

**MYA: OFF-GRID RENEWABLE ENERGY DEMONSTRATION PROJECT**  
(previously called Off-grid Renewable Energy Program)

**Technical Assistance Concept Paper**

**Date: November 2013**

1. Country partnership strategy (CPS) / Regional cooperation strategy (RCS): Myanmar Interim CPS 2012–2014			
<ul style="list-style-type: none"> <li>Year included in CPS/RCS/COBP/ROBP/CPS or RCS Midterm Review Report: COBP 2014-2016</li> <li>Document reference number and date approved: November 2013</li> <li>In case of change in the TA title, type, or amount, please state reason: N/A</li> </ul>			
2. TA Type		3. Modality:	
<input checked="" type="checkbox"/> CDTA	<input type="checkbox"/> R- CDTA	<input type="checkbox"/> Cluster	<input checked="" type="checkbox"/> sovereign <input type="checkbox"/> non-sovereign
<input type="checkbox"/> PATA	<input type="checkbox"/> R- PATA		
<input type="checkbox"/> RDTA	<input type="checkbox"/> R- RDTA		
4. Categorization of TA: <input type="checkbox"/> Category A TA <input checked="" type="checkbox"/> Category B TA			
5. Coverage:			
<input checked="" type="checkbox"/> Country <input type="checkbox"/> Subregional <input type="checkbox"/> Interregional			
6. Assistance Focus:			
a. Sector(s): {Check applicable sector(s). Underline main sector.}			
<input type="checkbox"/> Agriculture and natural resources	<input type="checkbox"/> Industry and trade		
<input type="checkbox"/> Education	<input type="checkbox"/> Public sector management		
<input checked="" type="checkbox"/> Energy	<input type="checkbox"/> Transport and ICT		
<input type="checkbox"/> Finance	<input type="checkbox"/> Water supply and other municipal infrastructure and services		
<input type="checkbox"/> Health and social protection	<input type="checkbox"/> Multisector		
Subsector(s): Renewable energy			
b. Targeting classification			
<input checked="" type="checkbox"/> Targeted intervention	<input checked="" type="checkbox"/> TI-H	<input type="checkbox"/> TI-M	<input type="checkbox"/> TI-G
<input type="checkbox"/> General intervention (more indirectly addressing poverty reduction)			
c. Theme(s):			
<input checked="" type="checkbox"/> Economic growth	<input type="checkbox"/> Gender equity		
<input type="checkbox"/> Social development	<input type="checkbox"/> Private sector development		
<input checked="" type="checkbox"/> Environmental sustainability	<input type="checkbox"/> Governance		
<input type="checkbox"/> Regional cooperation and integration	<input checked="" type="checkbox"/> Capacity development		
Subthemes: Promoting macroeconomic stability; institutional development			
d. Location impact:			
Relative weight of spatial impact of the project	High	Medium	Low
Rural	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Urban	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
National	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Regional	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
7. Partnership: Ministry of Electric Power, Government of Myanmar			
8. Name of the Specialist (project team leader) in charge of the project: Pradeep Tharakan		Name of the Alternate Specialist: Jong-Inn Kim	
<ul style="list-style-type: none"> <li>Local Number: 5511</li> <li>Email Address: <a href="mailto:ptharakan@adb.org">ptharakan@adb.org</a></li> </ul>		<ul style="list-style-type: none"> <li>Local Number: 6389</li> <li>Email Address: <a href="mailto:jkim@adb.org">jkim@adb.org</a></li> </ul>	

## 9. Department/Division: SERD/SEEN

## 10. Key Development Issues to be addressed:

Myanmar is one of the poorest countries in the world with a gross domestic product (GDP) per capita of \$857, a Human Development Index (HDI) rank of 149 out of 187 countries, and 26% of its population living in poverty in 2010.<sup>1</sup> The Asian Development Bank (ADB), like most other international development institutions, has not extended a loan or technical assistance to Myanmar since 1988. In response to the ongoing major reforms by the Government of Myanmar towards a democratic system and market-based economy, in early 2012, ADB adopted a phased approach to reengagement with Myanmar.<sup>2</sup>

### Energy Poverty in Myanmar

According to the International Energy Agency (IEA),<sup>3</sup> Myanmar is an extreme example of energy poverty. Myanmar's average electrification rate was about 26% in 2011. Yangon City has the highest electrification rate (63%), followed by Nay Pyi Taw (52%), Kayar (37%), and Mandalay (29%). Rural areas are poorly electrified, with an average rural electrification rate of 16%. Even though electricity consumption in Myanmar has doubled in the last 10 years, in 2011, national average per capita consumption of electricity, at about 105 kilowatt-hour (kWh) per annum, is the lowest among the 10 Association of Southeast Asian Nations (ASEAN) countries and among the lowest in Asia. This low national average per capita consumption of electricity is due to low electrification rates, low industrial development and lack of investment. Lack of electricity impedes economic development and achievement of the United Nations Millennium Development Goals (MDGs).<sup>4</sup>

As per data from IEA<sup>5</sup>, Myanmar's primary energy supply sources are coal, oil, natural gas, hydropower, and biomass. Myanmar's primary energy supply source was biomass, followed by natural gas and oil. Coal and hydropower accounted for only small shares (0.9% and 2.4%, respectively) of total energy supply, although they are the main sources of power generation. These shares are changing, with hydropower production growing at a rate of 9.2% per annum. Investment in coal-powered plants, gas fields, and oil and gas pipelines is also increasing rapidly. Total installed power generation capacity in Myanmar in 2011 was 3,361 megawatts (MW), consisting of 2,520 MW (75%) of hydropower capacity, 715 MW (21%) of gas-fired capacity, and 120 MW (4%) of coal-fired capacity. Although the installed capacity exceeds the 2011 peak load of 1,533 MW, the available capacity is low. Particularly, during the dry season, hydropower plants cannot generate at full capacity due to low water flows. Hence, Myanmar's power grid is unreliable during the dry season.<sup>6</sup>

Approximately two-thirds of primary energy in Myanmar is supplied by biomass (firewood, charcoal, agriculture residue, and animal waste). Firewood, used in both urban and rural areas, accounts for more than 90% of biomass-sourced energy, most of which is harvested from natural forests. Charcoal, which accounts for 4%–6% of total firewood consumption, is mainly used in urban areas. Due to high dependence on burning solid biomass fuels for energy in poorly ventilated dwellings causing indoor air pollution, Myanmar experiences high incidence of acute respiratory diseases and high mortality/morbidity rates. Nearly 91% of households collect firewood, 85% of households cook on open fires and only 12% of households own fuel efficient stoves. Hence, despite being home to Asia's most extensive tropical forest ecosystems, Myanmar's forests are considered to be under major threat from a combination of commercial logging and gathering of firewood.<sup>7</sup>

### Renewable Energy Potential

Myanmar has abundant renewable energy resources, notably solar, hydropower and biomass, but also potential for wind, and other sources of renewable energy. Among these resources, hydropower has been developed and utilized on a commercial scale. Other renewable energy resources remain under research and in development or pilot stages. The Ministry of Energy's (MOE) policy guidelines include promoting wider use of renewable sources of

<sup>1</sup> Ministry of National Planning and Economic Development, Swedish International Development Cooperation Agency, United Nations Children's Fund, United Nations Development Programme. 2011. *Integrated Household Living Conditions Survey in Myanmar (2009–2010)*; and ADB. 2012. *Asian Development Outlook 2001: Update*. Manila.

<sup>2</sup> ADB. 2012. *Interim Country Partnership Strategy: Myanmar, 2012–2014*. Manila.

<sup>3</sup> IEA. 2012. *World Energy Outlook 2012*. Paris.

<sup>4</sup> ADB. 2012. *Myanmar: Energy Sector Initial Assessment*. Manila.

<sup>5</sup> IEA. 2011. *Energy Balances of Non-OECD Countries –2011 Edition*. Paris.

<sup>6</sup> Footnote 4.

<sup>7</sup> Mercy Corps. 2012. *Household Energy Market Assessment Summary: An Assessment of Household Energy Use and Supply in Mandalay and Chin State, Myanmar*.

energy. Nevertheless, only 2,520 MW of hydropower has been installed in Myanmar as of 2011, as compared to a total potential of over 100,000 MW. The Myanmar Electric Power Enterprise (MEPE), a government enterprise operating under the MOE, has so far identified more than 200 locations suitable for hydropower development, with a combined potential capacity of about 40,000 MW. Thirty-six projects have been formed to tap this potential and 14 are under construction.

Due to the initial high cost of wind energy, its development is in experimental and research phase. The evaluation of wind energy resources using modern systems has been conducted since 1998, led by the Myanmar Scientific and Technological Research Department and the Department of Meteorology and Hydrology.<sup>8</sup>

Similarly, large potential exists for solar energy, particularly in the central dry zone area of Myanmar. A 2009 study<sup>9</sup> found that the country experiences an average solar radiation of 18 MJ/m<sup>2</sup> - 22 MJ/m<sup>2</sup> per day. Solar radiation of more than 20 MJ/m<sup>2</sup> per day was found in the summer months from January to May. Regions with high solar radiation (21 MJ/m<sup>2</sup> - 22 MJ/m<sup>2</sup> per day) are in the plain areas of Mandalay division, Sagaing division and Magway division. Long-term mean daily solar radiation, when averaged over the country, was found to be 18.3 MJ/m<sup>2</sup> per day, which is the same as Thailand and higher than most other countries in South East Asia. Nevertheless, a detailed solar energy resource assessment is required to evaluate overall solar power potential and attract private investments. Large potential exists for geothermal and tidal energy as well.

### **Government Programs to Increase Energy Access**

The Government of Myanmar recognizes the strong linkages between increased energy access and poverty alleviation through inclusive economic growth.

**Power Transmission and Distribution Network.** Myanmar has a unified, interconnected transmission and distribution network covering some parts of the country, as well as some off-grid distribution systems. MEPE is responsible for the transmission network. Two distribution companies under the Ministry of Electric Power (MOEP) provide electricity to all grid-connected consumers: the Yangon City Electric Supply Board (YESB) and Electricity Supply Enterprise (ESE). ESE serves 1.42 million consumers in fourteen states and divisions across the country, though its network is available mainly in urban areas. From 2012 to 2016, MOEP's focus is on expanding the national grid to all townships in the country by 2013 and achieving 43% national electrification rate by 2015-16.<sup>10</sup> ESE plans to carry out system improvements to reduce losses and enhance the quality of the supply.

**Off-grid Energy Access Projects.** The Ministry of Industry (MOI) under the Government of Myanmar has the overall responsibility of providing electricity to off-grid areas in the country. In addition to off-grid micro-hydro, solar, biogas and biomass installations, about 39 off-grid villages have also been electrified using diesel generators. The Department of Rural Development within the Ministry of Border Areas (MOBA) has also been carrying rural infrastructure provisions in the country, including the deployment of small-scale rural energy systems including pico- and micro hydrosites, solar PV mini-grids, and solar lanterns and solar home systems. Recently, the government has entrusted the Ministry of Livestock, Fisheries and Rural Development with the responsibility of providing rural infrastructure, including energy services. The Department of Rural Development has been moved from MOBA to this Ministry.

**Micro and Mini Hydropower.** As of 2013, nearly 38 off-grid micro hydro power plants have been installed by the Ministry of Agriculture and Irrigation (MOAI) and owned and operated by Ministry of Electric Power (MOEP). Many of these projects have been implemented in border areas, aimed at improving social and economic conditions of poor rural households and remote communities in these areas. These mini-hydropower projects also facilitate cottage industries and enhance agricultural productivity through improved irrigation. Ministry of Science and Technology (MOST) is responsible for conducting research on renewable energy technologies and it has designed and constructed low-head propeller hydropower turbines of capacities 3 kW and 7 kW for rural electrification. MOI owns and operates a factory (Heavy Industry No 26) in Thagaya industrial complex in Bago division which manufactures hydro turbines of capacities 3 kW to 2 MW.

<sup>8</sup> Myanmar has a 2,832 kilometer (km) coastal strip facing the Bay of Bengal and the Andaman Sea, which receives south-westerly wind for 9 months and north-easterly wind for 3 months, with average wind speeds ranging from 5.6 to 7.4 meters per second. However, available data on wind energy resource is not sufficient to evaluate suitable sites for large-scale wind power generation.

<sup>9</sup> Department of Alternative Energy Development and Efficiency, Thailand; Ministry of Energy and Ministry of Transport, Myanmar; Silpakorn University, Thailand. 2009. *Assessment of Solar Energy Potential for the Union of Myanmar*. Bangkok.

<sup>10</sup> Ministry of Electric Power (MOEP)

**Bio-Energy.** The Ministry of Environmental Conservation and Forestry's (MOECAF) National Forestry Master Plan aims to reduce consumption of solid biomass fuels from nearly two-thirds of current primary energy supply to less than half by 2030. The MOECAF has encouraged firewood and forest conservation by promoting the use of efficient cooking and heating stoves and the use of alternative energy sources, such as agricultural waste and coal briquettes. The MOF initiated distribution of efficient stoves in the 1990s, which was a project implemented in cooperation with the United Nations Development Programme (UNDP) and the Food and Agriculture Organization (FAO). Since 2004, MOF has been implementing the Bago Yoma Greening Project, which includes dissemination of efficient stoves and utilization of wood fuel substitutes, such as coal briquettes and agricultural waste. By March 2011, around 232,000 fuel efficient stoves had been distributed free of charge or at an affordable price.<sup>11</sup>

Community-based and family-sized fixed-dome type biogas digester plants have been built in nearly 200 villages by the Ministry of Science and Technology (MOST) with support from MOI mainly in the central region (Mandalay, Saigaing, and Magwe divisions) for cooking, lighting and other electricity purposes.<sup>12</sup> These digesters typically provide 4-6 hours of electricity per day and vary in capacity from 25 m<sup>3</sup> to 100 m<sup>3</sup> and electricity output ranges from 5 kW to 25 kW. According to some estimates, over 1000 rice mills across the country are being powered by small-scale biomass gasifiers using rice husk and woodchips as feedstock.

**Solar Power.** A few pilot solar power installations are also operational in Myanmar. Solar energy is being provided by MOI in a few off-grid villages to generate electricity for street lighting, home lighting and for community infrastructure such as schools, healthcare centres and monasteries. As of 2013, MOI has installed solar home systems in 152 villages, solar mini-grid in one village and it has distributed solar lanterns in 543 villages across the country. MOI owns and operates a factory (Heavy Industry No 24) in Hlaing township near Yangon which mainly assembles thin film solar panels of 92 watt-peak capacity.

#### **Barriers to Renewable Energy Deployment**

While Myanmar has abundant renewable energy resources, harnessing them for increasing energy access is hampered by several factors: (i) lack of a fully transparent institutional and legal framework to support exploration, development, and deployment; (ii) limited financial resources to support research and development, market-based investment programs, and development of physical infrastructure; (iii) lack of human resource capability; and (iv) subsidized power and petroleum prices, which make it difficult for wind and solar energy alternatives to be competitive. Establishment of a supportive environment for development of Myanmar's renewable energy resources should include the following: (i) more information on renewable energy resource potential; (ii) improved inter-ministerial cooperation and coordination; (iii) promotion of private sector participation; (iv) clarification of government policy on renewable energy; and (v) technology dissemination of family-size biogas digesters, mini-hydropower plants, and other options for increasing rural energy access.<sup>13</sup>

#### **Energy Access and Renewable Energy Initiatives by Development Agencies**

Apart from the involvement of UNDP and FAO in an efficient cookstove distribution project in 1990s and intermittent support for energy sector studies and planning from bilateral development agencies such as JICA in early-2000s, Myanmar hasn't received much support from international development institutions for rural electrification and renewable energy development. However, since 2011, most international development institutions have begun activities such as market scoping studies which might be scaled up in the next few years.

Mercy Corps, which is the lead agency for the Livelihoods and Food Security Trust (LIFT) fund program in Ayeyarwaddy Delta of Myanmar, has conducted a survey of household energy demand and supply in Mandalay, Chin and Rakhine states in August 2012. European Energy Initiative–Partnership Dialogue Facility (EUEI- PDF), in partnership with UNDP, has conducted an energy market scoping exercise in 2012. World Bank and World Economic Forum have also conducted high-level studies on energy sector strategy and architecture for Myanmar.

#### **Opportunity for ADB Capacity Development Technical Assistance**

In addition to the Government's political and economic reforms since 2011, its economic development and poverty reduction plan, together with its intent to provide institutional, regulatory and policy support to increasing rural electrification and renewable energy deployment have improved the prospects of initiating ADB technical assistance

<sup>11</sup> Footnote 4.

<sup>12</sup> Data provided by MOI and MoST. In June 2013, an ADB mission visited 4 villages with biogas digester plants and solar PV installations in Mandalay division together with MOI and MoST staff

<sup>13</sup> Footnote 4.

activities. The Government's 5-year National Development Plan (NDP) 2012-2016 focuses on (i) agricultural development and industrialization, (ii) balanced growth among regions and states, and (iii) inclusive growth. The government aims to achieve inclusive growth by mobilizing human capital, financial resources, and technology; increasing investments; strengthening the role of the private sector in the economy; implementing measures to achieve MDG targets; and mobilizing official development assistance along with domestic and foreign investments.<sup>14</sup>

On the basis of ADB's initial assessment,<sup>15</sup> there is a near-term need for (i) a detailed energy sector assessment, including demand projections and supply options, and investment requirements for meeting the growing energy demand; (ii) advisory TA for institutional strengthening and coordination in the energy sector and capacity building; and (iii) capacity building in environmental and social safeguards.

Medium-term needs include (i) assessment and promotion of renewable energy and energy efficiency; and (ii) rural electrification (expansion of transmission and distribution line projects and off-grid renewable energy options).

#### **Institutional Arrangements in Myanmar for Off-grid Renewable Energy Activities:**

During 2010-2013, the Ministry of Industry was given the responsibility of promoting off-grid energy access. The Directorate of Industrial Planning, Ministry of Industry (MOI), presented a project proposal<sup>16</sup> for rural energy development at the Myanmar Development Cooperation Forum (MDCF) held in Nay Pyi Taw (19–20 January 2013). This proposal builds on the ministry's ongoing efforts (2011–2013) to provide energy access in 591 remote villages in the country using diesel generation sets, biomass gasifiers, micro hydro, and solar lanterns. In response to MOI's request, ADB initiated pilot (**Phase 1**) off-grid renewable energy activities using grant funds from RETA 7512: Empowering the Poor through Increasing Access to Energy. This phase will focus on piloting a limited number of off-grid clean energy installations in 20 villages in Chin State in the eastern part of the country and Mandalay region in the central part of the country, and developing a geo-spatial least cost energy access plan for Mandalay region. These activities are ongoing with MOI as the executing agency (EA) and are expected to be completed by May 2014.

In September 2013, the President of Myanmar's office took the decision to move the Department of Rural Development from the Ministry of Border Areas to the Ministry of Livestock, Fisheries and Rural Development (MLFRD) and make this reconfigured Ministry the lead on rural infrastructure provision, including energy access. MLFRD also will now chair the national rural development committee which reports to the Vice President, and counts among its members, MOI, MOST, MOAI, MOEP and the Ministry of Development Planning. In addition to being the executing agency for both the World Bank's and ADB's community-driven development (CDD) projects, which involves support for rural energy provision, MLFRD is embarking on an ambitious energy access program and has submitted a supplementary budget request for 2014 to the parliament. ADB proposes to make MLFRD the executing agency (EA) for the proposed CDTA that is being submitted to JFPR for financial support. This work would constitute **Phase 2** of ADB's engagement.

#### 11. TA Description:

It is proposed that ADB support the Off-grid Renewable Energy Demonstration Project in Myanmar with MLFRD as the executing agency (EA). The proposed ADB capacity development technical assistance program (CDTA) to be financed by JFPR will build on the ongoing pilot activities financed by RSDD's Energy for All (Phase 1), and will have as its main objectives: (i) to support the installation of clean energy-based systems for providing energy access (mostly solar PV and biomass-based systems) to schools and other public infrastructure in at least 25 villages, (ii) develop geospatial least cost energy access plans and an investment plan for select states and regions in the country, and (iii) to strengthen the capacity of the government institutions and the private sector to manufacture, install, operate and maintain small-scale clean energy systems. The TA's implementation period would be February 2014 to February 2016.

This grant is meant to complement the on-grid focus of the proposed ADB loan: Power Distribution Improvement Project<sup>17</sup> by supporting off-grid energy access in the same geographical areas. Therefore, this grant will finance pilot

<sup>14</sup> Footnote 2.

<sup>15</sup> Footnote 4.

<sup>16</sup> Directorate of Industrial Planning, Ministry of Industry. 2013. *Project Proposal for Rural Energy Development Plan in Myanmar*. Nay Pyi Taw.

<sup>17</sup> The investment project is being considered for financing by the ADB Board in December 2013.

installations in the central dry zone (Mandalay region, Sagaing region and Magway region) and Chin, Kayah and Rakhine states. Further, MLFRD is the EA for the ADB's Enhancing Rural Livelihoods and Incomes in Myanmar project that is also financed by JFPR. This project aims to support the creation of rural infrastructure, including energy access projects. The TA can also provide the analytical support and help screen and prepare projects, which can then be financed through the larger JFPR investment grant.

a. Link to Country Partnership Strategy/Regional Cooperation Strategy:

This TA addresses key medium-term goals of ADB elaborated in the interim CPS 2012–2014 for Myanmar, namely (i) to assist the government in promoting sustainable and inclusive economic development and job creation in support of poverty reduction, (ii) enhancing connectivity—domestic and regional, rural and urban—through both hard and soft infrastructure, and (iii) help accelerate economic growth, create income opportunities, and bridge rural–urban gaps.

The TA also addresses ADB's three priority areas in the interim strategy period: (i) building human and institutional capacity in ADB's areas of focus and to help lay the foundation for medium-term engagement and effective development processes; (ii) creating access and connectivity for rural livelihoods and infrastructure development by promoting basic social services, improving rural infrastructure to boost farm productivity and incomes, lowering transaction costs, enhancing opportunities for domestic and cross-border trade and investment, and (iii) improving access to reliable and sustainable utility services.

b. Impact

The impact of this TA will be increased access to energy in rural Myanmar from renewable energy sources. In terms of performance indicators, this is expected to lead to about 20 MW of new small-scale renewable energy capacity installed and 120,000 households and 100 public facilities such as schools to obtain access to modern forms of energy by 2020. The TA's impact is consistent with ADB's Strategy 2020<sup>18</sup> which promotes inclusive and environmentally sustainable economic growth. The TA is also consistent with the UN's international year of sustainable energy for all which emphasized the importance of energy access for sustainable development.

c. Outcome

The outcome of this TA will be improved capacity within MLFRD, other relevant Government ministries and agencies such as MOE, MOEP, ESE and MEPE, and the governments of select states and regions, and the private sector in the country to design and manage rural energy access programs using renewable energy resources. In terms of performance indicators, this is expected to lead to at least 25 small-scale renewable energy based mini-grids (totaling 0.25 MW capacity) generation facilities to be developed and installed by 2016.

d. Outputs

The outputs of this TA are:

- (i) **Renewable energy systems designed and installed in 25 villages to power community infrastructure and households.** Provide project development support and financing for installation of renewable energy systems (mostly solar PV and biomass-based systems) in at least 25 villages in the central dry zone and Chin, Kayah and Rakhine states, to power schools and other public infrastructure, as well as households.<sup>19</sup>
- (ii) **Geospatial least cost energy access plan and investment plan for select regions and states of the country developed.** Develop GIS-based geospatial maps and detailed renewable-based energy access plans. The maps, plans, data and learning will be used to create a comprehensive investment plan to scale-up energy access in Myanmar. This proposed investment project may be financed by the government, ADB or other donors.
- (iii) **Capacity of government entities and the private sector strengthened.** Create a policy and regulatory structure for off-grid energy access in the country. This will also include assessing the potential for and

<sup>18</sup> ADB. 2008. Strategy 2020: The Long Term Strategic Framework of the Asian Development Bank, 2008-2020. Manila.

<sup>19</sup> Several business models such as payback of upfront capital expenditure by the communities or tariff payments by communities based on operational expenses are already operational in Myanmar and these installations will follow business and implementation models that are found to be viable and sustainable during phase 1 of this program

providing assistance for the creation of a separate government agency or entity that would focus on off-grid energy access.<sup>20</sup> The feasibility of alternate financing approaches such as revolving funds and output-based aid will also be evaluated.

## 12. Assumptions and Risks:

The main assumptions that underlie the TA concept are: (i) the national government and MLFRD continue to emphasize promotion of energy access in remote areas to be a key priority, (ii) in the case of the chosen off-grid areas, ESE does not plan to carry out grid extension in the near term, (iii) strong ownership by MLFRD, and local governments, and (iv) strong support from relevant stakeholders, including banks, renewable energy (RE) vendors, and NGOs.

The main risks to the TA include (i) inadequate implementation capacities at the local level, and (ii) benefits accruing to non-poor segments of society.

## 13. Implementation Arrangements:

### a. Proposed executing/implementing agency (EA/IA):

The Ministry of Livestock, Fisheries and Rural Development will be the EA. The choice of EA was confirmed through consultations with MLFRD, NEMC, MOI and MOEP, during an ADB fact-finding mission on 23-30 September 2013. A steering committee comprising senior officials from the National Rural Development Committee, the National Energy Management Committee (NEMC), the MOE, MOEP, MOBA, MOAI and MOST will be constituted to oversee TA implementation and provide inputs. The committee will also comprise one senior representative from a non-governmental or civil society organization. Within ADB, this project would be managed by the Southeast Asia Energy Division (SEEN) with support from RSDD's Energy For All RETA, and the ADB's Extended Mission to Myanmar.

The Department of Rural Development within MLFRD will be the implementing agency. The TA will also work closely with the regional governments of the selected areas for development and implementation of the pilots, and the Electricity Supply Enterprise (ESE), the power utility, for development of the geo-spatial plans.

### b. Institutional/organizational/procurement/financial management assessments on the EA/IA previously conducted:

Yes  No

### c. ADB inputs:

1. A total of approximately 101 person-months of consulting services (36 person-months of international consultants and 65 person-months of national consultants) will be engaged through a firm. The international consulting firm, together with the national consultants will be hired through quality-and cost-based selection (quality-cost ratio of 90:10) on the basis of a full technical proposal. The 90:10 ratio is proposed taking into account the specific technical skills and knowledge of the country that is required. The international consultants will include: (i) Energy access planning and RE technical specialist/team leader, (ii) off-grid solar PV solution specialist, (iii) biogas/biomass energy specialist, (iv) micro-hydro specialist, (v) RE finance specialist, (vi) capacity development and institutional strengthening specialist, (vii) geospatial planning specialist, (viii) GIS specialist and (ix) procurement specialist. National consultants will have expertise that complements the international experts and support them in their work. The draft outline of the terms of reference for consultants is attached as Appendix 2. The consultants will be responsible for administration of training, seminars and conferences and surveys and this is duly reflected in their TOR.

All disbursements under the TA will be done in accordance with the ADB's Technical Assistance Disbursement Handbook (May 2010, as amended from time to time). All equipment purchased under the TA will be turned over to the EA upon completion of the TA.

<sup>20</sup> Renewable energy policies and activities are currently distributed among 7 ministries – MOE, MOI, MOEP, MOST, MOBA, MOAI and Ministry of Environmental Conservation and Forestry (MOECAF).

d. Complementary inputs to be provided by Government and/or other TA providing agencies:

The MLFRD will set up a project management unit (PMU) and provide an office for the TA consultants in Nay Pyi Taw (NPT) along with the requisite utilities, and support the costs of their staff time and travel to project sites in the region. Since the JFPR grant does not allow support for civil works, thus wherever required, they will be financed by MLFRD. The local governments will help identify the villages which will be selected, will provide access to relevant data and information to the TA consultants, as well as provide office space and travel and logistics support as required. MOEP, MOST, MOAI, MOBA and other government ministries and agencies will provide access to baseline information and resource surveys<sup>21</sup> that have been conducted.

14. Nature/extent of government/beneficiary involvement in identifying or conceptualizing the assistance:

In formulating the proposed CDTA, ADB held initial discussions with a few stakeholders in April 2013 and following successful completion of a departmental review meeting, and launch of Phase 1 of ADB's support, SEEN conducted a TA fact finding mission in September – November 2013 to refine the scope, design and obtain formal government support through a memorandum of understanding. The mission held meetings with MLFRD, MOI, other government ministries and other international development agencies such as JICA, DFID, European Energy Initiative – Partnership Dialogue Facility (EUEI – PDF) and the World Bank.

15. Cost Estimates and Proposed Financing Arrangements:

The total cost of the TA<sup>22</sup> is estimated at \$2,000,000 equivalent (Table 1). It is proposed that ADB provides \$2,000,000 equivalent on a grant basis from the Japan Fund for Poverty Reduction<sup>23</sup>. A ITD and TPP has been submitted to and discussed with the Government of Japan. The Government of Myanmar will finance civil works, and counterpart support in the form of staff time, office space and travel costs for its staff, estimated at \$200,000.

**Table 1: TA Cost Estimates and Financing Plan (\$'000)**

Item	Total Cost
<b>A. Asian Development Bank Financing (Source: JFPR<sup>a</sup>)</b>	
1. Consultants	1200.6
a. Remuneration and Per Diem	1085.6
i. International Consultants (36 person months)	798.1
ii. National Consultants (65 person months)	287.5
b. International and Local Travel	100.0
c. Reports and Communications	15.0
2. Equipment <sup>b</sup>	4.0
3. Training, Seminars, and Conferences	40.0
4. Surveys <sup>c</sup>	18.0
5. Pilot installations <sup>d</sup>	500.0
6. Vehicle rentals	30.0
7. Representative for contract negotiations	5.0
8. Contingencies	202.0
<b>Subtotal (A)<sup>24</sup></b>	<b>2000.0</b>

<sup>21</sup> Renewable resource surveys will build on resource data, such as solar radiation, water flow, bio waste generated etc. currently available with government agencies and international institutions.

<sup>22</sup> The TA will install an aggregate of 0.25 MW of clean energy equipment in off-grid areas of Myanmar and is expected to catalyze investments for nearly 10 MW of off-grid clean energy deployment by 2020 in the country, thereby furthering ADB's clean energy deployment targets.

<sup>23</sup> Established by the Government of Japan and administered by ADB.

<sup>24</sup> Total may not add up due to rounding off



**B. Government Financing**

1. Office Accommodation and Transport	50.0
2. Remuneration and Per Diem of Counterpart Staff	50.0
3. Civil works for the pilots	100.0
	<b>Subtotal (B)</b> 200.0
	<b>Total</b> 2200.0

<sup>a</sup> Established by the Government of Japan. Administered by the Asian Development Bank.

<sup>b</sup> Will include desktops, laptops, printers and camera. All equipment will be handed over to the executing agency following completion of the TA.

<sup>c</sup> May include cost of imagery, maps, photos, and handheld equipment for digitization of information such as scanners.

<sup>d</sup> May include solar photovoltaic-based systems, biomass digesters and other small-scale renewable energy systems. This line item only covers hardware, transport and installation charges. All detailed engineering design and civil works will be supported by the executing agency.

Source: ADB staff estimates.

**16. Monitoring and Evaluation:**

The TA will be monitored through monthly reports, consensus building activities with workshops, and soliciting feedback from key stakeholders. An inception workshop will be held within one month of consultants being mobilized. A series of focused workshops may also be held to discuss progress with relevant institutions and agencies including MLFRD, MOEP, MEPE, ESE, and regional governments. The TA outcomes will also be discussed with other development partners involved in rural energy access programs such as World Bank, UNDP and NGOs. The TA outputs, including knowledge products and services, will be disseminated to identified users by a variety of means, including in-country workshops, electronic reports, and other means to be specified in a knowledge dissemination and communication plan developed and presented as part of the inception report by the consultants.

**17. Estimated period of TA implementation:**

a. Finalize TA Concept Paper and confirmation of financing	May-December 2013
b. Approval of TA	January 2014
c. Recruitment of TA consultants	December 2013- January 2014
d. Commencement of TA implementation	February 2014
e. Physical completion of TA	February 2016
f. Closing of the TA	April 2016

## PRELIMINARY DESIGN AND MONITORING FRAMEWORK

Design Summary	Performance Targets/Indicators	Data Sources/ Reporting Mechanisms	Assumptions and Risks
<p><b>Impact</b> Increased access to energy in rural Myanmar from renewable energy sources.</p>	<p>About 20 MW of new small-scale renewable energy capacity installed and an additional 120,000 households<sup>a</sup> and 100 public facilities such as schools obtain access to modern forms of energy<sup>b</sup> by 2020.</p>	<p>Government statistics. Surveys by NGOs, and UN agencies.</p> <p>Annual budget activity reports for regional governments and MLFRD, MOI, MOEP and NEMC</p>	<p><b>Assumption</b></p> <ul style="list-style-type: none"> <li>MLFRD retains its mandate to develop community-oriented energy access programs and is strengthened with time</li> </ul> <p><b>Risk</b></p> <ul style="list-style-type: none"> <li>Government decides to replace community-driven programs with grid-extension by ESE.</li> </ul>
<p><b>Outcome</b> Improved capacity within MLFRD and the governments of select regions and states to design and manage rural energy access programs using renewable energy resources.</p>	<p>At least 25 small-scale renewable energy based mini-grids (totaling 0.25 MW capacity) generation facilities to be developed and installed by 2016.<sup>25</sup></p>	<p>Government statistics</p> <p>MLFRD, MOI, MOEP and NEMC reports</p> <p>TA reports</p> <p>ADB mission reports</p>	<p><b>Assumptions</b></p> <ul style="list-style-type: none"> <li>MOI maintains rural electrification as a priority agenda</li> <li>Government and international development agency financing earmarked for community driven development programs</li> <li>Private sector investors and local and regional banks interested in lending for rural energy access projects</li> </ul> <p><b>Risks</b></p> <ul style="list-style-type: none"> <li>Benefits accruing to non-poor segments of society.</li> </ul>
<p><b>Outputs</b> 1. Renewable energy systems designed and installed in 25 villages to power community infrastructure and households</p>	<p>Final project designs and implementation plans for 25 mini-grid or stand-alone investments are endorsed by MLFRD and regional governments by mid-2014.</p> <p>Suitable financing models, procurement plans, community engagement models that involve women, and tariff recovery and revenue management programs are designed by end 2014.</p> <p>Identify and train at least 25 local equipment vendors,</p>	<p>Project monitoring, progress, and final assessment reports</p> <p>CDTA reports</p> <p>Post installation reports and consumer survey documentation</p>	<p><b>Assumptions</b></p> <ul style="list-style-type: none"> <li>Timely access to data and relevant key personnel in the priority areas.</li> <li>MLFRD, ESE and other stakeholders effectively participate in TA implementation</li> <li>Effective collaboration and information sharing amongst the various stakeholders</li> <li>Banks remain interested in financing energy access projects.</li> </ul>

<sup>25</sup> Footnote 19

Design Summary	Performance Targets/Indicators	Data Sources/ Reporting Mechanisms	Assumptions and Risks
<p>2. Geospatial least cost energy access plan and investment plan for select regions and states of the country developed.</p>	<p>installers and service providers for operations and maintenance, (including at least 25% of whom are women or women-owned) by end 2014</p> <p>Installation of the pilots by mid-2015.</p> <p>Baseline socio-economic surveys and energy poverty studies implemented by mid-2014</p> <p>Geospatial maps of resources, communities and least cost energy access plans are developed by end 2014</p> <p>Comprehensive investment plan for off-grid energy access in all fifteen states and regions developed and presented at an international investor forum by mid-2015</p>	<p>CDTA reports</p>	<p><b>Risks</b></p> <ul style="list-style-type: none"> <li>• Change in MOI and ESE priorities resulting in possible lack of interest</li> <li>• Weak and commercially unviable pilot delivery models</li> </ul>
<p>3. Capacity of government entities and the private sector strengthened</p>	<p>In addition to the 25 RE-based rural electrification pilots implemented under this project, at least 25 additional pilots for promoting small-scale community-based off-grid energy access are designed, including financing, hardware specifications, procurement plans, and community engagement by end 2015.</p> <p>At least 50 staff (from MLFRD, MOI, MOEP and NEMC and the state/regional governments) enhance their capacity in areas relating to procurement, financial management, community development, and safeguards. Ensure that at least 50% of the trainees are women. Ex-ante and ex-post surveys will be conducted to evaluate degree of capacity enhancement by end 2015.</p>	<p>CDTA reports</p> <p>Workshop documentation</p> <p>Training and development feedback forms</p>	

Design Summary	Performance Targets/Indicators	Data Sources/ Reporting Mechanisms	Assumptions and Risks
	Evaluation of a policy and regulatory structure for off-grid energy access in the country, and review of alternate approaches such as a dedicated agency, fund, and output-based aid.		
<p><b>Activities with Milestones</b></p> <p><b>1 Renewable energy systems designed and installed in 25 villages to power community infrastructure and households</b></p> <p>1.1 Identify 25 locations to be developed in consultation with MLFRD and regional governments. (February 2014– May 2014),</p> <p>1.2 Determine the optimal combination of RE technologies to deliver reliable and low-cost electricity to the project sites.(April 2014–September 2014)</p> <p>1.3 Establish accountability among the local community, the promoters, contractors and suppliers for the operation and maintenance of the plants. (September 2014– November 2014)</p> <p>1.4 Facilitate bidding and procurement of the projects to RE subcontractors and suppliers that are able to construct the plants up to specification at the lowest cost. (November 2014 – March 2015)</p> <p>1.5 Construction and commissioning of the renewable energy systems. (March 2015- September 2015)</p> <p>1.6 Post use survey and consumer feedback. (September 2015 – December 2015)</p> <p><b>2 Geospatial least cost energy access plan and investment plan for select regions and states of the country developed</b></p> <p>2.1 Review existing surveys and conduct new physical surveys (as appropriate) of all applicable RE resources (e.g. small wind, solar, micro hydro and biomass) including power density, availability, total electricity potential, and costs. (February 2014–May 2014)</p> <p>2.2 Assess energy demand, current source of energy and willingness to pay for improved energy services. (June 2014–September 2014)</p> <p>2.3 Evaluate various financing schemes, role of the private sector and develop proposals for promoting energy access in all fifteen states and regions of the country. (September 2014 – March 2015)</p> <p>2.4 Use the maps, plans, data and learning from the TA to create a comprehensive investment plan for the next phase to scale-up energy access in Myanmar. (July 2015–January 2016).</p> <p>2.5 Conduct an international workshop to present findings and crowd in financing from bilateral and multilateral sources and the private sector.</p> <p><b>3 Capacity of government entities and the private sector strengthened</b></p> <p>3.1 Assess manpower resources and capability of MOI, MOEP, NEMC and regional government agencies to facilitate coordination between agencies and the private sector. (February 2014–March 2014)</p> <p>3.2 Evaluate availability and capacity of local RE technology vendors and after sales service providers, and access to finance and financing schemes. (June 2014– September 2014)</p> <p>3.3 Introduce the renewable technologies and delivery models that are going to be implemented on the project sites through seminars and workshops to the government and private sector. (January 2014–June 2014)</p> <p>3.4 Design and deliver training and capacity development activities focused on</p>			<p><b>Inputs (\$'000)</b></p> <p><b>JFPR: 2,000.00</b></p> <p><b>Government Financing 200.00</b></p>

<b>Design Summary</b>	<b>Performance Targets/Indicators</b>	<b>Data Sources/ Reporting Mechanisms</b>	<b>Assumptions and Risks</b>
hardware specifications, installation, and operations and maintenance of various RE systems, and alternate financing models and community engagement approaches. (July 2014–July 2015)			

JFPR=Japan Fund for Poverty Reduction, ADB=Asian Development Bank, MOI=Ministry of Industry, CDTA=capacity development technical assistance, ESE=Energy Supply Enterprise, NEMC=National Energy Management Committee, MOEP = Ministry of Electric Power, RE=renewable energy, TA=technical assistance.

<sup>a</sup> For the computation, it is assumed that households in remote rural areas would consume on an average 100 kWh per annum. A plant capacity factor of 50% is used for the RE systems.

<sup>b</sup> As of 2013, nearly 74% of people in Myanmar or nearly 45 million people (over 9.5 million households) do not have access to electricity.

Source: Asian Development Bank.

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**Chong Chi Nai**  
Director, SEEN

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**James Nugent**  
Director General, SERD

## OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

### A. Scope of the Project

1. As part of its ongoing energy sector assistance to the government of Myanmar, ADB is currently engaged in pilot activities (**Phase 1**) focused on off-grid renewable energy deployment in Mandalay region and Chin State. A team of consultants are currently in the field, developing a geo-spatial plan for least cost electrification of off-grid areas in Mandalay region, undertaking baseline survey of socio-economic variables and energy use, and identifying villages for pilot installations (up to 20 villages) of mini-grid systems based on solar PV and biomass for supporting community infrastructure such as monasteries, schools, and clinics. Phase 1 activities will be carried out during September 2013 – May 2014. An interim report of Phase 1 activities will be shared with all shortlisted firms.

2. ADB now proposes to design and launch **Phase 2** of the program with a budget of \$2 million in grant resources<sup>26</sup> and has identified the Department of Rural Development within the Ministry of Livestock, Fisheries and Rural Development (MLFRD) as the government counterpart (executing agency) for this Phase. The capacity development technical assistance program (CDTA) aims to: (i) design and implement off-grid energy solutions for social infrastructure facilities in 25 villages, (ii) pilot a spatial planning approach for off-grid energy access in selected regions and states in the country, (iii) development of policies, and a regulatory framework for enabling off-grid energy access, and (iv) scoping of a larger investment project (proposed **Phase 3**) for national off-grid energy access that can be financed by the ADB or the government during 2015-2017. A team of consultants provided by a firm will work closely with the department of rural development, Ministry of Livestock, Fisheries and Rural Development (MLFRD), Government of Myanmar, and the local governments of select states and regions of the country. This technical assistance grant program is financed by the Japan Fund for Poverty Reduction, administered by the ADB and the executing agency and implementing agency is MLFRD. The government will also constitute a steering committee comprising senior officials from the National Rural Development Committee and National Energy Management Committee to oversee TA implementation, provide inputs and ensure quality.

### B. Terms of Reference

3. The technical assistance (TA) will require 101 person-months of consulting services: 36 person-months of international consultants, and 65 person-months of national consultants. The consultants, both international and national, will be hired through a consulting firm through quality and cost-based selection (90:10) on the basis of a full technical proposal. The person-months may be provided intermittently, based on agreement between the consultants and ADB. The overall terms of reference are subject to change during implementation depending upon circumstances. It is strongly recommended that the international firm consider including in a consortium, the following: (i) an international research institute or university that has demonstrated qualifications in geospatial least cost energy access planning, and (ii) a national firm that has strong capabilities in geographical information systems (GIS), surveys and data acquisition. These entities would provide the international and national geospatial planners and GIS specialists, and community development facilitators, respectively.

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<sup>26</sup> A request for financial support for the TA has been submitted by the ADB to the Japan Fund for Poverty Reduction.

4. Overall, the consultants should have extensive experience and knowledge in (i) renewable energy-based rural energy access project design, development and deployment and energy access planning, (ii) institutional, financial, commercial and social (including gender dimensions) aspects of small-scale renewable energy development in rural and remote areas, (iii) suitable knowledge of renewable energy development in Myanmar, and (iv) ADB operations including its policies, guidelines, and operational frameworks. The consultants will be expected to have extensive consultations with government representatives at central, regional and local levels, development partners, civil society, non-governmental organizations, and communities. The consultants are expected to devote significant portion of their time in the field and are expected to set up and manage a project office in Nay Pyi Taw. Space for the office and basic utilities will be provided by MLFRD as part of their contribution to the TA program.

5. The specific terms of reference for the consultants include but are not limited to:

**1. Energy Access Planning and Renewable Energy Technical Specialist and Team Leader** (international, 8 person-months, intermittent)

6. The team leader (TL) will be responsible for: (i) the overall supervision of the consulting team; (ii) timely and successful implementation of the TA, including managing the overall quality of the deliverables and outputs, and (iii) coordination with MLFRD, regional governments, and other counterparts including civil society, and nongovernmental organizations (NGOs). The TL should have demonstrated expertise in energy planning, particularly energy access planning, and a deep knowledge of small-scale renewable energy systems deployment for off-grid rural electrification in various countries in South East Asia, preferably in Myanmar. In the capacity of energy planning specialist, this individual will be responsible for developing detailed energy access plans for all states and regions of the country. This will involve designing and supervising energy demand and supply surveys, review of alternate financing models and development of possible community-led energy access models. The specialist should have demonstrated expertise in off-grid and mini-grid energy planning, in energy demand and supply estimation, least-cost and low-carbon energy deployment, and other relevant aspects of energy planning in developing countries, preferably in Myanmar and/or other developing countries in South East Asia. Advanced academic qualifications in either engineering, environmental science or business administration is preferred.

**2. Off-grid Solar PV Solution Specialist** (international, 4 person months)

7. The off-grid solar PV solution specialist will: (i) review solar irradiance surveys that are available, assess solar availability and identify a priority list of locations for solar hybrid solution based electrification, (ii) review investment plans and engineering cost estimates, and support due diligence on all solar hybrid projects being considered for development under the TA, (iii) where needed, the specialist will work closely with the national solar PV solution specialist to upgrade resource analysis and fill in gaps, (iv) develop project implementation guidelines and recommendations, including scheduling, contract packaging, and procurement based on competitive bidding procedures, and (v) the specialist will also support the team leader on solar power related aspects of energy access planning task of the TA. Advanced academic qualifications in mechanical or electrical engineering with regional experience in the design, erection and commissioning of small scale PV systems is preferred.

**3. Biogas/Biomass Energy Specialist,** (international, 4 person months, intermittent)

8. The biogas/biomass energy specialist will: (i) review resource availability surveys that are available, assess resource availability for biogas digester and biomass gasifier technologies and identify a priority list of locations and technology approaches for biogas or biomass technology based electrification; (ii) develop specifications and standards for equipment and civil works for systems that are being deployed and suggest improvements as appropriate, (iii) review investment plans and project cost estimates, and support due diligence on all biogas and biomass projects being considered under the TA, (iv) where needed, the specialist will work closely with the national biomass/biogas energy specialist to develop project implementation guidelines and recommendations, including scheduling, contract packaging, and procurement, and conduct training programs and ongoing monitoring of construction, and (v) the specialist will also support the team leader on biogas/biomass energy related aspects of energy access planning task of the TA. Advanced academic qualifications in mechanical or agricultural engineering with regional experience in the design, erection and commissioning of small scale biogas/biomass systems is preferred.

**4. Micro-hydro specialist** (international, 3 person months, intermittent )

9. The Micro hydro specialist will: (i) review available hydrological studies conducted by the MOAI or other entities, conduct due diligence on resource availability, and identify a priority list of locations for the pilots; (ii) review investment plans and engineering cost estimates, and support due diligence on all micro hydro projects being considered for development in the TA; (iii) where needed, the micro hydro specialist will work closely with the national micro hydro specialist to upgrade hydrological analysis, and fill in gaps; and (iv) develop project implementation guidelines and recommendations, including scheduling, contract packaging, and procurement based on competitive bidding procedures. The candidate must have a degree in electrical, mechanical or civil engineering and at least 12 years of experience with pico and micro hydro projects.

**5. Renewable Energy Finance Specialist** (international, 4 person months)

10. The RE finance specialist will be responsible for: (i) conducting financial feasibility analysis (including cash flow analysis and IRR, due diligence on the project proponents) for various RE generation and distribution systems identified for implementation at the 25 of the 103 off-grid villages identified by MLFRD, (ii) liaise with various local and national banks, government agencies and private sector independent power producers (IPPs) to evaluate the viability of local financing/co-financing of future RE-based rural electrification in Myanmar in collaboration with these agencies, and (iii) based on these surveys, propose suitable financing initiatives that can be deployed in future to scale-up RE-based rural electrification in Myanmar, (iv) work closely with MLFRD, MOEP and ESE to identify barriers and policy, regulatory and technical support needed for private sector bankable projects for RE-based rural electrification in Myanmar and (vi) the specialist will also support the team leader on RE finance related aspects of energy access planning task of the TA. Advanced academic qualifications in engineering, finance or business administration with regional experience in the financing of renewable energy systems is preferred.



**6. Capacity Development and Institutional Strengthening Specialist** (international, 3 person-months, intermittent)

11. The Capacity Development Specialist (CDS), in collaboration with the technical experts on the team, will develop capacity building and training programs for MLFRD and representatives of regional governments and agencies, covering technical and institutional management in the areas of procurement, financial management, community development, and environmental and social safeguards. These programs will be held periodically in Yangon or Nay Pyi Taw or in the select states and regions for which geospatial maps and energy access plans will be developed under the TA. The CDS will help design and supervise the overall capacity development program, and work closely with the national CDS/institutional strengthening specialist who will be in charge of implementation. Academic qualifications in sociology, anthropology or political science with regional experience in donor-funded and community-focused development programs is preferred.

**7. Geo-spatial energy access planning specialist** (international, 2 person-months, intermittent)

12. The specialist will be responsible for the overall design, development and implementation of a GIS mapping exercise and development of a least cost electrification plan using an existing decision support system such as Network Planner or GEOSIM. This will include designing a layered GIS mapping and analytical framework for conducting spatial least cost electrification planning, including listing of key variables, resolution of maps, and choice of analytical approaches. This person will work closely with an international GIS specialist who will be responsible for the day-to-day activities relating to data collection, digitizing, mapping, analysis and report writing. Academic qualifications engineering, or environmental science, with globally-acknowledged credentials in geo-spatial energy access planning, and prior work in developing countries in Africa and or Asia is strongly preferred.

**8. GIS specialist** (international, 5 person-months, intermittent)

13. The GIS specialist will be responsible for conducting the necessary geo-referenced data collection, preparation, digitization and analysis to arrive at least-cost off-grid energy access deployment plans for select states and regions. The specialist will liaise with the entire consulting team to obtain the necessary household energy demand, supply, renewable energy resource availability and other data and also with government ministries and agencies to obtain data such as location and expansion plans of national grid, location of communities and geographical terrains. Specific tasks include: (i) preparing a structured GIS-layered database to support all the spatial analysis, (ii) geospatial identification and characterization of power (cluster) loads from communities and social infrastructure, and (iii) creating geospatial maps for least cost off-grid energy access planning. The specialist will also be required to organize user training seminars on geospatial planning and least cost rural electrification planning to participants from the relevant government ministries, research institutes, other donors and the private sector in Myanmar. Advanced training in engineering, geography, environmental sciences, mapping technologies, and prior experience of collecting data from developing country government agencies for geospatial mapping will be preferred.

**9. Procurement Specialist** (international, 3 person-months, intermittent)

14. The Procurement Specialist (PS) will work together with the team leader and deputy team leader to develop suitable contract packaging and procurement plans for the proposed

RE-based energy access projects in 25 off-grid villages in line with the requirements of MLFRD and the regional governments, as appropriate. The PS will also assist the CDS in preparing procurement capacity-related training program modules and other requirements as appropriate. Regional experience with small-scale infrastructure projects, small grants programs, and prior experience with procurement practices of the ADB is preferred.

**10. National Consultants** (intermittent)

15. The national consultants (intermittent except when specified, 65 person-months) will include (i) deputy team leader (DTL) and energy access planning and renewable energy technical specialist (10 person-months); (ii) off-grid solar PV solution specialist (4 person-months), (iii) biogas/biomass energy systems specialist (4 person-months), (iv) micro-hydro specialist (3 person-months), (v) RE finance specialist (4 person-months); (vi) capacity development/institutional strengthening specialist (4 person-months); (vii) community development facilitators (CDF), two positions (12 person-months each), (viii) geospatial energy access planning specialist (4 person-months), and (ix) GIS specialist (8 person-months).

16. The national consultants will work closely and support the activities of the international consultant counterparts. The CDF will work with the local communities and project design and implementation teams and other relevant stakeholders to facilitate the community’s mobilization, organization and engagement in project planning and assist in strengthening the community’s overall capacity to ensure sustainability of the RE installations. The CDF will also facilitate project planning through group meetings and organized working groups.

**C. Reporting Requirements**

17. The consultants will work under the supervision and guidance of the TL and DTL. The following reports will be produced at key stages of the implementation of this TA:

- (i) An inception report within one calendar month of contract signing, a mid-term report within 12 months of TA commencement and a draft final report (20<sup>th</sup> month) and a final report (23<sup>rd</sup> month) of TA implementation. These reports will provide information on progress, reports of trainings held and key achievements. The inception report should include a knowledge and communication plan. The plan should include by output, the knowledge products to be, the method of delivery, the target audience (MLFRD, MOEP, NEMC, local governments, line agencies, service providers, beneficiaries etc.) and approximate schedule in line with the activity timeline.
- (ii) In addition, the consultants will produce the following technical reports that relate to various project outputs. In consultation with the ADB project officer, a subset of these reports will be developed into ADB knowledge products.

<b>TA OUTPUTS</b>	<b>KNOWLEDGE PRODUCTS</b>
Geospatial maps, energy access plans and comprehensive investment plan for select regions and states of the country developed	A. Review of the policy and financing environment for expanding energy access in Myanmar, including a review of global best practices and implications for Myanmar  B. A least cost geo-spatial energy access plan for select states and regions.

Provide technical assistance for institutional strengthening and capacity building of the government and private sector.	C. Review and evaluation of the government's ongoing energy access programs and illustrative business models for scaling up energy access through public, public-private and private-sector led initiatives (e.g. output-based aid schemes, concessions, private sector-led schemes etc.)
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18. The consulting team will submit five (5) hard copies of each report and three digital copies on CD-ROM to ADB and the EA.

19. The consultants will administer the training, seminars and surveys that are envisioned under the TA.