PROMOTING PRODUCTIVE USES OF ELECTRICITY

A CORNERSTONE OF MINI GRID DEVELOPMENT

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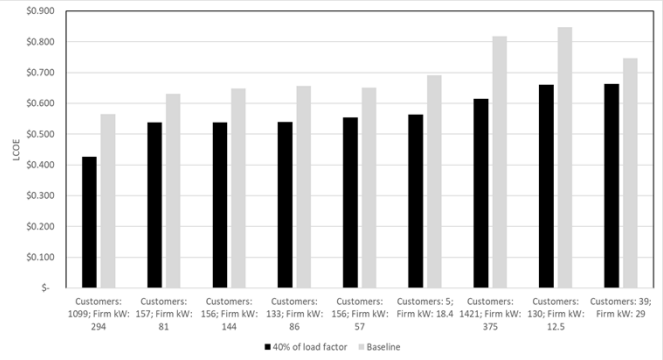
Impacts on LCOE with increasing the use of electricity



Source: HOMER

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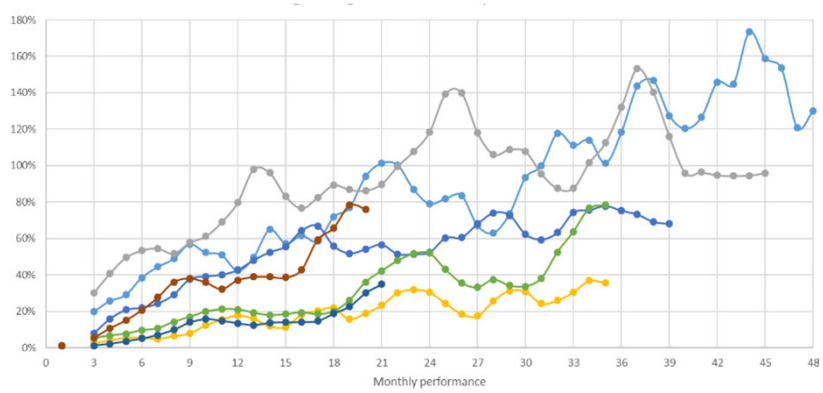
Income-generating and productive uses of electricity have a critical impact on mini grid viability and efficiency as they generate additional revenues while improving the utilization capacity of the systems – especially if income-generating loads happen during day time, when residential load is low and when electricity generated by solar power is cheapest. This results in more efficient and affordable use of mg assets.

In addition, it enables the delivery of the full benefits of electrification. We tend to forget that electrification is not an end in itself, and to make it transformational and actually improve communities' livelihoods, it should support an increase in income, productivity and ultimately create jobs and new activities.

The growth of income-generating activities using electricity has significant positive impacts on the operational efficiency and financial viability of mini grids. By increasing the load factor, it allows for a significant decrease in the system levelized cost of electricity (LCOE). Out of the sample of mini grids that were analyzed as part of the Mini Grids for Half a Billion People report, of 9 surveyed sites located in Asia and Sub-Saharan Africa, an increase to a 40% of load factor has on average enabled a decrease in the LCOE from $0.70 to $0.57 (18%). These figures are an average based on diverse mini grids and thus should be seen as illustrative.

However, load uptake does not always happen as expected

Share of expected load achieved by selected mini grids in Bangladesh



Source: IDCOL

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HOWEVER

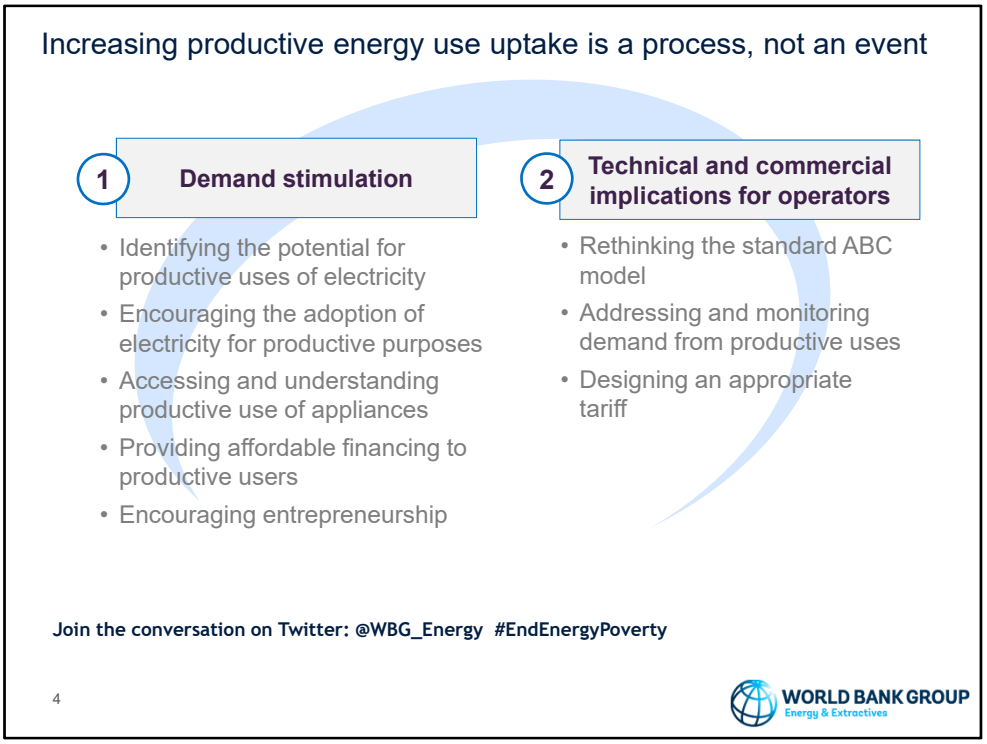
Until recently, electrification projects were designed solely to provide access to electricity, assuming demand will organically grow after the arrival of a mini grid and load uptake will happen by itself.

This chart shows the contrary through the example of the Infrastructure Development Company Limited in Bangladesh, with its experience of the recent installation of 24 pilot solar mini grids. It shows very unequal load uptakes across different sites. Despite careful and detailed consumer surveys and load analysis, months after installation existing users' uptake was lower than predicted.

Uptake lags were particularly striking among larger mini grids (>200kWp), among which income-generating energy use accounts for 40–65 percent of energy demand. Daytime productive energy users were not connecting as planned, and in some cases, larger night-time load components were saturating plant capacity more quickly than expected.

This has been partially explained by high upfront costs of converting diesel-powered tools to electric in case of income-generating loads, combined with lack of information

and support to design, cost and implement equipment conversions, lack of knowledge of savings possible by conversion to mini-grid electricity, and lack of information about business models among new entrepreneurs. We will come back to this example shortly to see how IDCOL handled that matter.



Given these observations, major demand and supply constraints should be overcome to increase mini grid load uptake for income-generating uses

On the demand side, there are several dimensions to be covered while designing and implementing a project in order to stimulate demand. Some of the questions that mini grid developers should be asking themselves at the earliest planning stages include:

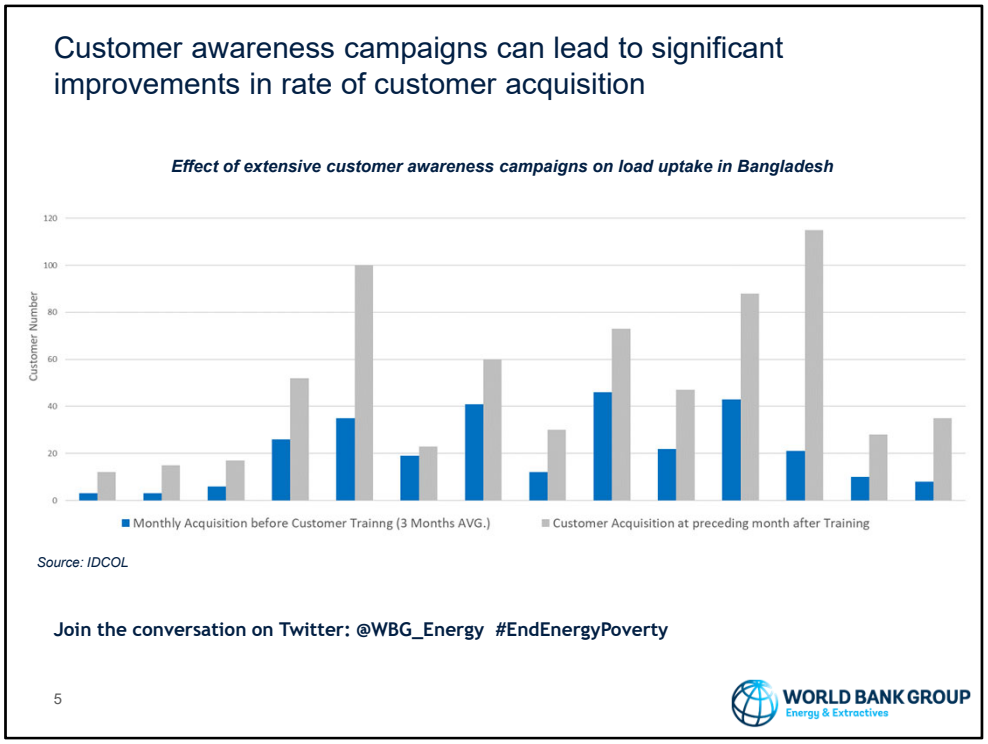
- Where do i find the productive opportunities?
- How do i convince existing or potential businesses to use electricity?
- How do i make sure they access the right appliances?
- What type of financing could i offer to make the adoption affordable?
- How do I support them in developing businesses?

Campaigns can be launched through thematic meetings to better assess productive demand and potentially demonstrate equipment and share feedback from current productive users of electricity. If the mini grid developer can lead this effort, support from the national agency tasked with electrification, NGOs, and development partners can facilitate interaction with productive sectors and local businesses. Other agents, such as microfinance institutions, chambers of commerce, and small business

accelerators, can also be mobilized.

On the supply side, there are quite a few issues to be tackled as well. These include:

- **Rethinking the ABC model**: to increasingly favor the B (businesses) rather than only the A (i.e. the anchor load) in order to diversify the mini grid customer basis, de-risk the investment, and ensure a balanced load mix.
- **Demand and load management:** which are essential to smooth out loads and ensure an optimized utilization capacity of the systems.
- **Tariff schedule alignment with end-user needs:** The tariff structure should allow a reasonable return on investment while remaining attractive and affordable for productive end-users.



Delving a bit further into the demand-side of the equation - customer awareness campaigns can be very effective in demand stimulation, as illustrated in the Bangladesh example.

Following the slow load uptake on the pilot solar mini grids, in October 2017 IDCOL launched intensive customer awareness campaigns to address these challenges. They have combined customer training with public events such as folk song, shows and street drama. These efforts have enabled significant improvements, with increase in customer acquisition of up to 500% after tailored customer training.

More specifically, IDCOL organized three-day intensive sessions conducted by international experts and trainers from major equipment manufacturers. imultaneously management skill development trainings were arranged for developers. In addition, IDCOL tried to incentivize daytime loads via time-of-use packages and financing conversion packages offered at the fairs to interested businesses (these ranged from $120 to $400 depending on industry and load).

The equipment adoption process is meaningless if income generating appliances are not compatible, available or affordable

Adding productive electric appliances to the systems is not technically and economically straightforward

Finding the right income generating appliances

- Limited knowledge on the compatibility of appliances

Including them into mini grid business models

- End-use financing
- End-use availability and education
- End-use targeting
- Tariff innovation
- Maintenance

A repair shop owner using welding machines and lathes

Source: TechnoHill

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Another essential topic on the demand side is the affordability and accessibility of income-generating appliances. These appliances often consume much more power than consumer appliances, such as fans or TVs, and can in general be challenging for users to adjust to.

There is limited knowledge of the compatibility of income-generating appliances with mini grid systems and their business models. Mini grid developers often lack information on their power and energy requirements and load profiles, which can frequently lead to inaccurate demand forecasts and wrong-sizing of the mini grid's generation and storage capacity.

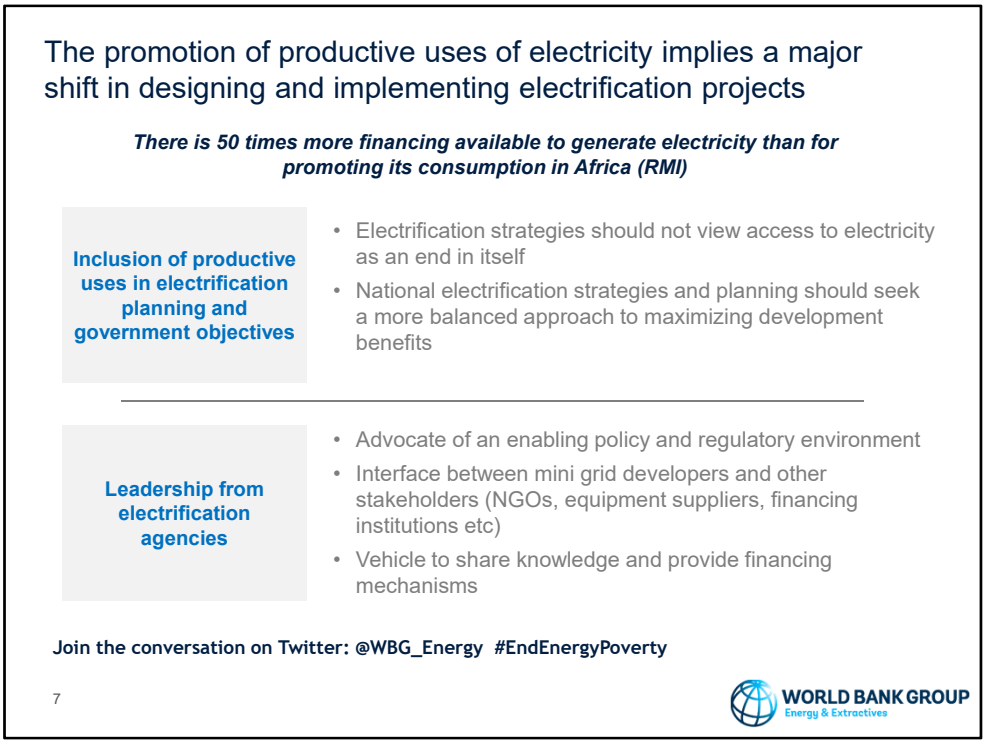
End-use financing: What are the most effective and scalable mechanisms for appliance financing? Which entity should provide financing—a developer, a bank, or a co-op? What financing terms meet customer needs?

End-use availability and education: How can appliances with the right balance of cost, efficiency, and durability be made available to customers?

End-use targeting: When going beyond electrifying existing diesel-based equipment, which appliances/equipment will be most beneficial for a given community?

Tariff innovation: To what extent can innovative tariff schemes incentivize demand that is profitable for the customer and the mini grid operator? Is the limiting barrier for consumers the inability to afford the loan to pay for the appliance or the tariff and electricity payments?

Maintenance: What is the most sustainable and effective model to ensure the maintenance of income-generating equipment?



Another crucial topic is the role of the broader energy sector and the supportive institutional framework. The RMI estimates that there is 50 times as much financing available to generate electricity as there is for the promotion of its consumption in Africa.

To rebalance and foster economic and social development, the promotion of productive uses should become an integral part of rural electrification activities, not a separate pilot project.

In Peru the promotion of productive uses of electricity was clearly mentioned in the 2007 Rural Electrification Law and included in the 2013–2022 National Plan for Rural Electrification. It aims to tap into this potential through capacity building and education of rural producers, in coordination with other government agencies, in value chains such as coffee, cocoa and grain processing, bakeries, and livestock and dairy production.

Rural electrification authorities play a strategic role in leading the promotion of productive uses of electricity, as they

- provide financing mechanisms (results-based financing, capital subsidies)

- Share knowledge through the organization of training programs and provide tools to developers – for example, the work that IDCOL has been doing in Bangladesh
- Interface with central level institutions if regulations need to be adjusted
- Supervise the activities of the stakeholders involved (NGOs, developers, equipment suppliers) and facilitate interactions among them
- Can contract directly with competitively selected local NGOs to assess the market and identify and promote activities in close collaboration with developers and launch information campaigns

Moving forward

The promotion of productive uses of electricity in mini grid development is neither straightforward nor organic

It requires:

- Strong **multi-stakeholder collaboration**
- **Driving role of electrification authorities**
- High degree of understanding of productive demand and close interactions with end-users
- **Availability and affordability** of income-generating appliances
- Specific **financing mechanisms**

Source: Pact/Smart Power Myanmar

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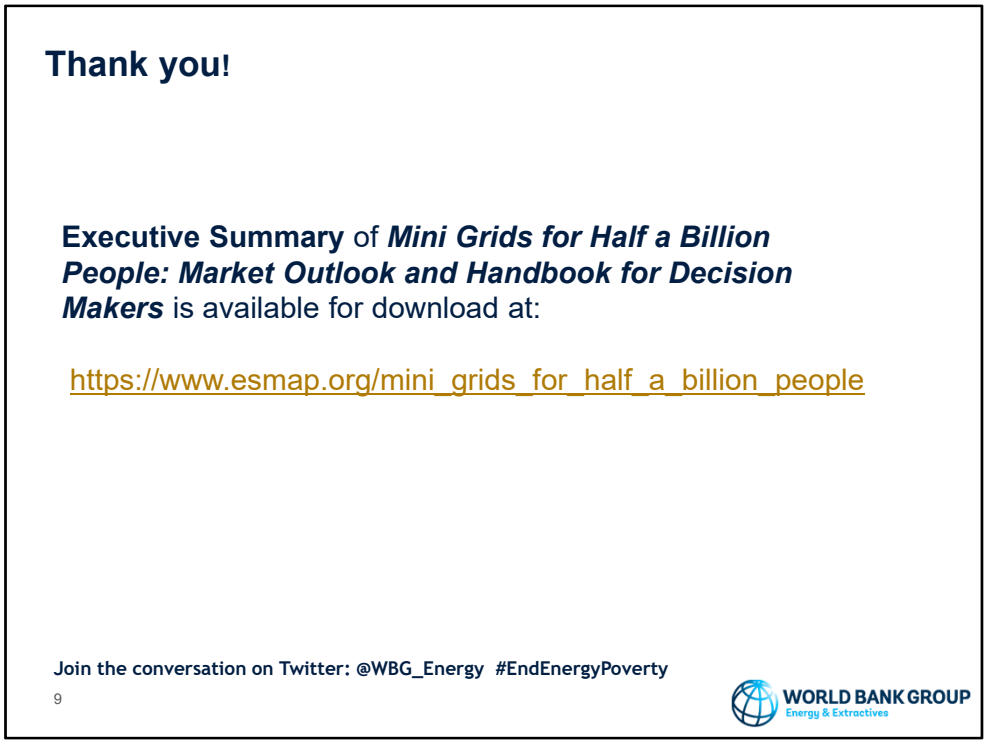
Given all of this, the promotion of income-generating uses of electricity in mini grid development is neither straightforward nor organic.

In the recent years, we have started to see positive impacts of having more inclusive approaches with productive users with a more accurate demand assessment, in countries such as Bangladesh and Myanmar. But it has to be done as early as possible.

These approaches require:

- strong multi-stakeholder collaboration
- Driving role of electrification authorities
- High degree of understanding of productive demand and close interactions with end-users
- Availability and affordability of income-generating appliances
- And specific, targeted and flexible financing mechanisms



Thank you. For your convenience, the electronic version of the report is available at the link on the screen.

Demand assessment and end-users' awareness should begin as early as possible in the mini grid development project cycle

- **Identification of opportunities** for productive uses through two methods: systematic or pragmatic
- **Launch of information and marketing campaigns** among entrepreneurs in the sectors selected in the identification phase
- **Need for change agents** to initiate the adoption process of income-generating equipment

Organization of workshops to better assess demand in Myanmar

Source: Pact/Smart Power Myanmar

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If we focus more on demand assessment and identification of opportunities for productive uses at the earlier stages of project design and preparation, there are two general approaches that are utilized by developers:

- The **systematic** approach maps all potential activities that could benefit from access to electricity. Each stage of existing and potential value chains—from inputs and processing to outputs and end uses—is screened to capture actors, market dynamics, cycles, and seasonality. This approach assesses the role electricity already plays and could play in the prioritized sectors.

- The **pragmatic** approach takes advantage of existing projects in sectors outside the power sector (agriculture, transport, industrial development) and see how electrification could help developing the activities targeted in the existing project. It enables rapid gains by quickly moving to the implementation stage as it builds on cross-sector coordination that already exists.

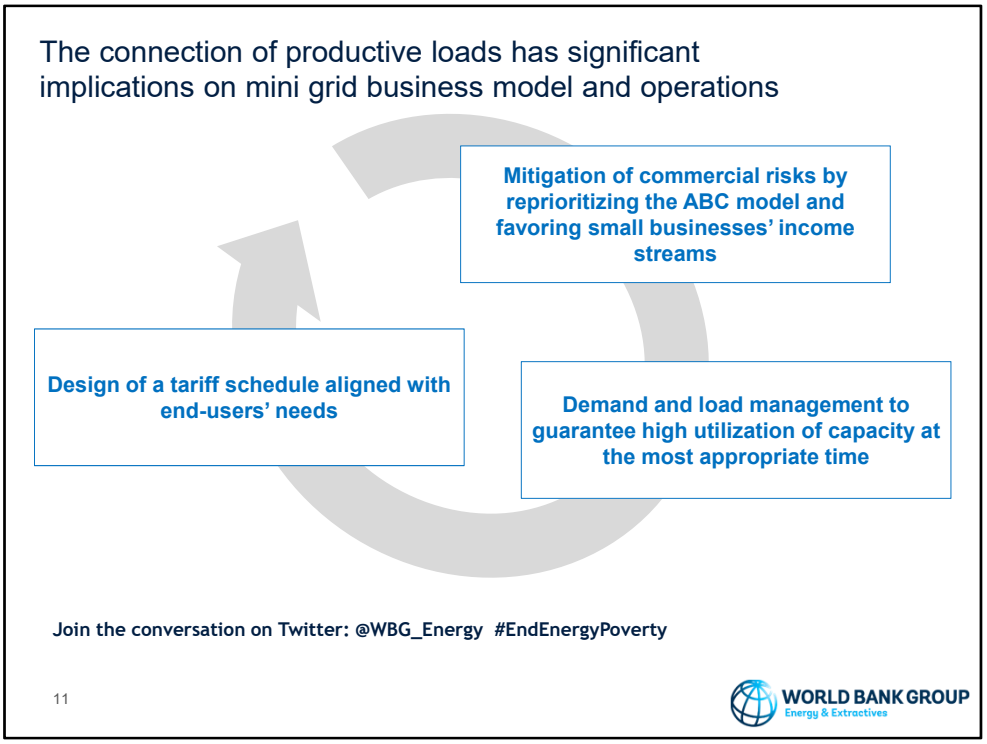
Campaigns can be launched through thematic meetings to better assess productive demand and potentially demonstrate equipment and share feedback from current productive users of electricity. While the transition from diesel to electricity is straightforward, adding new electrical-powered transformation activities may require

reorganization and deeper rethinking of business activities, for which productive players may need support. Campaigns have to be adapted to the level of literacy and habits of the targeted audiences.

If the mini grid developer can lead this effort, support from the agency tasked with electrification, NGOs, and development partners can facilitate interaction with productive sectors and local businesses.

NGOs have demonstrated that they can be successful partners. They can work with entrepreneurs and ensure the coordination among stakeholders. Beyond identification and promotional activities, NGOs can be involved in business development - advising small enterprises on ways to address business challenges.

Other agents, such as microfinance institutions, chambers of commerce, and small business accelerators, can also be mobilized. Many other stakeholders can be involved at specific points of the process: implementation units of agriculture and rural development programs, appliance companies, municipalities, and local associations. Their coordination requires institutional support through REA or NGOs.

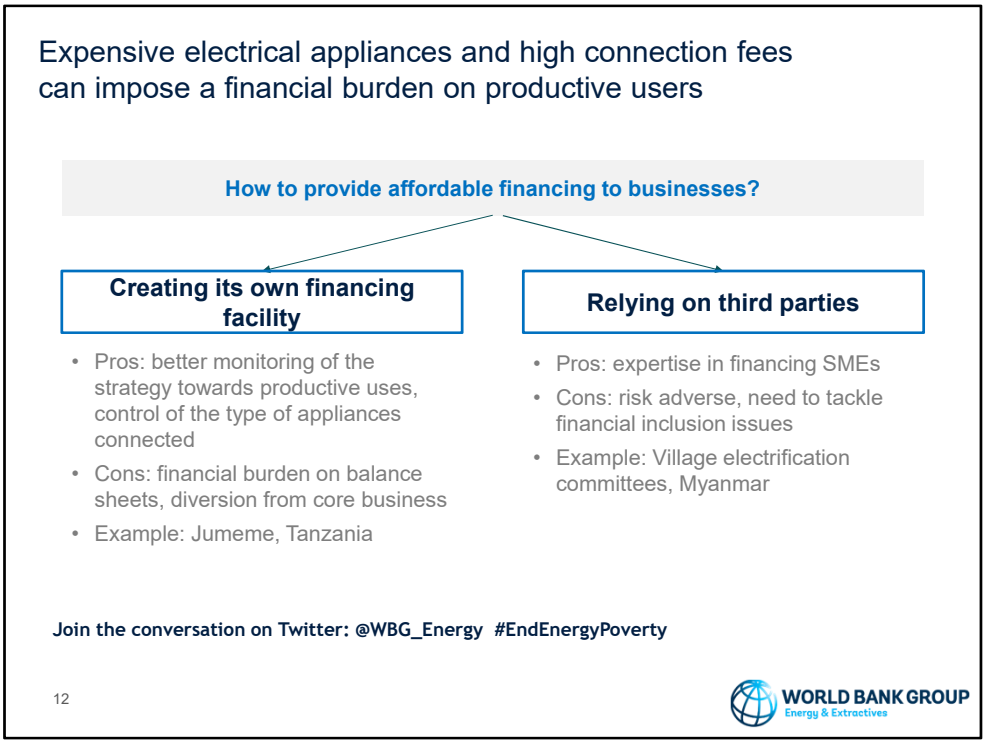


On the supply side, there are some issues to be tackled:

- **On the ABC (Anchor, Business, Community)** model, it usually prioritizes the connection of large productive anchor consumers to secure stable and predictable revenues (mining, telecom towers, large agro-processing activities). However, securing anchor clients can be difficult and fraught with risk if a mini grid is dependent only on one anchor customer for its financial viability. Subsistence agriculture, small-scale artisan networks, and local services are the general profile of rural income-generating customers. Therefore, developers are increasingly looking to also focus more attention on the B of the model (to favor small businesses' income streams), as it helps diversify the mini grid customer basis.

- **Demand and load management**: productive users of electricity have more specific power requirements than residential users. Understanding the productive load profiles enables the developer to target particular businesses. Operators can encourage a shift of some productive consumption to daytime or other nonpeak periods. Once operational, mini grid operators should monitor users for one to two years after their connections, to enrich their knowledge of demand dynamics. The Tanzania villages of Lupande, Mawengi, and Madunda are connected to a 300kW hydropower mini grid. Corn milling and welding activities are allowed to run only between 9 am and 6 pm, in order to ensure sufficient electricity for households at night.

- **Tariff schedule alignment with end-user needs:** Tariff incentives can significantly increase utilization, but they should be well adjusted to productive users' needs and constraints. To tailor tariffs to end-user needs, tariff rates can be adjusted based on the load location, load size, and type of connection, and also seasonality of the business. It's also important to keep in mind that pre-payment/ connection charges can be problematic for productive users with limited cash flows or those who are just launching an activity.



Two options exist to provide financing mechanisms to productive clients:

Option 1: Offering financing directly to productive users enables the developer to control who to connect and the choice of appliances. It may facilitate the system management and increase operational efficiency.

- A lease-to-own model (or on-bill financing) could enable end-users to pay 30 percent of the purchase price upfront, paying the rest to the mini grid operator month by month for a certain period through the electricity bill.

In Tanzania, the private operator Jumeme, (solar mini grid of 90kW in Bwisya on Lake Victoria since 2016) runs a shop selling appliances in the largest village. Small and medium-size enterprises acquire appliances on credit (usually for about six months) provided by the mini grid operator.

HOWEVER, this model may impose a **financial burden on developers' balance sheets**, and **divert the developer from its core business**. Mini grid developers do not necessarily have the skills, expertise or bandwidth to handle in-house financing.

Option 2: Involving third parties is an option that enables developers to remain focused

on their primary activity. **Microfinance institutions** (MFIs) are well established and offer a variety of financing products and benefit from existing customer bases and loan distribution networks. Another option is to work through **local governance structures**, as Smart Power Myanmar has done with the creation of village electrification committees which act as loan managers to finance connection fees, energy-efficient appliances, and productive end-use equipment and collect repayments.

Third parties should however tackle financial inclusion issues with end- users often lacking collateral and excluded from the formal financial system.

Development partners can play a key role in increasing the awareness of financing agencies or equipment sellers regarding **nontraditional proxies for creditworthiness and new approaches to assessing consumer risk** (using new sources of data, such as social network data, and mobile phone usage, to determine the ability and willingness to repay of unbanked users).

As we are talking about entrepreneurship, business development, and maximizing the benefits of electrification, the issue of the gender gap should be tackled at every step that we mentioned (demand assessment, adoption, financing),

Electricity access can support income earning for women's enterprises by extending the working day or enhancing agro-processing, manufacturing or service delivery.

Electric assets and services, such as electric water pumping and grain grinding, yield time savings and reduce the labor burden of women, which can allow them to set up their own small enterprises.

Gender gaps constrain the ability of women-owned enterprises to expand. For example, in the agriculture sector, women's access to resources is often mediated through men and their contributions to the sector often go unrecognized. **Women tend to work in the informal market in micro enterprises and subsistence farming.**

Change agents that we previously mentioned should focus on **assessing and tackling some of the drivers behind the gender gap related to productivity**: ensure a better access to financial products for women, enhance the technical and financial management capacity of women's enterprises by making sure that women are specifically targeted by business development trainings. These activities should start

from the very beginning of the process when we map productive use opportunities and when we prioritize certain sectors or value chains.