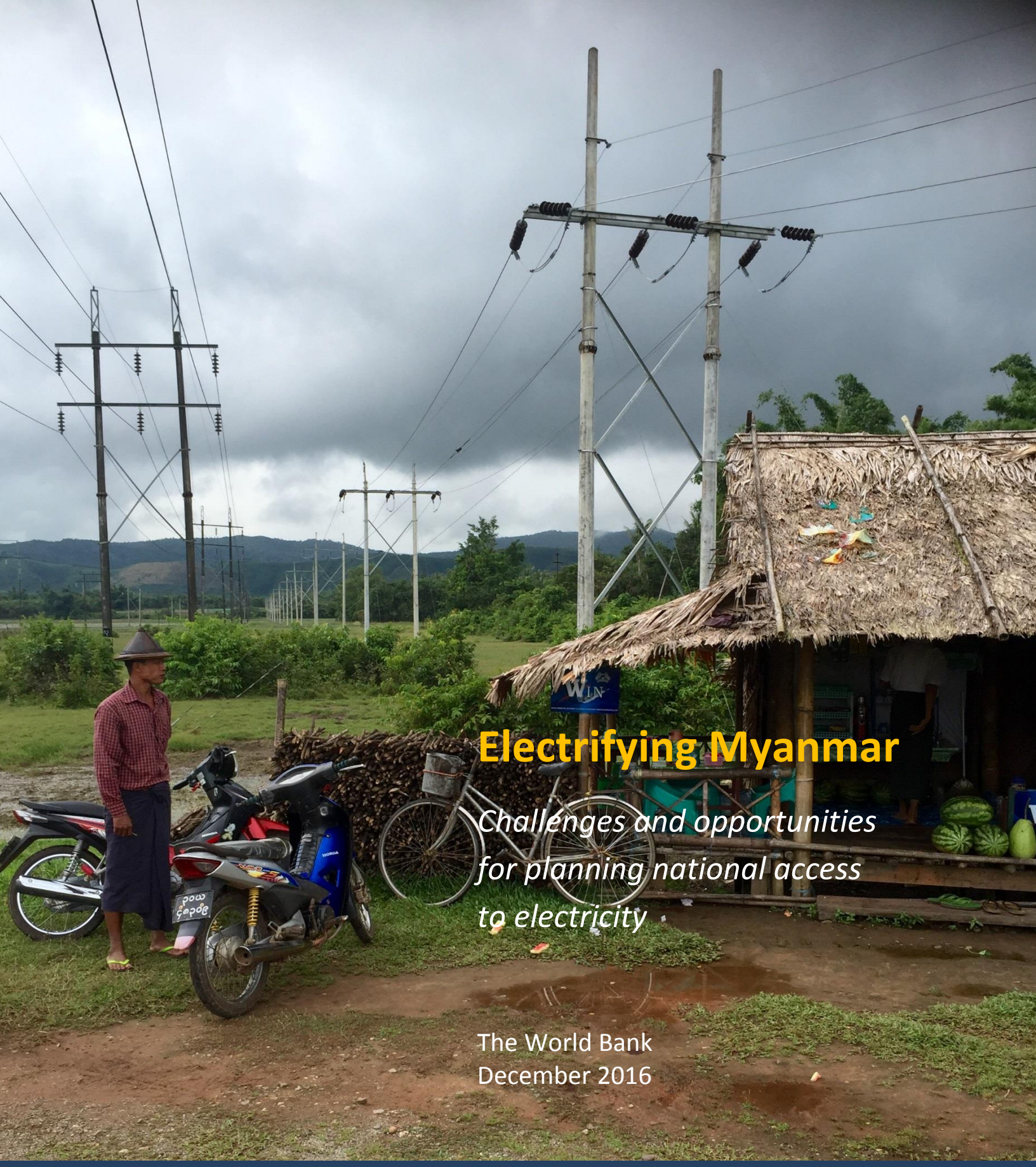

Electrifying Myanmar

Challenges and opportunities for planning national access to electricity

The World Bank
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Electrifying Myanmar: Challenges and opportunities planning nation-wide access to electricity

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INTRODUCTION

This report describes key challenges and opportunities for the people of Myanmar to achieve universal access to electricity by 2030. Specifically, the report takes stock of work done in preparation for Myanmar's 2015–2021 National Electrification Project, including the 2014 National Electrification Plan, in context of lessons from World Bank support to electrification efforts in Southeast Asia and beyond. The report has been prepared by World Bank staff[1] for the Government of the Republic of the Union of Myanmar and all other parties with an interest in the goal of universal electricity access. The report does not focus on implementation of electrification efforts in Myanmar to date, though readers may refer to other resources for related information.[2]

The report is structured as follows:

- Section 1 describes the country and sector context, as well as the main challenges faced, to aggressively increase access to reliable, affordable electricity in an efficient and sustainable manner.

- Section 2 presents international best practice and lessons learned from experiences of rapid transitions from low to high access in other countries, including in the East Asia Region.

- Section 3 describes the National Electrification Plan, which includes a geospatial analysis and estimate of financing needs.

- Section 4 discusses implementation challenges for the plan's first phase to 2021, including institutional and sector reforms, without which national electrification is unlikely to be carried out efficiently or on schedule.

- Section 5 describes the development rationale for international donor support for national electrification, including the role of the World Bank Group, for the 2016–2021 project.

[1] See Acknowledgements for author details.
[2] For links to source document and information resources, see Annex 2.

EXECUTIVE SUMMARY

1. **Access to reliable, affordable, and clean electricity is a critical part of Myanmar's development agenda.** Myanmar is one of the poorest countries in Southeast Asia. Only one out of every three households in Myanmar is connected to grid electricity, and for rural households, this number is just two in five. Fulfilling the country's great potential for development will depend in large part on progress in the energy sector. Improving access to electricity can enable better delivery of vital services such as health, education, and finance to boost jobs, well-being, and economic prosperity.

2. **Other countries have shown that rapid electrification is possible, even for rural populations with relatively low average incomes.** In the Lao People's Democratic Republic (Lao PDR) for example, around 90 percent of the population have access to grid electricity despite a population of relatively low-income households in rural mountainous areas. Best practice international experiences show that a transition from low to high or universal access can be made within two decades, as Lao PDR and Vietnam in particular have accomplished. Rapid electrification is most effective when there is sector-wide planning and coordination to mobilize financial and physical resources at least cost, in a predictable and structured fashion.

3. **Achieving Myanmar's electrification goals requires a concerted effort to build institutions, reform policy, and mobilize finance from private and public sources.** The Government has set a strategic goal of universal access electricity by 2030. Intermediate milestones are for 50 percent of all households to have electricity by 2020 and 75 percent by 2025. Given Myanmar's relatively low level of grid electrification today, the Government must sustain and scale up electrification efforts to achieve this. The Government's National Electrification Plan aims to connect 2 million households from 2015 to 2020 and an additional 5.2 million households in the 10 years to 2030. The plan calls for investments of US$5.8 billion from 2016 to 2030 under a two-pronged approach, based on a complementary and coordinated extension of grid connections and off-grid electricity. Myanmar's patterns of settlement and electricity demand suggest that grid power will dominate in the long term. However, to bring basic electricity service as soon as possible to a maximum number of households, there is also a need for a systematic off-grid program, consisting mostly of solar home systems (SHSs) and mini-grids.

4. In recent years, the Government has initiated several reforms to improve energy sector institutions and policy. While these policy developments are significant and commendable, national electrification will require further deep reforms to overcome existing institutional and financing constraints. The 2014 Electricity Law has created the foundation for further sector reforms, including establishment of an electricity regulatory commission. However, these reforms will take time and in the meantime, electrification must increase rapidly to achieve the targets on time. With this in mind, a number of measures are suggested to improve operational efficiency and flexibility of electricity utilities in the short term, and enable steps to scale up electrification. These include the following measures:

- Power generation and distribution utilities to operate as corporations on an increasingly commercial basis

- Establishment of the dedicated energy regulatory commission to set electricity tariffs in a transparent and rigorous process.

- The Government to develop and announce a five-year tariff path policy consistent with the electrification plan and with a realistic assessment of consumers' ability and willingness to pay.

- Distribution utilities to adopt medium, and long-term planning practices, beyond current annual investment and implementation plans.

- Increase in private sector participation across the electricity value chain.

5. **National electrification will require a growing role for the private sector, including a mix of private equity and commercial debt.** However, in the immediate future, access to appropriate private finance is expected to be severely constrained. Therefore, it is very likely that without substantial support from the international development partners, the electrification targets will not be met. Concessional donor finance will ensure that the burden on Myanmar consumers and the Government is consistent with their ability to pay, while sector reforms are implemented to enable greater private investment.

6. This 2016–2021 National Electrification Project establishes the basis for the World Bank Group, other development partners, and the private sector to sustain investments and strengthen the Government's institutional capacities needed for universal electricity access by 2030.

1. MYANMAR'S ELECTRIFICATION CHALLENGE

1. The Government's long-term objective is universal electricity access by 2030 with secure reliable, affordable, and environmentally and socially sustainable energy supply to all consumers. This involves many challenges, as described in the following sections.

1.1 Low Access, Rapidly Growing Demand, and Rampant Power Shortages

2. Endowed with abundant natural and human resources in a country that once possessed Southeast Asia's most dynamic economy, perhaps no economic issue is as pressing as the need to upgrade and expand Myanmar's antiquated power sector, which is unable to provide adequate, reliable, and affordable electricity service to most of its 51 million people (KWR 2015; World Bank 2016). At around 160 kWh, Myanmar's annual electricity consumption per capita is twenty times lower than the world average. Two-thirds of the population and 84 percent of rural households are not connected to the national electricity grid.[3] At about 30 percent, the overall electricity access rate is low compared with Myanmar's regional peers (Figure 1). The lack of affordable and reliable power is a key constraint to the delivery of vital services such as health, education, and finance for rural populations as well as private sector development and job creation. Also, access to modern fuels for cooking (such as liquefied petroleum gas) is limited to urban areas. Consequently, traditional biomass (wood and animal dung) is widely used and accounts for about 70 percent of primary energy consumption.

3. In Myanmar, around 22 percent of households have off-grid electricity schemes, which typically provide high-cost, low-reliability power service for a few hours per day.[4] Consequently, traditional biomass (wood and animal dung) is widely used and accounts for about two-thirds of primary energy consumption. According to the 2014 census (The Republic of the Union of Myanmar 2015), 69 percent of the population uses firewood as the main energy source for cooking and 46 percent uses kerosene, candles, or batteries as the main source for lighting.

4. After decades of isolation, Myanmar's political and economic transformation since 2011 have significantly improved the economy's performance, making it one of the fastest growing economies in Asia. As a result, electricity consumption is growing extremely fast. Peak load demand reached 2,100 MW in 2014, increasing at an average 14 percent per year over the past five years.[5] During this period, the electricity supplied by the national grid grew rapidly at 15 percent per year and reached 9.6 terawatt-hours in 2013, exerting much pressure on an overstressed and

[3] According to the 2014 Census (Republic of the Union of Myanmar 2015), 7.35 million households' main source of lighting was not electricity (kerosene, candle, battery, generator, water mill, solar system, or other). Average household size is 4.4 persons.

[4] In this report, 'grid' refers to Myanmar's national electricity distribution networks operated by the Yangon Electricity Supply Corporation (YESC), Mandalay Electricity Supply Corporation (MESC), or Electricity Supply Enterprise (ESE). 'Off-grid' electricity refers to sources other the grid. Any given household or community may have grid or off-grid electricity, both or neither.

[5] Peak load demand is estimated at about 2,400 MW, but due to load shedding the realized peak is only 2,100 MW.

degraded grid infrastructure, which is mostly concentrated in urban areas.[6] Hydropower accounts for 68 percent (3,151 MW),[7] natural gas 29 percent (1,329 MW), and a small coal-fired power plant 3 percent (120 MW) of total installed capacity (4,600 MW) on the grid. Small off-grid diesel and mini-hydropower units dispersed across the country have an estimated total capacity of about 114 MW. Due to heavy reliance on extremely seasonal hydropower with low firm capacity, the existing power generation system cannot meet the peak demand during the dry season.

5. Electricity shortages and supply disruptions are widespread. Accumulated delays in investments in power infrastructure, degraded generation plants,[8] fuel shortages,[9] over-reliance on seasonal hydropower production, together with a rapid increase in electricity demand (which tripled over the last decade), have resulted in large electricity shortages, which peaked at about 30 percent of power demand in 2012–2013. Despite a significant recent increase in gas-fired power generation, load shedding, blackouts, and generally low reliability of power supply remain prevalent.

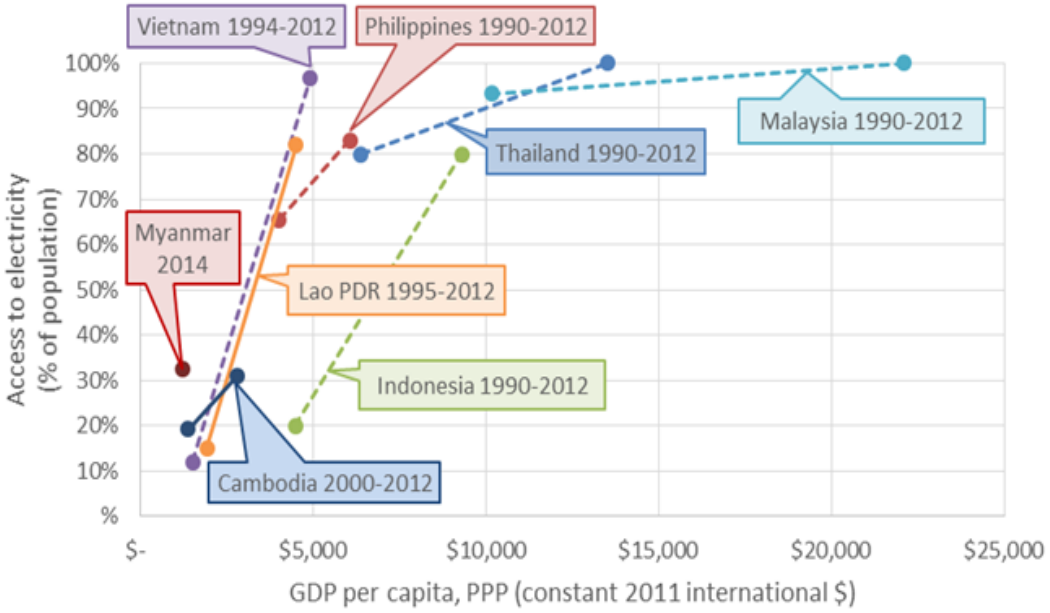
[6] More than half the wiring in the power grid is estimated to be at least 70 years old (KWR 2015). According to Government estimates, 20 percent of power is lost during transmission and distribution. On the positive side, ESE has made significant progress in reducing distribution losses from around 23 percent in FY2009 to 13.7 percent in FY2014. In FY2014 alone, the losses were reduced by 3.2 percent through a strong focus on eradication of commercial losses. YESC has also made progress in reducing distribution losses to about 15.6 percent in FY2014. While significant room for reduction of commercial losses still exists, it will be increasingly difficult to continue the loss reduction program without major investments to modernize the existing power distribution system, reduce overloading, and improve the metering system.

[7] Including joint venture hydropower projects which exported about 2 terawatt-hours to China in 2013/2014.

[8] For example, the installed capacity of Myanmar's single operational coal-fired power plant (at Tigyit) is 120 MW. But due to inadequate maintenance and degradation of equipment the available capacity was only 27 MW in 2013 (Intelligent Energy Systems 2014). The thermal efficiency of fossil fuel power plants is only 28 percent, the lowest in the region (Ross 2015).

[9] There have been periodic shortages of natural gas, much of which is exported. This circumstance limits the construction of new gas-fired power generation capacity. Presently, nearly one-third of Myanmar's electricity is generated from natural gas (Intelligent Energy Systems 2014).

Figure 1. Electricity Access in Myanmar and Select Countries, 1990–2014



Source: World Bank 2016.
Note: GDP = Gross domestic product; PPP = Purchasing power parity

1.2 Institutional Setting: Need to Strengthen Coordination, Capacity, and Legal Frameworks

6. Myanmar has a highly complex energy policy environment. Government decision making in regard to energy and electrification has until recently been divided among at least eight ministries (KWR 2015). Furthermore, the low number and capacity of staff dedicated to energy policy, electrification, planning, and regulation severely limits the power sector development. This complicated structure of responsibility sharing tends to cause slow decision-making and approval processes and creates challenges for coordination among the multiple authorities (Intelligent Energy Systems 2014).

7. The Ministry of Energy and Electricity (established in April 2016) is responsible for overall energy policy, with subsidiary departments and enterprises responsible for oil and gas and the various elements of the power sector (hydropower, thermal power, transmission, and distribution). Under MOEE, the Electric Power Generation Enterprise (EPGE) is a 'single buyer' of electricity from public and private producers, including a small number of independent power producers (IPPs). EPGE then sells electricity to three state-owned distribution utilities who report to MOEE. YESC and MESC became corporations in 2015 but remain state-owned and cover Myanmar's two most populous and urbanized regions. ESE serves the rest of the country. These distribution enterprises partner with private companies for delivery to end users in respective operating franchises (World Bank 2015a; Ross 2015).

8. Government policy formally limits the role of these distribution utilities to medium voltage (MV) primary distribution, leaving low voltage (LV) secondary distribution open for private sector participation, including through village initiatives and direct private investments. The utilities nevertheless carried out significant investments in second distribution over the last couple of years

as shown by the increased number of new household connections, but such investments tended to be discretionary and without systematic planning. In rural areas, the Department of Rural Development (DRD) within the Ministry of Agriculture, Livestock, and Irrigation (MOALI) is responsible for off-grid electrification. In addition to the national (Union level) ministries, the seven states and seven regions have their own energy ministry and are responsible for issuing permit to power projects below 30 MW capacity without connection to national grid. The Government has transferred a portion of the 2015–2016 Union Budget for electrification to states/regions as a part of a broader decentralization effort. The state/regional energy ministers usually have no or few staff and work under the Chief Minister.

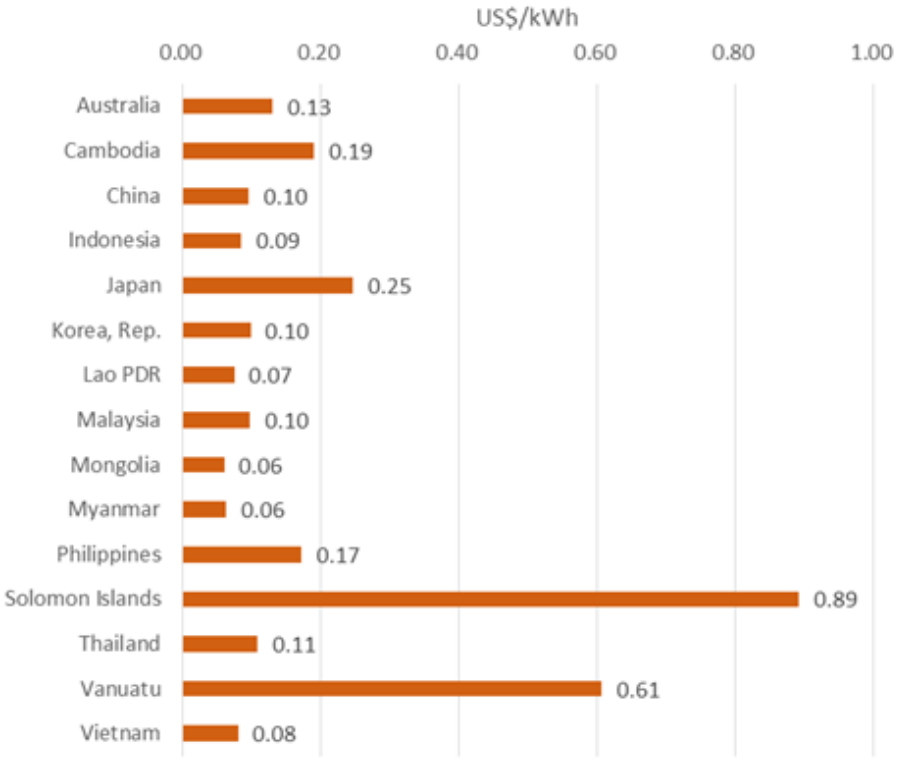
9. **Regulatory Framework.** In 2014, the Government passed a new electricity law. However, the law does not yet include implementing rules and detailed guidelines. As a result, the regulatory environment is ambiguous and can be challenging to navigate, particularly for off-grid service providers. For example, for small power producers, this means a lack of standards for connecting rural renewable electricity supplies to the national grid. Thus, most electrification activity is bifurcated between grid-extension efforts and off-grid rural projects, with limited opportunities to integrate these approaches. Myanmar does not yet have standardized practices for joint ventures and power purchase agreements (PPAs), which leads to time-consuming, case-by-case negotiations (KWR 2015; Ross 2015).

10. Electricity tariffs are tightly controlled by the Government and are severely distorted and heavily cross-subsidized. As Figure 2 and Figure 3 show, Myanmar's power tariffs are among the lowest in Asia. On average, electricity is sold to end users at a tariff well below the cost paid to producers. Large commercial and industrial users cross-subsidize residential and small-medium commercial and public sector customers, whose tariffs remain below the average cost of supply (World Bank 2016; Ross 2015).

11. The low tariffs create barriers to investment in the energy sector and disincentives to improving energy efficiency in the economy. There is global competition for private sector investment. The main expectations of the private investors are that (a) tariffs must reflect costs; (b) tariffs must ensure adequate returns on investments; (c) the law must protect private assets; and (d) there must be transparency through mechanisms (for example, via auctions). While private sector interest to invest in Myanmar is high, especially in generation, a legal and regulatory framework that meets international standards would increase Myanmar's attractiveness even further (Intelligent Energy Systems 2014).

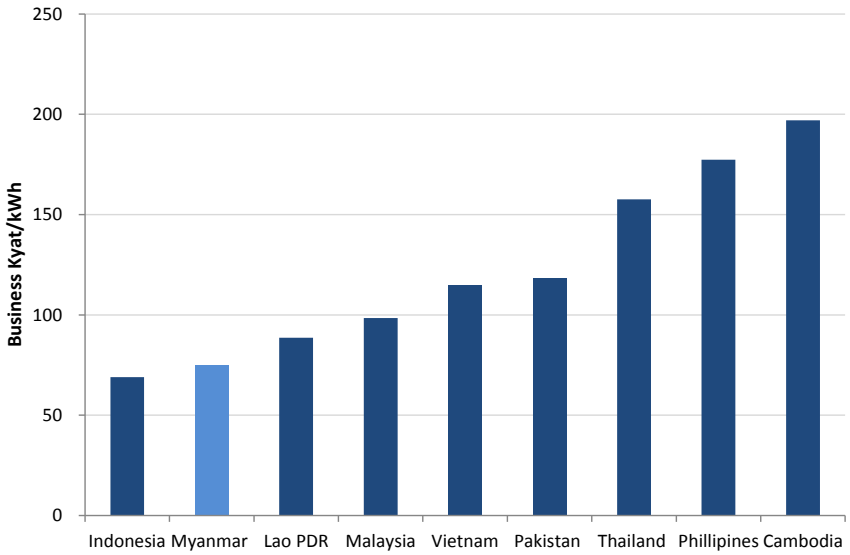
12. Chronic underinvestment in energy infrastructure over the past decades has led to shortages and deteriorating reliability of energy and hindered the development of social services including healthcare and education. Therefore, a sound energy pricing policy is not just a cornerstone of a financially viable energy sector but a catalyst for wider economic and social development.

Figure 2. Electricity Prices in Select Countries of East Asia and Pacific (Average Price for All End Users, 2014 or Latest Available Year)



Source: World Bank staff estimates based on data collected for Regulatory Indicators in Sustainable Energy.

Figure 3. Business Electricity Prices: International Comparison, 2013



Source: Castalia Strategic Advisors 2014.

1.3 Electrification Status and the Importance of Financing

13. Sustained funding for up-front investments, the financial viability of the power sector, and affordability are closely linked to successful electrification programs.

14. **Grid-based electrification.** As of 2014, the power distribution network comprises about 15,500 miles of MV lines, 14,000 miles of LV lines, and 30,308 distribution transformers with a combined capacity of 7,452 megavolt-ampere. The MV network uses a two-tier distribution system with the primary distribution at 33 kV and the 11 kV distribution feeders supplying MV/LV transformers. As of early 2015, about 86 percent of MV and 75 percent of LV network was operated by ESE, with the remainder operated by YESC. However, ESE accounts for only 53 percent of installed transformer capacity, showing the low level of grid density outside Yangon Region. Furthermore, the average installed transformer capacity is only 2.1 kilovolt-ampere (kVA) per consumer for ESE, which compares to 3.4 kVA per consumer for YESC. The average age of YESC's distribution network is more than twice the age of ESE's, which was mostly developed in the last 10–15 years.

15. The number of existing household consumers served by ESE (1.9 million) and YESC (1 million) indicate the share of all households with electricity was about 20 percent in ESE's service area and 65 percent in YESC's service area. The average annual electricity consumption per residential connection in Yangon (2,011 kWh) was about twice the average consumption in ESE (953 kWh) in 2013–2014.

16. Achieving the plan's objective requires an electrification rate of 400,000 connections per year on average. New connections added in FY2015 already reached this average rate, double the 200,000 total national connections in FY2014. The number of new connections per year steadily increased from 90,000 to about 150,000 in ESE over the five years to 2014. During this period, the number of new connections per year for the Yangon service area increased from 30,000 to 54,000. In 2014, the number of new connections showed a steep increase to about 204,000 in ESE and 76,000 in YESC, as electrification has become a Government priority.

17. Grid extension in Myanmar has long been constrained by chronic underinvestment due to insufficient government funding. The utilities were financially sound before 2013, serving a small market, but were negatively affected that year by deep currency devaluation. The recent increase in the Government's support for investments in power distribution has come after a long period of low investments, but to achieve universal access by 2030 will require greater investment still. Given the large investment needs for MV and LV networks, at the current pace of financing for grid-based electrification, it would take more than 26 years to reach universal access to electricity in Myanmar.

18. Due to the historically slow extension of ESE's and YESC's distribution networks, the private sector, led by self-organized village committees, emerged as an important contributor to grid-based electrification. Committees are self-organized by relatively higher-income villagers willing to pay the cost and able to mobilize funding for village electrification. Committee responsibilities vary from village to village, but they typically include mobilizing financing from villagers and external sources, obtaining utility approval for project design, hiring contractors for construction, assisting the utility to connect households, and commissioning the new facilities.

Once they are commissioned, the distribution assets are transferred to the utility for operation and maintenance.

19. The connection cost has also been a significant barrier for poor households even in villages that are already electrified. Currently, the connection cost includes (a) the electricity meter, (b) service drop cable, and (c) installation works. The charge is about K 65,000 (or US$65) for the analogue meter and K 90,000 (US$90) for the electronic meter. The service drop is charged based on the actual length and cable size/type, but on average it costs about US$50 per household. The distribution utilities charge and collect the connection cost (World Bank 2015b).

20. **Off-grid electrification.** As of 2014, about 2 million households have access to off-grid electrification. Financing has especially been difficult in the off-grid space. Companies installing off-grid systems lack investment capital and working capital, including access to trade finance. Consumers have limited access to financing for electrification. Overall, Myanmar's banking sector is severely constrained, with limited products, services, and outreach.[10] The sector is largely confined to fixed deposits and one-year fixed-rate loans with collateral requirements. While over 100 microfinance license holders (of 236 licenses in total) are active in the country, they primarily focus on easier-to-access peri-urban and dry-zone areas. Myanmar's 2011 legal framework for microfinance institutions (MFIs) has several challenges, including limited differentiation between deposit and non-deposit MFIs, low capital requirements for deposit-taking institutions, and an interest rate ceiling of 30 percent per year.

21. Microfinance for off-grid electricity systems is in an embryonic stage with only a few companies offering microfinancing in limited areas for solar lanterns and solar home systems (SHSs). Demand for microcredit far outweighs supply and until recently, thousands of households have had little option for obtaining an SHS other than to purchase it outright. Self-help approaches are widespread, reaching thousands of villages and hundreds of thousands of households. The technologies include pico-, micro-, and mini-hydro; biomass gasification; diesel generator-based mini-grids; and SHSs. These systems are usually financed by small entrepreneurs, township/village committees, or the households themselves with almost no public financial or technical support. They provide electricity for lights, entertainment, and limited productive use equipment that the users would not have otherwise. However, power quality and reliability are generally low (World Bank 2015a).

22. The Government is committed to providing basic electricity services for lighting and information and communication technology in a sustainable, participatory manner to those households which will connect to the national grid only in the later phases of its extension. The affected households are likely to have lower incomes and face higher operating costs to access electricity services given their remote locations, thus not favored by the private sector in the absence of proper financial incentives. However, the Government's budgetary resources and limited technical and institutional capacity present serious constraints. Achieving off-grid electrification requires engaging a broad set of stakeholders, including multilateral/bilateral

[10] Most borrowers—including mini-grid developers—are limited to one-year loans at 13 percent interest rates and they must use their homes or other immovable property as collateral (Ross 2015).

development organizations, financial institutions, private companies, local governments at the state/region/district/township level, and village communities.

23. Within the Government, MOALI is mandated to promote renewable energy for rural electrification and has received a sizable government budget to this effect. Since 2012, DRD within MOALI (and its equivalent predecessor agency) has run an off-grid lighting program, giving away SHSs to end users free of charge (that is, with a 100 percent subsidy). DRD provided 17,616 SHSs in FY2013, 18,342 in FY2014, and 179,163 in FY2015, as well as more than 100 mini-grids during the same period. The Government budget for FY2015 amounted to about US$37 million, representing a tenfold scale-up from previous years. The budget for FY2016 is US$36 million.

24. However, in addition to budgetary limitations, the Government's off-grid program faces additional challenges as follows (World Bank 2015a).

(a) **Untested business models.** DRD's lighting program uses two polarized approaches (fully public or fully private sector-driven), neither of which are sustainable to scale up over the long term. The 100 percent giveaway policy under the DRD program misses the opportunity to leverage other resources and is not conducive to user ownership of the systems. Vague specifications and a price-capped tendering procedure do not lend themselves to obtaining the best products at the most competitive price. Systems installed under the DRD program have not included provisions for maintenance and repairs. To the extent that maintenance and repairs occur, they are conducted ad hoc by users with little understanding of proper maintenance procedures. Furthermore, in some cases when companies and development organizations have approached communities to sell high-quality photovoltaic (PV) systems, local expectation for free gifts from the Government eliminated villagers' willingness to pay (Ross 2015). On the other hand, the self-help approach has often left the poor behind, involves inefficient use of limited resources, and damages consumers' confidence in the quality of off-grid products. Both approaches hinder the market development in the long run.

(b) **Lack of institutional capacity.** Since its inauguration, DRD's lighting program has focused on project implementation using Government budgetary resources. However, there is insufficient capacity in strategic planning, coordination, and policy-making functions in off-grid electrification. This is a daunting task and requires a significant amount of capacity building. The institutional capacity of local governments and village committees are also lacking for off-grid electrification.

(c) **High cost of quality SHS equipment and mini-grid systems relative to the ability to pay of the users.** Despite the advances in technology and related cost reduction in off-grid electrification technologies, the high capital costs of SHSs and mini-grid systems are beyond the means of many rural households in the pre-grid electrification target areas. Even if consumer microfinancing is available, some poor households will not be able to make the estimated monthly payments for pre-grid electrification services (lighting plus information and communication technologies). In addition, currently, solar installation companies are largely based in Yangon with little sales and service presence in remote rural areas. Expanding their business to village

households in pre-grid electrification areas will incur additional operating costs, which increases costs to consumers.

(d) **Lack of quality assurance for equipment and installations.** Suppliers have limited knowledge of, and access to, better-quality products. Consumers have even less information to differentiate good quality from poor quality. There are many products of questionable quality in the market. DRD staff and other implementing agencies do not have necessary knowledge and skills to inspect the performance of the systems and quality of installation. Local manufacturers of mini-hydro equipment and of certain solar components lack access to knowledge and technical assistance (TA) for improving quality and efficiency.

25. Near-term opportunities include (a) increasing capacity and efficiency of power generation and (b) reducing the large losses in transmission and distribution networks to reduce electricity shortages. The main medium-term opportunities will be sector reforms, particularly corporatization of power sector enterprises and pricing reform to reflect the full economic cost of electricity supply while protecting consumers with low incomes (or vulnerable to exclusion) through well-targeted and fiscally affordable subsidies.

2. APPLYING PRINCIPLES AND LESSONS FROM SUCCESSFUL INTERNATIONAL ELECTRIFICATION PROGRAMS

2.1 Common Underlying Principles of Successful, Rapid Electrification

26. Given Myanmar's relatively low level of electricity access today, the Government must continue and scale up existing efforts to achieve universal access by 2030. In this regard, international electrification experiences point to promising opportunities. Best practice country experiences show that the transition from low to high or universal access can be made within two decades. In the East Asia Region, Lao PDR and Vietnam have accomplished this feat (World Bank 2011a; Independent Evaluation Group 2015) and are perhaps the most inspiring examples for Myanmar.[11]

27. While every country has achieved universal or near-universal access suited to its unique and homegrown institutional and geographical setting, there are nevertheless common principles underlying successful fast-track electrification programs, including those discussed in the following sections (Government of Indonesia and ADB 2015; World Bank 2015a; Independent Evaluation Group 2015).

Grid Electrification.

- **Vision and sustained government commitment and leadership.** Unwavering commitment to achieving universal electrification from the highest levels of government and staying the course over the entire duration of the program implementation are essential.

[11] Indonesia started at a much higher gross domestic product level and as mentioned later in this report, suffered serious setbacks.

- **'Many partners, one team and one plan': comprehensive rollout planning.** Planning national electrification needs to be comprehensive and synchronized, adhering to nationwide least-cost electrification plan, coordinating grid and off-grid delivery as appropriate, and bringing key stakeholders together systematically. Electricity access is more than just a connection to a distribution network. The timely and sustainable provision of adequate, reliable, and affordable electricity requires balanced attention to the synchronized development of all components of the electricity supply chain—fuel supply, generation, transmission and distribution, and customer connections.

- **Enabling institutional environment.** A comprehensive and conducive institutional and regulatory framework, with accountability for results, is required to ensure efficient program implementation. Adequate institutional capacity and program management across the entire electricity value chain are essential for timely and efficient access implementation. Therefore, institutional capacity development throughout the value chain, including the electric utilities and sector institutions as well as local contractors, is critical to organize and mobilize work teams all the way to regional and village levels.

- **Sufficient and sustained financing.** Effective policies and regulation are needed to facilitate the large capital investments needed to bridge the access gap and to ensure the electricity services are financially viable and affordable for all, especially for the poor. Maintaining the financial viability of electricity utilities is essential for the provision of adequate and reliable electricity services. If utilities are not strong enough financially, Government commitment must be demonstrated by the full funding of the access program over its entire life, which may require appropriately targeted subsidies.

- **Affordability, equity, and inclusion.** The Government should address these important social aspects up front by targeting the poor and those in remote and inaccessible areas.

- **Sector-wide programs for structured stakeholder engagement.**[12] The first sector-wide approaches to electricity in Rwanda and Kenya show better results than what

[12] The sector-wide approach emerged in the 1990s as an alternative to traditional development aid and is based on a country-led, results-focused framework, as opposed to the traditional project-by-project approach. It encourages engagement across all sector stakeholders to ensure that investments work together to contribute to desired outcomes (for example, universal rural electrification). This approach emphasizes government and donor partnerships, with the government leading and working with partners to formulate policy. The use of existing government systems and processes and the achievement of specific goals and outcomes are key. In addition, donors and other stakeholders assist with coordinated financing, drawing on diverse channels of funding, and bringing ongoing projects in line with sector priorities. A sector-wide approach can help promote local involvement, accountability, and capacity in the countries in which they are implemented. In 2009, Rwanda, with World Bank support, initiated a sector-wide approach to help achieve its target of increasing access to electricity from 6 percent of the population to 19 percent through 2016. The ongoing program focuses on providing off-grid access to electricity for schools, hospitals, and administrative buildings that would not have electricity otherwise. A comprehensive investment prospectus provided development partners and local stakeholders with the technical and financial implementation plans for the program (ESMAP 2012).

can be achieved using a project-by-project approach to electrification. These World Bank-supported sector-wide rollout plans form the basis for structured engagement of the Government with multilateral banks, donors, and private sector partners. This arrangement, coupled with Government commitment, led to significant financing commitments from development partners. In particular, the private sector made commitments that may not have been possible without the sector-wide programs.

Off-grid Electrification.

- There are important emerging good practices in off-grid electrification such as the SHSs program in Bangladesh, which installed and successfully serviced 2 million systems in the past decade. The program is largely driven by the private sector, albeit enabled by 'light touch' government regulation, especially at the outset, within the framework of PPP and in a context of weak grid utility performance.

- The right policy framework is a requirement for any successful off-grid program. The fact that a large share of the unelectrified rural households is located in poor, remote, and isolated areas underpins the importance of developing a dedicated off-grid policy framework.

- Subsidies are an important part of a well-designed off-grid policy framework given the fact that off-grid schemes are usually more expensive than grid electricity, and off-grid communities tend to have the lowest incomes. The sustainability of the subsidy scheme requires a well-defined source of financing, preferably on a declining scale at the commercial market matures. A sustainable long-run off-grid electrification market requires maximizing private investment while minimizing subsidies.

- There is no one superior business model to accomplish off-grid electrification. Specific country conditions are important determinants of the model choice. For Myanmar, a transition from Government-led off-grid electrification to a more commercially oriented one—for example, along the lines of Bangladesh's Infrastructure Development Company Limited (IDCOL) model—will take time, depending chiefly on availability of access to financing.[13]

- The World Bank Group's 'Lighting Global' programs have supported commercial nonsubsidized markets in a number of developing countries. In these markets, nearly 50 million people gained access to improved electricity services from Lighting Global quality-verified products, delivered through commercial businesses. Allowing a nonsubsidized, commercial private market to develop with a range of quality-assured products addresses multiple market segments and helps meet an array of energy service needs.

[13] IDCOL was established by the Government of Bangladesh and licensed by Bangladesh Bank as a 'non-bank financial institution'. It promotes and finances infrastructure and renewable energy projects, including off-grid electrification. IDCOL has been the central actor in managing and funding Bangladesh's highly successful off-grid electrification in the past 15 years with considerable World Bank support. The IDCOL model and the relevant lessons learned from it are shown in greater detail in Annex 1.

- Off-grid solutions tend to thrive in countries where the grid extension is deficient, such as Bangladesh. Off-grid electricity in Vietnam is largely non-existent and in Laos has played a negligible role in their overall electrification achievements.

2.2 Closer to Home: East Asian Experiences and Lessons

28. Lao PDR and Vietnam have increased the access to electricity from less than 20 percent in the mid-1990s to more than 90 percent (Lao PDR) and close to universal access (Vietnam) over the last two decades (see Figure 1). The key element of success in both countries was long-term national commitment to electrification which was broad-based and not unduly affected by political and economic changes. Thailand, which achieved near-universal access to electricity a decade earlier, consistently included rural electrification in its five-year National Economic and Social Development Plans. A similar approach was taken in Malaysia throughout the 1980s and 1990s following the establishment of the Rural Electrification Department in 1978.

29. As rural electrification requires significant capital investments, stable and predictable availability of funds has been a key factor for successful programs. In Thailand, the Provincial Electricity Authority (PEA) received low-cost, long-term loans for grid extension. These loans significantly reduced the costs and enabled PEA to build its revenue base before the loan repayment began. In Vietnam, the electrification program involved a major public investment effort, matched by significant local contributions. The national power utility, Electricity of Vietnam (EVN), was able to self-finance a large portion of the capital costs necessary for rural electrification, and, in the early years, local governments and consumers also contributed significantly. In Indonesia, the 1997 Asian financial crisis badly damaged the financial health of the state electricity company (PLN) and made it difficult for the government to provide funds. As a result, the electrification program slowed down and it only recently regained the speed after the government secured financial viability of PLN through a subsidy scheme.

30. Adequate institutional capacity is essential for a timely and sustainable electrification program. For example, Thailand created the Office of Rural Electrification (ORE) under PEA, and dissolved it after the grid reached most villages, at which point PEA resumed responsibility for serving villages. Under the successful ‘service agent model’ in Vietnam, local community members maintained LV distribution lines, carried out simple repairs, and handled collections until EVN took over these functions after the electrification phase was completed.

31. Vietnam’s rural electrification success shows the importance of clear allocation of responsibilities among stakeholders. The rural electrification model relied on a cooperative approach involving commitment and support from all levels of society. The process involved major political decisions, working with provinces and local decision makers to ensure fairness, sharing financing needs and management responsibilities, and ensuring significant social and economic impact. In this process, EVN emerged as a strong national champion for rural electrification. The policy and regulatory measures introduced by the Government of Vietnam, equipping EVN with the mandate and resources it needed to perform its leadership role in a commercially sustainable way, were critical components of Vietnam’s success in rural electrification (World Bank 2011b).

32. A regulatory agency with a clear mandate, and mechanism for accountability, can balance viability of an electrification program with protection of vulnerable consumers. Thailand and Vietnam established such energy regulators to design tariffs and subsidy schemes that secure reasonable financial position of service providers and affordability for consumers. A well-designed and stable regulatory framework is essential for private sector participation, protection of consumers, and management of boundaries between grid and off-grid options for rural electrification.

33. Establishing appropriate technical codes and introducing recent technical innovations can lower the cost and accelerate the implementation of the electrification program. In setting up their networks, all power utilities must follow a technical code. However, codes which are designed for densely populated urban areas may not be optimal for rural electrification. In China, for example, costs were kept under control by developing two compatible national technical codes: one for high-demand regions and the other for low-demand areas, with provisions for gradual transition to the more stringent code over time. Many countries, including Lao PDR, adopted low-cost options for low-demand areas, such as 'single-phase supply and single-wire earth return'. Lao PDR also deployed shield wire technology with significant savings in the mountainous regions.

3. THE NATIONAL ELECTRIFICATION PLAN

3.1 Context and Objectives of the Plan

34. The Government's 2014 National Establishment Plan comprises two key documents: (a) a least-cost geospatial electrification plan and (b) an implementation road map and investment prospectus.[14] The overall objective is to electrify 7.2 million households to achieve universal electricity access by 2030. The plan calls for investments of US$5.8 billion over a 15-year period to extend the distribution grid and electrify off-grid areas. To this end, the plan aims to provide a common basis for coordination among different local and donor stakeholders, through a comprehensive sector-wide, programmatic, least-cost approach.

35. Alongside the National Electrification Plan, the Government has developed an Energy Master Plan for primary energy sources, with Asian Development Bank (ADB) assistance, and a Power Sector Master Plan for generation and transmission, with assistance from the Japan International Cooperation Agency (JICA).

3.2 Least-cost Geospatial Planning Approach

36. To achieve universal electricity access in a timely and least-cost manner, the plan envisages coordinated grid extension and off-grid solutions. A key objective of the least-cost approach is to make electrification planning geospatially specific, both to reflect the geographic diversity of Myanmar and to ensure that resources for electrification are used as effectively as possible. Underlying analysis (Earth Institute, Sustainable Engineering Lab, Columbia University 2014) shows that the grid alone cannot reach all communities in an optimal manner, particularly outside the central plains of Myanmar. For example, in Shan, Kayah, and Chin States, settlements are

[14] At the Government's request, with funding from the ESMAP, the World Bank supervised the preparation of the geospatial plan by the Earth Institute, Sustainable Engineering Lab, Columbia University (2014) and the implementation road map and investment prospectus by Castalia Strategic Advisors (2014).

sparse and the investment requirements for grid connections (per household) would be much higher than in the central part of the country. Therefore, the off-grid program is to proceed in parallel with the grid extension, focusing on villages which are unlikely to connect to the grid in the next 10 or more years.

Geospatial Plan Method

37. To derive the geospatial plan, location-specific information for electricity demand and power infrastructure was used, along with cost and technical values from local sources. A substantial part of this work was the creation of a national geospatial dataset with three main types of information: (a) geo-located populated places (or 'settlements'); (b) MV grid line locations; and (c) technology costs, technical specifications, and other values used for modeling energy demand and system costs.

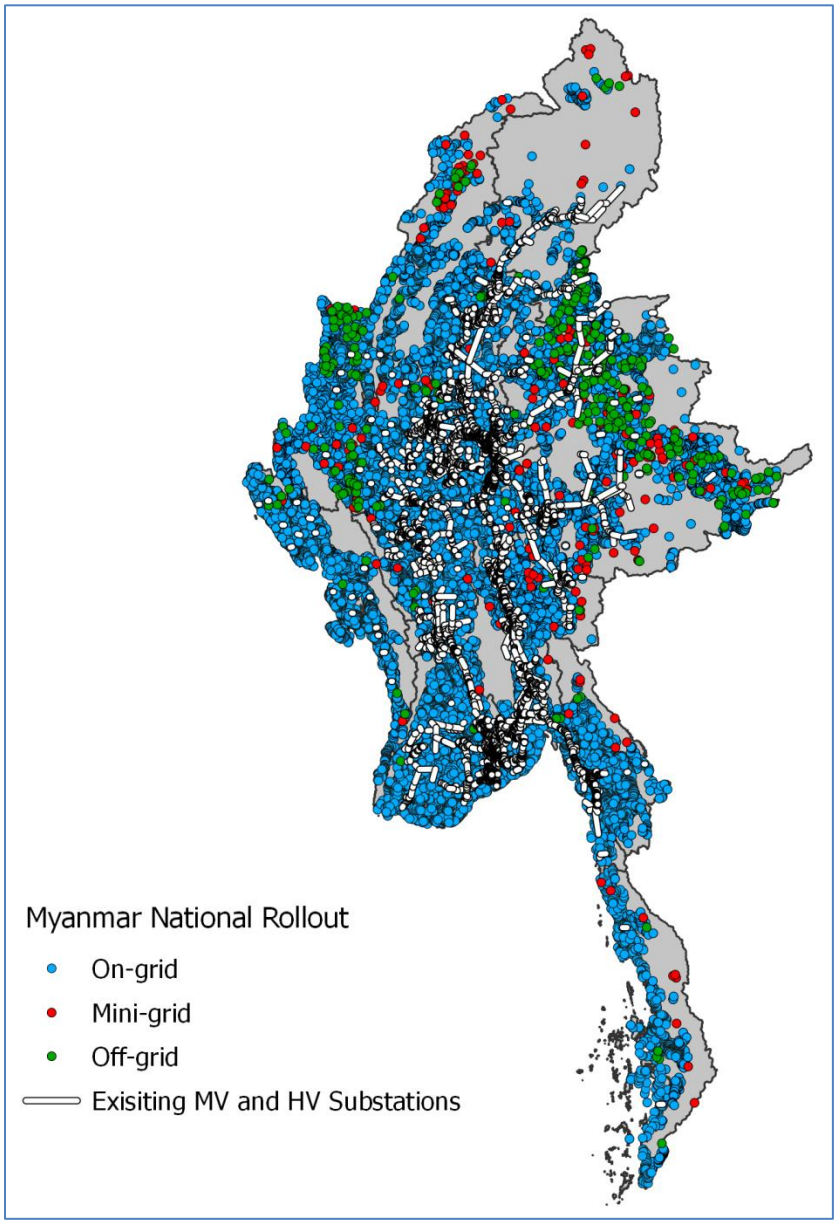
38. Once all data were prepared, the next step was a least-cost comparison of on-grid, mini-grid, and off-grid electricity systems for each settlement. The model first projected the expected population and electricity demand for each settlement. Cost calculations were then made, incorporating all initial and recurring costs over the long-term (30 years) for all system types (grid, mini-grid, off-grid), with a particular focus on the first 5 years. The model then used a customized algorithm to select the lowest cost electrification option for each location. Communities recommended for the grid were identified and the corresponding electricity network was mapped. Locations where the grid was not recommended were assigned the least-cost non-grid alternative which may have been mini-grid (solar, diesel, hybrid, and so on) or off-grid (typically solar PV home systems).

39. For connection to the national grid, an algorithm was developed for an optimal connection sequence extension plan. Many costs related to electric power infrastructure are either the same for all households (for example, the cost for an electric meter) or vary with electricity demand (the costs for transformers, solar panels, or diesel engines). However, some costs related to electric grid infrastructure have spatial factors to incorporate, an important one being the length of MV grid line required to connect communities. A key metric which reflects this geospatial factor is meters of MV line installed per new household connection (MV/HH). MV/HH is a valuable metric, first, for understanding the cost-benefit trade-offs related to grid extension versus off-grid alternatives and, second, for prioritizing grid extensions in a least-cost manner. In general, the MV/HH is low in urban and peri-urban areas, reducing grid extension costs on a per household basis, and higher in remote and rural areas. When the metric MV/HH was used to select which communities should be reached by grid and then to algorithmically determine the most cost-effective pattern of connections, the result is typically to concentrate connections and prioritize sequential extension within denser areas, which are lower cost and continue onto more remote, less dense, higher-cost areas. This practically means that initial phases of grid construction reach areas that are closest to the existing grid, where less extension of the MV lines is needed per household. Later phases reach the next closest areas, toward rural remote communities where more MV lines are required. Overall, under the least-cost extension, grid connections are prioritized in areas that meet higher electricity demand with the shortest MV line extension.

Geospatial Plan Results

40. The most important recommendation of the geospatial least-cost electrification plan was that grid extension is the most cost-effective means of electrifying for more than 90 percent of current and projected unelectrified households throughout Myanmar over the long term (see Figure 4).

Figure 4. Geographic Distribution of Communities for Different Electricity System Types

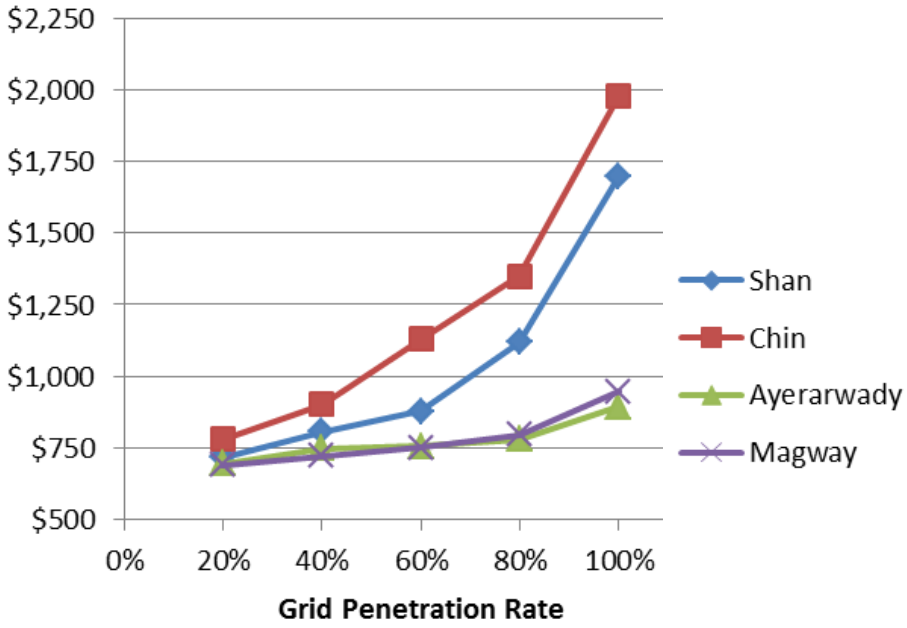


Source: Earth Institute, Sustainable Engineering Lab, Columbia University 2014.
Note: HV = High voltage. MV = Medium voltage.

41. At the same time, the investment requirements per household will continue to rise with increasing penetration of electricity toward less-populated areas. Even if electrification were to proceed according to the initial grid extension plan and the corresponding coordinated investments

in generation and transmission continue apace, more than 1 million households would not be connected to the grid for 10 or more years. Myanmar has a large populated region in the central plains where the investment requirements for grid extension per household are modest and would remain relatively low as grid penetration increases. However, in much of Shan or Chin States (as well as other highland and remote areas) where settlements are sparse, the investment requirements per household will rise sharply as the length of MV wire required rises quickly as electrification proceeds in rural and remote areas (see Figure 5). Throughout the country, approximately 300,000 households, with a total population of perhaps 1.5–1.7 million (3–4 percent of the population) reside in communities which, due to sparse and remote settlement patterns, are estimated to cost more than US$1,200 per household for grid connection.

Figure 5. Initial Costs per Household Connection with Increasing Penetration Rate for Four Regions within Myanmar

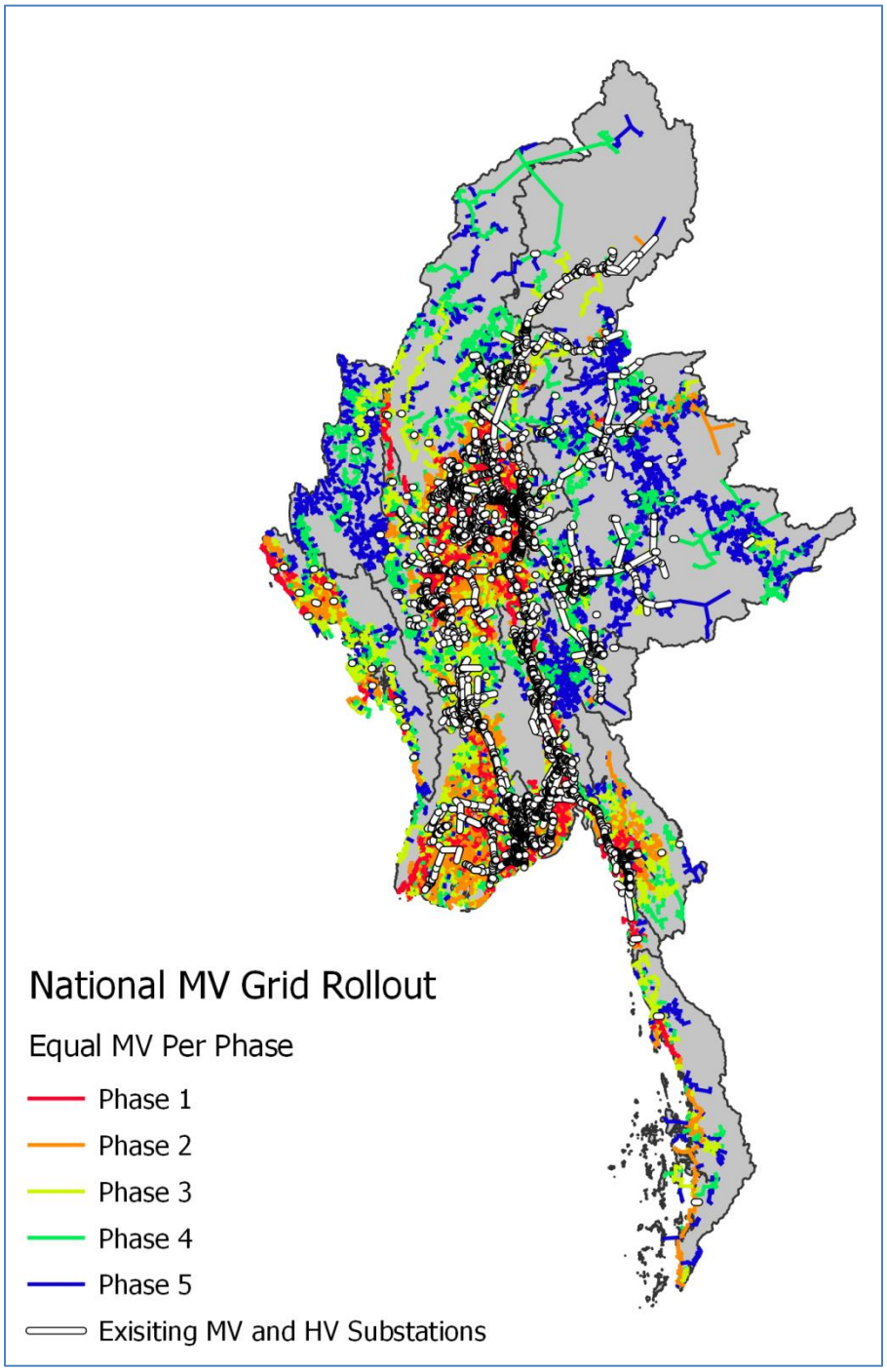


Source: Earth Institute, Sustainable Engineering Lab, Columbia University 2014.Unit is US dollars.

Grid Connection Phases

42. The grid extension has been planned in five phases, in line with the above approach. The first phase connects the most and easier to reach households. The map in Figure 6 shows that in a five-phase grid extension plan, it is most cost-effective to first electrify lowland regions, such as Mandalay, Ayeyarwady, and Mon, where populations are dense and the grid is nearby (red and orange lines). However, highland states such as Chin, Shan, Kachin, and Kayah are designated for later phases of grid extension (green and blue lines) because populations are less dense, communities are smaller and widely spaced, and grid extension costs are higher.

Figure 6. National MV Grid Extension in Five Phases, 2015–2030

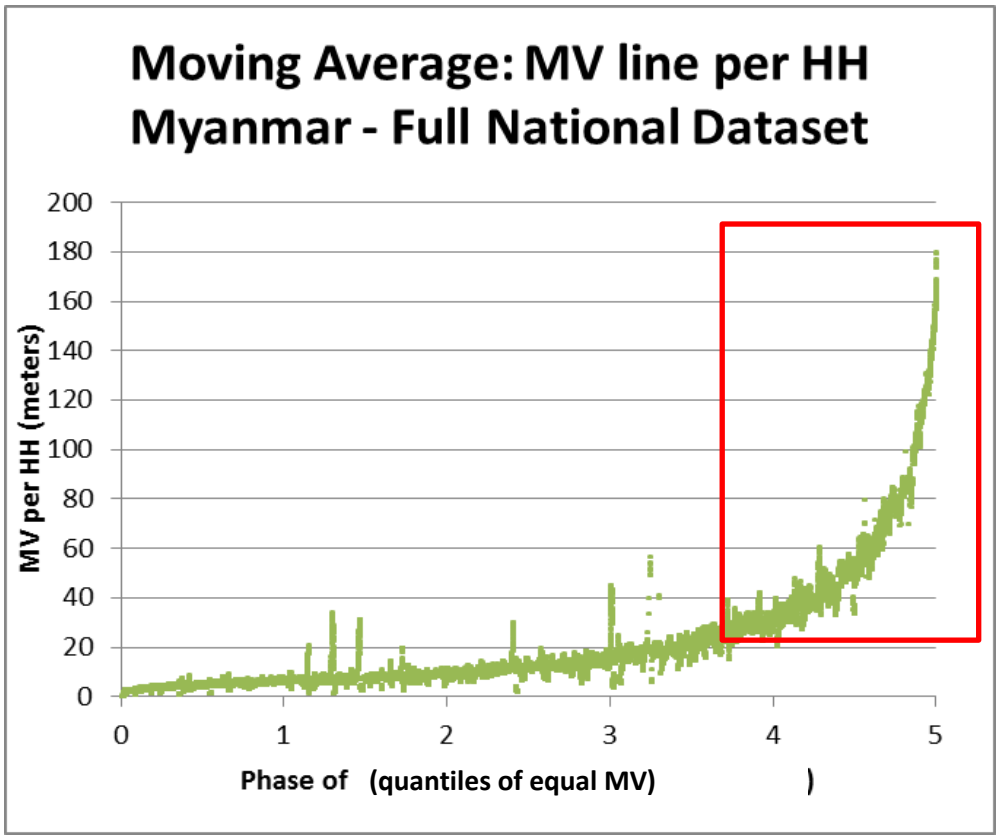


Source: Earth Institute, Sustainable Engineering Lab, Columbia University 2014.

3.3 Rationale for Off-Grid Electrification

43. The analysis indicates that, in the long run, grid extension is cost-effective for virtually the entire population. However, full grid electrification will take 15 years or longer. Costs to electrify remote locations rise rapidly for the last 5 percent or so of grid extension as suggested in Figure 7.

Figure 7. Increase in the Length of MV Lines Installed per Household



Source: Earth Institute, Sustainable Engineering Lab, Columbia University 2014.

44. Furthermore, other factors, aside from MV/HH, will likely contribute to increasing costs of serving these communities even more. These include challenges in electricity service provision that utilities experience but which are often quite difficult to measure, such as the following:

(a) Demand density falls in more remote and poorer locations since commercial loads of markets are reduced and household consumption falls.

(b) Transformer and distribution losses are higher as loads become more spread out and loads tend to be characterized more by peaks than overall demand, when types of demand are fewer.

(c) Operation and maintenance costs rise in remote areas since equipment is harder to access and replace due to poorer roads and longer distances, and management costs also rise as activities such as metering and bill collection become more difficult.

45. One of the most important factors to consider in electrification planning is timing of access. Full grid electrification is expected to take at least 15 years. The highest-cost areas of Myanmar are targeted for grid extension in the latest phases of grid extension, but they have urgent need for basic power to service lighting for homes and power for clinics and schools. One response to this issue is to plan temporary or transitional electrification option, which will provide electricity access in the short to medium term to the most remote rural areas that are targeted for grid extension in the later phases (hereafter referred to as 'pre-electrification'). Non-grid electrification

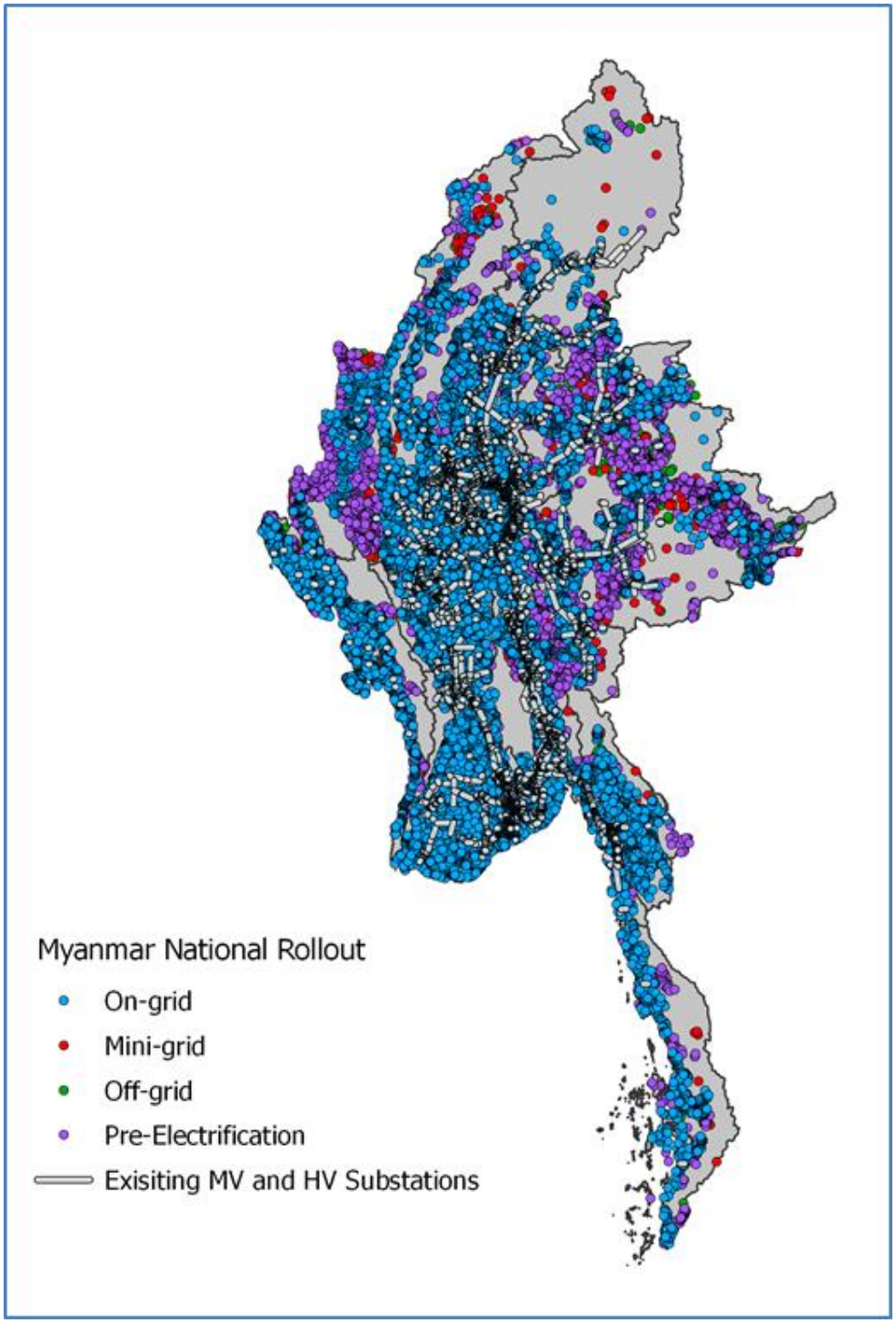
technologies such as mini-grids and SHSs can provide electricity in the short to medium term. Figure 8 shows the geographic areas that are targeted for pre-electrification.

46. Clearly, the areas (indicated in violet) proposed for pre-electrification—which fall mostly in Chin, Shan, Kachin, and other highland states—show substantial overlap with the later phases of planned grid extension, as shown in blue previously in Figure 6.

47. Quantitative information on pre-electrification by state/region is provided in Figure 9. The 'last mile' locations identified as 'high cost' represent around 5,000 settlements, containing about 250,000 households. As the table and bar chart show, the greatest needs are in Shan and Chin States, while the needs of other areas that are relatively rural and remote from the existing grid are also substantial.

48. It is important to note that the estimates in the 2014 plan, as described here, are based on various assumptions. As off-grid electrification efforts proceed, there is a considerable chance that demand for pre-electrification may turn out to be higher than expected. An update of the 2014 National Electrification Plan is due in 2017, considering progress on the ground and revised assumptions as appropriate.

Figure 8. Locations Proposed for Grid and for Pre-Electrification under the 2014 Plan

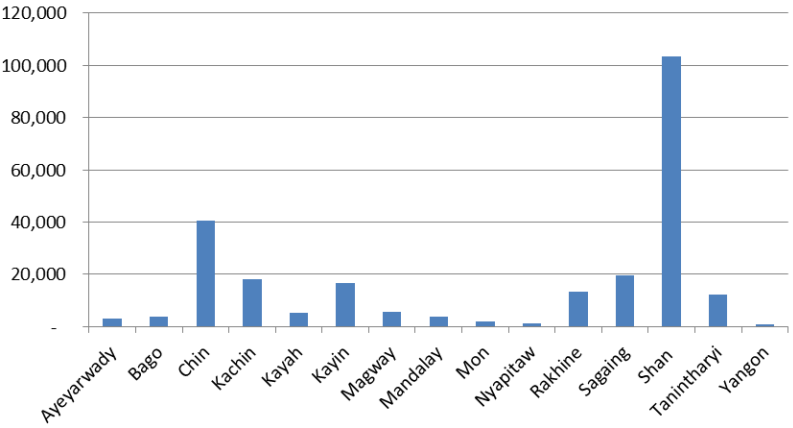


Source: Earth Institute, Sustainable Engineering Lab, Columbia University 2014.

Note: In areas where grid services arrive later, off-grid pre-electrification can provide basic electricity service in the near to medium term. Over the long term, grid extension is the least-cost option for more than 90 percent of households.

Figure 9. Number of Households Targeted for Pre-Electrification by State/Region

State	Population	HH
Ayeyarwady	10,646	2,973
Bago	13,802	3794
Chin	192,509	40557
Kachin	105,997	18328
Kayah	18,456	5153
Kayin	71,472	16584
Magway	24,485	5586
Mandalay	14,779	3862
Mon	9,782	2147
Nyapitaw	5,402	1415
Rakhine	56,433	13294
Sagaing	84,688	19539
Shan	495,572	103405
Tanintharyi	49,485	12253
Yangon	3,874	964
Grand Total	1,157,382	249,854



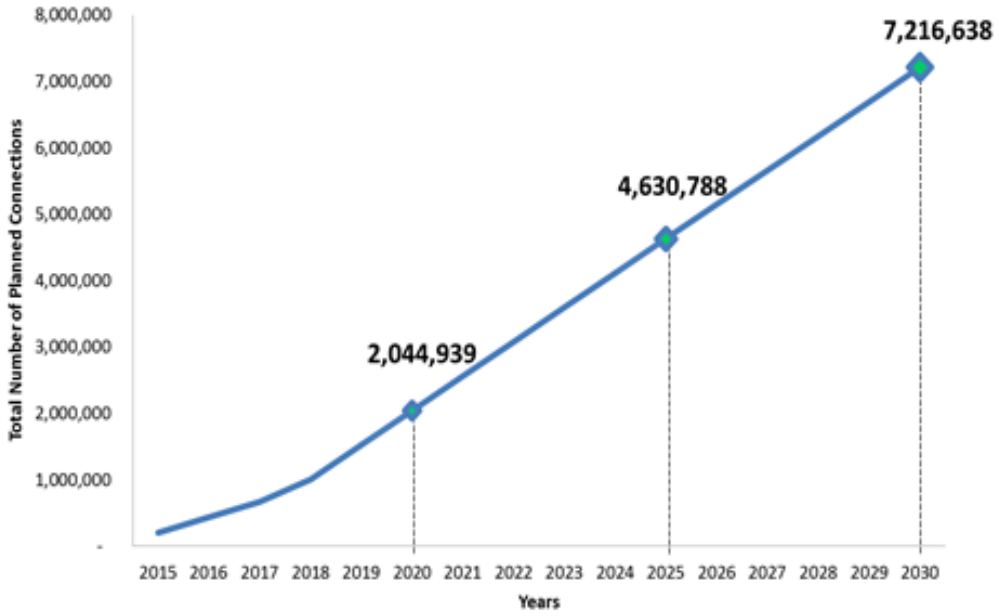
Source: Earth Institute, Sustainable Engineering Lab, Columbia University 2014.Note: the scenario shown here assumes that around 250,000 households will be included in the program.

3.4 Road Map to Universal Access by 2030

49. Analysis for the plan (Castalia Strategic Advisors 2014) suggests that universal access by 2030 will require 7,216,638 new residential connections over the 15-year period from now to then. Figure 6 and Figure 10 show the main phases and intermediate milestones for implementation to 2030. Electrification will need to start with a steady ramp-up from the 2012 rate of 189,000 connections per year, to a steady state of around 517,000 connections per year. If so, this can expect to result in approximately 47 percent of households having electricity by 2020, 76 percent by 2025, and 100 percent by 2030. The last 10 to 20 percent of households will be particularly difficult to reach, both from engineering and financial perspectives.

50. The 2014 plan estimates include projected population growth between now and 2030. As such, the electrification program should evolve dynamically, both as more information becomes available and as on-the-ground conditions change over time. The plan will need regular updating and adjustments to reflect emerging new information (for example, the recently completed population census) and the changing patterns in settlements, population, and electricity demand. The national least-cost plan provides only a key benchmark for the electrification extension. The Government may legitimately change the sequence of the extension for social or economic reasons.

Figure 10. Projected Number of Connections to Achieve National Electrification



Source: Castalia Strategic Advisors 2014.

3.5 Implementation Arrangements

51. To build institutional capacity and implement sector reforms, the Government will need to sustain a long-term commitment to national electrification. The 2014 plan states that a National Electrification Executive Committee (NEEC) should oversee the electrification program, under the patronage of a Vice President of Myanmar and co-chaired by the ministers of the respective ministries responsible for electric power and rural electrification. With a permanent Secretariat, headed by Deputy Ministers of both ministries, the NEEC should perform several major roles including the following:

- Provide overall strategic guidance on national electrification strategy and its implementation.
- Maintain and update the geospatial and financial plans for national electrification, and monitor the achievement of targets.
- Serve as the main point of contact for Myanmar's international development partners and advise the Government on managing a coherent financing program for the sector-wide plan.
- Provide advice and support to the ministries involved in implementing national electrification activities for which they are responsible.

52. Until a regulator is established, the NEEC could also take on the additional responsibility to:

- Review and update the estimates of the total funding requirement for the coming five years;

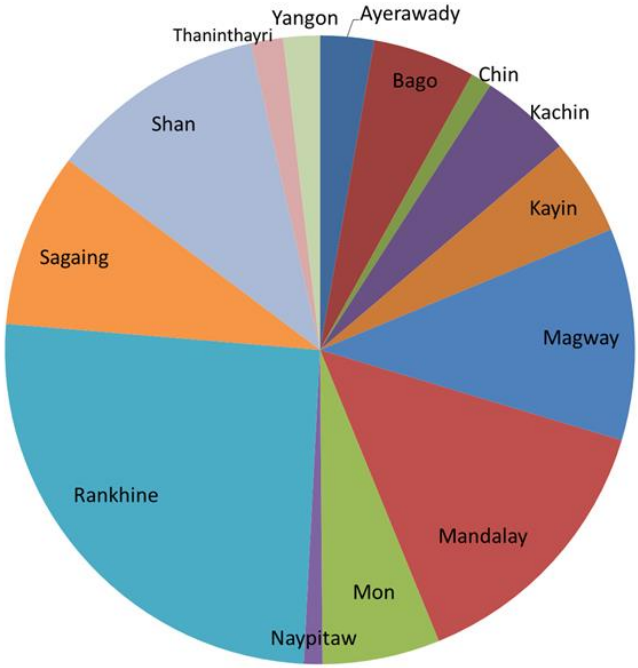
- Advise the Government on tariff options and the implications for the subsidy requirement; and

- Coordinate timely delivery of the required subsidy.

3.6 Phase One of the Plan: 2015–2020

53. According to the plan (Castalia Strategic Advisors 2014), the first five years of implementation require total investments and TA of about US$700 million to electrify around 2 million households (or about 10 million people) by 2020. Figure 11 displays the national least-cost extension by state and region for the first five years. Table 1 shows the early estimates of annual capital expenditures by connection type, noting that costs especially for pre-electrification may be much higher in practice.

Figure 11. National Least-Cost Extension by State/Region, 2015–2019



Source: Castalia Strategic Advisors 2014.

Table 1. Early Estimate of Annual Capital Expenditure by Connection Type according to 2014 Plan (US$, millions)

	2015	2016	2017	2018	2019
Grid	72.5	80.6	79.8	139.9	232.2
Planned mini-grid	0.6	0.6	0.6	0.6	0.6
Pre-electrification	16.2	22.6	32.3	45.1	58.2
Off-grid	2.2	2.2	2.2	3.2	3.2
Total	**91.5**	**106.0**	**114.9**	**188.8**	**294.2**

Source: Castalia Strategic Advisors 2014.
Note: Includes 10 percent contingency.

3.7. The National Electrification Project

54. To help implement the electrification plan's first phase, the Government has begun a National Electrification Project to cover the period 2016–2021, with a total investment of around US$567 million, including a US$400 million concessional loan from the World Bank. The project formally began in September 2015. It aims to support the national electrification plan in coordination with all development partners and the private sector, and establish the basis for a sustained engagement for investments to achieve universal access to electricity by 2030, as well as to strengthen the Government's institutional capacities. National electrification requires finance beyond any one partner's contribution and so the project is open for development partners and private sector participation. The project will also seek to leverage climate and carbon finance and other possible sources of multilateral and bilateral financing. Initial results in implementation to date include mobilization of donor financing from Germany (*Kreditanstalt für Wiederaufbau* [KfW], German Agency for International Cooperation [*Deutsche Gesellschaft fur Internationale Zusammenarbeit*, GIZ]); France (*Agence Francaise de Developpement* [AFD]); Italy; and the ADB.[15]

55. The World Bank finance will support activities which combine investment and capacity building in grid and off-grid electrification. The project is explicitly designed to bridge public and private service provision and complements activities of the International Finance Corporation (IFC) as part of an overall integrated World Bank Group Joint Implementation Plan (JIP). The project has three main components, as summarized in the following paragraphs. IFC's Lighting Myanmar proposal is included to highlight its complementarity with the Government's off-grid electrification activities.

56. **Component 1: Grid extension.** This component supports the distribution utilities to extend their networks and connect communities and households to the national power grid, including through the provision of goods and materials for (a) the expansion of existing MV substations and construction of new MV substations; (b) the construction of new LV/MV lines and transformers; and (c) household and community connections and public lighting. The World Bank is financing the cost of goods and materials (transformers, poles, conductors, insulators, switchgear, materials, and so on) for this component. The participating utilities support installation, with private (community level) contributions at a rate set by the Government and possible private sector participation.

57. **Component 2: Off-grid electrification.** About 5.5 million households are estimated to remain without access to the national grid by 2021. Of these, 1.3 million are in the remote Chin, Kachin, Kayin, Shan, Rakhine, Tanintharyi, and Sagaing States/Regions. The project's off-grid component targets communities in these areas, located far beyond the existing national grid and unlikely to receive grid access in the next 10 or more years and where private sector is not active due to relatively high operating costs and low ability to pay. World Bank finance will cover partial costs of goods and services for: (a) solar PV devices or systems for a target of 456,500 households; (b) mini-grids to serve some 35,500 households; (c) electricity connections for 11,400 health clinics, schools, and other community buildings; and (d) installation of 19,000 public street lights. Villages, and the Government (with grant finance from other sources), will share the balance of related costs. World Bank finance will disburse after installation and required services are

[15] For up-to-date information on implementation status, see Annex 2: Information Resources.

delivered and field-verified in accordance with criteria to be detailed in DRD's Project Operation Manual.[16] Mini-grid and community electrification will be 'technology neutral' and may include solar PV, mini-hydropower, wind, diesel, or a hybrid (for example, diesel and solar), depending on assessment of each community.

58. **IFC's Proposed Lighting Myanmar program.** By targeting remote areas, the Government's off-grid activities are designed to complement and coordinate with IFC's proposed Lighting Myanmar program. The IFC program would provide advisory services to help develop commercial market solutions for solar PV devices and kits in central Myanmar. This approach recognizes the market segmentation between central regions and remote border areas, which require different solutions. The scope of IFC's program includes (a) consumer profiling and segmentation, service demands, willingness and ability to pay, and other market intelligence; (b) quality assurance including products certification, enabling participation of Lighting Global quality-assured products in price-competitive procurement, building local capacity to assure quality, and field performance testing; (c) consumer awareness and education on selection and quality and acquisition channels of PV products as well as qualified service delivery agents; (d) business-to-business support, including targeted business development services; and (e) access to finance for the supply chain, including support to local distributors to assess working capital needs and access to financing, identifying solutions to provide funds to the MFI sector and providing linkages on the potential pipeline to MFI clients. Its total cost is estimated to be about US$4 million, financed with the donor's trust fund and fees from IFC clients. The proposed IFC program would provide such services separately and in parallel to World Bank support for the Government's project, as part of the overall integrated World Bank Group JIP.

59. **Component 3: Technical assistance and project management.** This component provides support to MOEE and MOALI to (a) strengthen institutional capacity to implement the project; (b) improve the policy and regulatory framework related to electrification and RE; (c) develop an integrated framework to plan electrification, monitor result, and evaluate impacts; (d) secure technical advice and consulting services, including on standards, technology assessment, and technical design, economic and financial analysis, environmental and social impact management, procurement, and financial management; and (e) improve project management.

60. **Project cost and financing.** As Table 2 shows, overall project cost is estimated at US$567 million, of which the World Bank covers US$400 million (71 percent).[17] Other finance includes an estimated US$75 million of community contributions for Component 1, US$32 million of community contributions for Component 2, and US$60 million from the Government budget for Component 2.

[16] The MOEP and DRD will each have a separate Project Operation Manual for their respective parts of the project.
[17] IFC's proposed 'Lighting Myanmar' program is not included in the cost and finance figures of this project.

Table 2. Estimated Project Cost and Financing Requirement by Component

Component	Project Cost (U$, millions)	Source of Finance (US$, millions) (Share of Project Cost)					
		World Bank Finance		Government		Local Communities	
1. Grid extension	375	300	(80%)	—	—	75	(20%)
2. Off-grid electrification	172	80	(47%)	60	(35%)	32	(18%)
3. TA and project management	20	20	(100%)	—	—	—	—
Total Project Costs	567	400	(71%)	60	(11%)	107	(18%)

Source: World Bank 2015a.

Note: It includes contributions from villagers, local governments, other donors, and the private sector, as applicable, for village electrification.

61. **Project beneficiaries.** As Table 3 shows, the project is expected to benefit about 6.2 million people with new electricity connections by 2021. The beneficiaries will span rural and urban areas in all of Myanmar's seven states and seven regions. The project's support to off-grid areas will especially target communities in locations the grid is unlikely to reach in the next 10 or more years (remote areas where social and/or ethnic tensions are often present).[18]

Table 3. Results Indicators for National Electrification Project

Indicator Name	Cumulative Target by December 2021 (Compared to Baseline of 0 in December 2015)
1. People provided with access to electricity under the project by household connections, of which	**6,210,000 people** (1,242,000 households)
Grid	3,750,000 people (750,000 households)
Off-grid solar	2,282,500 people (456,500 households)
Mini-grid	177,500 people (35,500 households)
2. Community electricity connections under the project, of which	**23,000 connections**
Grid	11,600 connections
Off-grid/mini-grid	11,400 connections
3. Public lighting, of which	**151,000 lights**
Grid	132,000 lights
Off-grid/mini-grid	19,000 lights

Source: World Bank 2015a.

62. People living in areas electrified under the project are expected to benefit from (a) reduced costs of electricity; (b) enhanced well-being through electricity for lighting, telecommunications, and entertainment; and (c) job creation and opportunities to boost incomes and economic productivity. To maximize developmental impacts, including health, education, and social benefits, the project will prioritize connections for health clinics, schools, religious, and other community buildings. The project will benefit groups vulnerable to social exclusion, such as low-income and female-headed households, people with disabilities, students, and people of different ethnic groups and religious beliefs. The project is also expected to strengthen the capacity of village committees and improve the participation of community members, especially women, in decision making for electrification.

[18] In parallel, IFC expects that approximately 4 million people in central Myanmar would benefit from better access to market-based solar PV devices and kits under its proposed Lighting Myanmar program.

63. Finally, the Government and private sector participants of the project will benefit from TA and support for institutional development, capacity building, and gender-sensitive training for grid and off-grid electrification activities.

4. ELECTRIFICATION AND POWER SECTOR REFORMS

4.1 Recent Reform and Policy Developments

64. In recent years, the Government has initiated several reforms to improve the institutional and policy environment in the energy sector. After the lifting of many U.S. and European Union sanctions in 2012, private sector participation has significantly increased in Myanmar's power generation. In 2013, the National Energy Management Committee was established to improve coordination and policy making among multiple agencies responsible for energy at the time. The then Ministry of Energy prepared an Energy Master Plan and a National Energy Policy, which was adopted in 2014 to provide a broad framework and strategic directions for sector development including electrification. Other major goals of the policy include energy mix diversification, higher energy efficiency, and energy pricing policies that reflect economic costs for both suppliers and users in the energy market.

65. In 2014, a new Electricity Law was adopted, which established the legal basis for IPPs and PPPs and provided for introducing an Electricity Regulatory Commission that would catalyze further sector reforms and much-needed private sector participation.[19] This further opening up of the sector to private developers under the 2014 Electricity Law created a surge of unsolicited IPP and PPP proposals. However, associated secondary legislation (rules and regulations) have not yet been adopted and the Commissions has yet to be established. The lack of detailed implementing guidelines leaves investors uncertain about legality of and market feasibility of private electrification projects, particularly in the off-grid space (Ross 2015; World Bank 2015a).[20]

66. Restructuring and corporatization have been initiated in the power distribution sector. To improve performance and overall efficiency in power distribution, in April 2015, the Government corporatized the former Yangon Electricity Supply Board (which accounts for about half of the national electricity market) and created MESC for Mandalay, "to commercialize…in line with the system of market economy."[21] ESE continues to serve all states and regions in the rest of the country. Short-term concessions for LV distribution grid in urban areas (for example, Yangon and Mandalay) have also been piloted to reduce distribution losses through private sector participation in billing and collections. As a result, distribution losses have been significantly reduced. However, continuing the loss reduction program will require substantial investments in expansion and modernization of overloaded and outdated distribution networks.

67. As of August 2015, the small number of foreign investment enterprises in the power sector represented approximately 28 percent of Myanmar's total foreign investments, second only to oil

[19] Pyidaungsu Hluttaw Law No. 44, October 27, 2014.
[20] Advised by IFC, in April 2015, the former Myanmar Electric Power Enterprise completed the first competitive bidding for an IPP and awarded a contract to operate a 225 MW gas-fired plant, in Myingyan, under a 22-year PPA, with the former Ministry of Electric Power guaranteeing payment for purchase. This PPA is expected to serve as a blueprint for use by other IPPs in the future (Ross 2015).
[21] Notification No. 094/2015 dated March 30, 2015.

and gas at 40 percent (Ross 2015). It is estimated that the Government has entered memoranda of understanding for several thousand MW of gas-fired, coal-fired, and hydropower projects over the last couple of years. However, moving these proposals toward the signing of bankable PPAs proved much more difficult. By 2015, the total installed capacity of IPPs reached about 440 MW (270 MW in gas-fired plants and 170 MW in hydropower plants) or about 10 percent of the total installed capacity of the country. Around 260 MW of rental power plants was connected to the power grid to help alleviate acute power shortages. In April 2015, the Government completed its first competitive bidding for the 240 MW Myingyan IPP, which resulted in a notably lower price and better plant performance compared to unsolicited bids received earlier.

Tariffs

68. Electricity tariff reforms have enabled power generators and suppliers to cover the operating cost of service (short-run marginal cost) but as of 2016 are insufficient to generate funds for capital replacement and significant assets modernization for the future. The devaluation of the Myanmar kyat in 2012 significantly increased the cost of electricity supply due to the higher cost of U.S. dollar-denominated natural gas for power generation. The Government responded by increasing electricity tariffs by 21 percent per year during FY2012–FY2014. The latest electricity tariff structure for end users (effective from April 2014) provides three tariff blocks for residential and small consumers and six tariff blocks for industrial and large consumers. However, effectively, the residential consumers are still cross-subsidized by large commercial customers. Despite the cross-subsidies, in 2014, the overall tariffs covered the cost of service, while the investment cost remains subsidized by the Government. As a result, the sector on the whole has stayed profitable during this period although the rate of profitability has been declining.[22]

69. In addition to the tariff increases, sector finances benefited from the higher proportion of depreciated hydro power assets in the generation mix, preferential natural gas pricing and reduced system losses. However, the increasing proportion of natural gas-based power plants, such as rentals and IPPs, and the recent increase in domestic gas price are now altering the cost structure of the industry and incurring financial loss for the sector (Deloitte 2016).

4.2 Agenda for Further Reforms

70. While these policy developments are commendable, national electrification will require further deep sector reforms to overcome existing institutional and financing constraints. It is unlikely that the existing sector institutions—in their current state—will have the capacity needed to implement the program efficiently and at sufficient speed. Sector reforms will take time and the electrification program cannot wait for the completion of the reform program. With this in mind, a number of measures are suggested to improve operational efficiency and flexibility of the utilities in the short term and enable first steps toward scaling up of electrification. These include the following.

- Distribution utilities to adopt medium- and long-term planning practices, beyond current annual investment and implementation plans.

[22] For example, profitability per kWh sold dropped from K 6.57 in FY2014 to K 4.00 in FY2015 (Deloitte 2016).

- MOEE to provide the utilities with the flexibility to hire staff on short-term contracts to enable more rapid expansion.

- The Government to develop and announce a five-year tariff path policy consistent with the electrification plan and with a realistic assessment of consumers' ability and willingness to pay.

71. The 2014 Electricity Law creates the foundation for further sector reforms, including establishment of the Electricity Regulatory Commission. The complete corporatization and commercialization of distribution utilities will go a long way in overcoming institutional and financial constraints in the sector and will help attract more private sector participation, including in the electrification program. The reforms expected in the financial sector are also important for the electrification program. Strengthening institutional in the currently weak financial sector would allow a transition from the current grant-funded off-grid program to a more commercialized and private sector-driven program. Going forward, the Government should consider the policy options discussed in the following sections.

72. **Establishment of transparent regulatory framework.** The Government should, as a matter of priority, adopt secondary legislation (rules and regulations) which is necessary to operationalize the 2014 Electricity Law. The new regulatory framework should focus on the establishment of a transparent and efficient electricity market, particularly related to competitive bidding for new generation on IPP/PPP basis. This will require adopting and maintaining a transparent pricing policy, consistent with the principles of full cost recovery, and establishing the Electricity Regulatory Commission provided by the 2014 Electricity Law. The commission would ideally help depoliticize the tariff-setting process, scrutinize all costs incurred by sector utilities, and reduce the current large cross-subsidies among consumer categories, thus providing both the corporatized utilities and new private investors and lenders with greater certainty about the future level of tariffs. Independent tariff regulation also ensures that the management and Board of the corporatized utility cannot meet their financial performance objectives through the exploitation of monopoly power rather than through efficient operation of the utility. By ensuring that the tariffs are set so that the utility is only able to recover reasonably efficient costs, including the cost and return on capital, a sound regulatory regime ensures that strong financial performance by the utility is only possible if it operates efficiently.

73. **Completion of corporatization and commercialization in power generation and distribution.** Effective corporatization and commercialization of YESC, MESC, and ESE can improve sector performance and sustainable electricity supply. The utilities are allowed to operate as independent commercial entities under a commercially skilled Board; are able to conduct financing operations using their own budget; and are able to make independent decisions about staffing levels, pay, and other resources. Under the corporatized structure, the utility's performance is judged by its ability to earn a return on capital, with the Board and management rewarded for commercial performance in the same way as would occur in the private sector. Successful corporatization programs should ideally result in reduction of undue political involvement in the operation of utilities.

74. Further restructuring of ESE may be a medium-term objective subject to the future market growth and electrification rate outside Yangon and Mandalay. Finally, a Myanmar Transmission

System Operator could be established as an independent transmission company. With sizable investments being envisaged in the transmission subsector, corporatization of such an operator should reduce the burden on the Union Government budget and allow financing to be raised on the balance sheet.

75. **Increased private sector participation.** Scaling up access to the planned level will be impossible without substantial private participation. Corporatization of the distribution utilities should create better conditions for private sector investments in this subsector. The level of private sector involvement may range from system loss reduction contracts, to management contracts to full concession for utilities. The Government should encourage concessions for various sub-franchises. This will greatly speed up the extension and will lead to lower costs. However, it is essential that the process for sub-franchising be orderly and that it should encourage competitive procurement.

76. MOEE, as the ministry overseeing ESE, should develop clear rules and standard application forms for a sub-franchise (whether private or community owned). Such rules should specify the responsibilities of the sub-franchisee (including the obligation to serve the entire population in the area); define the boundaries between the sub-franchise and ESE as well as other sub-franchises; and set the wheeling charges to be paid by the sub-franchises depending on the extent of its reliance on ESE's MV network.

77. Before the establishment of a regulator, MOEE, with advice from the NEEC, should set the tariff rules and the starting tariff for the sub-franchise.

78. Sub-franchises should be allocated to operators on the basis of least subsidy. In some cases, it should be possible to conduct competitive tenders: for example, MOALI could conduct a competitive tender for minimum subsidy for its proposed PPP for rural electrification in the priority areas. Similarly, if ESE designates an area as a potential sub-franchise, it could be bid out on the basis of a minimum subsidy.

4.3 Need for New Generation and Transmission Capacity

79. In addition to the new distribution infrastructure costed under the electrification plan, Myanmar would also require around 2.5–3.0 GW of new power generation capacity till 2030 just to meet the needs of the 7.2 million new household connections under the assumed service standard of 1,000 kWh per household per year. This is equivalent to doubling of the current generating capacity. Because this represents only new residential demand—omitting commercial and industrial demand, as well as demand growth for currently connected customers—the objective of universal access clearly implies doubling the generation capacity at the minimum, all else being equal.

80. **Strengthened planning capacity and development of Gas Sector Master Plan and Hydropower Development Plan.** Myanmar has abundant energy resources, including natural gas, hydropower, solar, and other renewable energy for power generation which has to increase in tandem with the rapid growth in demand driven by rural electrification. The country is also well positioned to be a regional trading hub in natural gas and electric power. Unlocking this potential in an economically effective and environmentally and socially sustainable manner will require

careful analysis of all alternatives and rigorous planning to chart a sustainable development path which will generate best economic and social results for the country and affected population. This will require institutional development and capacity building for system planning, particularly in the natural gas and hydropower sectors, as well as strengthening of environmental and social safeguards and including public consultations in the planning process and project preparation activities.

81. Table 4 summarizes the key policy proposals for the short-term (within two years) and long-term (within three to five years) policy options for 2020 to help deliver on the above objectives of increasing the rate of electrification; improving transparency and competition in the electricity market and mobilizing private sector investments while protecting vulnerable consumers; increasing operational efficiency through corporatization and commercialization of enterprises in the power sector; and improving strategic planning capacity and mainstreaming principles of environmental and social sustainability in power sector planning.

Table 4. Proposed Short-term and Long-term Policy Actions

Objectives	Short-term Actions	Long-term Actions
Increase the rate of electrification and reach at least 500,000 connections per year by 2020.	Maintain the NEEC accountable to the country's Vice President for electrification activities. Ensure that MOEE, MOALI, and the utilities are adequately staffed and equipped for effective coordination of electrification program across the country.	Improve institutional capacity throughout the electricity value chain. Provide support for institutional capacity building to the utilities (ESE, YESC, and MESC); local contractors; and sector institutions at the regional/state and district level. Adopt grid codes and introduce modern technologies and low-cost solutions for rural electrification.
Improve transparency and competition in the electricity market and mobilize private sector investments while protecting vulnerable consumers.	Adopt secondary legislation (rules and regulations) for operationalization of the Electricity Law. Establish the Electricity Regulatory Commission. Adopt and start implementing pricing policy based on full cost recovery of the economic cost of gas and electricity supply. Ensure that subsidies to vulnerable consumers (direct or cross-subsidies) are explicit, well targeted, adequately budgeted, and fiscally affordable.	Increase private sector participation and leverage public resources through transparent and competitive IPPs/PPPs. Mobilize private resources and commercial financing to leverage public resources and donors funding (including World Bank) through a competitive selection of private developers for priority investments on IPP/PPP basis.
Increase efficiency through corporatization and commercialization of enterprises in the energy and power sector.	Complete corporatization of YESC and MESC and foster their commercialization by (in the first year) appointing CEOs, adopting bylaws, and setting Key Performance Indicators (KPI) for the newly established corporations. Transform YESC, MESC, ESE and EPGE into financially viable companies with sound corporate governance, clear development objectives and Key Performance Indicators by developing a Financial Viability Action Plan in the first year. Introduce financial auditing in line with international accounting standards.	Develop and start implementing divestment program in the power sector focusing on YESC and MESC. Develop and start implementing restructuring program for ESE, focusing on corporatization of regional distribution companies and creation of a Rural Electrification Agency under ESE. Establish the Myanmar Transmission System Operator responsible for the HV transmission system.

Objectives	Short-term Actions	Long-term Actions
Improve strategic planning capacity and mainstream principles of environmental and social sustainability in the energy and power sector planning.	Create a joint task force led by MOEE for the review of gas sector development plans and initiate preparation of gas sector master plan. Create a joint task force led by MOEE for the review of hydropower plans and initiate preparation of hydropower development program. Establish guidelines for environmental and social safeguards and encourage public consultations in formulation of energy master plans.	Improve resource mapping and develop geographic information system-based maps of renewable energy resources. Carry out system studies for integration of renewable energy in the power grid. Develop an integrated generation and transmission expansion plan to meet future electricity demand in affordable, reliable and sustainable manner based on master plans for gas, hydropower, and renewable energy development.

5. INTERNATIONAL DONOR SUPPORT FOR ELECTRIFICATION

5.1 Rationale for Concessional Finance

82. National electrification is being undertaken at the same time as Myanmar's economy is undergoing major transformations. The electrification plan envisages a growing role for the private sector, including reliance on private finance through a mix of equity and commercial borrowing. However, in the immediate future, access to appropriate finance remains severely constrained.

- The Myanmar banking system is poorly developed. No banks offer loans for periods of more than two to three years and refinancing of existing debt is extremely difficult. The Village Electrification Committees often are only able to borrow for three to six months. Hence, any finance that could be obtained from the Myanmar banking system would require rapid amortization through tariffs or subsidies.

- The banking system has little experience in infrastructure project finance. Hence, there would likely be delays in securing the necessary credit, at whatever cost and tenor. Furthermore, the banking system is unlikely to be able to accommodate overall credit demand of over US$100 million per year from the power sector.

- While international commercial lenders may be willing to finance electricity generation IPPs in Myanmar, it is unlikely that such lenders would provide systematic and reliable support to the distribution extension without significant structural reforms, such as full corporatization of the major electric utilities and the introduction of an independent electricity regulator. However, such reforms would take time and this circumstance should not delay the implementation of the electrification extension.

- Finally, the cost of commercial finance is initially likely to be substantially higher than the cost of finance provided by international development partners. Myanmar is still seen as a high-risk investment destination. However, over time, the risk premium of lending to Myanmar businesses should decline.

83. Therefore, it is very likely that without substantial support from the development partners, the objective of achieving 2 million new connections in the next five years would not be met. It would be unrealistic to expect to raise the required US$700 million (including TA) over this period from commercial sources, and even if this amount could be financed, the burden on the consumers

and the Government of servicing such debt at commercial rates and tenors would not be sustainable. It is estimated that electricity tariffs would need to rise from the current weighted average of US$0.064 per kWh to US$0.27 per kWh (Castalia Strategic Advisors 2014). Such a steep tariff hike would not be socially acceptable. In effect, to keep tariffs affordable and to achieve universal electrification without access to concessional finance, the Government would have to substantially increase its current funding commitment to the sector. However, this does not appear possible, given the existing severe fiscal constraints. Even if it were possible, such fiscal commitment would undermine the Government's other national development objectives and deter private sector participation in the sector.

84. Given the existing financing constraints, meeting the financing need through concessional donor finance will make a significant development contribution.

- It will enable Myanmar to achieve the targeted 2 million new connections in the next five years. Not only will this make a significant contribution to the country's development by giving those households access to electricity, it will underwrite the ramp-up in both technical and institutional capability required to achieve full electrification by 2030.

- It will ensure that the burden on Myanmar consumers and the Government is consistent with their ability to pay. In the absence of donor financing, tariffs should rise to unaffordable levels. The long tenor of the concessional finance ensures that the future users of electricity—who can expect to be substantially better off than the current users—assume a fair share of the burden.

- It will support the extension program over the period of economic reforms. Over time, as Myanmar's economy becomes more integrated with the global financial system, and as the local banking system matures, commercial finance will increasingly become available, which can replace concessional finance without a material shock to tariffs.

5.2 World Bank Group Support

85. The National Electrification Plan was developed with World Bank TA of US$1.5 million funded by the Sustainable Energy for All initiative. The World Bank Group JIP for Myanmar supports public and private efforts to increase electricity access and alleviate acute electricity shortages. The JIP's first stage (2013–2015) focused on increasing gas-fired power generation capacity and efficiency and laid the foundation for national electrification. The US$140 million World Bank finance for the 2013–2018 Myanmar Electric Power Project includes investment to increase the capacity and efficiency of a gas-fired power plant in Thaton, Mon State. The IFC and Multilateral Investment Guarantee Agency have supported MOEE to conduct Myanmar's first competitive bidding for an IPP, a new 240 MW gas-fired plant in Myingyan, Mandalay Region.

86. Scaling up access to electricity requires sector reforms and increased private sector participation. The Government and its development partners recognize that the next stage of sector development will require further reforms, institutional strengthening, and deeper private sector involvement. With help from IFC, the Government has already initiated corporatization in the power distribution sector, which will create conditions for private sector investments in the distribution utilities. Also, a proposed IFC-led 'Lighting Myanmar' initiative supports the private

sector to develop a commercial market for off-grid solar devices and kits as an integral part of national electrification efforts. In addition to financing support, the World Bank Group provides TA and policy advice on power sector financial viability, electricity tariffs, and subsidies review and institutional capacity building for environmental and social due diligence, procurement, and financial management in MOEE and other sector entities.

87. The World Bank Group helped the Government develop its national electrification plan with support from the Energy Sector Management Assistance Program (ESMAP. A major step to turn the plan into reality was taken in September 2015 when the Government and World Bank agreed on a loan of US$400 million for a National Electrification Project, covering grid extension and off-grid electrification for the period 2016–2021. In addition to working with the public and private investors, development partners active in Myanmar collaborate closely, including the ADB, Australia, Japan, Germany, Norway, the United Kingdom, and the World Bank Group.

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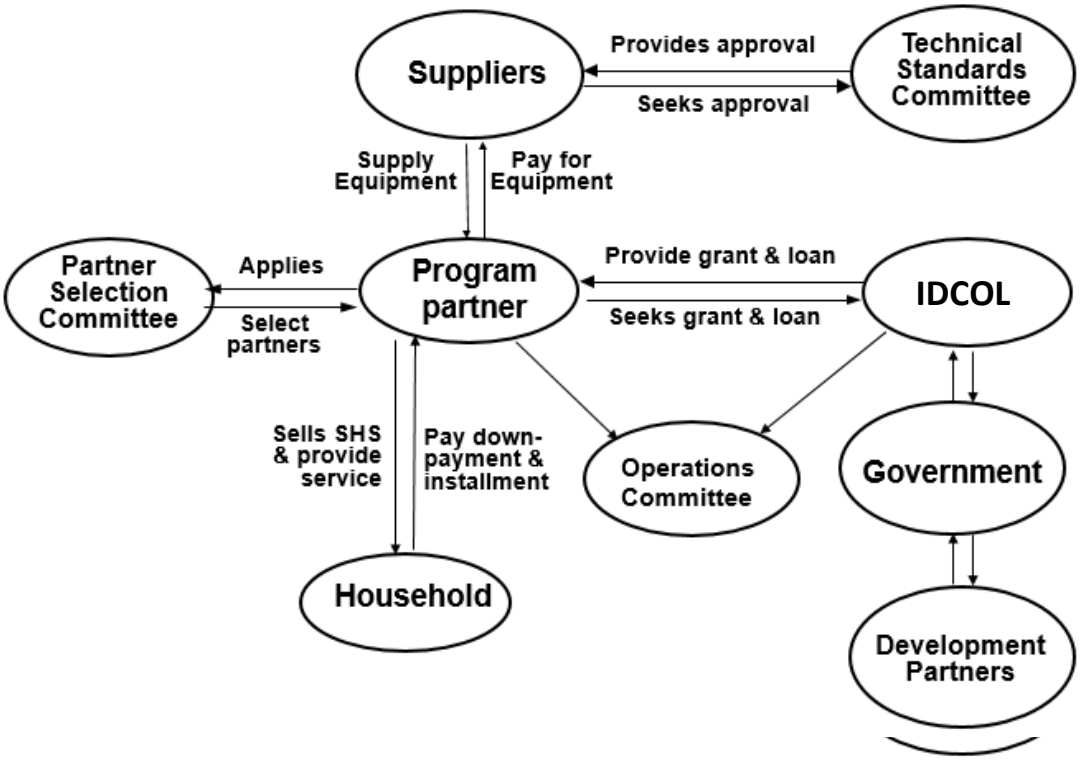
Annex 1. Bangladesh IDCOL Model for Off-Grid Electrification



Source: World Bank 2015a

1. Generally, key elements of this best practice model include:

   (a) Public-private partnerships to implement a phased long-term national off-grid program at scale;

   (b) Existence of a strong commercially oriented, well-managed, and well-capitalized Program Manager (PM) (IDCOL);

   (c) Delivering off-grid products and services through program partners that use quality products, offer effective services, honor warranties, adopt a competitive sales and service model, and follow responsible financial management practices;

   (d) Access to reasonably priced financing and availability of grant assistance to increase affordability and to ensure the program partners have adequate capital for investing and operating the off-grid service infrastructure and consumers can pay for their off-grid investments over time;

   (e) Social acceptability and confidence in the program partners at the community level and the existence of a microcredit culture in rural areas resulting in customer readiness to try the off-grid systems;

   (f) Risk sharing between the PM and program partners, proper customer selection, and attention by both the PM and the program partners to collection efficiencies;

(g) The ability to achieve low costs through economies of scale, competitive procurement, and competitive sales, and offering and honoring multiyear warranty for batteries and maintenance;

(h) Customer training imparted by the program partners enabling the customers to carry out regular, simple maintenance work themselves to enhance reliability, availability, and customer satisfaction—crucial requirement to ensure loans are repaid;

(i) Sense of ownership by consumers resulting in proper system care;

(j) Large customer base in relatively densely populated areas

(k) Setting technical standards and enforcing the standards through strong supervision and monitoring by the PM.

Annex 2. Information Resources

- The MOEE website is www.moep.gov.mm and Facebook page is https://www.facebook.com/MinistryOfElectricityandEnergy.Myanmar/.

- The DRD website is www.drdmyanmar.org and the Facebook page specifically on the National Electrification Project off-grid component is www.facebook.com/NEP-DRD-157149644665246/.

- The World Bank provides information about the National Electrification Project including Implementation Status and Results Reports at http://projects.worldbank.org/P152936?lang=en

- IFC has information about its Myanmar program here: http://www.ifc.org/wps/wcm/connect/region__ext_content/regions/east+asia+and+the+pacific/countries/ifc+in+myanmar.

- Other materials including workshop presentations are available at Energypedia: https://energypedia.info/wiki/Achieving_Universal_Access_to_Electricity_in_Myanmar.

The Energypedia website also hosts the two documents that comprise the 2014 National Electrification Plan:

- Myanmar Geospatial Least-Cost Electrification Plan https://energypedia.info/wiki/File:MMR-NEP-Geospatial_Least_Cost_Planning_Draft_FinalReport-2014-08-28.pdf

- Myanmar National Electrification Plan: Roadmap and Prospectus https://energypedia.info/wiki/File:Myanmar_NEP_Roadmap_and_Prospectus_Draft_Final_14_08_28.pdf

Annex 3. Development Partner Support for Electrification[23]

Partner	Project Description	Budget	Time Frame	Geography
ADB	TA for the Off-Grid Renewable Energy Demonstration Project to support the scale-up of off-grid solutions for RE in Myanmar. The TA has three activities: 1. Demonstration of Solar Mini-Grid: Procurement and installation of modular solar PV mini-grids for 12 piloted villages (about 1,500 households) in Mandalay, Sagaing, and Magway Regions. US$500,000 is used to finance part of the cost of these modular solar PV mini-grids. The communities contribute 10% of the cost. 2. Least-cost Energy Access and Off-grid Investment Plan. The TA utilizes geospatial planning tools to develop off-grid investment plans for villages in Mandalay, Sagaing, and Magway Regions. This investment plan also includes business models and financing recommendations for scale-up of off-grid renewable energies. 3. Strengthen Off-Grid Planning and Business Capacity for Myanmar government institutions. The TA helps creation of a government office responsible for technical standards and certification of RE systems and service providers.	~US$2 million, including US$500,000 for pilot projects	2015–early 2017 Activity 1 almost completed Investment plan ongoing	Magway, Mandalay, Sagaing
Australia	Supporting Lighting Myanmar			
UK Department for International Development	Pilot testing mini-grids with solar hybrid power systems using the ABC model in Mandalay, Magway, and Shan through Infracapital Myanmar. In discussions with DRD. TA and investment. Also supporting Lighting Myanmar.			
European Union	Rural development is one of the four areas of focus. Preliminary stages of planning for next year, funding for rural electrification. Plan to use blended facility at regional level (Asian Investment Facility). Emphasis on climate change mitigation.	EUR 10 million (grant funding)	2017–?	TBD

[23] Known to World Bank as of October 2016.

Partner	Project Description	Budget	Time Frame	Geography
Germany GIZ	Supporting DRD on mini-grids through TA and some for pilot projects. Main thematic areas: • Supporting DRD on rules and regulations for mini-grids (for example, grid interconnection) • Capacity building for private sector (local project developers), technical and business development skills • Supporting DRD on site assessments (focus on Shan) • Supporting DRD on mini-grid project proposal appraisal	~US$2.2million	Q1 2016–2020	Southern Shan (projects) Nationwide (TA/enabling environment)
IFC	Lighting Myanmar project supporting manufacturers and distributors of high-quality solar to enter and scale in Myanmar, through market research, business development support, consumer education, and policy engagement. Supported by U.K. Department for International Development and the Australian Government. Also exploring potential support for mini-grid sector.	~US$4 million	Q3 2016–Q2 2020	Central Myanmar (Ayeyarwady, Bago, Magway, Mandalay, Mon, Naypyitaw, Sagaing, Yangon)
Italy	Parallel soft loan for National Electrification Project (in collaboration with World Bank); in this framework, a TA component is under evaluation, along with a capacity development contribution focused on gender. Possibility to use part of the soft loan for mini grid.	Soft loan EUR 30 million, Grant EUR 2.5 million (under study)	Q2 2017–2020	Magway - Chin
Japan JICA	'Regional Development Project for Poverty Reduction Phase I' (loan) provided financial support for MV/LV distribution lines and mini-grid system by diesel generators. Off-grid works are done. Preparing Phase II project (loan); final report to be published around December 2016. Have decided to focus on the on-grid sector only. Support installment of SHS system in remote villages in Yangon Region (grant base technical cooperation). Support a survey conducted by a private firm to examine business model of off-grid solutions (for example, SHS/solar lantern) for low-income customers.	Approximately US$35 million for on-grid electrification Approximately US$5 million for off-grid Approximately US$50 million for grid electrification Approximately US$0.1 million for off-grid survey	Phase I: Q2 2013–Q2 2017 Phase II: Q4 2017–2021 SHS completed Survey March–October 2016	Nationwide Nationwide Taikkyi T/S, Yangon Region Kyaukpadaung T/S, Mandalay Region
JICA	Mini-grid projects in Chin and Shan—mix of hydro and solar, 11 projects total		2016?	Chin and Shan

Partner	Project Description	Budget	Time Frame	Geography
Germany KFW	Overall rural electrification program around EUR 60 million, split between loans and grants, EUR 40 million German funds, EUR 5 million DRD funds, EUR 10 million from MOEE/ESE and regional government of Shan State's funds, and EUR 5 million end user's funds. Both components are designed under the NEP. Off-grid Component 1: Grants for SHS in Southern Shan State, implemented by DRD. International competitive bidding of implementation consultant is ongoing; planning to start work in 2017. On-grid Component 2: Mainly soft loan for grid extension in Southern Shan State implemented by ESE under MOEE. International competitive bidding of implementation consultant is ongoing, planning to start work in 2017.	EUR 9 million for off-grid component (including EUR 7 million investment and EUR 2 million for accompanying measures) Around EUR 30 million for grid extension (including EUR 6.535 million for specific HHs' connection and consulting measures)	2017–2020	Southern Shan
World Bank	Capital support for SHS, mini-grids, and public lighting systems. The first contract for SHS at value of approximately US$30 million has been signed for delivery and one-year maintenance of some 136,000 SHSs and 14,000 public facilities, where installation will begin in January 2017. The second contract for SHSs with estimated value of US$71 million is under way. The mini-grid subcomponent has been progressing and proposals are being vetted by the Project Implementation Office with TA from GIZ. Thirteen proposals are on solar mini-grids. Project Management Office is identifying attractive cofinancing arrangement and improving communication and information sharing to facilitate greater participation from the private sector for investment in hydro mini-grids. Also substantial TA, including technical consultants for DRD and electrification planning. Terms of reference for geospatial electrification planning and investment prospective is being updated and call for proposals is expected in late January 2017.	US$80 million capital support ~US$10 million TA	2016–2020	Solar systems: Border areas (Ayeyarwady, Chin, Kayin, Rakhine, Sagaing, Shan, Tanintaryi) TA: nationwide/enabling environment
UN Development Programme	In conception phase for rural electrification project in Myanmar		2018–?	

Partner	Project Description	Budget	Time Frame	Geography
UN Economic and Social Commission for Asia and the Pacific	Has TA with DRD to promote 5G community participation model for rural electrification (trying to replicate Indonesia experience)			

Acknowledgements

The report is a synthesis of multiple technical documents and reports resulting from extensive World Bank engagement with Myanmar for national electrification since 2013. Dejan Ostojic and Xiaoping Wang co-led this engagement on behalf of the World Bank, including for preparation of the National Electrification Plan and the follow-on project with IDA support of US$400 million. Julie Fraser provided strategic guidance. Other core members of the World Bank team include Alan David Lee, Rome Chavapricha, and Myoe Myint. Istvan Dobozi was the principal author of this synthesis report, with assistance from the rest of the World Bank team.

Throughout the World Bank's engagement, numerous consultations were carried out by and with government agencies, development partners, private sector, and civil society organizations, involving several hundred participants. Major source documents and reports include the 2014 geospatial, least cost electrification plan and universal access road map and prospectus by Earth Institute, Sustainable Engineering Lab, Columbia University and Castalia Strategic Advisors, respectively, as World Bank consultants and the 2015 National Electrification Project Appraisal Document by the World Bank team.

In addition, many consultants and staff members contributed to the discussions and preparation of the Government's Plan and IDA-supported project, including, but not limited to, Arun Sanghvi, Anil Cabraal, Chris Greacen, Panos Vlahakis, Chris Purcell, Voravate 'Tig' Tuntivate, and Huong Mai Nguyen. Theingi Min, Thida Aung, and Chawsu Devi are acknowledged for their operational support from Myanmar. World Bank engagement was made possible partly due to generous financial support from the Sustainable Energy for All Technical Assistance Program of the Energy Sector Management Assistance Program and the Asia Sustainable and Alternative Energy Program.

Above all, the World Bank team extends its sincerest appreciation to the Government of the Republic of the Union of Myanmar for their leadership, hospitality, and cooperation for the partnership to realize Myanmar's goals for the energy sector and sustainable development more broadly.

Map of Myanmar

Glossary and abbreviations

CURRENCY EQUIVALENTS

As of May 15, 2016

1 United States Dollar (US$) = 1,171.8 Myanmar Kyat (K)

MYANMAR FISCAL YEAR

April 1 – March 31

ABBREVIATIONS AND ACRONYMS

ADB	Asian Development Bank
DRD	Department of Rural Development (Myanmar)
ESE	Electricity Supply Enterprise (Myanmar)
ESMAP	Energy Sector Management Assistance Program
EPGE	Electric Power Generation Enterprise (Myanmar)
EVN	Electricity of Vietnam
FY	Fiscal year
GIZ	German Agency for International Cooperation (*Deutsche Gesellschaft fur Internationale Zusammenarbeit*)
GDP	Gross domestic product
HH	Household
HV	High voltage
IDCOL	Infrastructure Development Company Limited (Bangladesh)
IEG	Independent Evaluation Group (World Bank Group)
IFC	International Finance Corporation
IPP	Independent power producer
JICA	Japan International Cooperation Agency
JIP	Joint Implementation Plan (World Bank Group)
kVA	Kilovolt-ampere
kWh	Kilowatt-hour
Lao PDR	Lao People's Democratic Republic
LPG	Liquefied petroleum gas
LV	Low voltage
MESC	Mandalay Electricity Supply Corporation
MFI	Microfinance institution
MOALI	Ministry of Agriculture, Livestock, and Irrigation (Myanmar)
MOEE	Ministry of Energy and Electricity (Myanmar)
MV	Medium voltage
MW	Megawatt
NEEC	National Electrification Executive Committee
PEA	Provincial Electricity Authority (Thailand)
PM	Program Manager
PV	Photovoltaic
PPA	Power Purchase Agreement
PPP	Public-private Partnership
SHS	Solar home system
TA	Technical assistance
YESC	Yangon Electricity Supply Corporation