

Independent Review of Renewable Energy Mini-grids and Distributed Power Generation with CTF Financing

Introduction

An estimated 53% of people in Asia do not have access to electricity, and over 60% of these people live in just three countries – India (306 million), Indonesia (66 million) and the Philippines (16 million)¹. Access to commercial energy can transform the economic and social wellbeing of these populations. The three countries have broadly supportive policies for electrification of off-grid areas, which promote private sector led initiatives. Private developers are participating in the provision of electrification services to populations without access to electricity in the three pilot countries and have piloted different implementation approaches and business models. However, the private sector continues to face barriers to the scaling up of programs including adequate access to equity and debt financing.

The “Renewable Energy Mini-grids and Distributed Power Generation” project proposed by the Asian Development Bank (ADB) for supplemental financing from the Clean Technology Funds (CTF) can potentially bring a transformational change to people’s lives by providing them with clean, safe, reliable and affordable electricity services through the installation of local mini-grids powered by renewable energy (RE) sources.

The ADB sub-program aims to catalyze growth in access to electricity in the three CTF pilot countries of India, Indonesia and Philippines by addressing financial barriers to private sector led development of RE-based mini-grids. The program proposes to introduce and pilot business models, which will help alleviate the principal barriers to private sector led development of mini-grids in rural areas without access to national electricity grids.

ADB proposes to deploy \$30 million of investment capital over approximately three years to multiple private sector companies, supported by a \$3.5 million technical assistance advisory program. Successful business models could then be adapted to other CIF eligible countries in Asia and the Pacific to replicate and scale up the program.

This document comments on the eligibility of the project for CTF co-financing based on a review of project documents made available to the reviewer.

Project Scope and Objectives

ADB has proposed a \$34.2 million program to be funded by the CTF for the promotion and development of mini-grid and distributed power systems in India, Indonesia and the Philippines. ADB proposes to invest \$30 million in a combination of: (i) direct investments in mini-grid and distributed power companies, and (ii) impact investment funds. ADB has proposed a grant of \$3.5 million for technical assistance (TA), project advisory and a knowledge management facility.

¹ Data from ADB CTF Proposal

The program would draw from a pipeline of mini-grid projects (in the range of 100 kW to 5 MW) and impacts funds the ADB is currently evaluating. The proposed program would provide sustainable electricity supply to between 50,000 and 100,000 households.

The \$3.5 million in TA would be used to conduct due diligence on candidate companies and investment funds; identify investment deals that meet ADB and CTF objectives; evaluate project business plans; develop templates for legal documentation; build the capacity of local financial institutions and other stakeholders; help leverage capital resources from sources other than ADB and CTF; and develop knowledge products to facilitate south-south sharing of successful experiences and business models that would support program replication and scale-up beyond the projects directly supported by the program.

Overall Compliance with CTF Objectives and Criteria

Objectives

CTF is designed to support high abatement opportunities and promote low carbon technologies including power sector projects that result in substantial reductions in carbon intensity of electricity production, increase substantially the share of renewable energy in the total electricity supply, and reduce transmission and distribution losses. The proposed mini-grid project in India, Indonesia and the Philippines is thus consistent with the overall objectives of CTF. The activities to be financed with CTF funds are also broadly consistent with the development strategy for the energy sector in the three countries and their goal to expand energy access to un-electrified areas through increased use of RE.

Overall Compliance with CTF Criteria

Potential for GHG emissions savings

The proposed program is expected to support the implementation of up to 10 MW of new generation capacity, which over a project life of 20 years is estimated to result in avoided GHG emissions of about 630,000 tons of tCO_{2e}. The proposal estimates that replication and scale-up of the program would result in capacity addition of 860 MW from RE sources, which would lower program lifetime GHG emissions by about 54.3 million tCO_{2e}.

Mini-grids powered by RE sources are a widely used commercial technology and have high GHG mitigation potential, but their wider implementation is being impeded by policy, regulatory and financial barriers, and the proposed program will address the financial barrier to the wider deployment of mini-grids. It is reasonable to estimate that if implemented, the program will result in the reduction of GHG emissions as indicated. Co-financing from CTF for the proposed project is thus justified. The assumption that the project will help overcome financing barriers and lead to an additional 860 MW of mini-grid capacity and 54.3 million tCO_{2e} of emissions is however less tenable (see discussion below).

Cost effectiveness

The project document estimates the cost of reducing GHG emissions to be about \$54 per ton of CO_{2e}. The proposal estimates that program replication and scale-up would further reduce the cost of reducing GHG emissions to about \$38 per tCO_{2e}. The

threshold for CTF co-financing is projects where the marginal cost of reducing a ton of CO₂-equivalent is lower than US\$200.

The economic rate of return (ERR) for the program has not been evaluated and is to be estimated for individual sub-projects to be financed with CTF assistance. The Financial Internal Rate of Return (FIRR) has also not been estimated, but is expected to be higher than the estimated Weighted Average Cost of capital (WACC) given the high cost of equity and debt in the pilot countries for projects that target electricity provision to rural and remote areas un-served by the main grid.

The proposal conjectures that the wide spread deployment of mini-grids through the program will reduce system costs by about 3% per year. There is no clear basis to endorse this estimation, but the assumption is not unreasonable given worldwide experience with large-scale implementation of RE projects.

Demonstration potential at scale

The proposal estimates that replication and scale-up of the program would result in capacity addition of 860 MW from RE sources powering mini-grids, which would lower program lifetime GHG emissions by about 54.3 million tCO₂e, and further lower the cost of reducing GHG emissions to about \$38 per tCO₂e.

This assumption for scale-up is based on the program achieving 10% of the International Energy Agency's (IEA) estimate of 70% of the current world population with no access to electricity being supplied with electricity from mini-grids by 2030, which would require capacity additions of some 8,600 MW. The proposal estimates this to be consistent with the goal of India alone which plans to add some 2,000 MW of off-grid solar PV by 2022.

Regardless of whether the IEA estimates for expanded electricity access, and the Indian target for solar PV are achieved, it is not clear how the success of these programs in achieving their targets can be attributed to the proposed program. This program will no doubt alleviate some of the barriers to financing of mini-grids and help unleash some of the vast potential for development of RE mini-grids to expand electricity access. A more reasonable approach to estimating the scaling up potential attributable to this program could perhaps be based on the ADB's experience in leveraging financing, its knowledge of financial markets in Asia and Asia Pacific, its experience in supporting the development of rural energy programs, its knowledge of the policy and regulatory framework in these countries, and its discussions with stakeholders. This admittedly will not be easy, but the assumption that 860 MW of project development could be attributed to this program needs to be better justified (also see Conclusions below)

Development impact

The proposed project seeks to provide electricity to 50,000 to 100,000 people (and 43 million if scaled up as assumed in the proposal) who presently have no access to modern commercial forms of energy. This clearly will have a transformative impact on the lives of the project beneficiaries. This aspect of electricity provision is well demonstrated and documented, and the proposed program would positively impact the social and economic wellbeing of beneficiaries. These positive impacts would only increase with any level of scale-up that can be attributed to this program. As the proposal has indicated, the proposed program will directly help pilot countries achieve four of the eight Millennium Development Goals, and will continue to do so as the program is replicated and scaled-up.

The project if implemented as planned will thus very likely result in significant developmental impacts consistent with CTF eligibility criteria. This will occur regardless of the level of scale-up achieved by the program.

Implementation potential

The program will very likely be implemented as proposed given the vast need to electrify households with no access to electricity in the three pilot countries. The governments in the three countries have broadly supportive policies and regulations (see Conclusions below), which will be supportive of program implementation. The ADB also already has a pipeline of target projects and investment funds, and is in discussions with private sector and financial institutions for supporting mini-grid projects. It is thus highly likely that the program will lead to the implementation of the planned 10 MW of RE-based mini-grid capacity.

CTF financing will be important to alleviate the financing barrier to the project pipeline. The program thus meets CTF eligibility criteria for its implementation potential.

Additional costs and risk premium

The additional costs are principally the transaction costs for due diligence, developing business plans, assistance in financing and other issues relating to developing establishing the mini-grid businesses. The \$3.5 million in TA will support these activities and will likely help develop a wider market for mini-grids. Stakeholders will thus benefit from this TA.

The principal risk is that project developers likely to be active in the development of small scale of rural energy projects may not be able to leverage much debt financing based on their own balance sheets. Spread over the entire portfolio the risks are likely to be mitigated. The proposed program and the support sought is thus consistent with CTF requirements for financing.

Financial Sustainability

The financial sustainability of the program hinges on the ability of largely rural and low-income beneficiaries to pay for the electricity supplied by the sub-projects. But given that the average spending on non-commercial fuels is likely higher than the estimated cost of electricity provision, the program is likely to be financially sustainable. While non-payment risks are high, there are many commercial and well demonstrated smart metering and related technologies that can be incorporated to mitigate risks relating to the financial sustainability of the program.

Technology Readiness

Mini-grids based on RE generation sources are a commercial and well-tested technology and many such systems have been installed in emerging economies and developing countries, including in the three pilot countries. The market is thus primed for scaling up the installation of RE-based mini-grids provided some of the key policy, regulatory and financing barriers can be overcome. The proposed project will likely lower the barriers to increased installation of mini-grids in Asia and Asia-Pacific countries.

Conclusions and Recommendations

As discussed above, the proposed project to implement RE-based mini-grids in the pilot countries of India, Indonesia and Philippines would alleviate some of the financing barriers and help scale up the deployment of such electrification strategies for rural and remote areas, which are not served by the national electricity grid. The proposed project thus meets the eligibility criteria for CTF co-financing.

Some comments on the proposal are summarized below, which if addressed would strengthen the case for CTF co-financing.

- The proposal provides an overview of the supportive policy framework in the three pilot countries and provides the targets established by the countries for expanding electricity access. But there are some key differences in the policy and regulatory frameworks of the three countries as it relates to support for mini-grids and private sector led development of mini-grids. The policies in India are very supportive (for instance, India's Electricity Act of 2003 allowed mini-utilities to operate without licenses in rural areas provided they complied with safety standards), and several private sector firms have successfully developed RE-based mini-grids in India. Indonesia, on the other hand, has policies that are far less supportive – The IFC reports² that the state-owned power company PLN has a constitutionally provided monopoly on power distribution, and though the utility serves only about 65 percent of the population, other companies cannot supply electricity to the un-served areas without permission from PLN, which it has so far not provided. The World Bank has estimated that mini-grids in a number of areas in Indonesia would be viable, provided PLN permissions were readily forthcoming. In the Philippines, it is reported that onerous licensing and permitting requirements are constraining mini-grids despite the “Electric Power Industry Reform Act” passed in 2001, which specifically allows mini-grids to operate in un-served parts of the country. Though regulatory reforms in 2006 created rules for implementation of the Act, it is reported that designation of un-served areas requires public hearings and decisions by the regulatory commission to allow a mini-grid to operate. As an outcome, it is reported that in five years only one company managed to meet regulatory requirements and qualified to serve the market, and other mini-grids remain illegal. It would thus appear that in Indonesia and the Philippines, policy and regulatory barriers have perhaps been more onerous for the development of mini-grids than just financing barriers.

The proposal would be strengthened if this significant policy and regulatory barrier in Indonesia and the Philippines were acknowledged in the proposal and an appropriate project implementation approach proposed for these countries. ADB could leverage the TA and its projects in these countries to support policy and regulatory reforms for mini-grid development. The scale-up and replication of the project in other Asian and Asia-Pacific countries would also depend very much on an enabling policy and regulatory environment in those countries.

- The proposal conjectures that replication and scale-up of the program could lead to capacity addition of 860 MW from RE sources powering mini-grids. As noted earlier, this assumption is based on the program achieving scale-up equivalent to 10% of the IEA's estimate for development of mini-grids by 2030, and on India's target to add some 2,000 MW of off-grid solar PV by 2022. It does not appear reasonable to attribute the success (or failure, for that matter) in achieving these targets to outcomes

² From Gap to Opportunity: Business Models for Scaling Up Energy Access, IFC

resulting from the proposed program. Moreover, the proposal estimates that scaling up to 860 MW will require financing of about \$2 billion. It is unlikely that the experience and knowledge gained from developing a \$30 million program will leverage that much financing. This is borne out by the experience in India, which has not scaled up mini-grid development with commercial financing despite a favorable policy and regulatory environment and several successful private sector developed mini-grids.

The proposed program will clearly alleviate some financial barriers and increase the probability of attracting commercial financing for mini-grids. But the fact remains that the financial returns from mini-grids supplying subsistence level electricity supplies to low-income customers are low relative to the cost of capital, and such projects are viewed as social development programs, which perhaps will continue to need public funds and concessional financing given their high economic returns to communities and countries.

As noted above, the proposal would be strengthened if the potential for scaling up attributable to the proposed program were estimated based on the ADB's experience in leveraging financing, its knowledge of financial markets in Asia and Asia Pacific, its experience in supporting the development of rural energy programs, its knowledge of the policy and regulatory framework in these countries, and its discussions with stakeholders. Some of the TA, perhaps supplemented by other resources, could also be used to further develop the pipeline of viable mini-grid projects.

- The proposal indicates that of the several barriers to the private sector led development of mini-grids, financial barriers are the most critical and concessional financing is required to demonstrate commercial success. The proposal would be strengthened if it were to address why India has failed to scale up the development of mini-grids despite the presence of some private developers who have pioneered new business models and raised financing from various sources including funds from public, private and multi-lateral agencies. The TA, or other ADB support, could be used to examine why these successful business models have failed to scale-up, and why financing has remained a barrier despite the successful demonstration of these firms in operating mini-grids. The proposal would be strengthened if it addresses how these business models would be improved to attract commercial financing and made scalable to mainstream mini-grid development.
- Given the competing objectives of projects being financially sustainable and electricity being affordability to low-income rural customers, it is likely that the private firms will target markets, which have relatively affluent rural populations and ignore market segments with poorer populations. Private developers would also generally target markets with greater demand for productive end use, which can pay more and help stabilize grid operations. It is thus possible that projects benefiting relatively affluent rural markets could perhaps be financed by the private sector through commercial financing and the provision of concessional financing will lead to rent-seeking. The proposal would be strengthened if it were to address this issue and support concessional financing for projects in poorer communities.
- The proposal is to develop 10 MW of mini-grids in the range of 100 kW to 5 MW to supply between 50,000 to 100,000 households (based on an assumed 100-200 W per household for 8 hours per day). The proposal would be strengthened if it were to indicate that this is the normal practice for sizing mini-grids in the pilot countries based on financing needed, fuel source, affordability to pay, etc. It would also be useful to

indicate how the capacity of such mini-grids could be expanded to meet rising household demand, and the demand for productive end-use, which is critical to making projects commercially viable.

- Project costs are based on an estimate of \$3 million per MW (Appendix 6 of the proposal), and it is noted that this is lower than the typical cost for developing mini-grids in the range of 10 to 250 kW, which is of the order of \$4.5 million per MW. The proposal notes that larger mini-grids developed by efficient private developers are likely to be cheaper – as they well may be given that the transaction costs for larger systems would also be lower. The proposal would be strengthened if this cost estimate were provided based on the experience of the private mini-grid developers in the pilot countries who have developed larger capacity systems.
- The financial markets in the India, Indonesia and the Philippines are relatively well developed and financing barriers to RE mini-grids are perhaps more because of the perceived risks and lower return from such projects (and regulatory barriers in the latter two countries). Scaling up of the program in some of the other Asian and Asia-Pacific countries may face additional barriers due to underdeveloped financial markets in addition to any policy and regulatory barriers to the development of mini-grids.

By Annand Subbiah, 3 March 2014

Independent Reviewer's Comments	ADB's Response
<p>1. A more reasonable approach to estimating the scaling up potential attributable to this program could perhaps be based on the ADB's experience in leveraging financing, its knowledge of financial markets in Asia and Asia Pacific, its experience in supporting the development of rural energy programs, its knowledge of the policy and regulatory framework in these countries, and its discussions with stakeholders. This admittedly will not be easy, but the assumption that 860 MW of project development could be attributed to this program needs to be better justified</p>	<p>The scale up potential (and related performance indicators) for the Program have been re-estimated based on discussions with stakeholders, further data on the market potential for mini grids in pilot countries, and from ADB's experience leveraging finance in the energy access sector. This has led to more conservative factors. Please see revised proposal.</p>
<p>2. The proposal would be strengthened if this significant policy and regulatory barrier in Indonesia and the Philippines were acknowledged in the proposal and an appropriate project implementation approach proposed for these countries. ADB could leverage the TA and its projects in these countries to support policy and regulatory reforms for mini-grid development. The scale-up and replication of the project in other Asian and Asia-Pacific countries would also depend very much on an enabling policy and regulatory environment in those countries.</p>	<p>The revised proposal incorporates more information on the enabling environments in pilot countries, and in particular the challenges faced in Indonesia and the Philippines. More specific support under the TA has been incorporated to share lessons learned from those markets with more progressive regulations and better enabling environments.</p>
<p>3. The proposal would be strengthened if it were to address why India has failed to scale up the development of mini-grids despite the presence of some private developers who have pioneered new business models and raised financing from various sources including funds from public, private and multi-lateral agencies. The TA, or other ADB support, could be used to examine why these successful business models have failed to scale-up, and why financing has remained a barrier despite the successful demonstration of these firms in operating mini-grids. The proposal would be strengthened if it addresses how these business models would be improved to attract commercial financing and made scalable to mainstream mini-grid development.</p>	<p>Section C of the Proposal (Barriers to scale up) has been expanded, and now includes discussion on a range of additional barriers experienced in case studies in India, which help to explain the limited rates of uptake. The Program's TA will further expand upon these to better target the Program's intended investments.</p>
<p>4. Given the competing objectives of projects being financially sustainable and electricity being affordability to low-income rural customers, it is likely that the private firms will target markets, which have relatively affluent rural populations and ignore market segments with poorer populations. Private developers would also generally target markets with greater demand for productive end use, which can pay more and help stabilize grid operations. It is thus possible that projects benefiting relatively affluent rural markets could perhaps be financed by the private sector through commercial financing and the provision of concessional financing will lead to rent-seeking. The proposal would be strengthened if it were to address this issue and support concessional financing for projects in poorer communities.</p>	<p>Whilst private sector developers may choose more profitable projects to develop, affluence will not be the determining factor for selecting viable investments. In addition to creditworthiness, criteria will likely include the size of the population, the density of the dwellings, the estimated demand (productive use), the remoteness and the level of scalability. Further to this, we have observed that successful mini grid projects often benefit from an "anchor" client in terms of either credit quality or electricity demand, which provides a stable base for the business. Thus, it is anticipated that the Program will reach a range of customers with varying levels of income.</p> <p>It is also worth noting that financial and other barriers have thus far inhibited mini-grid development in almost all locations. For</p>

	<p>reasons explained in the proposal, concessional financing is currently required to catalyze even the most financially attractive projects.</p>
<p>5. <i>The proposal is to develop 10 MW of mini-grids in the range of 100 kW to 5 MW to supply between 50,000 to 100,000 households (based on an assumed 100-200 W per household for 8 hours per day). The proposal would be strengthened if it were to indicate that this is the normal practice for sizing mini-grids in the pilot countries based on financing needed, fuel source, affordability to pay, etc. It would also be useful to indicate how the capacity of such mini-grids could be expanded to meet rising household demand, and the demand for productive end-use, which is critical to making projects commercially viable.</i></p>	<p>There is no accepted standard definition for the sizing of “mini-grids”. Systems are often designed based on observed and forecast electricity loads and also geographical constraints of the service area. A major advantage of mini-grids is that they are modular i.e., they can accommodate future increases in demand and can easily be “topped up” with additional RE supply.</p> <p>Assumptions regarding electricity demand are described in Appendix 6,</p>
<p>6. <i>Project costs are based on an estimate of \$3 million per MW (Appendix 6 of the proposal), and it is noted that this is lower than the typical cost for developing mini-grids in the range of 10 to 250 kW, which is of the order of \$4.5 million per MW. The proposal notes that larger mini-grids developed by efficient private developers are likely to be cheaper – as they well may be given that the transaction costs for larger systems would also be lower. The proposal would be strengthened if this cost estimate were provided based on the experience of the private mini-grid developers in the pilot countries who have developed larger capacity systems.</i></p>	<p>The cost of installed mini grid capacity has fallen in recent years due mainly to lower RE technology costs. Data from recent case studies in India show that costs are currently around \$2.5 million per MW. Costs in Indonesia and the Philippines are expected to be slightly higher due to the earlier stage of market development in these countries, and therefore the Program uses an average cost of \$3 million per MW. Appendix 6 of the revised proposal has been updated.</p>
<p>7. <i>The financial markets in the India, Indonesia and the Philippines are relatively well developed and financing barriers to RE mini-grids are perhaps more because of the perceived risks and lower return from such projects (and regulatory barriers in the latter two countries). Scaling up of the program in some of the other Asian and Asia-Pacific countries may face additional barriers due to underdeveloped financial markets in addition to any policy and regulatory barriers to the development of mini-grids.</i></p>	<p>We would agree with this assessment that other markets in Asia and the Pacific (e.g., DPSP Phase II) may be more challenging, in terms of raising other financial resources. It may be the case the leverage ratio would be less ambitious and the MDBs would have to invest in common shares more frequently.</p>