

Executive Summary

Myanmar's power sector confronts two main issues – how to satisfy the ever-rising demand of electricity on the main grid, and how to electrify rural areas, including those with prior and ongoing conflicts. Although the government has been making substantial progress in solving these problems, much remains to be done. Blackouts are not uncommon, even in big cities such as Yangon, because of the lack of power capacity. Thanks to the National Electrification Plan, more villagers are enjoying access to modern electricity services, and the electrification rate now stands at 42%. But much must be done to achieve universal access by 2030.

Energy policies cannot be tackled with engineering and economics alone as they are also entwined in societal and political problems. The literature on techno-economic assessments of the power sector has been growing and can now provide alternative policy options for Myanmar. Renewable energy sources can contribute more to power generation mix than the government currently assumes. Solar photovoltaics can significantly help to expand power-grid capacity. Renewable-based mini-grids can accelerate rural electrification. However, there is a dearth of comprehensive examination of non-economic factors and socio-political and geopolitical considerations.

This report rectifies the lack of adequate research and identifies ways to contribute to sustainable development, a notion that has received increasing attention since the adoption of the 2015 Sustainable Development Goals.

Potential Role of Renewables in Electrifying Peripheral Areas and Facilitating Peace Processes

The goal of universal electricity access by 2030 requires Myanmar to bring electricity to peripheral areas, where ethnic conflicts were rife until recently or remain ongoing. Achieving the goal is a significant challenge but also offers an opportunity to reflect on rural electrification and peace processes.

Since its independence in 1948, Myanmar, a diverse country with more than 100 ethnic-minority groups, has experienced ethnic conflicts, which continue unresolved today. Large-scale energy projects such as hydropower dams exacerbated the adversarial relationship between the central government and ethnic armed organisations (EAOs). Bringing small-scale

hydropower and solar photovoltaics to rural areas could have favourable social effects by ameliorating unequal energy access.

Semi-structured interviews were conducted with stakeholders to elicit their views on the possible role of renewables in facilitating peace processes. Many interviewees agreed that decentralised renewable energy could be an important component of cooperative projects and build trust amongst local stakeholders. However, how such projects are implemented needs to be carefully examined since they might be conducted top-down. It is crucial to foster a partnership amongst the state government and existing local service providers such as EAOs and civil society organisations (CSOs). The issues such projects will be dealing with should be less political and more practical.

Such bottom-up initiatives need many more engineers, and Myanmar should enhance training programmes for them.

In addition to the primary political process of the Nationwide Ceasefire Agreement (NCA), there have been some cooperative projects between the state and region governments and EAOs. The NCA excludes many EAOs, when such cooperation should ideally be extended to NCA non-participants.

Regional Power Connectivity for Myanmar and the GMS

The main grid's lack of power capacity persists, and the government recognises the need to double it by adding approximately 3,000 MW by 2020. Such expansion is not feasible without considering social and environmental conditions, in addition to engineering and economic constraints.

Many avenues for expanding power capacity have been explored, including constructing large-scale hydropower dams, coal-fired power plants, and natural gas-fired plants that use imported liquefied natural gas, which are featured in the National Electricity Master Plan. Unfortunately, all these options would take many years to implement, either because of community opposition or technical issues. Solar farms would be able to provide desperately needed electrical access in a short period but progress has been slow.

Cheaper electricity imports from neighbouring countries have emerged as a possible solution to the electrical supply shortage. Myanmar already utilises some small-scale cross-border

exchanges to meet electricity demand in peripheral regions. In recent years, the government has conducted exploratory discussions, and in some cases signed memoranda of understanding (MOUs), with the Lao People's Democratic Republic (Lao PDR), China, and India. For example, Myanmar recently announced an agreement to import 1,000 MW from Yunnan, China.

The government has taken an important step but should consider this interdisciplinary issue strategically in terms of economics, geopolitics, and environmental sustainability, according to our thorough review of the academic and grey literature. In the short term, regional interconnections will present Myanmar with a crucial opportunity to meet the growing demand for electricity in a short time. At the same time, regional power connectivity presents numerous critical issues.

Importing affordable power could directly reduce power shortages but requires investments in energy transmission infrastructure. If well done, these infrastructure improvements could also contribute to rural electrification through benefit-sharing mechanisms.

Myanmar is at the centre of an interregional energy cooperation network between South Asia (Bangladesh, India) and Southeast Asia (Lao PDR) and China. This is a potential positive first step towards fostering economic and political cooperation with other areas in the region. It could also provide Myanmar with a strategically important regional position as a 'power' bridge between South Asia and Southeast Asia and southern China. Myanmar should exploit this strategic advantage to balance relations between itself and its neighbours rather than become increasingly dependent on them for energy.

In the GMS, international connectivity has become synonymous with large-scale hydropower development. Basin-wide planning could simultaneously bring energy and environmental benefits to the region, and a strategic environment assessment could be an important first step in that direction.

Finally, strengthening the national power grid should be considered as critical to development. Myanmar has no 500 kilovolt (kV) lines, which limits the viability of cross-border power trade. The construction of such infrastructure, already in the early planning stages, is critical for low-cost imports. The system's ageing infrastructure leads to increased technical losses, which also need to be addressed.

Barriers to Development of Renewable-based Mini-grids

Mini-grid development should be accelerated to achieve equitable growth. Decentralised approaches should be considered in addition to centralised options such as national grid extension.

Mini-grids are an effective option to fill the supply gap between solar home systems (SHSs) and national grids. In rural areas, where diesel fuel is considerably more expensive than in urban centres, mini-grids powered by renewable energy may be a cost-competitive alternative to diesel generators. However, adoption of mini-grids is slow and they continue to be subsidised.

A survey questionnaire was administered to stakeholders to analyse barriers to widespread diffusion of mini-grids. A multi-criteria decision-making method – the analytic hierarchy process (AHP) – was utilised, along with k-means clustering, to rank barriers to implementation based on stakeholder evaluations.

The inconsistency amongst clusters represents the disagreement amongst each clustered group of respondents. The results demonstrate that stakeholders were divided on mini-grid implementation, making it difficult to identify a primary or dominant barrier. This differs from other countries, where a single lead barrier to implementation can be easily identified. In the social and cultural barrier survey category, opinions were divided amongst clusters of stakeholder respondents. One cluster prioritised the perception of the inferior quality of renewable energy as the biggest barrier, whilst the other cluster prioritised the educational gaps of local mini-grid developers and operators. These results show that there is no single ‘silver bullet’ for implementing mini-grids and that overcoming multiple barriers requires significant effort.

Financing Mini-grids

To expand mini-grids to the entire country, significant public sector financial support is required to shoulder the costs of developing mini-grid infrastructure. Myanmar can look to neighbouring countries such as Thailand for an effective financing model based on secured revenue sources such as a petroleum tax. To pursue such large-scale energy infrastructure projects, institutional reform and integration of electrification policy will be required eventually.

To secure significant government support for developing electrical infrastructure, a public financing mechanism such as a public fund is desperately needed. In a country such as Myanmar, where the banking sector is not advanced, fund mechanisms are required to achieve multi-year targets. A law providing for a rural development fund is in the final stages of approval. As the law broadly dictates that the proposed fund can be used for rural infrastructure electrification projects, it is reasonable to interpret it as permitting the use of fund revenues to support community-based mini-grid development.

The source for a potential fund could be secured through an earmarked tax such as a gasoline tax. The initial costs of a mini-grid would have to be subsidised, especially for the proposed community-based model. Current public support for one project by the Department of Rural Development is around US\$180,000. The Ministry of Energy and Electricity (MOEE) reports that 2,000 rural villages need mini-grid energy systems, so roughly US\$360 million is needed to achieve mini-grid targets in rural and/or conflict-prone areas. Thailand's model (Thai Energy Conservation Fund) suggests that a petroleum tax is a feasible revenue-generating option. Assuming surging urban transportation usage, an approximately 5% tax rate increase on both regular and diesel gasoline is sufficient to fund rural mini-grid development.

Ministries need to be reformed to facilitate large-scale mini-grid development. The MOEE oversees on-grid electrification, whilst the Ministry of Agriculture and Livelihood (MoALI) conducts off-grid electrification projects such as the '60-20-20' programme. As MoALI is not an 'energy' ministry, the programme it manages remains small. To enlarge the scale of the MoALI programme and integrate off-grid systems with on-grid ones, the MOEE and MoALI need to be reformed and to coordinate with each other. Ultimately, an integrated energy policy and planning body such as the previous administration's National Energy Management Committee is required, with broad authority to enact energy projects.