Bringing Power Back to the People: A review of renewable energy and energy education in Myanmar

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Introduction: DEEM and internship

The Mekong Region is experiencing the impacts of climate change, and greenhouse gas emissions in Southeast Asia are predicted to increase rapidly due to economic growth. At the same time, a significant proportion of especially rural households still lack access to modern energy services although the energy sector is rapidly developing as the countries aim to graduate from the least developed country status. In the face of climate change, there is a strong need to support building sustainable energy pathways. Responses to the variable challenges present in the energy-poverty-environment-climate nexus call for multidisciplinary and situated knowledge and capacities.

Currently, there is a gap in local capacity in the sustainable energy and climate change issues to respond to these challenges. The aim of FFRC's 'Development of Energy Education in the Mekong' (DEEM)[1] project is to build on the educational collaboration established in the previous projects focusing on basic environment, climate and energy education. The wish of the partners is to expand capacity development to include multidisciplinary and sustainability factors in the energy education.

In Myanmar, it has been identified that sustainability issues need to be integrated throughout the existing subjects in curricula at University of Yangon (UY) and Yangon Technological University (YTU) to foster national energy expertise and markets.

In order to contribute to the objectives outlined by the DEEM project, an internship was created geared towards supporting the review of the current state of renewable energy in Myanmar and the review of issues observed in renewable energy curricula at UY and YTU. Furthermore, recommendations are put forward on how to close the gaps between energy education and corresponding labour markets. The research results following the internship are presented in this paper.

Research methodology and limitations

In order to conduct a sound sociological research, several methods were used in triangulation. Firstly, a literature review was done in which academic and secondary literature regarding the current status of renewable energy in Myanmar, the future outlook, and national power development plans are discussed. Secondly, desk research in combination with interviews was crucial to perform the review of energy curricula. Third, semi-structured interviews with university staff, ministry officials, civil society actors, and renewable energy companies were conducted. Lastly, a field trip to southern Shan State was organised in collaboration with a local environmental civil society organisation.

Limitations to this type of research include the limited sample size of interviewees, cultural barriers, issues of confidentiality due to the sensitivity of the issues at hand, and the density of the subject matter.

[1] http://erasmus-deem.fi

Image taken by
Nicole Garces
Inle Lake, Myanmar

Brief overview of Myanmar's current energy mix and renewable energy potential

Myanmar, also known as Burma, is situated along the Bay of Bengal and the Andaman Sea. Bordered by India and Bangladesh to the west, China to the north, and Thailand and Laos to the east, Myanmar forms the gateway between South and Southeast Asia. A country of approximately 53.3 million inhabitants, Myanmar has had a tumultuous uncoupling from the long reign of British colonial rule (and brief Japanese occupation), enduring decades of oppressive military regimes, relentless censorship, intense ethnic strife, continuous civil wars, and systemic human rights violations. However, with the recent untightening of military grip through the demise of the State Peace and Development Council (SPDC) and subsequent to a series of elections, Myanmar is opening up and laying foundations for the growth of a robust democracy. Though the current Rohingya crisis in Rakhine state is hampering the continuation of economic growth, Myanmar remains one of the fastest growing economies in Southeast Asia, and globally, with its GDP growing at a rate of 6 to 7 percent annually (World Bank 2017). Simultaneously, it remains affected by substantial rates of rural poverty, leaving up to 70 percent of the population with no electricity connection, the majority being rural communities (WWF 2016). Myanmar has the poorest level of energy access in all of the Asia-Pacific, providing access to electricity to less than a third of its population (Sovacool 2013). Access to reliable and affordable electricity is absolutely vital for increasing living standards and lifting communities out of poverty.

The country is endowed with abundant fossil fuels (oil, natural gas, coal), hydropower, and renewable energy resources. More specifically, Myanmar is the largest natural gas exporter in the region, pumping around 80 percent of its output to Thailand and China (WWF 2016: 83). Roughly 68 percent of Myanmar's electricity is generated through large-scale hydropower resources – the remaining 32 percent comes from the burning of fossil fuels (WWF 2016). Scattered across the country are 24 existing hydropower plants (of which 22 possess a capacity greater than 10 MW) and 7 under construction, 14 existing gas-fired power plants and 12 under construction, and 2 existing coal fired plants (WWF 2016).

Consensus regarding which energy source should supply Myanmar's energy needs in the years to come has not yet been reached, it seems. The national power development plan – the Myanmar Energy Master Plan, put forward by the Asian Development Bank and Myanmar Ministry of Energy and Electricity – does not leave immense space for the introduction of renewable energy, but rather places emphasis on the continuation of energy generation with the use of big dams and coal-fired power plants. Focusing primarily on the economic aspects of energy production and supply, the Myanmar Energy Master Plan (MEMP) argues for example that natural gas should be utilised as a strategic energy resource while continuing the search for undiscovered national oil reserves (MEMP viii). Furthermore, growing local demand of electricity is best addressed by "increasing the supply of petroleum products" for electricity production (MEMP ii). In order to increase the stock of petroleum products, the MEMP suggests that Myanmar could utilise the Sino-Burma in order to establish a new oil refinery (MEMP viii). Throughout the report, there is very little mention of substitution of traditional energy sources by alternative ones. For example, the report argues that the import of gasoline and diesel fuels is necessary to meet the increasing demand of electricity use, and that oil or stored hydropower could be used alongside gas in times of peak demand (MEMP xi). On pages x-xi, the future outlook for 2015 and 2030 are described respectively, outlining that there will be a 'dramatic change' over the coming 15 year period, with the dependence on coal increasing from 2 percent in 2015 to 20 percent in 2030, large scale hydro increasing from 5 to 11 percent, oil percentages remaining the same, and solar PV and wind increasing from 0 percent to 1 (MEMP). On environmental or social concerns that come with large scale hydropower dams and gas pipelines, the report merely states that the social acceptance has diminished in recent year, and that the government should try to make local communities see the ways in which they can benefit from energy development projects (MEMP xx). Clearly, the Myanmar government aims to meet the increasing electricity demand of a modernizing population with conventional and arguably unsustainable energy resources.

The Myanmar National Electrification Plan (NEP), a World Bank-funded and government-based project, aims to electrify 100 percent of Myanmar's households by the year 2030. Currently, about 30 percent of the population is connected to electricity, the lowest rate in Southeast Asia. Around 98 percent of the new connections will be grid-based, meaning the currently unelectrified households will gain access to electricity by connecting to the national grid, which is extended every year to reach more remote settlements. When exactly the grid arrives in what areas is unknown. During the September field trip to southern Shan state it became evident that many transmission towers had already been placed, yet many of the connection lines were missing. The other remaining 2 percent of the currently unelectrified households will become electrified through off-grid solutions (i.e. independent grids). Furthermore, through the pre-electrification plan, households can, with government substitution, set up mini-grids or off grid solar home systems while they await connection to the national grid. Communities who are expected to be connected to the grid in the final years of the phase (2025-2030) can apply for government substitution to the Department of Rural Development (DRD). The NEP favours the expansion of national grid lines as opposed to independent renewable energy grids, and these grid lines will transmit power generated almost entirely by large hydro and natural gas-fired power plants (Pawletko 2015).

The goal is 100 percent electrification by 2030, yet the energy generation mix does not include a substantial percentage of sustainable renewables. Though a heavy emphasis is placed on hydropower, large-scale hydropower projects are not a form of sustainable energy, as they often bring harmful environmental and social impacts. According to a report released by the WWF, however, it is feasible to meet national electricity demands using 100 percent renewable energy resources by the year 2050. Under the Sustainable Energy Scenario (SES) and the Advanced Sustainable Energy Scenario (ASES) put forward by the report, fossil fuels can potentially be entirely phased out by 2043 and 2038 respectively (WWF 2016). Wind, solar, photovoltaic (PV) and concentrating solar power (CSP), biomass, and, to a lesser extent, hydropower (micro and pico) are envisioned to be the largest sources of renewable energy generation by 2050. Ocean energy is included under the ASES as well.

The overall potential supply of renewable energy sources in Myanmar is 46,000 MW for large-scale hydropower plants; 231 MW for small-scale hydropower plants; 33,829 MW for (onshore) wind; 26,962 MW for solar; 6,899 MW for biomass; 4,741 MW for biogas; 1,150 MW for ocean; and 400 MW for geothermal (WWF 2016). As outlined by the WWF report, by 2050, under the SES, solar energy (PV cells and CSP) could supply 46 percent of the total national electricity; onshore wind could supply 17 percent (not taking offshore wind into account); bioenergy (derived from biomass) could supply 17 percent; and geothermal and ocean power are still constrained, and could therefore supply around 1 percent each. Geothermal energy is abundant in Myanmar, however, with up to 93 potential locations across the country (WWF 2016). Moreover, ocean energy is a relatively untapped renewable energy resource, despite its high potential due to Myanmar's vast coastline of 2,832 kilometres, providing strong currents and tides along the coast. The first tidal power plant became operational in 2007 (WWF 2016). Additionally, approximately two-thirds of primary energy in Myanmar is supplied by biomass (e.g. fuelwood, charcoal, agricultural residue, animal waste, etc). The heavy dependence on traditional energy fuels in rural settings (e.g. fuelwood accounts for more than 90 percent of the total biomass energy sector, WWF 2016) is due to the fact that the majority of Myanmar's population – up to 65 percent – lives in rural areas, restricting their ability to be connected to the national electricity grid or to commercial fuel markets. Solar energy, however, has the potential to supply rural communities with renewable forms of energy, through the instalment of stand- alone PV systems or PV systems that are connected to micro- and meso-grids. Hydropower is currently the only renewable energy resource that is exploited commercially, on a large scale, supplying around 68 percent of national energy needs. However, as argued by the WWF, hydropower (with the exception of pico or micro-hydropower) could have severely negative environmental and social impacts, including threatening freshwater ecosystems and the livelihoods of millions of people depending on fisheries and wetlands. Displacement of communities in the name of hydropower development is not an uncommon phenomenon in Myanmar. It is estimated that the construction of large dams has led to the displacement of 40 to 80 million people worldwide (World Commission on Dams 2000). Additionally, communities are often forced to relocate due to flooding, reduction of water quality, or a loss of access to a water source. Overall, hydropower, under the SES, should only supply up to 14 percent electricity. When it comes to nuclear energy as a source of renewable energy, the debate is divided. Some deem it a good source of renewable energy due to its low carbon emissions, while the fact remains that the process of nuclear fission produces highly toxic waste that remains radioactive for thousands of years and hazardous to all forms of life. One major challenge in the development of renewable energy technologies is the inherent intermittency (Nowotny et al 2017). What is needed to overcome these shortcomings are energy storage facilities and energy storage systems, such as grid level batteries (Sadoway 2012). According to calculations made by Intelligent Energy Systems Pty Ltd (IES) and Mekong Economics (MKE), Myanmar does already possess good seasonal diversification across hydropower, wind energy, and solar energy in order to mitigate issues of intermittency (WWF 2016: 98):

> "The annual maximum solar irradiation is in February and the minimum is July to August. For hydropower, the annual maximum output occurs in October, which is when the reservoirs are filled following the dry season rains (which occur typically in May to June). (...) [G]eneration from wind reaches its maximum between July and September and complements hydro and solar resources very well."

Barriers to the renewable energy potential in Myanmar

A major barrier currently to the widespread implementation of independent off-grid renewable energy solutions is the lack of willingness of the Myanmar central government to decentralize energy planning and incentivize the local development of renewable energy grids. The main focus of the Union seems to be the expansion of the national grid and 100 percent electrification by the year 2030 (NEP). While there is enough evidence that local communities possess the capacity to generate their own electricity using alternative and renewable small-scale energy resources, the 2014 Electricity Law hinders the flourishing of this process. Essentially, the 2014 Electricity Law gives regional and state governments the power to directly administer permits to those who wish to develop a power generating system under 30MW. Power generating systems above 30MW need a permit from the Ministry of Electricity and Energy (MoEE). There are two ways in which this hinders local developers and energy engineers: firstly, every independent grid needs a permit, even those as small as 1kw, secondly, grid interconnection is not allowed, meaning that small independent grids may not be connected to the national government grid. The implications of this are as follows: There is little to no investment security, as independent grids are often abandoned when the national grid arrives, since grid connection tariffs are low. Considering it takes 5-10 years to develop an independent small-scale grid and establish the transmission lines for household connection, the national grid could arrive during these years of development. If the corresponding village decides they prefer to be connected to the national grid, and a law on grid interconnection has still not been drafted, then the development of an independent grid will have been a waste and local developers (and private sector investors in some cases) lose out. Since there is no transparency on when the national grid will arrive in what areas, local developers take a huge risk when developing their own energy generation systems. Essentially, the extension of the national grid combined with a lack of transparency and a lack of a rural regulatory energy framework is threatening the life of these local alternative energy solutions. The reason for central government not to establish a regulatory framework for the management and interconnection of off-grid solutions is that the government generates a large income from several sources. Firstly, the government receives a lot of funding for the National Electrification Plan from big development banks such as the World Bank. Secondly, the government receives income from grid connection fees paid by local communities. Third, by supplying a reliable and stable energy supply, the government creates an attractive landscape for commercial businesses to settle their manufacturing process. Lastly, the government believes that independent renewable energy grids will interfere with the stability of the national grid, if connected.

Bringing power back to the people

Shan state, Myanmar's largest state, has long been a pioneer of grassroot micro-hydropower initiatives, with hundreds of micro-hydro plants scattered around the landscape (Pawletko 2015). Communities in Shan state are strong, which was especially evident in the villages that were visited during the September field trip to the Ywar Ngan/Taunggyi region in southern Shan. The Mya Say Ti village rejected the national grid, as they are independently generating energy using micro-hydropower sources; the Myaing village hosts two larger mini-hydro turbines, with a generating capacity of 60 and 80kw respectively; and the Tat Gone village gained access to electricity through community leader and self-taught local engineer, who set up a constellation of micro-hydro turbines, each turbine generating no more than 5kw. Local communities have the capacity and rely on their own traditional knowledge to buy, sell, and use their own energy, and they have been doing this for decades, with very little to no government support and a limited educational foundations to build upon. Another major barrier to the widespread implementation and adoption of renewable energy technologies in Myanmar is thus the lack of needed human resource capacity and a gap in skilled labour (Nowotny et al 2017;

WWF 2016; Ciriminna et al 2016; Finland Futures Research Centre 2016; Kandpal and Broman 2014; Jennings 2009). In order to support these pioneers of independent renewable energy systems, the power needs to be brought back to the people. One way to achieve such a bottom-up approach is through sound education:

> "Tapping into the potential resource of the people could launch Myanmar as a champion country of the decentralized energy system. Our energy consumption is still very low, and we can use this to our advantage. There are a lot of small power projects across the country, awaiting their chance." – Renewable Energy Association Myanmar (REAM 2018).

A note on energy education at HEIs in Mekong region and DEEM

The project Development of Energy Education in the Mekong Area (DEEM) was initiated by the Sustainable Development Futures (SDF) group at the Finland Futures Research Centre (FFRC) in 2016 and is expected to run until 2019. The aim of DEEM is to contribute to capacity building in renewable energy technologies in higher education institutions in Cambodia, Laos, and Myanmar. Challenges hampering the widespread implementation and adoption of renewable energy technologies in the Mekong region and Myanmar specifically include: a lack of energy access (especially in rural settings); a lack of energy security and regional connectivity issues; disjointed climate change mitigation policies, energy efficiency standards, and renewable energy frameworks; and outdated energy engineering programmes, curricula, research laboratories, and teaching methods at universities (FFRC 2016). DEEM responds to the needs of Mekong HEIs by supporting the creation of sustainable energy engineering curricula, improving the sustainable energy knowledge, and promoting innovative pedagogical approaches and skills to foster research-oriented learning (FFRC 2016). In Myanmar, DEEM will support the integration of sustainability issues throughout the existing subjects in curricula at the University of Yangon (UY) and the Yangon Technological University (YTU). More generally, the need for renewable energy education first became apparent after the oil crisis of the 1970s and received increased pressure in the late 1990s when climate change concerns became more widespread and scientifically backed. Consequently, a large number of countries initiated academic programmes in the field of renewable energy in order to support the development and dissemination of renewable energy technologies needed to combat increased greenhouse gas emissions and rising temperatures (Kandpal and Broman 2014: 302).

Additionally, solar energy education became almost obsolescent in Europe, until the 'solar boom' in the early 2000s, when the cost of generating electricity from solar power decreased substantially (Ciriminna et al 2016). Education is often said to be the most effective way to shape a society, hence why the renewable energy transition should be supported by global education systems. As argued by Jennings (2009), "education is a powerful agent for social change." Crucial in these efforts, however, according to Kandpal and Broman (2014), remains developing energy curricula that are context specific, meaning that all renewable energy sources and respective technologies should be discussed while emphasis should be placed on local needs. Contrastingly, global standardized guidelines for renewable energy education curricula seem to be lacking currently, though they could provide a useful blueprint, aiding education institutes in the development of adequate curricula. Furthermore, synergy needs to be created between renewable energy education needs and renewable energy labour markets, in order to ensure employment to graduates. Competency based renewable energy education curricula seem to be important in this matter.

Additionally, several authors have reached consensus about the importance of matching up curricula and job needs, as mismatches could negatively affect end-user perspectives and hamper widespread adoption of renewable energy sources (Ciriminna et al 2016; Mälkki and Paatero 2015; Kandpal and Broman 2014; Jennings 2009). For example, the current shortage of skilled professionals with adequate experience in renewable energy technologies may result in reduced quality of installed renewable energy systems, which may in turn adversely affect the demand for and acceptance of these technologies (Kandpal and Broman 2014; Jennings 2009). Educating the community of end-users – through awareness campaigns for example – is also crucial to smoothen the transition to renewable energy, as it increases their confidence in using the technologies themselves. Thus, assessing the current status of the job market in terms of required knowledge and skills prior to the development and implementation of curricula is crucial in order to identify potential gaps between the two.

Lastly, renewable energy education programmes need to be holistic in the sense that they cover all aspects relevant to the development and dissemination of renewable energy technologies, including but not limited to political, environmental, socio-cultural, technological, and economic aspects (Ciriminna et al 2016; Kandpal and Broman 2014; Jennings 2009). An example of this is presented by Jenkins, Sovacool and McCauley (2018) in their article *Humanizing sociotechnical transitions through energy justice*, in which they highlight the importance of integrating the concept of energy justice into the formulation and implementation of energy policy, a concept often overlooked in energy curricula and policy. The concept of energy justice very much relates to the concept of environmental justice, whereby the unequal distribution of environmental hazards and access to natural resources – and thus essentially issues of power – are central issues. Energy justice refers to the idea that all human beings have an equal right to available, accessible, and affordable energy (Eames and Hunt 2013). It is often assumed that a transition to low-carbon energy is automatically positive, however considerations of equity and justice are neglected (Jenkins et al 2018; Eames and Hunt 2013) and need to be integrated in energy and sustainability related curricula, along with other political, environmental, social, technological, and economic aspects, to create a truly multidisciplinary and holistic approach to energy education.

Research results

Discussing energy education with a variety of actors in the renewable energy sector in Myanmar, consensus was reached regarding several observed issues within national renewable energy education. Currently, the most prominent issue is that there is no established renewable energy education programme at either universities. As argued by one of the interviewees, energy engineer at a Myanmar solar energy company, “in order for the link between companies and the university to be strengthened, the renewable energy programmes need to be expanded. Create a renewable energy major, for example.” Only then, he argues, can students become aware and interested in the field of renewable energy and can energy companies trust that they are employing knowledgeable, trained and capable students. Often times, knowledge possessed by students is very outdated, basic, or based on misconceptions. This was mentioned by most interviewees. Both students and teaching staff possess only basic, outdated, or inaccurate knowledge regarding renewable energy sources. As mentioned by energy manager at an environmental NGO, “[the teaching staff] seemed a bit lost, and there seemed to be many wrong, outdated assumption about renewable energy [during trainings, seminars, and workshops].” Director of a solar power company added to this statement by arguing that the interns at the company often lack basic knowledge, “especially in renewable energy: their knowledge is still very much situated in traditional energy resources.” The energy engineer tells of a story of an intern who once asked if electricity could still be generated through solar PV cells if the Sun is not shining. “There was no deep knowledge. Even university lecturers would counterargue our teachings to interns, questioning why we would use hybrid energy systems”. The limited field practice of university lecturers was pointed out as a factor that contributed to the problem of outdated knowledge: “Lecturers and professors are academically trained, but they have little hands-on experience”. This then leads to a textbook transferal from lecturers to students, to which the director added: “[students] receive too much academic training, no practical training. That’s why I share my field experiences with university classes.” When it comes to what is actually being taught in the limited number of renewable energy related courses and modules, many interviewees argued that the emphasis is placed on the technical aspects of renewable energy, not on social, environmental, or political aspects. When asked what skills were required for internships at energy companies, emphasis was placed on technical knowledge. As argued by the interviewed energy engineer: “It is very difficult to include social issues in university energy curricula, as they are context dependent. Each project has different problems. For example, one project aimed to install a Telecom tower, but the land owner and main investor had an issue with each other: the investor had not paid the land owner. We [the company] could not do anything until this payment was made, since we are the third party. The same goes for environmental issues, they are also highly contextual.” When speaking to a professor at the Department of Geology at UY and to a professor at the Department of Electrical Power Engineering at YTU, both confirmed their curricula almost exclusively focus on technical issues: “Some environmental issues are paid attention to, such as pollution or deforestation as negative consequences of traditional energy sources, but our curricula are not very concerned with politics or social issues”.

Another recurrent issue is the segregation of university departments both in UY and YTU. Students are often unaware that renewable energy electives exist in other departments, and therefore they are not introduced to the subject matter. Separate energy courses are not streamlined and are often taught alongside each other, rather than integrated. The issue with streamlining renewable energy courses, updating curricula, creating energy majors, or making any drastic changes to university systems for that matter, is the rigidity of Myanmar’s education system as a whole. Drastic changes in curricula cannot be made, and even minor ones can lead to an arduous process. Currently, for any change to be made to a curriculum within one department in one university, this department needs to call a curricula meeting and invite all heads of all similar departments of all universities, nationwide. In the Department of Physics alone, there are 79 higher education institutes with a physics department in Myanmar. This means that 79 heads need to come together to discuss curricula changes, despite HEIs having academic freedom in the sense that the ministries cannot reject curricula changes. Most major proposed curricula changes in the field of renewable energy have been rejected due to a lack of institutional capacity to teach advanced energy subjects. Minor changes are best to be made at higher level degrees, since 30 out of 79 higher education institutes do not teach postgraduate Physics courses. Out of the remaining 49, only 2 universities offer a PhD in physics. This is why renewable energy courses at UY are only offered in postgraduate programmes. At YTU, it works slightly differently, as it is a standalone university with its own university senate and council. YTU does not need to hold curricula meetings to make changes to their curricula.

Furthermore, universities in Myanmar do not have the freedom to collaborate with international partners, unless granted permission from the relevant ministries (e.g. the Ministry of Education). This means that if a university still wishes to teach its students advanced renewable energy knowledge without the proper curricula, it could accept help from foreign universities, companies, or civil society groups. Education in Myanmar, however, is deeply rooted in politics, and the Ministry might reject expert training offers based on geopolitical reasons. "There is always a tradeoff between permission and funding: when there's permission, there's no funding, and when there's funding, there's no permission" (Head of Department at UY).

Thus, to sum up, several issues have been defined when it comes to energy curricula at the University of Yangon and Yangon Technological University, namely:

- *There is no established renewable energy programme*
- *Knowledge on renewable energy is traditional, outdated, or inaccurate*
- *There is little emphasis on field (practical) training*
- *Existing renewable energy curricula are very technical, leaving out political, environmental, and social aspects*
- *University departments are segregated; energy courses are not streamlined*
- *Curricula change is slow due to rigidity of Myanmar education system*
- *Renewable energy is mostly taught at postgraduate level*
- *Universities need permission to collaborate with international partners*

With the limited number of interviews, it is difficult to comment on which specific aspects need to be included in future energy and sustainability related curricula. What is important to note is that renewable energy curricula are in initial stages of development at UY and YTU, or do not exist in its entirety. Emphasis for now needs to be placed on how to streamline existing renewable energy courses or how to create one established renewable energy programme in both universities: a programme that starts at undergraduate level and continues up until postgraduate or even PhD level. Students need to be provided with the opportunity to learn about this topic from start to finish, in order to avoid the transferal of basic and disconnected knowledge.

Closing the gap between HEIs and labour market

Recommendation 1: Streamline existing renewable energy courses at UY and YTU into one course, or one established energy education programme (at undergraduate and postgraduate level). Only then will students move beyond the possession of basic, outdated, disjointed knowledge and become high capacity energy engineers, attractive to potential employers.

Recommendation 2: Organise crossovers to different departments through seminars, tours, guest lectures, (elective) course flyers, and the like.

Recommendation 3: Strengthen the collaboration between renewable energy education and renewable energy companies through guest lectures, practicals, tutorials, workshops, tours and day visits, thesis guidance, and the like.

Recommendation 4: Organise internship meetings and seminars discussing the option to work with a renewable energy institute (e.g. company, civil society group, ministry).

Recommendation 5: Survey renewable energy companies on skills needed, in order to create competency based renewable energy curricula.

Conclusion

As identified by the DEEM project, the creation of sustainable energy pathways in the Mekong region is strongly needed in the face of climate change, as greenhouse emissions are expected to increase rapidly in these countries. In order to build such energy pathways, multidisciplinary and situated knowledge and capacities are vital. However, in Myanmar there currently exists a gap in the local capacity in sustainable energy issues. The DEEM project aims to contribute to the closing of this gap by supporting the integration of sustainability and energy issues throughout curricula at higher education institutes (HEIs). This report, a result of a four month internship programme, has contributed to the DEEM project by providing a brief analysis of the current status of renewable energy both in education at partner HEIs and in Myanmar generally, outlining issues experienced within energy modules at UY and YTU, and providing recommendations towards the closing of the gap between energy education and the labour market.

A major barrier to the widespread implementation and adoption of renewable energy technologies in Myanmar is the lack of human resource capacity and skilled labour. This is due in part to the outdated energy education system at national universities, including at UY and YTU. The most prominent issue is perfectly summed up with the words 'disjointed' and 'disconnected'. The universities are disconnected from each other, departments within universities are disjointed, the renewable energy courses that are offered are disjointed, and the universities are disconnected from renewable energy companies. It is difficult to understand what departments offer which renewable energy courses. A good place to start for future energy education related projects in Myanmar would be the creation of one schematic overview of all courses offered. Secondly, streamlining these courses or creating an established renewable energy programme would not only be preferred but also necessary in order to guide students, start to finish, in their energy education and increasing their chances of becoming what this country needs: skilled renewable energy engineers. The future is in the hands of the people, and it is time to give it back the power back to these people through the creation of a strong education system.

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