APPLIED ENERGY LAB BRIEF

OCTOBER 2020

Smart Power Myanmar

Consumption Trends

INSIGHT: Enhanced demand prediction tools, investment into productive uses and demand-side management strategies are all needed to secure mini-grid viability and sustainability.

Rural energy consumption in Myanmar remains largely unknown and challenging to predict, posing a significant problem for mini-grid developers. Equipped with a deeper understanding of historic and likely future energy consumption, developers can properly size their mini-grids. Correctly-sized and optimally-located mini-grids have a far greater chance of becoming viable and avoiding challenges faced by sites that struggle with limited productive use opportunities. Moreover, knowing *when* and *why* customers tend to consume electricity allows developers to identify specific opportunities to increase demand. However, the historical absence of information on rural energy consumption has prevented developers from making the data-driven decisions required to optimise the viability and sustainability of their projects.

To better understand this issue, and to help build a compelling case for investment in quality data management and analysis systems, Smart Power Myanmar's Applied Energy Lab examined consumption trends in projects subsidised under the National Electrification Plan (NEP) off-grid program managed by the Government of Myanmar's Department for Rural Development. Smart Power Myanmar analysed consumption data from January 2019 to June 2020 in eight villages across Tanintharyi, Magway and Mandalay Regions. Daily consumption data for individual connections were estimated by dividing the size of pre-paid electricity purchases by the time in between purchases. Smart Power Myanmar obtained access to the data management systems of five of the eight villages, allowing us to obtain plant-level load data. Information on plant sizing was gathered either directly from developers or from initial proposal documents.

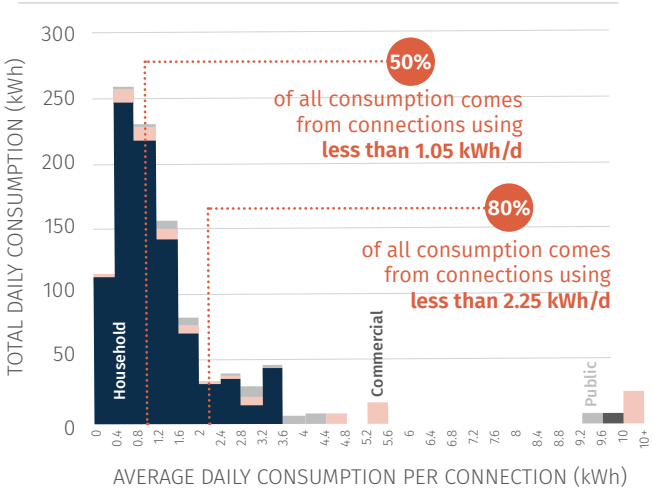
FINDINGS:

- **The total number of household connections did not meet predictions made during project planning.** A review of proposal documents revealed that 86% of forecasted connections were met. However, an analysis of productive use among the top 10% of users in each site revealed that 100% of sites met their expected number of productive use businesses.

- **By June 2020, almost a year and a half after the mini-grids were first commissioned, actual electricity consumption was significantly lower than had been forecasted during project planning.** Average household consumption was 0.67 kWh/day as opposed to the 1.62 kWh/day forecasted (40% of expected), though it varied greatly from site to site. Average consumption per commercial connection was 0.70 kWh/day as opposed to the 2.66 kWh/day forecasted (26% of expected), with approximately 75% of commercial connections consuming less than 2 kWh/day. Productive use businesses, which developers estimated would constitute 5% of the load, met 83% of estimated demand, though several of these businesses used household meters. Up to 80% of connections used less than 2.25kWh/day.

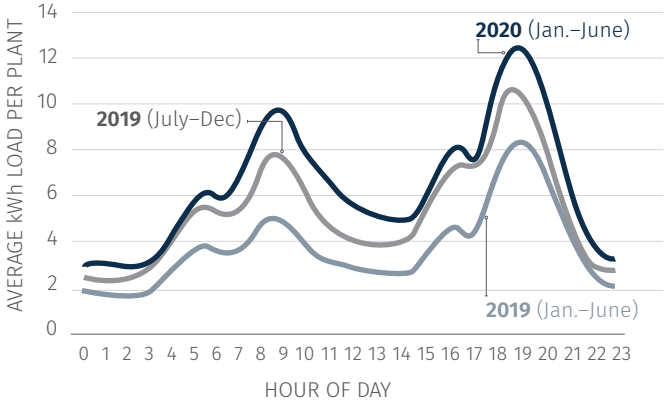
- **Though overall demand was lower than expected, plant utilisation steadily increased.** Between January and December, demand met 40% of installed capacity; by June 2020, this figure had risen to 54%. Between the July-December 2019 and January-June 2020 periods, night-time consumption grew by an average of 18%, reflecting a small increase in the number of connections. Day-time consumption rose by an average of 26% over the same period.

FIGURE 1: Average daily consumption per connection



- **Consumption was consistent with household-type consumption patterns with an early morning peak at 8AM, a larger evening peak at 7PM and a significant 'valley' of lower demand during day-time working hours.** Mini-grids were reliant on batteries or generators to meet demand at both peaks. The reduction in consumption during day-time hours indicates a lack of productive use as typical household users do not use significant amounts of energy during these hours.

FIGURE 2: Electricity consumption trends



INSIGHTS & FUTURE IMPLICATIONS

With this early data from a small number of communities, we have gained the following insights:

1 Improved demand prediction methods and tools are needed at the project planning phase to ensure the financial viability and sustainability of mini-grids. As the actual commercial consumption data revealed, commercial consumptions trends were considerably overestimated during project planning. Inaccurate demand prediction leads to oversizing which typically results in longer payback times, higher operational costs and lower overall efficiency. Better demand prediction tools, including predictive models on village growth potential and improved energy surveys, would help to maximise the likelihood of long-term viability, project development expansion and future investibility.

2 Mini-grid developers should implement demand-side management strategies to realise the significant opportunity for increased day-time loads. At present, limited day-time use poses a risk to developers' revenues and endangers the long-term viability of their projects by artificially reducing the lifespan of their batteries. Developers have various demand-side management strategies at their disposal, including implementing day-time tariffs, developing ancillary businesses and educating both customers and Village Electrification Committees (VECs) about productive uses and how to use power responsibly to optimise mini-grid plant health. Case studies from Tanzania show that, used in conjunction, demand-side management strategies can increase day-time demand by up to 30% (AfDB, 2020, p.34), boosting revenues and extending project lifespan. Prototyping the use of day-time tariffs and monitoring their impact on consumer behaviour and revenue will provide valuable information for setting tariffs moving forward.

3 Entire communities stand to benefit from engaging in the project planning process and developing ambitious plans for productive use. While productive loads constitute only 5% of the total day-time load, connection fees and tariffs will remain high and exclude some members of the community from enjoying the benefits of the mini-grid. By committing to ambitious productive use plans during the planning stage, whether these be community- or privately-owned enterprises, communities could improve the ratio of productive loads consumption to household consumption and, in doing so, lower the price of connections and tariffs for the benefit of the entire community without detriment to developers' revenues.

4 Performance-based subsidies with targets for loads are needed to increase overall consumption and plant utilisation. Low demand leads to higher connection fees which, in turn, prevents additional households from connecting and results in limited village consumption. Performance-based subsidies, which have been used in sub-Saharan Africa to boost mini-grid connections (IRENA, 2018, p.18), can be tailored to encourage developers to incentivise day-time loads by facilitating productive-use partnerships or adopting strategic tariff structures. Investment into these strategies, alongside value chain optimisation, would encourage further crucial growth in plant utilisation and allow developers to realise opportunities for growth in the mini-grid sector more broadly.

The Applied Energy Lab – in combination with the Energy Impact Fund for financing connections, appliances and productive use – is focused on solving some of the challenges that limit deploying mini-grids at scale in Myanmar. We hope to identify scalable prototypes and promote the sustainability and viability of mini-grid projects while increasing economic empowerment. Our market assessment suggests that the potential viable mini-grid market could be as large as 16,000 mini-grids. Future technical notes will continue to examine the impact and scalability of prototypes that optimise plant utilization and revenue.

REFERENCES

African Development Bank (AfDB). (2020). *Module 3: Mini-Grid Productive Use and Demand Management.*
International Renewable Energy Agency (IRENA). (2018). *Policies and Regulations for Renewable Energy Mini-Grids.*

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