Green Mini-Grid Market Development Program (GMG MDP): Access to Finance business line

Task 2: Training of financiers (Final Report)

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Contents

Tables and figures

Tables

Figures

Boxes

Abbreviations and acronyms

AMDA	Africa Mini-grid Developers Association
DCF	Discounted cash flow
DHC	Depreciated historical cost
DSCR	Debt service coverage ratio
EBIT	Earnings before interest and tax
EBITDA	Earnings before interest, tax, depreciation, and amortisation
EBT	Earnings before tax
ECA	Economic Consulting Associates
EUEI PDF RECP	European Union Energy Initiative Partnership Dialogue Facility Renewable Energy Cooperation Programme
EV	Enterprise value
GMG	Green mini-grid
IRR	Internal rate of return
MDP	Market Development Program
NPV	Net present value
PPA	Power purchase agreement
RAB	Regulated asset base
SPD	Small power distributor
WACC	Weighted average cost of capital

Executive summary

Financing mini-grids in Sub-Saharan Africa is still a nascent market	Mini-grids as commercial enterprises, in developing countries, operated by private entities, with independent financial support, that have a goal of being profitable, are relatively new and unproven. As such, the market for financing mini-grids contains many uncertainties and untested business models.
There are a range of options for financing mini-grids	Mini-grid financiers are considering multiple investment products and approaches, with developers requiring a range of types of support. Each has different characteristics, appropriate for different circumstances. The variants include: debt v equity; early-stage v long-term; project finance v balance sheet; international v domestic; commercial v charitable; project v company. The complexity is compounded through the influence of grants and subsidised funding.
Financiers haven't invested because of their unfamiliarity with risk and return profiles of mini-grids	Financiers active in Sub-Saharan Africa are unfamiliar with the risks involved in the mini-grid market, as it doesn't properly approximate markets with which they are more familiar, eg, solar home systems and grid-connected renewable generation. As the market is still developing, the risks are not yet properly priced in returns observed for financiers. Financiers remain more likely to invest in opportunities they understand with risks that are reflected in the returns being realised.
Regulatory risks, and how they correspond with financiers' returns, are not well understood	Financiers can benefit from increasing their understanding of mini-grid regulatory frameworks, which determine the level and profile of returns available. They determine the costs that an operator can recover, and the timeframe for doing so, which dictate potential returns to financiers. Frameworks set out how to treat subsidies received, which are typically to directly benefit customers rather than financiers. The value of a mini-grid sold when the grid arrives will likely follow an established formula based on the value of the assets.
Investment sizes aren't cost-effective for larger investors	International investors have minimum investment size thresholds, typically no lower than $1 million. With mini-grid investments usually well below this (for a single project), it is difficult to attract international investors, Packaging multiple sites into a single investment could allow an investment to pass this threshold and make the investor's transactions costs more efficient for the size of the investment.

Load forecasting is critical but not well understood	Forecasting customer demand for electricity services is critical for calculating tariffs, and therefore for cash flows and financier returns. Financiers can benefit from understanding the processes for developing load forecasts, and the risks of over-estimating or under-estimating loads.
Financial models could be standardised	All financiers require financial models of forecast cash flows and returns to investment. These models are also used by developers, regulators, and donors. While financiers will likely build their own models, a degree of standardisation of financial models can assist less sophisticated stakeholders and increase the transparent transfer of information between all parties.
There are a range of approaches to delivering training	A web-based platform can deliver materials to a wide range of financiers very cost effectively but lack the benefit of personal interaction. Classroom-style workshops allow interaction, and discussion and networking benefits, but can be overly time consuming. One-to-one training is costlier but can be very effective in working through materials at an appropriate pace. Transaction support following high-level introductions will cater to senior managers with limited time for training workshops but require costly expertise. All training options can be considered, with the chance to utilise the same materials across multiple approaches.
A range of potential training service providers already exists	We have had discussions with a selection of potential service providers, including universities, web-based platform providers, and transaction support advisers, all of whom are already engaged in supporting the mini-grid market, and would be willing to provide further targeted support for financiers alongside their existing mini-grid training.
Training materials can be developed especially for mini-grid financiers	Most stakeholders are already familiar with slide decks, available online or presented in person at workshops. Online slide decks can be enhanced through recorded audio narration. Many of the requirements identified can benefit from practical exercises, eg, allowable cost determination, tariff calculation, load and financial forecasting. These can be made available online and in workshops. Other materials can be developed on a bespoke basis for use in one-to-one training sessions and transaction support.

1 Introduction and key discussion

This Draft Report is submitted by Economic Consulting Associates Ltd (ECA) of the United Kingdom as the primary Task 2 deliverable for the assignment:

Green Mini-Grid Market Development Program (GMG MDP): Access to Finance business line

Task 2 of this assignment concerns the determination of commercial financiers' capacity building needs, and recommendations on a training programme to meet some or all these needs. This report sets out the identified training needs, and those recommendations on how to meet them.

In this Introduction, we first outline the process we have adopted for realising the objective. We then discuss two primary questions that frame the remainder of the report:

- Who are the financiers/investors[1]?
- Why have they not yet made investments in mini-grids?

The remainder of the report is as follows:

- Section 2 presents the training needs we have identified for financiers.
- Section 3 presents discussion of the options for delivering training to financiers.
- Section 4 discusses the next steps from this report, including the design of training materials and courses.

1.1 Process

The nature of the objective for the assignment, to identify mini-grid financiers' training needs and modalities for delivery, requires first-hand discussion with industry stakeholders. We have focused on three groups of stakeholders: financiers themselves, training providers, and developers.

We appreciate that gaining a complete insight of the subject requires sourcing a wide range of interviews. ECA's consulting team has advised extensively on mini-grid and small-scale renewable energy project financing, and as such has both a broad and deep understanding of the requirements of financiers to support mini-grids. We have built on this knowledge base through interviews with stakeholders in targeted countries with more established financial markets which have invested in mini-grids, shown interest in investing in mini-grids, or shown no interest in mini-grids. The financiers with whom we have spoken include:

- Fund managers: SunFunder, responsAbility, CrossBoundary

[1] While the term 'investors' can be used only to refer to equity investors, we use the terms 'financiers' and 'investors' interchangeably, to refer to any provider of capital to a mini-grids project or company.

- Banks in Kenya: Diamond Trust Bank, Commercial Bank of Africa, Equity Bank, Kenya Commercial Bank, Consolidated Bank, Development Bank of Kenya;
- Banks in Rwanda: Access Bank, I&M Bank, Bank of Kigali, Rwanda Development Bank.

Through our work with mini-grid project financing (and wider mini-grid development issues), we have interacted extensively with mini-grid developers. For this assignment, we have drawn on this experience, and our connections with developers, to get their perspectives on financiers' training requirements. Our primary channel for this has been both directly through our personal relationships with developers, and through AMDA.

Finally, we have discussed financier training with training providers. To date, training in the space has focused on two areas related tangentially to mini-grid financing: financiers investing in small-scale renewable energy projects, and developers taking projects to financiers for their support. We have found little evidence of training support for financiers specifically targeting mini-grid financiers. As such, we have taken the perspectives of the former two groups and integrated this into our analysis and recommendations.

1.2 Who are the investors?

Our first critical question asks about the identity and investment characteristics of the investors (and their investment instruments) who may already be investing in mini-grids, may be considering investing in mini-grids, may have dismissed the idea of investing in mini-grids, or have never considered investing in mini-grids. Table 1 summarises a few of the key considerations and our observations of the investor characteristics we have observed. These may be the same questions that investors will ask of themselves. We have considered all observations in our analysis and recommendations.

Table 1 Observations on the identity and nature of prospective mini-grid investors

Observation	Discussion
Debt v equity investors	Investors typically fit into one of these two categories. However, the characteristics of the two investment instruments are quite different, by their definition: debt investors have a primary claim on cash flows and assets, while equity investors have a residual interest. Whereas debt investors' financial returns are fixed, equity investor returns can be higher or lower than projected based upon the performance and success or failure of the business. While both are concerned with project risk, a debt investor wants to ensure the investment provides sufficient cash resources to make payments (monitored through metrics such as the Debt Service Coverage Ratio, DSCR) and in the absence of investment grade predictable cash flows or a project with higher levels of uncertainty, debt investors typically require some form of security to protect their investment in the form of collateral which tends to be titled land, buildings, or other resalable items. The equity investor takes an ownership stake in the business and wants to identify the potential return to their investment (monitored through metrics such as the Internal Rate of Return, IRR).
Early-stage v long-term	The nature of the risks in a mini-grid investment may be expected to change between its early stages of development, construction, early operations, and its

Observation	Discussion
	'steady state', primarily as customer consumption varies. An investor wanting an early stage investment may be concerned primarily with the ability of a mini-grid developer to accomplish the necessary preconditions to construct the project and an ability to secure follow on capital to allow it to exit its investment. A longer-term investor may be more concerned with regulatory (un)certainty around their returns from cash flows and potential sale if the main grid arrives.
Project finance v corporate finance / balance sheet	The two types of finance have very different characteristics, primarily in the expectation of the return of the investment principal. Mini-grids are often considered a combination of different types of asset, each with different financing support. Investors in mini-grids are not yet certain which type of asset they are investing in, and therefore which type of finance is best suited. Small mini-grids (or micro-grids) look like solar home systems and are currently financed entirely with equity (typically sourced by the companies' founders). Some debt financiers require repayment in 2-3 years, like solar home systems. Larger mini-grids may be powered by small renewable generation plants. Such plants are often observed selling power to a national utility or bankable offtaker, and may be financed on a **project finance** basis, with long-term loans and without the need for debt collateral as cash flows are regular and predictable as set forth in a long-term PPA. Mini-grids also resemble small distribution utilities, with long-term assets and **capital structures that are refinanced periodically**, and asset bases that are maintained for longevity. The uncertainty over the appropriate term of finance for mini-grids broadens the potential scope for training needs, including addressing this same uncertainty with reference to how regulators are defining mini-grids.
International v domestic finance	Mini-grids may be financed by either international or domestic financiers. A generalisation would suggest that international financiers have greater technical investment knowledge, while domestic financiers excel in local knowledge, and have access to local currency, which will off-set local currency risks. Both types of investors may have different levels of knowledge, sophistication, and investment constraints with corresponding training requirements.
Fully-commercial v semi-commercial v charitable	While mini-grids are seeking to establish themselves as commercial enterprises, the reality is that they remain, hopefully for now only, overall, profitable only in limited conditions. Mini-grids presently require investors without solely a commercial mindset and some form of subsidised, grant, developmental, or charitable investment. This may draw in different levels of expertise in project analysis, and a focus on a range of metrics, including social impact, that are beyond those of pure commercial investors.
Project v company support	Mini-grids may be considered quite small investments by larger investors yet have high due diligence and high transactional overhead costs. When such investors have high transactions costs for making investments, they are reluctant to make investments below a certain level, which may be multiples greater than a single mini-grid investment. To support the sector, some consider supporting the mini-grid developer's balance sheet, rather than individual projects. Most investment factors may simply be scaled.

1.3 Why have commercial investors not invested in mini-grids?

In this section, we discuss why investors have not invested in mini-grids at the scale some have expected, based around three hypotheses:

- ❑ Financiers don't understand the risks of mini-grids.
- ❑ Financiers' returns from mini-grids are not commensurate with the risk involved.
- ❑ Mini-grid investments are too small to attract investors.

We discuss these hypotheses in the following sub-sections.

1.3.1 Don't understand the risks

Globally mini-grids are not a new model for supplying electricity in rural areas where national grids have not reached. Most of the electricity networks operating in developed countries today started as isolated systems that were eventually inter-connected to form a national grid. In developing countries, mini-grids have been used for many years by national utilities to reach more remote communities.

However, mini-grids as commercial enterprises, in developing countries, operated by private entities, with independent financial support, are relatively new. The frameworks under which they operate and best practices in business models are still evolving. As a result, it is likely that there is an element of truth to the hypothesis that the risks aren't well understood[2]. Understanding of risks in general can probably be found on a spectrum, but the rate at which interest in the sector is growing is maybe outpacing the spread of stakeholders' understanding of the risks involved.

The implication of this is that the lack of understanding on the part of investors leads to uncertainty, and that uncertainty is priced into investments through a risk premium on returns and a shorter duration on investment periods. If expected returns from a mini-grid investment do not match the required returns (incorporating the additional risk premium) of the investor, then investments won't be made.

This lack of understanding of risks, and how to price them efficiently, can be mitigated through training and other technical assistance.

1.3.2 Investment returns are not commensurate with risk

For an investor to invest in a mini-grid willingly, they need an expectation that their return to that investment will be commensurate with the risk involved. That is, any investment should sit on a line whereby any increase in risk is compensated by an increase in the (expected) return. An investment that offers a return below this line may be said to have a

[2] The areas that aren't well understood are discussed in Section 2.

return that is not commensurate with its risk. Most mini-grid companies that fail to secure commercial investment fall into this category.

Expected returns to mini-grid investments are typically determined either by the market or by regulation; it is increasingly the latter across Africa. Where returns are determined by the market, they rely on the negotiation of prices between customers and providers. While the absence of any regulatory oversight of this transaction allows for higher returns than a regulated approach may offer, it also provides little protection to the investment. This introduces additional risk; customers may complain to the regulatory authority if they feel the prices are unreasonable (as is the case in Tanzania for the smallest mini-grids).

Where tariffs are determined by regulation, returns to investors (the costs of capital) are determined as inputs to a cost calculation, rather than as outputs from forecasts, following closely the pricing approach adopted by most national utilities. This offers greater protection to the investor, reducing the uncertainty over returns, as the independent body established what is reasonable for the investor to earn. However, there are currently two challenges to this for mini-grids:

- ❑ the 'reasonable' level of return to investors is uncertain, even for regulators, and
- ❑ operators are typically not earning this return, even when it is has been allowed by the regulator.

The 'text book' approach is to use benchmarked market comparisons, either through the returns of comparable companies (and the Capital Asset Pricing Model), or through transactions of mini-grid companies. To date, there is little of either data. Similarly, it is difficult to 'ask the market' for its views, eg, through a survey of investors, given the lack of understanding in the market presented in Section 1.3.1. There are other benchmarks from more established markets, such as small-scale grid-connected renewable energy projects, and solar home system companies, but neither is a truly reliable comparison. As such, a fair level for the 'reasonable' return remains uncertain.

The follow-up to this point is that even where returns have been determined, anecdotal evidence suggests that investors are not achieving them. Instead, they are earning much less, or barely making a profit at all. There are multiple factors which may contribute to this, eg, inefficient pricing, overly optimistic load forecasts, unanticipated risks, weak enforcement of regulatory frameworks, and currency fluctuations.

With such uncertainty over returns, and the reality not matching what little is known or anticipated for returns, investors are turning instead to investments in other sectors with which they are more familiar, and which have return profiles they understand.

Until returns are commensurate with the risks involved, training commercially-focused investors will not lead to increased investment in mini-grids.

1.3.3 Investment size is too small

Many of the investors with a mandate to invest in renewable energy projects in Africa, including grid-connected projects and small-scale systems, and which may also therefore have an interest in mini-grids, have minimum investment size thresholds. This is largely

because any investment they make must offer sufficient returns to cover their transactions costs, primarily incurred in the due diligence they must carry out on the investment.

Such costs are rarely scalable by the investment ticket size. As such, as the ticket size reduces, the transactions costs make up an increasingly higher proportion of the total costs of investment. As transactions costs are borne entirely by the investor, the return from that part of the total investment cost which is made in the investment target itself must increase to allow a sufficient **total return** on the whole investment. As noted in Section 1.3.2, returns are still not yet at a commercial level before considering transactions costs.

Minimum thresholds are typically no lower than $1 million, while a single mini-grid investment is likely to be significantly below this. Therefore, to attract the interest of these investors, multiple mini-grid sites need to be packaged together into a single investment. Such a packaging will be challenging for a developer without a strong track record of site development, thereby making them unattractive to these investors. Given the nascent stage of the market, there are very few mini-grid developers with the ability to meet such a threshold.

2 Financiers can benefit from training on a range of topics

Our discussions with financiers, and with those who interact with financiers, have identified a range of topics on which prospective mini-grid financiers could benefit from training:

- ❑ Understanding regulatory frameworks and implications for cash flows / financing.
- ❑ Types of finance at different stages of a project's life cycle, and for the type of project, eg, fully-private or PPP models.
- ❑ Building load / cash flow forecasts, and the importance of good data from existing sites to support this.
- ❑ The role of / possibility for standardised financial models, particularly in relation to the tariff models that regulators may use. Could there be a 'standard' tariff/financial model that developers use (in the same manner as Homer is used for system design)?
- ❑ The potential for factoring customer receivables (and other innovative financing options).

We discuss each of these points in turn, covering their importance to financiers, and possible content that would enhance their understanding.

2.1 Understanding regulatory frameworks

There is an increasing trend in Sub-Saharan African countries towards regulating mini-grids, with a fairly consistent approach to economic regulation:

- ❑ The smallest sites (< 100 kW installed capacity) may not have any tariff regulation. This aligns them with the discussion in Section 1.3.2 of risks when tariffs are not regulated.
- ❑ Where tariffs are assessed, the approach estimates the 'reasonable' costs to serve (including an allowed return on capital).
- ❑ Tariff structures (fixed v variable charges) can be determined by operators, but a reasonable adherence to the structure of the national utility's tariff structures may be preferred by the regulator.
- ❑ How these costs are recovered may include a subsidy (capital or operating).
- ❑ Compensation value for assets sold when the grid arrives is based on the regulated value of those assets.

2.1.1 Tariffs based on cost to serve

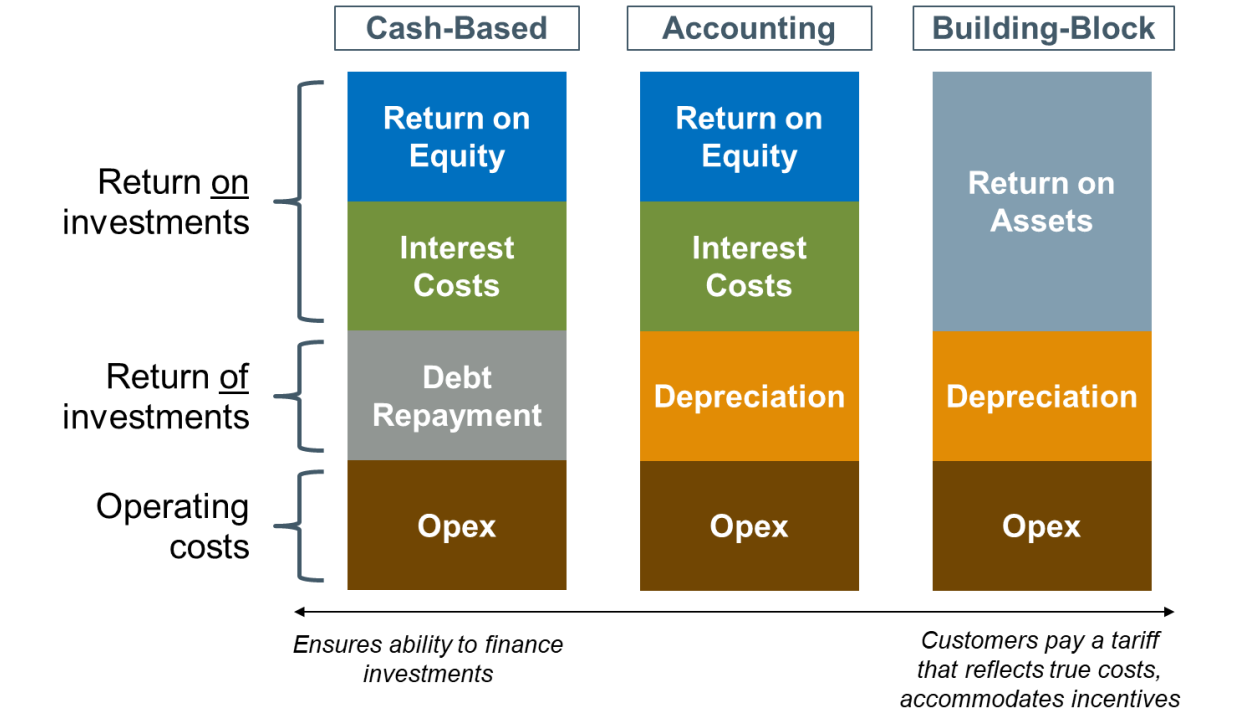
Mini-grid investors with background in other forms of renewable energy, such as solar home systems or grid-connected generation, will be familiar with prices that are negotiated between a willing buyer and a willing seller, and may assume that a mini-grid's price will follow the same approach. However, mini-grid tariffs are increasingly being determined by regulators, who consider the interests of both customers and operators (and their investors).

Determining tariffs is a two-stage process: firstly, calculating the allowed revenues needed to cover a mini-grid's costs to serve its customers, and secondly, allocating that allowed revenue across different customers classes and price structures as tariffs.

Determining allowed revenues

Many regulators will use one of three approaches for calculating the allowed revenues, as demonstrated in Figure 1[3].

Figure 1 Alternative approaches for determining allowed revenues by regulators



Source: ECA

Looking at Figure 1 from the bottom-up, characteristic to all three approaches is the recovery of operating costs, typically on an annual basis. The next block up is an allowance for the recovery of capital expenditure. This is allowed for in one of two ways: recovery of the debt principal to meet the cash requirements of debt borrowings (under the cash-based approach), or an allowance to recover cash at the rate at which the assets are depreciated over their useful lives (under the accounting and building block approaches). An investor

[3] For further discussion on determining regulated costs for mini-grids, see the ECA Viewpoint, 'Electricity mini-grids: how should costs be regulated?', found at http://www.eca-uk.com/2017/05/30/electricity-mini-grids-how-should-costs-be-regulated/

requiring repayment of its principal over a given period should check what the regulator will allow for the recovery of capital expenditure. In particular, a depreciation-based approach may only allow the recovery of capital expenditure over the useful life of the assets, which in the case of network assets, could be more than 30 years. This may not be fast enough to recover the cash necessary for the repayment of loan principal of a project finance product without refinancing.

The top block in the three approaches is an allowance for the recovery of the costs of finance. This is determined either as the cash or accounting-based costs of equity and debt (under the cash and accounting-based approaches), or as the weighted average cost of capital finance multiplied by an approved asset base. The requirements of cash recovery from customers for different financing structures is discussed further in Section 2.2.

Under all three approaches, the allowed returns to investors, be they debt or equity investors, will be determined by the regulator. These returns will be benchmarked against comparable market evidence, but as discussed in Section 1.3.2, regulators and their advisors are unsure what these benchmarks should be.

Mini-grid financiers should understand how regulators set allowed revenues, particularly the recovery of capital expenditure (investment principal) and financing costs (returns on equity and costs of debt).

Formulating tariff structures

The conventional structure of national electricity utility tariffs recovers most revenue through a variable charge, based on the volume of energy consumed by a customer. Some countries also apply a fixed monthly charge, but this is not universal.

Regulators approving mini-grid tariffs will typically require operators to follow the same approach. This is likely to be more familiar to customers who are aware of how national utility tariffs are structured, and therefore less likely to be thought to be 'concealing' costs. However, the cost structure of mini-grids, particularly those without large dependence on costly combustible fuel (eg, diesel, biomass), is largely fixed; networks have low operating costs, as do solar, hydro, and wind generation. Therefore, an operator may wish to set fixed tariffs for its customers, to minimise the exposure to volume risk, where sales of electricity don't meet forecasts and revenues collected don't meet the level of allowed revenues approved by the regulator.

Mini-grid financiers should understand the regulatory requirements of tariff structures, notably where certain structures are not permitted, and the implications this may have for the volatility of cash flows.

2.1.2 Adjustments for subsidies

Mini-grid tariff regulations increasingly adopt tariff methodologies that adjust an operator's allowed revenues for any subsidies received.

In a Building Blocks assessment of allowed revenues, the regulator calculates a regulated asset base (RAB), which represents the capital expenditure on assets the mini-grid will use to carry out its regulated activities. As discussed in Section 2.1.1, the regulator will allow the

utility to recover the RAB (asset values, or capital expenditure) through an allowance for depreciation of the assets (known as the 'return **of** capital'). They will also allow the utility to recover the costs of financing the RAB (debt, equity, and any other financing costs) through an allowed return on RAB (known as the 'return **on** capital').

The regulator will typically deduct the value of any capital subsidies from the RAB. Therefore, it is unlikely that a regulator will allow an operator to recover capital costs funded with subsidies, nor any financing costs of assets funded with subsidies. This means that the benefits to operators of subsidies will not be higher returns but realised through some combination of lower connection costs for customers (more customers), and lower tariffs (higher consumption, depending on the elasticity of demand), leading hopefully to lower volatility of cash flows, and less variability in returns to investors.

If a country's policy for mini-grid tariffs requires a mini-grid to adopt the national utility's tariff level and structure, subsidies may be necessary to 'top up' the difference between the approved tariffs and the reasonable costs to serve customers[4]. The adjustment for these tariffs is typically different to that discussed above for capital subsidies; full cost tariffs are determined first, and then the difference between these and the allowed tariffs is recovered after sales have been made.

Mini-grid financiers should understand how subsidies are administered for mini-grid developments, and how they are treated by regulators. In particular, financiers should understand that subsidies will not improve returns to investors, but more likely minimise the volatility of cash flows and returns.

2.1.3 Compensation for grid arrival

An investor's expected return from an investment is determined for a given period. If that period is reduced, the investor would expect to receive a final payment (or terminal value) equivalent to the present value of the cash flows they expected to receive beyond that point.

For mini-grids, the uncertain possibility of national grid extension reaching the mini-grid requires a regulatory assurance of fair compensation for the mini-grid investor, should they wish to sell the mini-grid to the network company (or another purchaser). There are three standard approaches one can take to valuing a mini-grid business:

- The **discounted cash flow (DCF)** approach is perhaps the most conventional valuation approach. It forecasts net free cash flows for a business into the future, taking account of growth in revenues and costs and necessary capital expenditure, and discounting this to a net present value (NPV) today at a given discount rate based on the cost of the financing used to finance the assets needed to generate that revenue.

- The **depreciated historical cost (DHC)** approach is used to calculate or determine otherwise the assets being valued. It takes an agreed value of the business' assets, typically their purchase price, and depreciates them at an agreed rate. The DHC approach is a useful cross-check against the DCF.

[4] Such approaches are rare, and difficult to administer.

- The **business multiple** approach's strength is its simplicity. It takes a forecast of a particular revenue stream, eg revenue, EBITDA, EBIT or EBT, and applies a market-based multiple to determine the Enterprise Value (EV) of the business. It is relatively imprecise as compared to the DCF approach, but at the same time, as the DCF approach relies on more detailed information, if this information is unavailable, the more high level and simplistic multiple approach may suffice for valuation purposes.

To determine an approach to valuing a mini-grid, we must first establish what information is available. The multiple approach relies on multiples from transactional market evidence, preferably the sale of equity in a comparable business, or a market-priced issue of new capital. Given the infancy of the mini-grid market, such evidence will be difficult to obtain, and will unlikely be truly efficient by market standards due to the lack of investor depth. Therefore we rule out the business multiple approach.

Contrastingly, we should be able to develop a forecast of cash flows for a mini-grid based on estimated customer consumption, tariffs and associated costs, and derive a discount rate from the cost of the financing employed, that will allow us to derive a value using the DCF approach. Similarly, we should be able to determine asset values and associated depreciation for all assets, at any point in time, to allow us to use the DHC approach.

To choose between the DCF and asset-based approaches, we can consider the principles of pricing for regulated utilities, which suggests that either approach can be used as they will derive approximately the same value, as discussed in Box 1.

Box 1 Correlation between the DCF and asset-based valuation approaches for a regulated mini-grid

The net cash flows received by a mini-grid are primarily in the form of revenues from customers (and subsidies, when the tariff income is restricted). For a regulated mini-grid, this revenue requirement is typically derived through a building blocks calculation of the costs to serve those customers. Of those building blocks, the operating costs are passed straight through as fuel, salaries, maintenance, etc, and have no bearing on the value of the business. However, the income from the return of capital and return on capital both remain with the business, and therefore are the key drivers of business operating cash flow, and therefore business value under the DCF approach.

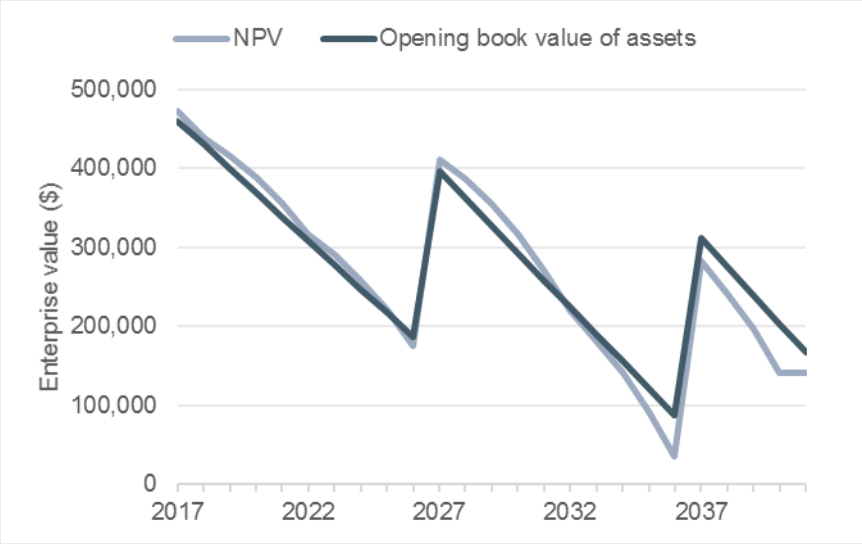
These two building blocks are based on the value of the RAB:

- the return of capital is the depreciation of the RAB over its regulatory life, and
- the return on capital is the cost of financing the RAB

Therefore, the value of the RAB approximates the value of future cash flows, and thus also approximates the value of the business, and the value that should be paid to the owners of assets sold, after adjusting for subsidies received.

To show that this assertion holds, Figure 2 presents a comparison of the two valuation approaches for a hypothetical mini-grid development, with periodic large capital expenditures, showing a close correlation between the two approaches.

Figure 2 DCF and asset-based mini-grid valuation approaches[5]



Source: ECA

Box 2 discusses why there may be diversions between the outputs of the two valuation approaches.

Box 2 Reasons for diversions between the DCF and asset-based valuation approaches for a regulated mini-grid

The analysis in Figure 2 raises a few clarificatory questions regarding the minor diversions in the two lines. The differences between our model and a 'pure' regulated model that would generate such values are:

- **Our use of a constant WACC** when the WACC should change as debt is repaid (changing the gearing). A regulated utility will typically have a constant capital structure, and therefore a constant WACC, whereas mini-grids tend to be project financed, with debt providers requiring repayment of their loans from operating cash flows.
- **The mismatch between asset lives and financing**. Under building blocks tariff theory, the cash allowance for depreciation should be used to repay financing or reinvest in assets. If the financing is repaid with operating cash flows rather than financing cash flows, with this happening well before the end of the assets' lives, the business pays out more cash earlier in the license period. Customers today are therefore paying for assets used by customers in the future, which is, debatably, inequitable.
- **The mismatch between asset lives and the license period**. A pure model would assume that assets are fully depreciated by the end of the license

[5] The stepped progression reflects the replacement of assets and commensurate increase in the RAB.

period, whereas this may not match reality; some assets may have some of their useful life remaining at the end of the license period.

- **Tariff periods**. To smooth retail tariff payments, we fix real tariffs for a certain period, eg, 5 years. Thus, the cash flows are not smoothed to reflect actual costs in a year, distorting NPVs within 5-year periods. The tariff period would typically be agreed between the regulator and operator.

Source: ECA

While the DCF and DHC approaches appear to produce approximately equivalent values, it raises a question of growth in aggregate customer consumption, and its impact on value. Typically, an increase in sales should increase the value of a business. In this case, however:

- Under regulated prices, any increase in consumption within the capacity of the system will simply reduce the average cost per customer (fuel costs are passed through), or the revenue required per unit of energy, and therefore the average tariff charged, without increasing aggregate revenue. There is no change to the revenue requirement.

- Any increase in consumption that requires an increase in capacity will be reflected by an increase in the RAB, and therefore the compensated value.

Application of the RAB for the compensation calculation

Some points to note when considering the RAB as compensation value for assets sold:

- The RAB should already be adjusted for capital subsidies received, and therefore the owner/seller would not need to repay the subsidy provider.

- The RAB will depreciate over time using regulatory depreciation.

- The RAB should be increased by inflation when calculating the compensation value.

- The rate of regulatory depreciation may increase to allow for earlier repayment of financing, thus lowering the RAB faster than the tax rate of depreciation would have done (and will be reflected in the mini-grid operator's financial statements).

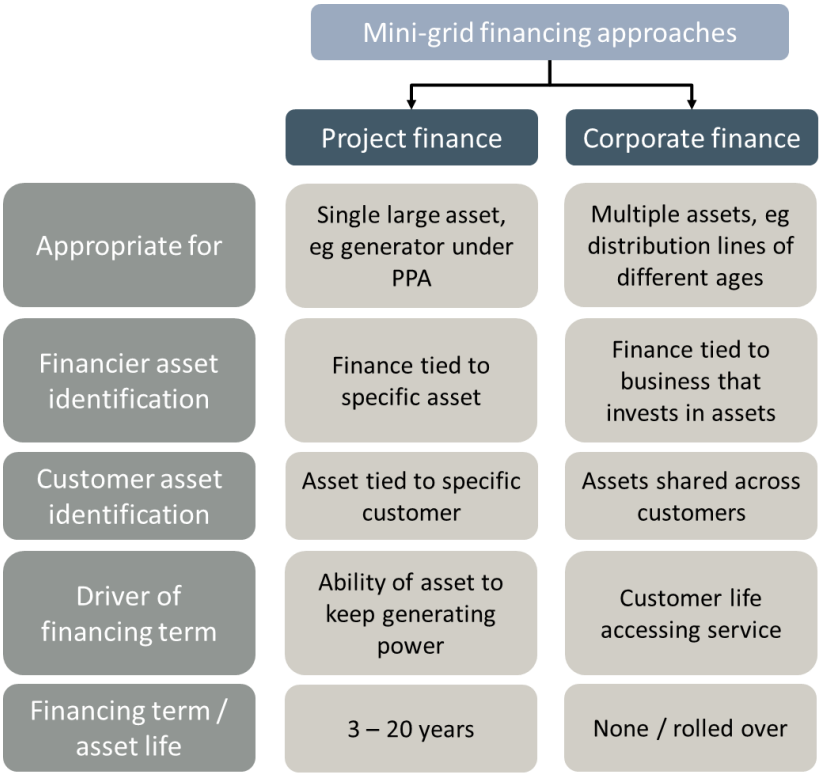
- The financial book value (for tax purposes) of the assets may be higher than the regulatory value. Therefore, if it pays the regulatory value, the network company would acquire assets below their accounting value. To account for this, the company should include the assets in its own asset base at the purchase / regulatory value, and then depreciate them at the same regulatory rate used for the mini-grid.

Mini-grid financiers should understand the valuation approach used by regulators for determining the compensation payable if a mini-grid is sold to a network company (or other party) if extensions to the national network reach the mini-grid.

2.2 Types of finance

As mentioned in Section 1.2, there are a range of investors looking at investing in mini-grids today, with different objectives and backgrounds. Section 1.3 notes that the market for financing mini-grids in Africa is still nascent, and the types of finance available are perhaps not yet appropriately suited to the characteristics of a mini-grid. Many investors are not yet sure how to finance a mini-grid. In some ways, financing for mini-grids fills a space between the financing for stand-alone energy sources such as solar home systems, small-scale renewable generation and large-scale distribution utilities, and each has different financing drivers, as summarised in Figure 3.

Figure 3 Illustrative mini-grid financing approaches



Source: ECA and TTA

As Figure 3 indicates, mini-grid developers have various factors to consider when determining how to finance their investments, particularly as to how their businesses should be viewed.

Project finance

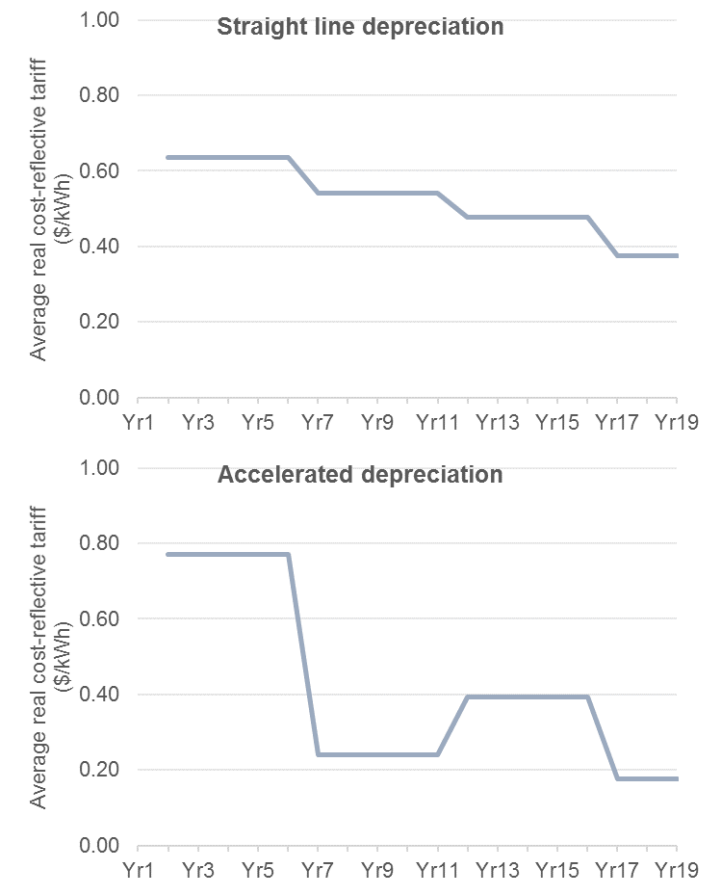
Many mini-grid financiers take a **project finance** approach to financing mini-grids. This can be argued as the mini-grid can be evaluated as a single specific asset (if the distribution network is not added to regularly), with a finite lifespan that should correspond to the financing term (although financing terms are currently shorter than asset lives). Any asset replacement will be paid for through new financing rather than operating cash flows. This type of financing is typical for a generation project selling to a bankable off-taker under a PPA with a single customer, eg, the utility.

The project finance approach requires regular predictable revenues from reliable sources and is often adopted as many prospective mini-grid financiers have a background of financing small-scale renewable generation project for which the project finance approach is appropriate. The allowance for depreciation (return of capital) allows the operator to recover cash from customers for the repayment of financing. The principle of this approach is that customers pay for the asset over its useful life, and that the loan period should match this, such that the recovery of the capital expenditure from customers matches the requirements for the loan repayment. However, loan periods may be shorter than the asset's useful life, in which case the rate of depreciation may need to be accelerated. Box 1 discussed the impacts of accelerated depreciation on customer tariffs.

Box 3 Accelerated depreciation

Accelerated depreciation can allow the operator to repay financing over a period shorter than the asset life, but this can lead to skewed depreciation schedules and uneven tariff profiles (see Figure 4).

Figure 4 Impact on tariffs of accelerated depreciation



Source: ECA and TTA

In this figure, the top chart shows a lower initial tariff level, and a slower reduction in the tariff. The only changes in costs are the reduced costs of financing the asset base as its value diminishes; depreciation remains constant. The bottom chart recovers more cash in early years to repay financing quicker than the asset life, requiring a higher tariff. Once this has been recovered, the tariff drops sharply as this requirement is either reduced or removed. The increase in year 10-11 is to accommodate additional capital expenditure,

which is incorporated much more smoothly in the top chart because of the longer period for capital value recovery.

Source: ECA

Under a project finance approach, it is difficult to assess the return on capital through the WACC as the business' gearing changes over time as debt is repaid (assuming equity isn't repaid at the same rate). While this may simply change the gearing in the WACC calculation, it could potentially change the required returns on each of debt and equity as the business' risk profile changes.

These factors above make comparison with national tariffs complicated as these are assessed on longer-run rates of depreciation and relatively constant WACC.

Corporate finance

Because of the unpredictability of many elements of a mini-grid's business, in most cases a c**orporate finance** approach is more appropriate for mini-grids. This would include equity and debt from a larger entity who has assets and collateral to lend against to finance the mini-grid. A mini-grid's assets may vary in age, eg, through extensions to the distribution network; this would be typical for a larger utility. Most of the assets are shared by multiple customers who would presumably continue paying for the service provided (rather than pay for the asset) beyond the lifetime of the assets. Financing is repaid from financing cash flows (refinanced, or rolled over) rather than operating cash flows, which means that cash received through the return of capital and the allowance for depreciation can be used to replace/upgrade the assets, under an assumption that they will continue to be used ad infinitum. Thus, WACC should be constant, ceteris paribus, and tariffs should be more comparable with national tariffs.

Mini-grid financiers should understand the differences and similarities between mini-grid financing and financing of other assets and businesses, and the implications this has for risk and investment returns.

Alternative business models

The discussion above presumes a fully-private business model for the mini-grids. Other business models will have other approaches for financing:

- PPP (generation assets only). There is a single buyer of power (likely the national utility), which makes this akin to a small-scale renewable project under a PPA. A PPA will have a finite term, with uncertain value at the end of the term, and therefore the project finance approach is appropriate.
- Distribution assets only (without retail). This model is rare, where the owner of the distribution assets simply charges a 'use of system' charge to the power retailer using the same methodology used for an integrated mini-grid. In this model, long-term corporate finance is most suitable, as the assets have a long life.

- Distribution assets only (with retail). This model is similar to a Small Power Distributor (SPD). The operator needs to make a margin on the purchase and sale of electricity to cover its costs, which is quite risky. The model is rare for isolated systems. Financing should be long-term on a corporate finance basis, to match asset lives.

- Construction and/or management contract. The operator doesn't own any of the assets, and as such, only operating working capital is needed, to cover creditor and debtor prepayments and late payments. Any losses from serving rural consumers on a fixed tariff would be borne by the utility.

- Wholly owned by utility. The utility finances, builds, owns, and operates the mini-grid. This is the primary form of mini-grid financing historically and globally.

Mini-grid financiers should understand the range of financing approaches for different mini-grid business models, and the risks and structures that each entail.

2.3 Building load / cash flow forecasts

As discussed in Section 2.1.1, mini-grid operators/investors need to develop an understanding of the demand for power, and cash flow forecasts before making their investments. This serves two purposes:

- Determine tariffs

- Determine investment returns

A demand forecast of energy sales is required to generate the revenue lines, and associated variable operating costs, prior to (or as part of) determining a full financial model of a mini-grid. Software already exists to serve this purpose and many operators will have their own modelling tools. It is likely that, over time, investors will do likewise.

Testing the reliability of forecasts against actual results has shown that they are difficult to develop accurately[6]. If overly optimistic forecasts are used to determine tariffs, actual consumption that is lower than the forecasts will lead to lower revenues, thereby impacting on the profitability of the project and the likely return to the investor. This will be exacerbated the more tariffs are based on energy consumed, rather than fixed per month by customer, regardless of consumption.

There are a range of factors that must be considered when developing load forecasts, including:

- Projected growth in customer numbers

- Projected growth in customer consumption

[6] See Blodgett, et al. 'Accuracy of energy-use surveys in predicting rural mini-grid user consumption', Energy for Sustainable Development 41 (2017) 88–105.

- ❑ Customer classes, eg, household, small business, industrial business, public body (eg, school, clinic)
- ❑ Seasonality of load, eg, agri-processing during harvests
- ❑ Load through the day
- ❑ Capacity of generation plant to meet load, and the requirement for energy storage (eg, batteries) or back-up generation (eg, diesel generation)

Mini-grid financiers should understand the challenges involved in developing demand and cash flow forecasts for mini-grid investments. They can be introduced to software which can aid this development.

2.4 Industry-standard financial models

We assume that all mini-grid investors will have their own financial models, with varying degrees of sophistication. These models may suit their own purposes, notably to determine the viability of potential investments, and to monitor those investments after they are made. However, much of the information contained in the model can be used by other stakeholders to inform their decisions, eg, regulators for tariff pricing (and ensuring commercial viability of the operator under given tariff scenarios), or donors for viability gap funding or to guide economic impact analysis.

For system design, the Homer® model has become an industry standard, used by many stakeholders. It allows the user to develop a least-cost design for a mini-grids, considering both economic and technical constraints. There is not yet an equivalent accepted industry standard model for financial analysis of mini-grids, that considers tariff design, financial returns, subsidy requirements, and economic outcomes.

Different consultants (including ECA) have provided models to regulators, and Odyssey Energy Solutions (Odyssey) has developed one as part of the design of their platform to support mini-grid developers. It is possible that a standardised model could be developed, or an existing model adopted, to support the industry, particularly less sophisticated stakeholders. The design of the model could include:

- ❑ Supply and load data for the system (likely an input from a separate model, eg, Homer)
- ❑ Costs that match the supply and load profiles
- ❑ Tariff structures that allow cost recovery
- ❑ Cash flows of the mini-grid business that show profitability and debt service coverage
- ❑ Subsidy amounts necessary to ensure profitability and debt service coverage
- ❑ Returns to investors through commonly used metrics, eg, IRR, NPV

- Socio-economic outcomes from the mini-grid, eg, displacement of inferior / more expensive energy supplies, health benefits from consumption of superior energy supplies, direct employment benefits from the mini-grid, indirect multiplier effects from greater power consumption (at lower prices)

The potential for such a standardised model requires further discussion, and ultimately buy-in from stakeholders who may use it. If this is accepted, then the model could be developed, with an accompanying user guide, and training as required.

3 There is a range of modalities for training on mini-grid investment

In Section 2, we identified a selection of topics on which financiers could benefit from training. In this Section, we introduce and discuss various modalities that may be used for delivering the training. We do not discuss in detail the recommended approaches, nor make definitive recommendations at this stage. This task in the workstream, 'Access to Finance', is complementary to another workstream, 'Mini-Grid Training Needs Assessment', being drafted by Energy4Impact and Inensus. Both reports can be read together for the collective perspective on training needs in the mini-grid sector. This report will also build on the analysis undertaken in the separate reports we have drafted under our Terms of Reference.

The Terms of Reference for the assignment has the following requirements:

- ❑ Identify a suitable (web-based) platform, to function as a PO/vehicle through which the GMG training programme can be delivered;
- ❑ Conduct a substantive review of shortlisted PO(s) for the Training Programme, with the aim of making a specific recommendation.

The first task presupposes that a web-based platform is an optimal approach for delivering training. We will discuss the applicability of a web-based platform among the various options.

The second task is covered at a high level and has been covered more substantially in the document prepared by Energy4Impact and Inensus.

3.1 Possible training modalities

In this Section, we discuss a selection of possible training modalities.

3.1.1 Web-based platform

The Terms of Reference recommend using a web-based platform for delivering training materials. From our discussions with financiers, we understood that this would be helpful for providing materials and overviews, including via videos and downloadable templates. The materials can link to more in-depth reading, eg, on tariff methodologies, or excerpts of the regulations in place in various countries. A web-based platform has the significant advantage of being accessible from anywhere with an internet connection, at any time that is convenient to an interested party. This is likely to be highly advantageous to any professionals with inflexible work schedules.

However, feedback from financiers suggested a web-based platform would not necessarily be as helpful as having an expert on the subjects with whom to interact and discuss the key points raised. This suggests that a web-based platform can play a role in informing financiers on the key topics raised in Section 2, but should be used alongside other forms of support that can only be provided in-person.

3.1.2 Classroom-style training

As compared with the web-based platform discussed in Section 3.1.1, classroom-style training allows participants to interact with an informed expert. They can be a very effective way of putting across information to large groups at once, and as such can be very cost effective as training vehicles. In our context, training workshops could be run in some of Africa's major investment centres, eg, Nairobi, Lagos, and Johannesburg[7].

Many conferences take place on an annual basis, attended by potential mini-grids financiers. Classroom-style training can be added on to conferences attended by key investors, which can then bring in both discussion benefits from knowledgeable participants sharing their own experiences, and networking benefits.

However, given the number of people involved, classroom-style training is likely to take longer to cover material that individuals may cover on their own, or in smaller settings. This will deter those potential participants with restricted schedules. As a result, the participants are less likely to be senior managers and decision makers with deep experience, but rather more junior staff with less ability to maximise the skills learned. In addition, investment staff in these sectors have a high degree of mobility which could result in classroom trained staff knowledge being lost when a staff member departs or gets reallocated.

3.1.3 One-to-one training

One-to-one training allows close interaction with specialised consultants, focused on specific training materials. The definition need not be restricted to a single recipient but could be extended to a small group of 3-5; the premise is that the recipients are part of the same organisation, and the trainer will come to the recipient's premises. As such, the costs involved are likely to be higher per recipient than classroom-style training.

Such one-to-one training is more likely to attract senior participants, at least for a short period, than classroom-style training and have higher institutional acceptance for increased effectiveness and longevity of results. During this time key points could be condensed for their benefit. Following this, more junior staff could remain for instruction on some more detailed or technical aspects, eg, modelling exercises.

3.1.4 Transaction advisory support

The three approaches recommended so far all require dedicated training time allocated for the recipients. For many financiers, this may be difficult to incorporate into their schedules when consideration of mini-grid investment is not a priority. Most investors prefer a 'learning by doing' approach to allocating specific time for training. An approach that might offer more support to such senior managers is to offer transaction advisory support from experts with specific transaction advice. The EUEI PDF RECP Finance Catalyst[8] programme offers such services to project developers but has not yet supported financiers directly. Its

[7] This is by no means an exclusive list.
[8] https://www.africa-eu-renewables.org/finance-catalyst/

support typically commences after a project has passed through a pre-feasibility stage and lasts until it reaches financial close.

One approach could start with senior managers attending an initial training session, as a precursor to transaction advisory support. The initial session could provide a high-level overview of the points raised in Section 2.1, notably including how mini-grid regulatory frameworks affect investment returns and key points for mitigating risk to achieve reasonable investment returns.

Box 4 presents the opportunity for incorporating a matchmaking function between mini-grid developers, suppliers, and financiers within the transaction advisory support facility.

Box 4 Integration of a Matchmaking function with transaction advisory support

In our report on Matchmaking opportunities for mini-grid developers, suppliers, and financiers, we propose that a matchmaking function be part of the technical assistance component for training and transaction advisory support to financiers and developers. The training programme could thus be expanded to include the setting-up of a technical assistance unit for transaction advisory matchmaking.

The purpose of the matchmaking would be to support, through pro-active contact making and a series of activities including awareness building, risk identification and mitigation, dissemination of investor-formatted project information, and regulatory commentary. The matchmaking would provide expert interactive involvement with developers, technology manufacturers, investors and providers of debt or trade finance within the GMG market in Africa. The specific project objective would be to 'crowd in' commercial financiers (investors, banks, trade finance providers), and match-make deals between financiers and developers.

The transaction-oriented tasks would be augmented by tasks that build synergies with the proposed training programme, such as developing a series of best practices for financing GMG projects and developers, and training and capacity building among interested financiers in evaluation of GMG developers and projects, using live examples.

The overall task for the matchmaking office holder would be to proactively help GMG developers and potential financiers to engage with each other.

3.1.5 Preliminary recommendations

From our discussion with mini-grid financiers, we see scope for each of the support options discussed above. However, we received the strongest support for training embedded in transaction advisory support, with materials available through an online platform, and therefore recommend (at this preliminary stage) investigating this further.

3.2 Providers of training and transaction support

The **Odyssey web-based platform** is already heavily engaged in supporting mini-grid developers and financiers. It has the capacity to provider training materials to its members, on a subscription basis. Similarly, the web-based 'Green Mini-Grid Help Desk'[9] developed for the African Development Bank by Energy4Impact and Inensus already provides a wide range of information to mini-grid stakeholders, to which training materials could be added.

We have had some high-level discussions with potential hosts of the training materials and **training service** providers.

We have held several discussions and meetings with the management of **Strathmore University - Energy Research Centre**, who are presently implementing an AfDB-funded mini-grid technical training program with Energy4Impact. Strathmore are currently in the process of designing a course on mini-grids in collaboration with the University of Berkeley, California. The planned course will include modules on technical aspects (design, installation, O&M), policy and regulations, business and finance models, productive uses, etc. Strathmore are actively looking for partners to support this initiative and we think this is a very suitable fit for our purpose.

Energy4Impact and other consultants in the MDP programme have had similar discussions with training service providers. We are in discussion with these group members to identify areas for collaboration both in our assignment (so as not to duplicate discussions with potential providers), and in the delivery of the training programmes. For example, while our intended audience is financiers, one of the identified training needs is to better understand the economic regulation of mini-grids, a topic which is likely to be relevant also for mini-grid developers.

We have discussed **transaction support** with Finance Catalyst.

In their own public listings, Finance Catalyst:

> *provides advisory support on project development, project structuring and accessing finance through a team of dedicated experts with extensive experience in renewable energy project development and finance in Africa.*
>
> …
>
> *The team assists private sector driven RE projects, on-grid as well as off-grid. Whether corporate embedded RE production projects or grid-connected independent power producers (IPPs), **mini-grids**, solar home system businesses, or (decentralized) energy services companies (ESCOs and DESCOs), projects with strong underlying fundamentals can be supported to access debt, equity or grants, aiming to reach financial close. The support is available to the whole range of technologies within the RE sector. The team has dealt with wind, solar, hybrid, hydro, biomass and biogas projects in a variety of business models.*

Finance Catalyst comprises a team of experts who are available on a call-down basis, providing services from a menu of options. It currently only provides support to project

[9] https://greenminigrid.se4all-africa.org/search/content

developers but interacts regularly with financiers. Such interactions have highlighted the lack of understanding of financiers on mini-grids.

Finance Catalyst's model of providing training support could be extended to financiers. Its current mandate doesn't allow for such support to financiers, but this could be discussed with its primary sponsors, EUEI PDF'S RECP programme. If this extension is not possible, a mandate for similar 'à la carte' transaction support could be tendered for providers.

4 Various materials will benefit financiers

In Section 3, we discussed the modalities for providing resources to financiers, including web-based platforms, classroom-style teaching, one-to-one teaching, and transaction support. In this Section, we discuss some of the materials that could be offered to financiers. At this stage, we present only a high-level discussion of the materials; further discussion will take place between ECA and other consultants regarding the complementarities between the 'Access to Finance' workstream and the other workstreams in the MDP programme.

4.1 Workshop-style presentations and slide decks

Visual presentations using slide decks are suitable for providing information on the topics covered in Section 2, particularly regulatory frameworks, types of finance, and innovative finance mechanisms. Most stakeholders will be familiar with slide deck presentations using software such as MS PowerPoint. They are helpful for presenting information in text and graphical form, which is often necessary for such topics as regulatory pricing of energy services. Slide decks can be presented by someone in-person or provided online for financiers to read at their leisure. Online resources could be accompanied by aural narrations, scripted by the writer(s) of the slide deck.

We presume that a slide deck covering the basic regulatory issues faced by mini-grid developers, financiers, regulators, and donors, could be addressed in a single presentation that is made available to all stakeholders through each delivery modality, ie, web-based platform, classroom-style teaching, one-to-one training, and as a precursor to training advisers. Such a presentation could be accessible for all financiers, including those with more limited time to attend training sessions; if it can be delivered in no more than one hour, it should be accessible to most stakeholders.

4.2 Practical exercises

The presentations and slide decks noted above can be aided with practical exercises for participants. This may be most applicable to those who have more flexible schedules for training purposes, although all can benefit from training. When running training courses on a range of topics, ECA typically includes practical exercises that allow participants the opportunity to work through the theory that has been presented, including:

- Building tariff models, from basic calculations of allowed revenues through to more complex models to determine tariff levels and structures
- Determining approaches for distributing subsidies to mini-grid operators and customers
- Valuing mini-grid assets for compensation when sold as the grid arrives
- Developing load forecasts, and the implications for revenues

- Developing full investment models, tracking all cash flows, and generating critical outputs, eg, NPV, IRR (project, equity, economic), DSCR

In addition to the topical training modules, ECA will provide training on additional and relevant skills, including the basics of accounting and finance for developers and on using MS Excel (neither of which should be necessary for financiers). Additional modules on these topics, and other relevant topics, could be made available alongside the topical modules.