COMMUNITY MOBILIZATION FOR ENERGY SECURITY: A CASE STUDY OF THE DANU SELF-ADMINISTERED ZONE IN MYANMAR

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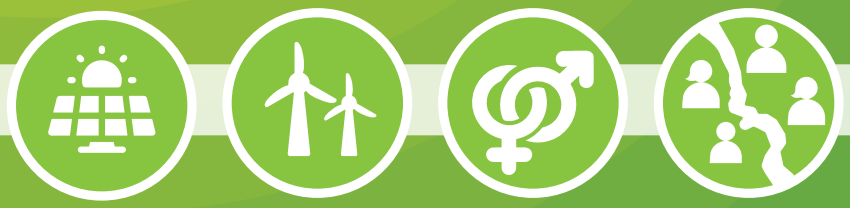

This paper is part of a research series on the energy landscape in Southeast Asia.

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ABSTRACT

Myanmar's energy planning is highly centralized. The state-managed energy infrastructure has struggled to meet growing demand for electricity and connect populations living in remote regions to the national electricity grid. The 2021 military coup has further undermined the centralized energy system, and the shortcomings call for alternative solutions to achieve energy security. Decentralized renewable energy systems, such as small-scale community hydropower and solar power schemes, have been an affordable way for communities to gain access to energy in many parts of the country and community-based approaches to energy are growing in importance. This paper highlights ongoing exclusions in energy access and evaluates the limitations of centralized electrification, before turning to examine the viability of decentralized off-grid energy options in Myanmar. We examine decentralized community-based pico- and micro-hydropower schemes developed and managed locally with the support of a local civil society organization (CSO) in the Danu Self-Administrated Zone to illustrate that community-managed energy systems fill a critical gap in electricity provision left by the government. The study finds that local communities' lack of technical capacity and financial resources has been partly mitigated by the support given by the CSO which harbors a network of technical experts and development cooperation partners. An intimate relationship between the CSO and local communities is a key factor in their successful collaboration. Myanmar's current political, economic, and humanitarian crises, however, is putting the power of community collective action to the test. International partners have an important role to play in ensuring energy access and security for people in Myanmar by strengthening their support for decentralized energy solutions under challenging post-coup contexts.

INTRODUCTION

Enhancing energy security is an important step for inclusive human development. Although access to electricity reached 90% globally in 2019 according to a global database (World Bank, 2021a), there is ongoing disparity between countries with and without electricity. Notably, only 54% of the population has access to electricity in conflict-affected and fragile countries (ibid). In the Global South, private citizens and communities have a key role to play in realizing affordable, reliable, and sustainable energy supply and access. Mobilizing investments and implementing national grids can take a long time in countries with weak public financing for basic services and infrastructure. Slow rollout of centrally organized electricity grids has left many unconnected communities in the dark. However, decentralized energy systems are increasingly filling this gap. As du Pont et al. (2019, p.1) argue, "[d]ecentralized, smaller-scale energy resources can... be deployed much more quickly than large-scale megaprojects; they are scalable; and they improve the reliability and resilience of the electric grid." This paper examines the viability of community-based renewable energy systems and specifically the role of community mobilization in enhancing energy access and security for communities in rural Myanmar.

Myanmar is a country with a population 54 million marred by protracted conflict. In southern Shan State, Danu ethnic minority communities have mobilized to gain access to energy by finding economically and environmentally sustainable solutions at the community level. The case study examined in this paper shows how a civil society organization (CSO), the Foundation for Renewable Energy and Ecology (FREE), has supported communities in the Danu Self-Administered Zone to maintain, repair and upgrade their village hydropower schemes by utilizing their networks to bring knowledge, technology, and financial resources to local communities. Through the case study, we argue that local communities hold the key to recovery from the Covid-19 pandemic and political crisis, but that ongoing international support will be crucial in the coming years to ensure communities have access to affordable and reliable energy. Community-based CSOs can act as effective brokers to arrange technical assistance and link communities to international development cooperation partners.

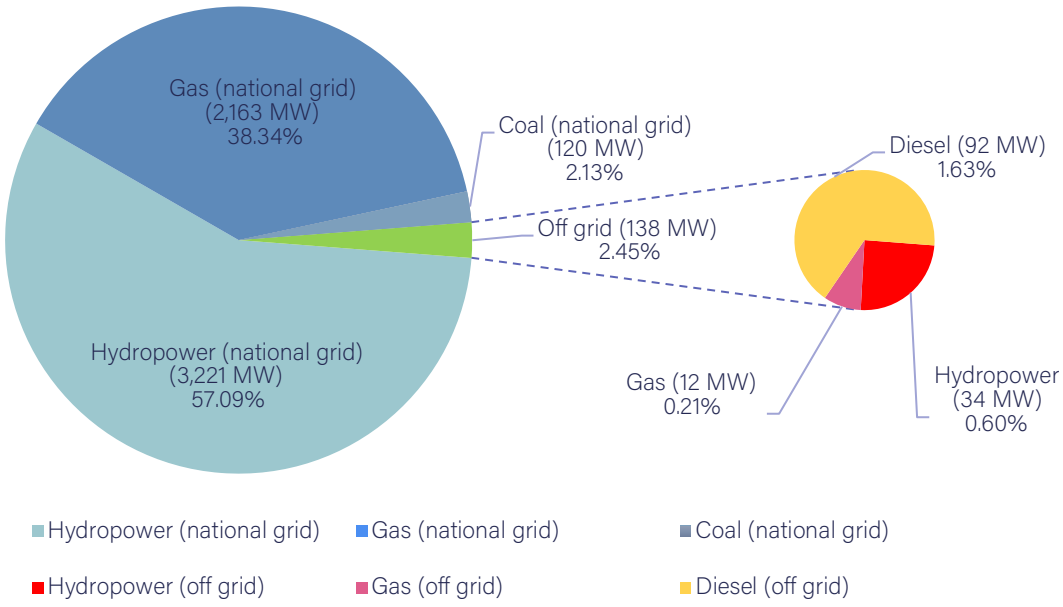
The paper is organized as follows. First, we present a brief overview of Myanmar's national energy policy. We then examine how Myanmar's state-driven energy planning process excludes segments of the population, drawing on Hall et al.'s (2011) powers of exclusion framework. Following a brief description of the methodology, we introduce the case study of the Danu Self-Administered Zone in Shan State of Myanmar. Drawing on the key findings of the case study, the final section discusses the potentials and limitations of community-based energy solutions. The paper concludes by contemplating the policy implications of the study in post-coup Myanmar.

Limitations of the centralized electrification policy

During the period of democratic opening in 2011-2020, Myanmar made significant progress in developing its national energy policy. By 2020, 68.4% of the population had access to electricity, and 50% of households were connected to the national grid (World Bank, 2020). Myanmar still has one of the lowest rates of electrification in Southeast Asia and these rates are much lower in rural areas and remote regions (Pode et al., 2016).

The democratically elected National League for Democracy (NLD) government set four development focal points — namely roads, water, education, and electricity. The National Electrification Project (NEP) set the goal of achieving 100% household electrification by 2030, which would require USD 5.8 billion in investment for an additional 7.2 million household connections (du Pont et al., 2019). In order to reach the goal, the government pursued several strategies including boosting the generation capacity of the national grid through large-scale projects. Myanmar's topography and hydrology allows for the construction of large dams for hydropower generation, which some consider an economic and clean source of electricity. According to 2018 data, the hydropower sector has 3,255 MW of installed capacity, which accounts for 58% of the country's electricity generation capacity (du Pont et al., 2019; see Figure 1). The Government of Myanmar plans to install an additional 5,738 megawatts (MW) of hydropower generation capacity by 2031 (U Aung Ko Ko, 2016). Natural gas also accounts for a significant and growing portion of the electricity supply, currently at around 40%.

Figure 1. Installed capacity of electricity generation by source in Myanmar



Source: Figures based on 2018 data from the Ministry of Electricity and Energy (du Pont et al., 2019)

Myanmar's ambitious energy policy has been met with challenges. Energy experts have pointed out that the government's highly centralized approach to energy provision is inefficient in tackling the growing challenges (WWF et al., 2018). According to Myanmar's 2008 Constitution, the Union Government is responsible for all generation and distribution of electricity connected to the national grid, while state and regional-level governments can obtain permission from the central government to manage small- and medium-level grids unconnected to the national grid. Facilities with 30 MW generation capacity or above need permission from the union government. The capacity of regional and state-level governments is still limited compared to the central government. For state- and regional level energy planning, budgeting and policymaking, staff from the Ministry of Electricity and Energy have taken on major tasks, and this practice has implications for policy development and meeting regional needs (du Pont et al., 2019).

The government's centralized approach to energy emphasizing large-scale hydropower dams and coal power plants has been met with societal resistance in several locations (Foran et al., 2017; Kim, 2021). Environmental activists and communities have expressed concern that these large- scale projects harm the land, forests and aquatic resources that local populations depend on for their livelihoods. Large hydropower projects have often resulted in environmental destruction and the involuntary relocation of people without the provision of adequate compensation.

More recently, the economic crisis due to the global Covid-19 pandemic and the political crisis after the military coup in February 2021 have severely impeded the prospect of achieving energy security in Myanmar. The state's legitimacy has been eroded since the coup, which has significant implications for policymaking and implementation. Civil servants and technicians at the Ministry of Electricity and Energy have refused to work under military rule (Lin, 2021). Since the coup the regime has faced problems with electricity bill collection due to striking staff and people's refusal to pay bills in resistance. This can prolong energy shortages and negatively affect economic and human development. State authorities have not yet dealt with the humanitarian crises that has flared up in many parts of the country, namely Kayah, Chin, Kachin, and Mon states as well as major urban centers in Yangon and Mandalay, among others. The UN estimates that 3 million people are in need of at least one form of humanitarian assistance and protection services (UN OCHA, 2021). Energy (in)security will continuously play an important role in the recovery from devastating consequences of violence and COVID-19 that have ravaged the country.

Exclusion in the energy sector

This paper uses a conceptual framework of "exclusion" in evaluating policies for energy planning and access. It is inspired by the "powers of exclusion" framework developed by Hall et al. (2011) in the field of critical agrarian studies. Focusing on land use changes in Southeast Asia, the framework examines four sources of power – (state) regulation, the market, force, and legitimation – that influence land-related social relations. Like land, access to electricity can be restricted and determined by the aforementioned exclusionary forces. Individuals can theoretically purchase their own generators powered by diesel or solar and install electricity at their home, but not everyone can afford the cost of investment, maintenance, and operation. Grid-connected electricity is much more affordable and stable than household-level systems. Therefore, public energy infrastructure is essential for ensuring stable and affordable electricity supply for large populations. Electricity provision is contingent on state policies and the regulation of public infrastructure, the availability of capital, functioning markets, and ideas of development.

The exclusion of large sections of the population from electricity access is not only caused by lack of state capacity and financing but also policy decisions on energy planning and priorities for basic service provision. States with limited financing and capacities like Myanmar are forced to roll out grid expansion plans gradually. Governance decisions prioritizing which sector and sub-national regions are eligible for grid expansion can determine who gets affordable and relatively stable electricity access.

The urban-rural and regional divide is prominent in this regard. So far, the progress made in electrification in Myanmar has been uneven and there are significant differences between economic centers and peripheries. For instance, Yangon's electrification rate is over 80% while the southern state of Tanintharyi is barely over 10% (Harrison & Arnold, 2020). For a country seeking a federal system accommodating diversity, equal access to electricity is a crucial issue for national harmony. Yet, energy policy has tended to exclude certain ethnic groups and border regions. State-led development plans often privilege electricity provision for industrial facilities in urban or peri-urban areas over expanding connections to remote, rural areas in the periphery. Ideas of modernity and development legitimize these priorities with visions of technological advances and industrialization powered by large-scale energy facilities generating hundreds if not thousands of megawatts of electricity every hour.

To expand energy infrastructure, neoliberal states have invited domestic and foreign private energy companies to fill the financing gap (Sims, 2021). The trend has been to privatize the energy sector, with many independent power producers generating and selling electricity to public and private grids. The effect of privatization on energy access depends on the

arrangements and regulations that determine the level of tariffs. In the hydropower sector, respective government ministries and agencies allocate a license for building and operating dams and power stations. The lack of transparency in project appraisal is problematic as it can harbor corruption and cronyism at the expense of the public interest.

Force, most notably the state's capacity to deploy violence, is another way in which exclusions in the energy sector occur. Myanmar's powerful military has been involved in clearing the way for energy infrastructure development such as the Myitsone Dam on the Irrawaddy River and several mega hydropower projects on the Salween River (Karen Rivers Watch, 2014; Kachin Development Network Group, 2007). The local population living in the vicinity of the Upper Paunglaung and Myitsone dams was forcibly removed without adequate resettlement plans or compensation (KDNG, 2007; Physicians for Human Rights, 2015). In ethnic areas, forced displacement and state violence against the civilian population has been used as part of counterinsurgency operations (Maung Aung Myoe, 2009). Human rights observers in Myanmar have continuously raised concerns about human rights violations by the military linked to large-scale dams and other energy development projects.

Ideology also plays a role in shaping official energy policies through narratives of large-scale energy infrastructure as constituting 'development' and 'progress'. The Myanmar state media frequently covers hydropower dams on its front page, describing dams as a symbol of 'modernity' and 'development' (The New Light of Myanmar, 2007; 2013). In the coverage, there is no mention of the environmental and social impacts of these projects. The Myanmar state has long justified the development of large dams in the country's ethnic minority areas by painting these groups as 'primitive', 'anti-state', and in need of economic development (Lambrecht, 2008). Such state ideology has been materialized into border development initiatives or Na Ta La projects in ethnic minority regions under the Ministry for Progress of Border Areas and National Races and Development Affairs (Lambrecht, 2008). The Na Ta La projects are problematic because they can be exploited for corruption and benefit local elites (see, for example, Karen Human Rights Group, 2016).

The above forces of exclusion are countered by collective resistance against state-driven energy policies and large-scale projects, as well as through the development of alternative approaches to energy provision, as elaborated in the following section.

Resistance against exclusionary energy policies

In many respects states hold the key to energy access because of their central role in energy policymaking and implementation. States can also use violence to enforce energy policies if they are met with resistance. Numerous documented cases show that forced evictions have been carried out by state security or law enforcement forces to make way for hydropower dams and other energy projects (Einbinder, 2017; Oliver-Smith, 2009). The state's decisions and actions can include or exclude segments of the population from 'development.' However, this does not mean that people do not exercise agency. The manifestation of people's agency in response to exclusionary energy policies is captured in two social phenomena in Myanmar. First, protest movements against hydropower dams have demonstrated people's opposition to controversial dams with adverse social and environmental impacts. Second, there have been various efforts to develop community-based energy solutions through collective action. These two areas of collective action are interlinked in terms of the expression of popular desire for more inclusive development and peace.

Protest movement against large hydro

In Myanmar, large hydropower projects are notorious for inflicting harm on diverse ethnic communities who have suffered from a protracted civil war between ethnic rebels and the state. Ethnic communities have led resistance campaigns against large hydropower dams on the last two free flowing rivers in Asia – the Irrawaddy and Salween rivers (Kim, 2021).

Some activists suspect that dam building is one of the reasons for increased military activities and forced relocation of villages in strategic locations (Karen Rivers Watch, 2014). A report published by Karenni activists links two periods of mass displacement to the construction of Salween dams (Karenni Development Research Group, 2006). Such suspicion is not without grounds. The Four Cuts policy is a well-known counter-insurgency strategy used by the military to control the civilian population whom they suspected of providing recruits, food, information, and funding to ethnic rebels. In order to combat socially embedded rebellion, the military forcibly relocated civilian populations who have connections with insurgencies, mostly through their shared ethnic identities, into military-controlled areas. The Hatgyi Dam site in northern Karen State was one of the sites of the 'Four Cuts' operations where tens of thousands of civilians were routinely displaced. The local population in the area has long opposed the construction of the Hatgyi Dam because they perceive the dam as a threat posed by the Myanmar government to control the area (Kim, 2021).

The limited benefits of existing hydropower projects to local populations reinforce these concerns. For instance, communities displaced by the Upper Paunglaung Dam in 2011 did not receive electricity from the dam despite their loss of livelihoods and forced relocation (Physicians for Human Rights, 2015). The Kachin population forcibly removed from their homes by the proposed Myitsone Dam in 2006 did not receive electricity for several years. Even after the electricity lines were connected, resettled villagers were resentful over the resettlement process and hardships in the new model village where they lacked arable farmland, water supply and sanitation (Kim, 2021).

Decentralized, community-led energy solutions

Local activists have argued that their critical view of large-scale dams is not an 'anti-development' stance but rather based on evidence that less harmful alternatives are available, including community-driven, decentralized energy systems (Bright, 2019; Kyaw Thu Han, 2018). Experts have assessed that off-grid micro-hydropower generation systems in remote mountainous regions can provide solutions to supplying electricity to local populations (Pawletko, 2015). Participation by local communities and their sustained engagement is key to developing these community-driven solutions.

Many communities in Myanmar have had to organize their own energy solutions because of the state's neglect and lack of social services under decades of military rule. Villagers have collected funds to purchase turbines, transmission lines, and converters to make their own small-scale hydropower energy systems. This collective approach to energy solutions has worked particularly well for households that could not afford their own diesel generators. Pico-scale hydropower stations can generate several kilowatts for the community, enough to keep the lights on. These decentralized energy systems were initially developed without international support prior to the country's opening in 2011.

We consider these community-led energy solutions as strong expressions of local agency, resisting exclusionary energy policies of the state, and taking control of local affairs. In conflict-affected areas, communities had limited access to public services, and mini-grids and village-level solutions were developed without assistance from the government. Community mobilization for public services has occurred in various places in Myanmar mostly because of the void of a functioning state (Wells & Aung, 2014). These experiences of handling things on their own have empowered communities and ordinary citizens.

Major progress has been made in decentralized, community-driven electricity solutions during the era of democratic opening. Off-grid solutions now provide electricity to nearly half a million households across the country (World Bank, 2015). These include 6,000 pico- and micro-hydropower stations in Shan State, mostly organized independently by local

communities (Hivos, 2019). In some cases, local communities have managed to organize village-level mini grids powered by solar and hydropower although collective solutions were not always favored (Asian Development Bank, 2017). International financing and support has contributed to the growth in the solar power sector as well (USAID, 2021).

To explore the viability of community-based solutions, we zoom in on one area of the country where a CSO has been mobilizing local communities to strengthen their off-grid renewable energy systems since 2017.

Community-based energy solutions: A case study of the Danu Self-Administered Zone

To empirically examine community-based renewable energy systems and their viability, we delve into a case study of the Danu Self-Administered Zone (see Figure 2). The case is illustrative of community mobilization for developing a mini-grid. Single case studies, if designed carefully, can generate heuristic insights and help identify relevant factors for further investigation (George & Bennett, 2005). This case study begins with a brief description of the methodology, before turning to examine the political history, geography and socio-economic context of the study area. The next section looks at energy access, including recent developments and challenges in community-based energy systems and national grid expansion. This is followed by an examination of the work of a CSO and their activities with local communities since 2018. We focus on the interactions between local communities and activists and reflect on the factors that have influenced their relationship building and mobilizing around community-based energy solutions.

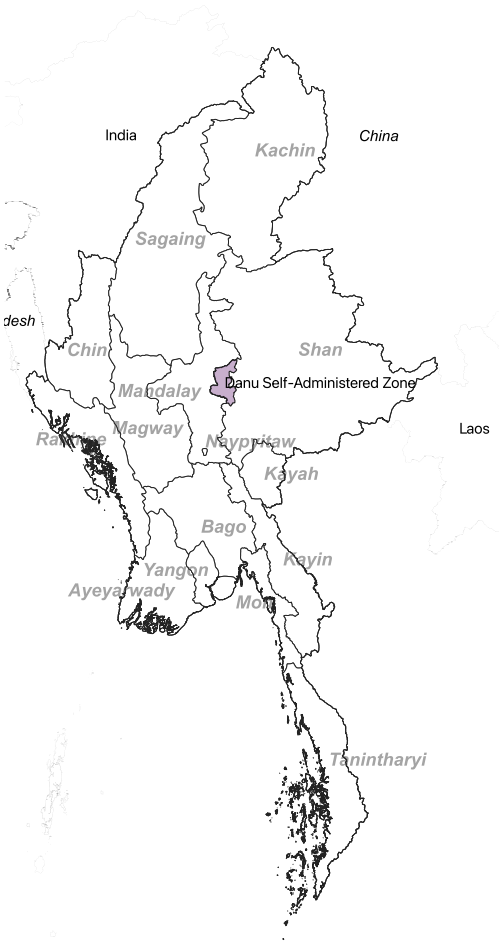


Figure 2 Location of the Danu Self-Administered Zone (map produced by QGIS by K. Kim using MIMU GIS layers)

Methodology

We consider the Danu Self-Administered Zone a case of successful community mobilization for village-level energy solutions. This is a not unique case. Dozens of communities in Myanmar have developed off-grid energy options according to the Asian Development Bank's pilot study on renewable mini-grids (ADB, 2017) as well as a recent report by USAID (2021) on the off-grid sector. The case selection is motivated by the authors' access to communities in this area due to one of the authors' direct involvement in community renewable energy activities as a staff of the Foundation for Renewable Energy and Ecology (FREE). The case study is based on information collected by one of the authors who has been based in the research site since 2018. Due to Covid restrictions and new regulations since the military coup in 2021, fieldwork within the Danu Self-Administered Zone has been hindered, and empirical material for the case study was gathered through a combination of remote and in-person interviews during September 2021. Research participants include staff members and volunteers of FREE, and community leaders and members in Pindaya and Ywangan townships in the Danu Self-Administered Zone.

Background: political history, geography, and socio-economic context

The Danu Self-Administered Zone is located in southern Shan State bordering Mandalay Region (see Figure 2). It consists of Pindaya and Ywangan townships with a population of 150,000. It is one of five self-administered zones in Myanmar designated for ethnic nationalities including the Danu, Naga, Ta'ang/Palaung, Pa-O, and Kokang. Section 276 of the 2008 Constitution provides for the formation of a representative body in each of the self-administered zones whose members consist of elected Members of Parliament (MP), military appointed personnel, and additional appointees by the MPs. This representative body or "Leading Body" can exercise legislative power. The five groups that retain self-administered zones have different degrees of autonomy. For example, the Ta'ang National Party and the Ta'ang/Palaung political party, which were formed after the demobilization of the Palaung National Liberation Organization in 2005, have little control of the self-administered zone because they do not have significant presence in the townships designated as a self-administered zone for the Ta'ang/Palaung (Meehan, 2016). The Pa-O National Organization (PNO) and the Myanmar National Democratic Alliance Army (MNDAA), the Kokang armed group, have more influence and control over public affairs in their respective self-administered zones.

Figure 3 Hillside farms in the Danu Self-Administered Zone (photo by Kyi Phyo)

The Danu ethnic group has a degree of autonomy in their self-administered zone, as they can elect their own representatives and carry out public affairs. The Danu is one of the few ethnic groups that have not rebelled against the state to demand self-determination, but they are not pro-military groups either. It is worth noting that National League for Democracy (NLD) candidates won all lower (MIMU, 2020a) and upper house (MIMU, 2020b) seats and three out of four Shan State parliament seats (MIMU, 2020c) in the Danu Self-Administered Zone in the 2020 General Election. Interestingly, U Arkar Lin, the only winning candidate fielded by the United Development and Solidarity Party, the military-proxy party, was elected Chairman of the Leading Body after the coup (MITV, 2020). This is an important indication of the complex relationship between the Danu population and the central government. The Danu population may share similar aspirations with the majority population as the election result shows (MIMU, 2020d), but they also understand the precariousness of being a minority group. In southern Shan State, the Danu live alongside the Shan, Pa-O, and Ta'ang/Palaung, among others. The complex ethnography of Shan State brings additional challenges for political arrangements for groups who have aspired autonomous rule within their respective areas.

The Danu Self-Administered Zone consists of mountainous forests and valleys. Although forests were degraded in the period from 2004 to 2014 (Bhagwat et al., 2017), forest coverage in the area remains high. Several streams and rivers run through the area including the Zawgyi River, a tributary of the Myitinge River, itself a major tributary of the Irrawaddy River. Streams in mountains and waterfalls are ideal for installing pico- or micro-hydropower stations, as explained later.

The area is predominantly rural and has lower access to basic services than urban centers, but better literacy rates and access to basic services than conflict-affected regions. Over 75% of the population in the Danu Self-Administered Zone relies on agriculture for their livelihoods (Department of Population, 2017a, 2017b). They grow subsistence crops as well as cash crops for sale such as tea, orange, avocado, ginger and vegetables. Irrigation facilities are limited, and farmlands are mainly rain-fed and located near streams for water (General Administration Department, 2019a, 2019b). Schooling rate for both boys and girls are similar or higher than the national average, and the literacy rate is significantly higher than the average in Shan State (The Union of Myanmar, 2015). Compared to other townships in Shan State, education through government-run schools is well provided for. About 50% of the population has access to improved water supply and about 90% has access to sanitation (Department of Population, 2017a, 2017b).

The Danu Self-Administered Zone is distinguished from other ethnic areas in Shan State by virtue of the absence of tensions and armed conflict. In a 2018 vulnerability assessment (HARP-F and MIMU, 2018), the Danu Self-Administered Zone scored mid-range in development indicators and was categorized as having 'very low access to basic services and infrastructure'. Compared to other townships in Shan State which are considered 'extreme outliers in terms of development needs and/or exposure to conflict', 'conflict-affected areas with poor human development', or 'hubs in conflict-affected areas', the Danu Self-Administered Zone has better access to basic services and scores higher in schooling, healthcare facilities, and energy access (HARP-F & MIMU, 2018). As mentioned earlier, the Danu is one of the few ethnic minority groups that has no armed groups, and the military had little presence in the region until the 2021 coup. These conditions are unique to the Danu region allowing it to enjoy a degree of autonomy without the presence of armed groups. In the Danu region, local communities have a strong preference for managing their own affairs. This is reflected in their selection of their own community leaders who work in parallel with government-appointed administrators.

Energy access in the Danu Self-Administered Zone

Access to energy in the Danu Self-Administered Zone has significantly improved during the last ten years. According to 2014 government census data, 18% of households are connected to the national grid, 30% use solar PV as their main source of lighting, 8% rely on community hydropower, and 30% rely on candles and kerosene for lighting (Department of Population, 2017a, 2017b). However, our own research shows these figures to be outdated. In 2021, the proportion of households still relying on candles and kerosene has decreased to a mere 5%, which is a significant improvement compared to the past. Solar and community hydropower has expanded significantly in the area, which is estimated to provide electricity to almost half of the population. The main factors contributing to improvements are the

further development of the community-based hydro systems, the installment of solar PV systems in households, and the expansion of the national grid.

Due to the geography and hydrology of the area, there is high potential for pico- and micro-hydropower. While there is limited data on energy access in the area prior to 2014, according to local people, electricity outside of towns has mostly come from pico-hydropower stations built and maintained by villagers (interview with villagers, Sept 2021). Since the 1990s, local technicians from Taunggyi started to build pico-hydropower stations in streams in mountainous Shan State (Hivos, 2019). Communities in the Danu region eventually learned how to use this technology and started to set turbines in the streams near their villages (interview with villagers, Sept 2021).

More than 100 village-run hydropower stations have been installed. They power electricity for lighting, charging batteries, water pumps and rice mills. Community hydropower systems have a capacity of between 50 and 500 kilowatts (kW) (interview with villagers, Sept 2021). For example, members of Htan Hla Pin village in Ywangan Township installed a 30 kW hydropower station in 2003-2004 (Figure 4, left). The system was designed to use the natural height of a waterfall (Figure 4, right). Villagers gradually upgraded the system by replacing old wooden transmission poles with concrete ones and exchanging the turbine with one of larger capacity. An important aspect is that villagers operating the pico-and micro-hydropower stations understand the importance of forest conservation in maintaining community hydropower systems (interview with staff members of FREE, Sept 2021). This is compatible with other community-led development initiatives in the Danu Self-Administered Zone such as promoting ecotourism.

However, many of these village hydropower stations are aging; some of them are nearly 20 years old and require repairs and replacements (interview with FREE, Sept 2021). Sometimes villagers want to upgrade the capacity of the system as electricity demand has surged over the years. This is challenging due to financial constraints. In most cases community technicians have the knowledge and skills to install and repair the systems themselves, but sometimes they need external technicians and replacement parts.

A major technical problem with existing community hydropower stations is voltage and frequency control. Community hydropower systems use natural streams with minimal construction to regulate the speed and flow of water (see Figure 5). Without regulating the voltage and frequency of generators, the risk of damaging electronic appliances is high. For pico-scale systems the risk can be mitigated through careful design. The micro-scale systems require technical solutions to regulate the voltage. Installing Electricity Load Controllers (ELCs) is probably the most cost-efficient solutions for this problem (Singh et al., 2018). However, the cost of ELCs is high for local people. Imported ELCs cost USD 2,000

- 5,000 per unit. Therefore, technicians in Taunggyi and Mandalay locally produce ELCs at a much lower price, but the locally produced ELCs are varied in availability and quality (interviews, Sept 2021).

Figure 4 Micro-hydropower system in Htan Hla Pin village, Ywangan Township (left: 30kW generator; right: water pipe connected to a waterfall, photo by Kyi Phyo)

Another challenge is related to the seasonal variability of water flows. Pico- and micro-hydropower use natural streams with minimal alteration of watershed areas. Most pico-hydro stations can operate six to nine months of the year, though some can run the whole year around. Changes in water availability affects power generation. Reduced water flow during the dry season requires communities to seek alternatives sources of power such as solar. The impact of climate change can lead to changes in precipitation and temperature, which can further influence the future of hydropower.

Solar power has become an important source of electricity in the area over the last ten years. More households can afford solar PV for charging batteries and water pumps because the price dropped sharply from USD 4.46 per watt in 2006 to under one US dollar in 2012. In 2019, the global average price of solar PV modules was around USD 0.38 for every watt (Our World in Data, 2020). We estimate the startup cost for solar panels and batteries for each household to range between MMK 20,000 and MMK 200,000 (USD $10-100) depending on the panel size and battery capacity. Scaling up the solar power system to the community level has not been discussed much by communities, as most solar PV systems are installed and managed at the household level.

New connections to the national grid have been made with several communities, and we estimate that about half of the population in the area is now connected to the grid. According to the National Electricity Plan, the Ministry of Electricity and Energy has allocated funds for expanding the national grid in order to achieve 100% electrification by

2030 (Japan International Cooperation Agency, 2014). The Danu Self-Administered Zone is located close to the Zawgyi hydropower station and Aungthapye sub-station in the main grid system, and many more households have been connected to the national grid over the last few years.

Although connecting to the grid has brought major improvements for communities, they also face some challenges. Villagers pay higher fees for electricity with a grid connection than village hydropower. Electricity with a grid connection costs MMK 4,500 (USD 2.50) per month per household while the operating costs of village hydropower stations is under MMK 1,000 (USD 0.55) and becomes free after several years of operation. Grid connection electricity fees are collected through Village Electrification Committees that set fixed rates for electricity because meters are not available. Despite having to pay the fixed fee, electricity supplied by the national grid is unreliable during both dry and rainy seasons.

Sometimes communities have had to mobilize their own funds to connect to the grid. One community surveyed in Ywangan Township said that the Ministry of Electricity and Energy had offered to extend the transmission cable but not all the way to their village. Villagers were asked to pay 40 million MMK (USD 22,000) for a one-mile-long 11 kV transmission cable, which was too expensive for the villagers. In the end villagers hired their own technician to make the connection, which ended up costing the community 16 million MMK (USD 8,700), not even half the sum asked by the Ministry. This incident suggests there is widespread corruption in the electricity sector.

Local people have little to no influence over the decision to connect their village to the central electricity grid. Once the Ministry decides an area is to be connected, communities have to mobilize funds if the allocated budget is insufficient to cover the cost. It is common in Myanmar for people to subsidize public infrastructure by contributing labor and funds. Despite all these issues, rural residents want to connect to the grid and see it as important progress because they recognize a growing need for electricity in the future.

There is a general upward spiral in electricity demand when communities are connected to the grid. Enhanced energy access has improved several aspects of people's daily lives. People start buying additional appliances such as televisions, electric kettles, rice cookers, and water pumps. This increasing reliance on electricity can be problematic when power outages become frequent. For instance, during the rainy season electricity is mostly cut off, and people turn to fuel and firewood for cooking and candles for lighting.

Various factors have contributed to improvements in electricity access in the Danu Self-Administered Zone. In many cases, local communities have taken the initiative to install and manage village micro- and pico-hydropower energy systems independently from the state.

However, at times communities need external support to repair and expand the system. As examined in the following section, civil society actors have played an important role supporting community-based energy initiatives.

Civil society support for community-based renewable energy

In 2018, a group of grassroots activists set up an organization advocating renewable energy and environmental conservation in Pindaya Township in the Danu Self-Administered Zone. The Foundation for Renewable Energy and Ecology (FREE) currently has four full-time staff and three volunteers, and several associates are available for technical consultation. These community-based activists have collaborated with Danu communities and provided training in renewable energy and forest conservation. Villagers were offered training in community-led resource management and planning, which included mini-hydropower stations and setting up community conservation zones (Figure 6). Through these trainings, activists have sought to promote decentralized renewable energy solutions that provide communities with energy access and security as well as protecting the local environment.

Local communities have been using village-level hydropower for almost 20 years; these systems were established long before FREE existed. However, activists identified gaps and challenges with these systems. Many communities have experienced an increase in electricity demand due to more household appliances and mobile phones being available. In addition, farmers want to use electricity to run rice mills and charge irrigation pumps. To meet these additional demands, existing hydropower systems need to be upgraded. When communities lack funds to purchase new turbines, cables, poles, and replacement parts, civil society organizations like FREE have helped channel financing from international development cooperation partners. FREE has also arranged technical assistance through their networks of local technicians and domestic micro-hydropower developers when villagers needed to design new systems and repair broken stations.

Staff members of FREE have built an intimate relationship with local communities and meaningfully engaged with youth and other community members through their activities. Tree planting days and community trainings in water and forest management have been popular activities, especially among the youth. Villagers requested FREE's assistance with community hydropower systems when they learned the organization had connections to engineers and technicians in bigger towns. These informal social networks functioned as an efficient referral system and facilitated collaboration. FREE has operated without politicizing issues related to energy, development and the environment, which is one of the reasons why local communities have been less hesitation to interact with them. This political neutrality became particularly important after the 2021 coup.

Figure 6 Community training session for integrated resource management
(Photo by Kyi Phyo, February 2020)

Covid restrictions and post-coup challenges for energy security

The Danu Self-Administered Zone has been spared from the worst of both the Covid outbreak and the political repression that followed the coup. Nevertheless, the population has experienced economic hardships. Travel restrictions have impacted the local economy: seasonal migrant workers could not travel to Shan State to pick tea and agricultural produce could not reach the market on time. This led to reduced incomes and livelihood challenges among most rural communities. People faced problems accessing necessary parts due to the sliding Myanmar currency and reduced cross-border trade with China.

The worst impacts came from the political crisis after the coup on February 1, 2021. Since the coup, all public activities came under scrutiny by the military regime. The Danu Self-Administered Zone was no exception. Community trainings for energy planning and environmental protection were neither political nor anti-regime activities but meetings of more than a dozen villagers with activists could bring unwanted attention by the local authorities. This predicament has suspended several training activities and made interactions between CSOs and villagers more difficult and uncertain.

The viability of community-driven solutions

Several insights from the case study highlight the potentials and limitations of community-driven energy solutions. The most important finding is that decentralized community-based renewable energy systems are already widespread, providing access to electricity to substantial proportions of the rural population. This finding is in line with previous research on rural electrification in Myanmar (Hivos, 2019; Pode et al., 2016). Communities in Danu Self-Administered Zone have installed these systems on their own and also continuously invested and even attempted to upgrade these in response to growing electricity demands. A factor that is often highlighted in successful development interventions is that local communities have ownership over projects implemented on the ground. Danu communities certainly see the value and utility in decentralized energy systems to take the initiative to establish, operate and maintain these systems, and villagers' ownership over these decisions and processes has enabled a degree of sustainability in these projects.

Second, the case demonstrates that CSOs such as FREE can facilitate local communities' access to critical technology and financial resources needed to maintain and upgrade community-based renewable energy systems. Their networks with technicians and external funding organizations, along with established relationships of trust with local communities are all factors critical to their successful engagement in this work. Village hydropower schemes with over one megawatt capacity generally require professional design and installation, and communities may find the investment risky without first having consulted trusted advisors. CSOs can act as knowledge brokers, providing communities with important information about potential energy options in the market and utilize their networks to assist communities make decisions that suit their needs. CSOs also link communities with external financing from international development organizations to help fill important gaps. Furthermore, FREE has linked up with other CSOs that support community-based renewable energy and environmental protection in remote areas of Chin and Karen States. Knowledge exchanges among these organizations would benefit the decentralized renewable energy sector and further promote a community-based approach.

CSOs that have close relations with communities and networks with technical experts are not uncommon in Myanmar. However, FREE is unique in that it has knowledge and expertise specific to the energy sector. Local CSOs and community-based groups could adopt a similar approach as demonstrated in this paper to promote ecologically sustainable and affordable energy in their respective communities. But this would require exchanges between these community organizations and the provision of training by local or international experts. The need for knowledge transfer and training is greater than ever since Myanmar's centralized energy policy has met a series of challenges after the 2021 coup.

Finally, the experience in Danu area suggests that national grid expansion and connection does not guarantee stable access to electricity. This has two implications. First, the national grid needs to improve its generation and transmission capacity; and second, communities need to manage electricity demand and/or consider supplementing electricity through local decentralized solutions. This means that national electrification plans need to seriously consider community-level renewable energy systems not only as interim solutions but also complementary systems to the national grid. This calls for greater incorporation of and support for decentralized energy options in Myanmar's energy planning, at least until important milestones are achieved in terms of stability of the national grid.

Conclusion

This paper has evaluated the potential and limitations of decentralized energy solutions in one of Myanmar's less conflict prone ethnic minority areas. The scope of evaluation focuses on the reliability and affordability of the electricity generated as well as the sustainability and ownership over energy systems. Community-based decentralized hydropower and solar power facilities have been crucial in providing rural residents in the study area with access to electricity. Nevertheless, communities have experienced challenges meeting growing electricity demands due to limited financial and technical resources required to install, upgrade, and maintain the systems. In this case study, a grassroots civil society organization, the Foundation for Renewable Energy and Ecology (FREE), has been instrumental in providing information, technical expertise and financial resources to communities. By interacting with the organization, communities have not only been able to upgrade and maintain their energy systems but also become more aware of the importance of forest conservation and watershed management. The organization's extensive knowledge of micro- and pico-hydropower, their network of technicians and engineers, and their bottom-up approach to community engagement and problem solving has been key to their effective support for local energy solutions.

This paper has highlighted how community collective action serves to counter exclusions in energy access by rural communities in Myanmar. Community-led energy initiatives have even greater significance after the 2021 coup as state control and capacities in public affairs are in decline. The military coup's derailing of a democratic transition in Myanmar has led to a political crisis that seriously impacts the centralized approach to energy planning, which has been met with even more resistance (The Irrawaddy, 2021a). A large proportion of the population has refused to pay their electricity bills, and hundreds of technicians at the Ministry of Electricity and Energy have resigned in protest. The military regime intends to govern the country without making political concessions to the opposition. In a futile quest to win people's hearts and minds, the junta has sought foreign investment to expand

energy facilities such as a tender issued in May 2021 for solar power facilities across central Myanmar. Both Chinese and Western investors have been skeptical of this proposal (Evans, 2021; Wallace & Robinson, 2021). Several investors in the hydropower sector have paused or been reconsidering their partnerships with the junta. For example, the Electricity de France suspended the Shweli 3 Dam project planned in northern Shan State after the coup (Protard & White, 2021). With shrinking foreign investment (Nikkei Asia, 2021), the government of Myanmar will struggle to meet growing electricity demand in the country.

The state's ability to operate, maintain and expand existing energy infrastructure is highly questionable since the coup. The economy has deteriorated sharply, and Myanmar's local currency, the kyat, has dropped to nearly half its value against US dollars (Reuters, 2021). The World Bank (2021b) forecasts an 18% decline in Myanmar's economy in 2021 due to the adverse impacts of the COVID-19 pandemic and the widespread political unrest and violence against protestors. Two liquefied natural gas power plants in Yangon have stopped operating since July because the Ministry cannot afford the rising prices of natural gas with the depreciating kyat (The Irrawaddy, 2021b). This means that the national electricity grid will function with limited capacity leading to frequent power outages with adverse economic and development impacts.

The current political, economic, and humanitarian crises puts the power of community collective action to the test. Under the previous military regime, communities set up their own self-help initiatives including village hydropower systems. An important question now is how these community energy initiatives can be supported. In this paper, we argue that strategic financial support and technical training for local communities is urgently needed to fill crucial gaps. Such support should be based on needs assessments with the input from Myanmar-based civil society networks. During the pandemic, technologies for web-based, remote training became widespread in Myanmar, and international development partners can explore opportunities through such channels if in-person trainings are difficult. These trainings can be combined with awareness campaigns that help communities to protect the environment.

The former Union Minister for Natural Resources and Environmental Conservation, U Ohn Winn, remarked that, "[D]ecisions made now will determine how Myanmar looks for future generations. We must make the right ones for people and for nature. Nature protects us and we must protect nature - together we are stronger, together we have a future. Sustainable way, it's the only way" (WWF et al., 2018, p. 2). Sustainable, reliable, and affordable energy is key to achieving sustainable development in Myanmar, and local communities are at the forefront. International actors, both researchers and development partners, have an important role to play in supporting Myanmar's recovery and sustainable development.

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COMMUNITY MOBILIZATION FOR ENERGY SECURITY: A CASE STUDY OF THE DANU SELF-ADMINISTERED ZONE IN MYANMAR

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