subsequent. 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 one provided by Odyssey Energy Solutions.
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.