Mid-Term Review

Bangladesh: Development of Sustainable Renewable Energy Power Generation (SREPGen)

Country: Bangladesh
UNDP PIMS# 3948
GEF Project ID# 4459
GEF Operational Focal Area: CCM (Climate Change Mitigation)
GEF Strategic Program: CCM-3 (Promotion of Investment in RE Technologies)

The Power Division of Ministry of Power, Energy, and Mineral Resources (MoPEMR), Implementing Partner
Sustainable and Renewable Energy Development Authority (SREDA), Responsible Partner/ Implementing Entity
United Nations Development Programme, GEF Implementing Agency
Global Environment Facility

November 12, 2017

MTR Timeframe: August 1 – November 30, 2017
MTR Mission: August 4 – 21, 2017, Dhaka and Gazipur, Bangladesh

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Project Information Table

Project Title	Bangladesh: Development of Sustainable Renewable Energy Power Generation (SREPGen)		
UNDP Project ID (PIMS#)	3948	PIF Approval Date:	Nov. 1, 2011
GEF Project ID (PMIS#)	4459	CEO Endorsement Date:	Aug. 15, 2013
Atlas Business Unit Award #: Proj. ID:	00073939 00091251	ProDoc Signature Date (date project began):	Nov. 26, 2013
Country:	Bangladesh	Date project manager hired:	Dec. 2014
Region:	Asia	Inception Workshop date:	March 5, 2015
Focal Area:	CCM (climate change mitigation)	Midterm Review completion date:	Nov. 12, 2017
GEF Focal Area Strategic Objective:	CCM-3: Promotion of Investment in RE Technologies	Planned project closing date:	Dec. 31, 2018
Trust Fund:	GEF TF	If revised, proposed op. closing date:	Dec. 31, 2019, i*f needed and pending acceptable progress by Feb. 28, 2018*
Executing Agency/ Implementing Partner:	The Power Division of Ministry of Power Energy and Mineral Resources (MoPEMR)		
Other Execution Partners:	Sustainable and Renewable Energy Development Authority (SREDA)		
Project Financing (USD)	*at CEO Endorsement (USD) – expected*	*at Midterm Review (USD) – expected*	*at Midterm Review (USD) – expenditures realized*
[1] GEF Financing:	$4,077,272	$4,077,272	$623,933 (as of 1/08/17)
[2] UNDP Contribution:	$5,000,000	$0.0	$0.0 (as of 13/09/17)
[3] Government:	$21,150,000	$21,150,000	$1,000,000 *for SREDA office renovation*
[4] GIZ	$250,000	$0.0	$0.0
[5] Clean Energy Alternatives	$200,000	$0.0	$0.0
[6] Tianjin MIE Co.	$20,000,000	$0.0	$0.0
[7] Private Sector	$3,000,000	$3,000,000	$0.0
[8] Total Co-financing [2+3+4+5+6+7]:	$49,600,000	$24,150,000	$1,000,000
TOTAL PROJECT COSTS (*OR EXPENDITURES*) [1+8]	$53,676,272	$28,227,272	$1,623,933

Acronyms, Abbreviations, and Other Definitions

ADB – Asian Development Bank
ACD – Assistant Country Director: a senior role in a UNDP CO
BDT – Bangladeshi Taka: currency of Bangladesh. There are roughly 80 BDT to the USD (83 BDT to the USD at the time this report was prepared).
BGEF – Bright Green Energy Foundation: A foundation in Bangladesh active in the PV field. The organization has provided a number of ideas to SREPGen for its project redesign.
BOO – build wwn operate
BPDB – Bangladesh Power Development Board
BSTI – Bangladesh Standards and Testing Institute
CER – GEF CEO Endorsement Request. A project design document submitted along with the project document to the GEF once full project design has been completed.
CCM – Climate Change Mitigation: the category of GEF project in which SREPGen falls.
CLASP – a US based non-profit that focuses on improving the energy and environmental performance of appliances and equipment.
Clean Energy Associates: An organization original intended to provide USD200,000 in co-financing to SREPGen and be active in the project's rice husk power generation work. By the time of the MTR, the company had not been involved in the project and is said to no longer be active in Bangladesh.
CO_2 – carbon dioxide
DC – direct current
EE – energy efficiency
EE&C – energy efficiency and conservation
EOP – end of project
GEF – Global Environment Facility. Core funding source of this project
GHG – greenhouse gas
GHG ER – greenhouse gas emission reduction
GIZ – German development organization
GOB – Government of Bangladesh
IDCOL – Infrastructure Development Company, Ltd: A state-owned company in Bangladesh that has played a central role in the distribution of SHSs in the country, with partial subsidies from a number of different donors. IDCOL monitors standards of equipment sold and works through a number of qualified IDCOL distributors.
INDC – Intended Nationally Determined Contributions (target GHG ERs that countries signing the Climate Change Convention have been asked to state)
IP – Implementing Partner: In a nationally implemented UNDP-GEF project, the government agency responsible for implementation.
JICA – Japan International Cooperation Agency
JS – joint secretary

kW – kilowatt: 1,000 watts
kWh – kilowatt hour: may be achieved by 1 kW of power provided over 1 hour of time; a unit of energy commonly used in billing for retail electricity use
M&E – monitoring and evaluation
mini-grid: an small electric grid as compared to the main national grid. In the case of Bangladesh, a PV mini-grid refers to a system that provides electricity to roughly 1,000 households.
MOPEMR – Ministry of Power, Energy, and Mineral Resources of Bangladesh: the Implementing Partner of the project being reviewed.
MTR – midterm review: An evaluation of a project taking place midway through its lifetime.
MW – megawatt: 1 million watts or 1,000 kilowatts, a unit of power
MWh – megawatt hour: may be achieved by 1 MW provided over 1 hour of time; a unit of energy
nano-grid: a small electric grid: In the case of SREPGen, a PV nano-grid refers to a system providing PV power to a group of households, generally on the scale of 20 to perhaps 60 or more households. It is to be distinguished from a PV mini-grid, which in the context of Bangladesh refers to a system that serves roughly 1,000 households.
NPD – National Project Director. For nationally implemented UNDP projects, a government official responsible for overseeing implementation and providing guidance to the project team.
pay-as-you-go: With regard to SHSs and pico-PV systems, refers to a technology that enables the buyer to make monthly installment payments to purchase a system they are using by topping up a SIM card similar to that used for cell phones.
PIF: initial proposal for a GEF project. The PIF is a rough concept document. Once approved, the GEF allocates funds for the project, but full project design must be completed and cleared (via submission of ProDoc and CER) before funds can be released.
PIR – Project Implementation Review. A template document that is prepared mid-year each year for active UNDP-GEF projects. The document reviews progress towards results and quality of implementation. It includes an update on the status of each project indicator.
pico-solar: refers to pico-solar system, a PV system of perhaps 10 W that provides the user with a few lights and place to charge a cell phone. Pico-solar systems tend to be smaller than SHSs as they use lithium ion batteries instead of lead acid batteries. The price is low, though the battery capacity is generally less than that of SHSs.
PM – project manager. For the SREPGen, the person leading the project team and responsible for day to day implementation.
PMO – Prime Minister's Office
PMU – Project Management Unit. In the case of the SREPGen, the PMU consists of three full-time persons: the Project Manager, the Monitoring and Evaluation Officer, and the Finance and Administrative Officer.

PPG – project preparation grant. Grant for design of GEF projects. The PPG phase is the phase during which this grant is used to prepare a full project document on the basis of the approved project concept.
PRC – People's Republic of China
ProDoc – Project Document. A full project design document. In the case of UNDP-GEF projects, the ProDoc is submitted to the GEF along with the CER to receive approval of the full project design.
PPA – power purchase agreement
PSC – Project Steering Committee: for a UNDP-GEF project, a group of individuals representing key organizations relevant to the project: The PSC is responsible for oversight and high-level M&E of the project.
PV – photo-voltaic: An effect whereby sunlight stimulates a flow of electrons. PV panels convert the sun's energy to electricity and are a key component of SHSs.
PVSL – photo-voltaic solar lantern, also known simply as solar lantern (see entry for solar lantern)
RE – renewable energy
REB – Rural Electrification Board (of Bangladesh)
RESCO – renewable energy service company; in the context of this project, a RESCO refers to a company responsible for operating and maintaining a PV nano-grid or PV mini-grid and that also collects billing fees from users.
RP – Responsible Party: In a nationally implemented UNDP-GEF project, an agency responsible for certain aspects of implementation. In this project, SREDA is an RP, or Implementing Entity.
RTA – Regional Technical Advisor. For UNDP-GEF projects, a regionally-based expert and manager who provides technical and management guidance to the design and implementation of UNDP-GEF projects in focal areas under his or her purview.
SHS – solar home system: A PV system that sit on a rooftop and provides PV power to the associated building.
SolarEn Foundation: an IDCOL distributor met during the MTR field trip to Gazipur
solar lantern: small, portable solar PV system that provides one light and perhaps a place to charge a cell phone
SolShare: a Bangladesh based company that has demonstrated the first SHS sharing system. The system interconnects neighboring SHSs and allows households to buy and sell electricity from one another.
SREDA – Sustainable and Renewable Energy Development Authority of Bangladesh: the RP or Implementing Entity of the project.
SREPGen – Abbreviated name of the project under review. Full name is Development of Sustainable Renewable Energy Power Generation.
SDGs – Sustainable Development Goals: a universal call to action, coordinated by the United Nations, to end poverty, protect the planet, and ensure that all people enjoy peace and prosperity
Taka: currency of Bangladesh. There are roughly 80 Taka to the USD.

Tianjin MIE Co – Tianjin Machinery Import and Export Company: A company originally anticipated to provide USD20 million in co-financing to the project. By the time of the MTR, this company had not been involved in the project and was not available for a meeting. It is anticipated this co-financing will not be realized.
TOR – terms of reference. A document describing work tasks. Often used to recruit consultants or contracting firms for a project.
UIU – United International University: a university in Dhaka
UNDP – United Nations Development Programme
UNDP CO – UNDP Country Office. In the case of the SREPGen, CO refers to the UNDP Bangladesh Country Office.
USAID – United States Agency for International Development
USD – US dollar: currency of the United States
W2E – waste to energy: a form of power generation using municipal waste

Executive Summary

1. Project Background

- The objective of the *Bangladesh Development of Sustainable Renewable Energy Power Generation* (SREPGen) project is to reduce the annual growth rate of GHG emissions from fossil fuel-based power.
- The project aims to contribute to this objective via its 4 components: (1) policy work and planning work and promotion of the government agency SREDA, (2) RE resource assessment work, (3) provision of off-grid PV power generation to poor households that lack electricity, and (4) scale-up of utility-scale RE power generation.
- The project document was signed by GOB and UNDP in November 26, 2013. With a five-year duration, the project is scheduled to close December 31, 2018. At the time of preparation of this report, the project has completed about four years of its five-year targeted duration, though nothing happened during the first year; and the first project manager was hired in Dec. 2014.
- The project's basic funding is USD4,077,272 from the Global Environment Facility of which USD623,933 (as of August 1, 2017) has been spent. Co-financing was initially targeted to be USD49,600,000, but expectations as of mid-term review are that co-financing will be USD24,150,000, the majority from the GOB.
- The project is a nationally implemented project of UNDP, with Bangldesh's MOPEMR as the IP. SREDA, which is under MOPEMR, is designated a Responsible Party (RP) or Implementing Entity of the project. In practice, SREDA has taken up the key roles of the IP, chairing the PSC and being involved in decision making regarding the project.
- The project team consists of three full-time staff: a project manager (PM), a monitoring and evaluation officer, and a project finance and administrative officer. At present, the project management team does not have any technical advisors for overall project guidance, though experts have been retained to carry out specific project activities.

2. Mid-Term Review Approach

- The MTR Consultant, after contract signing, was asked to carry out a non-traditional MTR, focusing on project redesign to address the stagnation of the project.
- The MTR Consultant conducted a 15-day mission to Bangladesh from August 6-20, 2017. Extensive interviews/ consultations were the main methodology of information and insight gathering. The MTR consultant conducted 50 interviews, most in-depth and face-to-face.
- The MTR consultant provided extensive redesign support including relevant documentation: redesigned outputs and activities, redesigned indicators ("Project Results Framework"), redesigned budget, redesigned timeline, and guidance for GHG ER calculations.

3. Project Timeline, Design, and Management and Governance

- The most concerning delay in the project timeline is the roughly 13 months between ProDoc signing and hiring of the project manager, due to the need for GOB approval of its internal TPP document, which turned out to have differences with the GEF approved ProDoc.
- The strengths of the project design are reflected in its comprehensive approach to the objective of promoting RE power generation in Bangladesh, covering in its components, respectively, policy/ planning, resource assessment, off-grid, and utility-scale on-grid. With this backdrop, despite the many problems of implementation and of activities no longer being appropriate to the environment in Bangladesh, a strong redesign was facilitated.
- In retrospect, one key shortcoming of project design was over-specificity of technology in outcome statement. Solar lanterns were mentioned in the statement of Outcome 3, to which over half of project funds were allocated. This created a roadblock to the project when solar lanterns were no longer deemed a viable product for the Bangladesh market, as changing of project outcomes is normally not permitted in GEF projects without special permission.
- The project has faced challenges in moving forward. The PSC has been approving activities on a one-by-one basis, even though the entire ProDoc was agreed to by GOB. Further, the PSC appears unaware of the focus of the project objective and outcomes, recommending activities that are not in line with these.

4. Component 1 Progress and Relevance

- Component 1, the "RE Policy and Regulatory Support Program," is the component that has had the greatest progress to date. The project has been successful in promoting SREDA, via workshops, trainings, and promotion to the press.
- No progress has been made in policy and regulatory aspects of the project. Originally intended activities in some cases become obsolete as they are "given" to other donors.

5. Component 2 Progress and Relevance

- There has been no progress on Component 2, the "Resource Assessment Support Program," aside from the preparation of a TOR for a nationwide biomass resource assessment.
- Plans to carry out wind resource assessment and related investment plans have been stymied because USAID has taken up this work.
- No work at all has been done on the solar resource assessment planned.
- The TOR for the nationwide biomass resource assessment projects a study that will cost USD1 million or more. There is a need to review the relevance of all aspects of the TOR and compare the scope and costs to similar work in other countries.

6. Component 3 Progress and Relevance

- Component 3, which focuses on PV power for the poor who lack electricity, has made only limited progress. The component originally targeted the distribution of 200,000 solar lanterns with a USD10 subsidy from the project for each lantern.
- Work on distributing lanterns was never initiated. The project partner, IDCOL, preferred to distribute pico PV systems (5 to 10 W), as these are stationary and can be monitored. A subsidy of USD20 per system was agreed upon. Yet, while efforts have been underway since Jan. 2016, only about 1,400 such systems were distributed as of August 2017, represented USD28,000 in subsidies from the project. Problems are said to be a general downturn in the SHS market, as well as the relatively high price of pico systems as compared to small SHS systems, which provide longer battery storage.

7. Component 4 Progress and Relevance

- Component 4, "RE Investment Scale Up," has seen limited progress in the areas intended, while activities not correlating well with its intended scope have been added.
- The main activity completed that corresponds to the original scope is six pre-feasibility studies on W2E. Results of these studies suggest the associated projects may not be viable.
- Activities added to Component 4 are the support of solar boats and of solar charging stations for auto-rickshaws and easy riders. The latter does not have a good business model, with estimated payback of 60 years. The former enables the boats to be about half powered by PV and half powered by diesel. These activities are not considered to be in line with the project's main focus on power generation and instead focus on niche application areas of PV power.

8. Expenditures, Co-financing, and Cost Efficiency

- With support from the PMU, breakdowns of components by major activities as of Aug. 17, 2017 enable identification of the main "big-ticket items" which have represented the largest expenditures so far. These include: (1) study tours of Component 1 – USD63,396 (not including the Oct. study tour to Germany, which may double this amount); (2) workshops, seminars and training of Component 1 - USD95,951; (3) pico solar subsidies of Component 3 – a transfer of USD100,000 to IDCOL, though only USD28,000 may in theory be considered spent as of Aug. 2017; (4) five solar boats as part of Component 4 - USD57,580 (though the full contract is USD88,623); (5) two solar charging stations as part of Component 4 – USD64,500; and (6) salaries as part of Project Management – USD125,667.
- While project expenditures as of Aug. 1, 2017 were only 15 percent of GEF funds, cost efficiency might still be ranked low as activities tend to veer off the main focus (solar boats and solar charging stations for vehicles) and there has been an overemphasis on study tours.
- The only reported co-financing is USD1 million to refurbish SREDA's rented offices. The refurbished offices are nice, though it is reported SREDA will soon be getting long-term offices near the airport soon.

9. Project Ratings

- Project progress towards results ratings are as follows: Overall – Unsatisfactory, Objective Achievement – Unsatisfactory, Outcome 1 (Policy/ SREDA Promotion) Achievement - Moderately Satisfactory, Outcome 2 (Resource Assessment) Achievement – Unsatisfactory, Outcome 3 (PV Power for the Poor without Electricity) Achievement – Unsatisfactory, Outcome 4 (RE Investment Scale-up) Achievement – Unsatisfactory.
- Project implementation and adaptive management rating is as follows: Moderately Unsatisfactory
- Sustainability rating is as follows: Moderately Unlikely

10. Recommendations

1. Overall: Major project redesign should be adopted (by Nov. 2017), followed by check on progress (at latest Feb. 2018). If progress is not sufficient, early project close should be considered to ensure funds are not wasted. If progress is acceptable, application to the GEF for a one-year extension from current project close date of Dec. 31, 2018 until Dec. 31, 2019 may be considered if needed. Project re-design documents are provided in Annexes 2-6 (activities, indicators, time line, budget, and GHG ER guidelines).

2. Component 1 – Recommendation 1. Policy and planning outputs and activities should be substantially revised to fit needs and should be the main focus of Component 1 going forward. Redesigned activities will include Net Metering Action Plan, technical solutions for grid integration of distributed RE power, template agreement for rooftop solar, quality and disposal guidelines for PV components, investment management and incentive policy/ regulations and guidelines for utility scale RE, and GOB Action Plan for RE Power Generation 2019-2040.

3. Component 1- Recommendation 2. While some SREDA promotion activities can be continued, given that this area has already had significant achievement and received significant budget allocation, this work should be secondary to Component 1's policy and planning work. In particular, with 3 study tours completed, no more should be carried out.

4. Component 2 – Recommendation 1. Wind resource assessment work should be redesigned to take into account extensive work already done by USAID and remaining needs. Assuming the results of the USAID wind resource assessment work at nine sites shows some positive results and that its retired towers can be transferred in time for no-cost use, SREPGen can fill in the gaps by carrying out learning-by-doing onshore wind resource assessment in Barisal and carrying out a desk study on offshore wind resource potential.

5. Component 2 – Recommendation 2. Nationwide biomass resource assessment, not initially included in the ProDoc, but with TOR design already initiated by a top biomass expert, should be launched as soon as possible. The current scope of work should be divided into two phases, with phase one efforts to be limited to a cost of USD300,000 of project funds, with contracting efforts

to be initiated immediately. As the total costs anticipated for the nation-wide study may be roughly USD1 million or more, the other USD700,000 or more of work should be allocated to phase two, for which other donor funds can be pursued in parallel with implementation of phase 1 of the study. Work should be done concurrently to justify and, if possible, reduce costing.

6. Component 2 – Recommendation 3. The need for project support of investment-grade solar resource assessment, now being proposed at five sites, should be further vetted and justified, before being contracted. If the project goes forward with this work, it should include a capacity building/ learning-by-doing dimension.

7. Component 3 – Recommendation 1. Component 3 work (which aims to address getting PV power to the poor that lack electricity) should put its greatest focus on those villages among the 1,024 identified long-term off-grid villages that are not suitable to PV mini-grids. A survey of the 1,024 villages is recommended (to be commenced promptly by January 2018) in order to: (a) confirm which villages are not suitable for PV mini-grids and which of these have the highest proportion of un-electrified households, (b) determine the best type of PV nano-grids when nano-grids are suitable for such villages, and (c1) identify those cases of villages for which free-standing, unconnected household systems (SHSs) are instead the best option and (c2) determine viability of and strategy for a pay-as-you-go distribution initiative for such villages.

8. Component 3 – Recommendation 2. The design and installation of 300 nano-grids for clusters of homes in long-term off-grid villages not suitable to PV mini-grids and with a high proportion of un-electrified households is recommended as the most extensive activity of Component 3, with budget of roughly USD1.255 million.

9. Component 3 – Recommendation 3. Small SHS and pico-solar sold on monthly installment plan implemented via automated pay-as-you-go payment technology is recommended as the second key activity of the re-designed Component 3 to get PV power to the poorest households. A preliminary budget allocation of roughly USD318,000 is recommended, pending confirmation of the viability of the pay-as-you-go strategy to generate substantial demand for systems. This work should also include training of “solar grandmas” to ensure repair services are available.

10. Component 4 – Recommendation 1. Re-design of RE power generation scale-up activities (the focus of Component 4) is recommended to suit the current needs to achieve actual installations of utility-scale PV, utility-scale wind, and utility scale biomass power generation projects. Redesigned activities should include a mix of barrier removal (with barriers identified via consultation with investors) for utility scale RE power generation, design and implementation of concession bidding programs for utility scale RE power generation, preparation of bankable financing documents for RE power generation, and direct support for a 100 kW W2E project (the last item, as requested by SREDA).

11. Component 4 – Recommendation 2. Special applications of RE power is an area less fully in line with the RE power generation objective of SREPGen. At the same time, pursuit of RE power

applications as a part of SREPGen is to some extent justifiable. Bangladesh's power grid is expanding rapidly, so that PV power applications represent an important means of increasing use of RE power in both on-grid and off-grid areas. Thus, it is recommended that special PV power applications be considered, but only if sufficient funding is first allocated to other project initiatives. Relevant sub-areas should all be contingent on the availability of a feasible business model for commercial replication. Areas to consider in this regard are: an additional auto-rickshaw and easy ride PV charging station, arsenic removing solar pump, solar freezer, household solar pump, and solar boats (with the last to be supported only if compelling new aspects are included as compared to the 5 boats already supported).

12. Cross-cutting – Recommendation 1. The project should recruit part-time experts to support its efforts to implement the re-designed project at a rapid pace. The mix of experts may follow one of two scenarios: (1) a part time expert in PV (most major contract in terms of time), as well as a part-time expert in each of wind and biomass (more limited contracts) or (2) a general RE expert and an expert in TOR preparation and contracting.

13. Cross-cutting – Recommendation 2. The project should aim to diversify its partners – the organizations with which is signs contracts to implement project activities. Partners should be chosen based on their capabilities in the relevant re-designed activities.

14. Cross-cutting – Recommendation 3. The project team, after finalizing indicators (initial draft provided in Annex 3), should carefully consider achievement of indicators (especially GHG ERs) in any further adjustment or re-prioritization of project activities. In the case of utility scale projects, it will be important for the project team to carefully monitor developments and provide evidence that SREPGen activities did indeed remove barriers for such utility-scale projects, so that SREPGen can "claim" credit for their GHG ERs.

15. Cross-cutting – Recommendation 4. Measures should be adopted as follows so that each of four key stakeholder groups (PSC, the Implementing Entity, UNDP, and the project team) are able to increase their effectiveness in promoting project progress:

- The PSC should discuss and approve the re-designed project as a whole by end of Nov. 2017. Further, PSC members should be made aware that the project objective concerns RE power generation and that the project has four clear outcomes on which project activities need to focus.
- As with the PSC, the implementing entity should be reminded repeatedly that the project objective concerns RE power generation and has four clear outcomes on which project activities need to focus. The implementing entity should further understand the GEF incremental strategy – that the project should aim to invest money in activities that stimulate replication of RE power generation initiatives on substantial scale and have the potential for commercial viability. Thus, one-off activities that lack replication potential and/or that lack commercial viability are not suitable for SREPGen.

- UNDP should make strong efforts to support the project in faster turnaround of procurement handled through UNDP, with a target of maximum six weeks between opportunity posting and contract signing.
- The performance of the project team should be enhanced and monitored. To ensure the project team's work is on target, each team member should keep a daily timesheet in Excel documenting time spent on various activities. UNDP should review these timesheets every two weeks to ensure the team is putting its full effort in the right areas.

1. Project Background

Background on the project: The objective of the *Bangladesh Development of Sustainable Renewable Energy Power Generation* (SREPGen) project is to reduce the annual growth rate of GHG emissions from fossil fuel-based power. The project aims to contribute to this objective via its four components: (1) policy work and planning work and promotion of the government agency SREDA, (2) RE resource assessment work, (3) provision of off-grid PV power generation to poor households that lack electricity, and (4) scale-up of utility-scale RE power generation. The project document was signed by the Government of Bangladesh and UNDP on November 26, 2013. With a five-year duration, the project is scheduled to close in Dec. 31, 2018. At the time of preparation of this report, the project has completed about four years of its five-year targeted duration, though the project manager was not hired until 13 months after project document signing. The project's basic funding is USD4,077,272 from the Global Environment Facility of which USD623,933 (as of August 1, 2017) has been spent. Co-financing was initially targeted to be USD49,600,000, but expectations as of mid-term review are that co-financing will be USD24,150,000, the majority from the GOB. Of this co-financing, USD1,000,000 has been confirmed to have been spent in refurbishing SREDA's rented office space. The project is a nationally implemented project of UNDP, with Bangldesh's Ministry of Power, Energy, and Mineral Resources (MOPEMR) as the Implementing Partner (IP). SREDA, which is under MOPEMR, is designated a Responsible Party (RP) or Implementing Entity of the project. In practice, SREDA has taken up the key roles of the IP, chairing the PSC and being involved in decision making regarding the project. The project team consists of three full-time staff: a project manager (PM), a monitoring and evaluation officer, and a project finance and administrative officer. At present, the project management team does not have any technical advisors for overall project guidance, though experts have been retained to carry out specific project activities.

Background on the situation of renewable energy power generation in Bangladesh: The situation of small-scale off-grid RE power generation in Bangladesh is quite advanced when it comes to individual household systems, while that of on-grid RE power generation in quite nascent. Bangladesh is said to have around five million solar home systems (SHSs) installed, more than any other country in the world. Many of these were distributed via a program managed by the state-owned company IDCOL, which channeled donor funds to provide partial subsidies for systems sold by its distribution partners in rural areas across the country. Since the initiation of the IDCOL program, cheaper Chinese products have also entered the market, creating a lot of competition. And, most recently, the GOB has a large-scale program to distribute systems for free to poor households, which reduces the incentive for purchases. At its peak, the SHS market is said to have reached a scale at which IDCOL partners were distributing 88,000 or 89,000 SHSs per month in 2013 or 2014. Since that time, there has been an apparently huge drop-off in demand, with many fewer systems being sold via the IDCOL program and most probably on the market generally.

An additional development that may be dampening demand for SHSs is that the GOB is rapidly expanding the main power grid across the country. While many grid-connected locations in rural areas suffer excessive load shedding (so that, for example, they may just get four hours of power per day), GOB is also rapidly ramping up fossil fuel fired grid capacity. REB has indicated that there will be just 1,024 villages that will be off-grid for the long-term, though experts point out that many off-grid pockets will probably remain in grid areas for a long time to come. Yet, given the greater certainty that they will remain off-grid for the long-term, the 1,024 long-term off-grid villages have been the focus of attention in recent off-grid RE rural electrification efforts in Bangladesh. In light of the lethargic SHS market, IDCOL has shifted its focus to donor supported PV-battery mini-grids that typically serve about 1,000 households, covering about three villages. The typical cost of these 200 to 250 kW PV battery mini-grids is USD1.2 million, half of which is covered by donor-provided subsidy. Based on an IDCOL provided update in April/ May 2017, IDCOL had completed seven of these PV mini-grids, had ten more under construction, and ten more in the pipeline with funds committed for a total of 27. MTR findings suggest that some donors are considering supporting even more of these mini-grids than they are already committed to. In addition, IDCOL, working with the World Bank, and REB, working with ADB, are targeting to develop PV powered solar irrigation pumps at numerous sites. (For the ADB program, 2,000 pumps of roughly 15 kW each will be developed.) As for the 1,024 long-term off-grid villages, an expert source provided an estimate to the MTR team that the village layouts in those areas mean that only about 100 mini-grids (perhaps covering 300 villages) are viable. The other areas will need to depend on individual SHSs or perhaps some form of nano-grid that each cover a cluster of 20 or more households.

As for other off-grid RE power generation options besides solar PV, it appears that not much work has been done in small-scale hydro. One source noted that Bangladesh is too flat for micro-hydro, but that pico-hydro, which has not really been pursued, may be interesting.

As for utility-scale RE power generation, it appears there is to date little actual installed capacity of this type in Bangladesh. Reacting to the GOB's new policy to offer PPAs with a relatively high guaranteed power purchase price for utility-scale solar PV, a number of developers are working to develop such projects. So far, the only operating utility-scale PV farm is an 8 MW installation developed by the ADB. Bangladesh, which has a very high population density, faces challenges in developing utility-scale PV due to lack of land availability. Government regulations require that PV farms be developed on non-agricultural land. Most utility-PV developers complain that they face challenges in securing land for their projects. As for wind power, preliminary indications are that the onshore wind resources in Bangladesh are not very attractive. Despite these indications, USAID pursued and has just completed an onshore wind resource assessment program using 80 m towers at eight or nine sites and should be releasing the data soon. The MTR team has heard reports of one or two small utility scale wind installations already in existence, but it appears these have had problems and may no longer be operating. As for biomass power generation, the MTR team heard reports that a few agricultural enterprises have onsite biogas power generation (e.g. poultry farms) or rice husk power generation (rice suppliers) facilities for self-use power ("captive power generation'), but did not hear reports of

any grid-connected biomass power of this type. One challenge for biomass power generation using agricultural or forestry wastes in Bangladesh is that there are now competing uses for such wastes. As for W2E, an NGO is said to have developed small-scale test installations in five or six municipalities, but no large-scale installations have been developed.

2. Midterm Review Approach

Purpose of midterm review: In general, midterm reviews (MTRs) of UNDP-GEF projects have two main purposes. The first general purpose is to provide transparency, so that there is accountability for funds spent and so that the successes and challenges of the project halfway through its course can be known by all. This transparency also provides insights and lessons learned that may be applied to other projects. The second general purpose is, based on findings, to provide recommendations to the project for course correction to improve results and/or for staying the course according to plans, as relevant. Yet, after contract signing and during the MTR mission launch meeting, UNDP Bangladesh CO explained to the MTR consultant that this MTR would be different. SREPGen, it turned out, was facing really substantial challenges and had been stagnant, despite 2.75 years of implementation. The problem, the CO explained, is that the project as designed no longer fits the real situation on the ground in Bangladesh. In particular, the project's Component 3, with a budget for GEF funds of USD2.24 million, representing over half of the project's total GEF budget, focuses on distribution of solar lanterns. The market uptake of these lanterns has been very slow. With over five million SHSs installed in Bangladesh, the solar lanterns are no longer a suitable focus for this large part of the project. Thus, UNDP Bangladesh CO asked the MTR consultant to focus the bulk of her attention on project re-design. It was agreed that the main output of the MTR mission would be a redesigned project rather than a standard MTR report.

Methodology of midterm review: Face-to-face interviews were the main methodology employed during the 15-day MTR mission. The MTR consultant also reviewed relevant documentation prior to the mission and provided some information requests to the project team during and after the mission, particularly expenditure related requests. The project team facilitated a wide range of interviews in Dhaka during the 15-day MTR mission, as well as a one-day field trip to Gazipur District, north of central Dhaka. Interviewees included a range of organizations/ persons relevant to RE power generation in Bangladesh, including those relevant both to small-scale off-grid and large on-grid RE power generation. Among those interviewed were experts, investors, government officials, other donors, villagers, and distributors. Given the project re-design focus of this MTR, the mission also included multiple meetings with UNDP Bangladesh CO, SREDA, and the project team to discuss findings to date and take the ideas for re-design to the next level. The MTR consultant drafted up interview notes for sharing within the

team. She also prepared a draft of re-designed project outputs and activities. This re-design document took the original project outputs and activities into careful consideration, showing correlation with the newly proposed outputs whenever possible. The first full draft of ideas for redesigned outputs and activities were formally discussed at an MTR debrief meeting the last day of the mission and then via email exchange following the mission. The MTR consultant then prepared a preliminary re-designed indicators table ("Project Results Framework"). Next she prepared a preliminary version of findings and recommendations from the MTR mission, so that these could be used for discussions of the project re-design between UNDP, SREDA and the project team. The project team, with input from SREDA, UNDP, and experts, prepared a draft project re-design budget. The MTR consultant reviewed this budget and then, finding it difficult to use the draft as a basis of a complete budget for remaining funds, prepared a new budget for remaining funds from scratch, taking the project team's draft budget and its comments into consideration. She then prepared guidance to the team on calculating GHG emission reductions for the re-designed activities and updated the project indicators table ("Project Results Framework"). Next she prepared a proposed project timeline, assuming completion of the redesigned outputs and activities during the period between November 2017 and November 2019, when the project is scheduled to close. At this point the UNDP-GEF RTA responsible for the project, along with a Senior RTA colleague, travelled to Bangladesh and were able to discuss the project re-design with UNDP CO, SREDA, and the project team. Agreement was reached, with some key adjustments, on the re-designed activities and plans for moving forward. The MTR consultant reviewed these results and prepared a revised draft of the MTR recommendations (the key part of the report, with main focus on redesign) and then prepared the rest of the report, updating and annexing the key project redesign documents that had been prepared along the way.

In total, 50 interviews/ consultation meetings were conducted, the majority of which were in-depth interviews. A listing of interviews is given in Exhibit 2-1. Most of the interviews were carried out during a fifteen-day mission to Bangladesh, though one kick-off tele-interview was held before the mission and a tele-interview with the project design consultant was held after the mission. Sequence and timing of the interviews is provided in Annex 1, *Mid-Term Review Mission and Other Consultations – Realized Schedule*. The original project design as well as ideas for new directions in project design that corresponded to the original framework of the project (namely, its objectives and outcomes, which are important to maintain) were used to guide interview discussions.

Because of challenges in planning and obtaining clearance for site visits, in the end a brief one-day mission to Gazipur District, driving distance from central Dhaka, was decided upon. This mission allowed the opportunity to interact with a local IDCOL distributor of SHSs and pico-PV systems in an off-grid area (one of many "pockets" of off-grid in what are considered on-grid

areas), parties who had recently purchased pico-PV systems, villagers who lacked SHSs or pico-PV systems, and an engineer developing a W2E project.

In addition to interviews and site visits, the MTR consultant attended a "Learning Hub Event" at SREDA. Potential utility-scale solar PV investors were invited to this event to explain the challenges they faced to the Advisor to the Prime Minister for Energy, as well as other government officials. This event was quite informative in terms of the type of activities SREP-Gen might undertake to remove barriers to utility-scale RE power generation scale-up.

Exhibit 2-1. Stakeholder Interviews

50 Interviews Conducted

Project Team and UNDP	
Project Monitoring and Evaluation Officer	UNDP ACD and Programme Specialist x 2
Project Administrative and Finance Officer	UNDP Programme Specialist (via Skype)
Project Manager x 2	UNDP Programme Associate
Former Project Manager x 2	UNDP Country Director
Government of Bangladesh	
SREDA Member for EE&C x 3	Wind Resource Mapping Project, Power Division
SREDA Chair (who is also NPD)	BERC
REB – Director for RE	Blue Economy Cell - Commodore, JS, and 1 other
RE Experts and Consultants to Project	
Project Biomass Expert	UIU – PV Expert
Project Capacity Building Expert	Project PV Applications Expert (via telephone)
Project Design Consultant (via telephone)	
Companies and Foundations involved in RE Sector	
IDCOL – CEO, Head of RE, RE Manager	SolShare – CEO
Amity Solar – Chairman	Rahimafrooz – Head of Access to Energy
Amity Solar – Engineer	BGEF – Chairman x 2 (2nd time with others)
Symbior Solar – Country Rep.	Waste Concern – Director
Paragon – Head of Business Development	SolarEn Foundation – Regional Manager, Sr. Manager, and 3 other staff
Donors	
World Bank – RE Specialist	ADB – Project Officer
JICA RE Expert (via telephone)	ChinaAid – Economic Office
JICA/ Mitsubishi EE Expert	GIZ – Responsible Officer and Sr. Adviser
USAID – Energy Team Lead, Advisor, PM	
Citizen Interviews re SHSs and pico-PV Systems	
Dhaka Resident with rural ties	Daumusala Village – Family #1 (with pico-PV)
Dentist in small off-grid town near Gaizpur	Damusala Village – Family #2 (no PV)
Village #2 – Household #1 (no PV)	Damusala Village –Family #3 (2nd hand SHS)
Village #2 – Household #2 (no PV)	Village #2 – Household #3 (no PV)

Content of midterm review report: This report has three preliminary sections, ten sections of main text, and six annexes. The preliminary sections include: the project information table; a listing of acronyms, abbreviations, and definitions; and an executive summary. As for the rest of the report, given the focus of this MTR on project re-design, the most important sections are Section 10, Recommendations (with a Focus on Redesign), and Annexes 2-6, which provide the redesigned outputs and activities (Annex 2), the redesigned indicators (Annex 3), the redesigned timeline (Annex 4), the redesigned budget (Annex 5), and guidance on GHG ER estimates (Annex 6). Other sections of the main text cover the standard MTR content, though overall in less detail due to the focus of the MTR on redesign and the very limited progress the project has made to date. These other sections include Project Background (Section 1); MTR Approach (Section 2); and Project Timeline, Design, and Management and Governance (Section 3). Sections 4 to 7, respectively, briefly review the progress of each of the project's four components, as well as their relevance. Section 8 reviews project expenditures to date, including a component-by-component breakdown, information on co-financing, and assessment of cost effeciency. Section 9 briefly reviews miscellaneous topics, including sustainability, M&E, gender, and project ratings.

3. Project Timeline, Design, and Management and Governance

3.1 Project Timeline

Exhibit 3-1 summarizes the project timeline. The gap between PIF approval and GEF ProDoc clearance is a bit long at 21.5 months. Currently, the time limitation for this gap is 18 months. Information on the date of submission of the ProDoc and CER to GEF is not available, but it is likely that this somewhat long gap is due to delays in the detailed project design process rather than in GEF approval of the submitted documents.

Yet, the really extraordinary delay illustrated in Exhibit 3-1 is the roughly 13 months between ProDoc by GOB/UNDP with concomitant launch of the project and hiring of the first project manager. Without impediments, this process could occur almost immediately and should certainly not take 13 months. Stakeholders explain that this 13 month delay was due to problems at the time with GOB approving their internal "ProDoc," called the TPP, as it was different than the UNDP-GEF ProDoc that had been approved by the GEF. According to one source, there is not a need to be concerned about such a problem repeating itself in the future, as now the GOB policy is such that the two documents are prepared and approved in parallel.

After the first project manager was hired in December 2014, there was then a gap of up to three months before the inception workshop was held. This, too, might have been done in a prompter fashion. Yet, the 13 month gap between ProDoc signing and hiring of the first project manager (due to the need for internal GOB preparation of its TPP) remains the really key, excessive problem with the timeline.

Exhibit 3-1. Project Timeline

Note: Notable time gaps are indicated with red ovals whose size roughly corresponds to the size of the gap.

Initial Idea	PIF Submission	GEF Approval of PIF	ProDoc and CER Submission	GEF ProDoc clearance	Signing of ProDoc/launch of Project	Project Manager Start Date	Inception Workshop	MTR mission start
2007/ 2008	Sept. 26, 2011	Nov. 1, 2011	NA	Aug. 15, 2013	Nov. 23, 2013	Dec. 2014	March 5, 2015	Aug. 6 2017

Original project close date: Dec. 31, 2018. Possible request for one-year extension to Dec. 31, 2019 contingent on acceptable progress by end of Feb. 2018. If acceptable progress not made, project may be recommended for early closure.

Unfortunately, since the time that the project was launched four years ago, progress on targeted outcomes and outputs has been very limited. This aspect of delay will be discussed in Sections 4-7, which cover project progress and relevance of each component, respectively.

3.2 Project Design

The strengths of the project design are reflected in its comprehensive approach to the objective of promoting RE power generation in Bangladesh. The first component focuses on policy and institutional aspects. It includes selected policies to be developed. And, very significantly, it includes the idea of promoting SREDA, which was at the time a newly planned government authority under MOPEMR that was to be responsible for renewable energy and energy efficiency. The second component covers RE resource assessment in the areas of wind, solar, and biomass, a necessary pre-requisite for utility-scale RE power generation, which Bangladesh, for the most part, lacks. The third component focuses on RE power generation for poor households that lack access to electricity, also an important area. The fourth component focuses on the scale-up of utility-scale RE power generation. During re-design, the MTR consultant found that this comprehensive framework provided an excellent back-drop against which to assess the current RE power generation environment in Bangladesh and re-design the outputs and activities. She also found that some of the key specifics “changes,” items that have come to prominence in the re-design, such as PV nano-grids, were actually included in the original design. In the case of PV nano-grids, while they are an important potential area of work that have not been deeply explored by others in Bangladesh, project implementers decided without close examination that they should be dropped, because “they have already been done.”

The main challenge of the project is that it got outdated with the large gap in time between initial design of project concept and project launch. This is not really a problem with design, but instead one of timing. Yet, there are also some weaknesses in project design worth noting. These weaknesses are two-fold. First, the outcome wording for Outcome 3, which mentions solar lanterns specifically, puts the project implementers in a bind. This is because it is generally not acceptable to change outcomes of GEF projects. Ideally, in retrospect, the outcome statement may have been more general. It might better have been stated as "small-scale RE power generation made accessible to the poor," for example, rather than mentioning solar lanterns specifically, to allow for some flexibility to fit a changing market environment. Of course, as will be apparent from the discussion in Section 6, it may have been difficult to anticipate the rapid changes in Bangladesh's SHS market. Yet, making project outcome statements more general in UNDP-GEF design can be considered a lesson learned. In this case, the outcome in question had over half of the project's GEF funds allocated to it, so that its wording became a very important issue.

The second weakness of project design, though not fully confirmed, is that it appears in some cases decisions were made without full consultation of the appropriate stakeholders. It is hard to confirm that this was indeed a problem, but some suggestions that is was are as follows: (1) The ProDoc states that Bangladesh already has done a good nation-wide biomass resource study and that the project will therefore instead do resource assessment studies at specific sites for biomass power generation projects. In contrast, the MTR consultant learned from stakeholders that a nation-wide biomass resource assessment is a top priority for the biomass power generation field in Bangladesh, as the last quality assessment was done in the 1980s. (2) A second example is that the project document puts very strong emphasis on rice husk power generation. Yet, SREDA does not seem interested in this area. It's possible that SREDA has changed its mind since the time of project design. On the other hand, the project design indicated two organizations, Clean Energy Associates and Tianjin MIE Co., would be involved in this work, so that may have been the motivation for focusing on rice husk power generation. These two companies appear to be no longer active in Bangladesh. (3) A third example has to do with the wind resource assessment work. Originally, the project was going to do wind resource assessment with towers at appropriately selected sites. By the time of full project design, however, USAID had already picked up this concept. To deal with this change the landscape, the full project design instead indicates that SREPGen will come up with investment plans (which it was explained to the MTR consultant were to be based on the USAID data). Yet, when the MTR consultant talked to USAID, USAID told the consultant they planned to do these investment plans and had always intended to do so from the start. Again, it's possible that USAID has changed its mind and decided later to do these investment plans. Findings suggest, however, that consultations during the project design phase may not have been extensive enough to confirm what USAID would be doing. To alleviate this weakness, UNDPCO in organizing project design missions should ensure

that project design consultants get good access and are able to carry out wide consultations, such as were facilitated excellently during the MTR mission.

Exhibit 3-2 shows the original project design in terms of objective, outcomes, and outputs and, as a preview, offers a comparison to the newly proposed redesign. The component titles and outcomes are kept with their original wording, except in a few cases where improved wording (only slight adjustments) is suggested in red. In the case of Outcome 3, in which PVSLs are specifically referred to, the spirit of the outcome, which is to provide PV power to the poor is maintained, but suggested adjustment to some words is recommended. The main changes are in the outputs (and later, as seen in Annex 2, the activities). All proposed changes are indicated in red.

Exhibit 3-2. Original Project Design as Compared to Proposed Redesign (down to output level, see Annex 2 for re-designed activities)

Note: The left column shows the component and outcome wording and the outputs in the ProDoc. The right column shows how the component and outcome wording in some cases might be adjusted slightly and the proposed redesigned outputs. Revisions are indicated in red.

Objective: Reduction in the annual growth rate of GHG emissions (as compared to business as usual) from fossil fuel fired power generation through the exploitation of Bangladesh's renewable energy resources for power Generation	
Original Outcomes and Outputs	**Slight Improvement in Outcome Wording with Redesigned Outputs**
Component 1: RE Policy and Regulatory Support Program **Outcome 1. SREDA evolves into a facilitation center to support private sector RE investment development, enable regulators to determine fair flexible tariff structures, bring confidence to private RE investors, and increase the number of approved RE projects** Output 1.1: Completed studies on RE policy and tariffs and grid integration with RE power sources Output 1.2: SREDA operational rules Output 1.3: Trained SREDA staff in RE development Output 1.4: SREDA-managed RE investment facilitation center	***Component 1: RE Policy and Regulatory Support Program*** **Outcome 1: SREDA evolves into a facilitation center to support private sector RE investment development; to enable regulators to determine fair flexible tariff structures, develop RE power plans, and adopt RE power management and incentive regulations; to bring confidence to private RE investors; and to increase the number of approved RE projects** Output 1.1 Regulations, guidelines, and technical solutions to promote distributed renewable energy power generation and its integration into the grid. Output 1.2 Law, regulations, policy, and guidelines to manage and incentivize investment in utility-scale RE power installations. Output 1.3: Trained SREDA and private sector staff in RE development Output 1.4: SREDA-managed RE facilitation center, including innovation lab Output 1.5 Detailed action plan for RE power generation in Bangladesh (Note: new output)
Component 2: Resource Assessment Support Program	***Component 2: Resource Assessment Support Program***

Outcome 2. Increased capacities of relevant government agencies to generate, process, obtain and disseminate reliable RE resource information for use by GoB and potential project developers and investors. Output 2.1: Wind resource maps Output 2.2: Investment-grade solar resource data Output 2.3: Biomass resource data	**Outcome 2. Increased capacities of relevant government agencies to generate, process, obtain and disseminate reliable RE resource information for use by GoB and potential project developers and investors.** Output 2.1 Wind resource ~~maps~~ assessment capabilities built in Bangladesh through useful assessments conducted for onshore and offshore areas. Output 2.2 Investment-grade solar resource data and relevant capacities built in Bangladesh Output 2.3 Nation-wide biomass resource ~~data~~ assessment study focused on availability of resources for biomass power generation and identification of potential project sites
Component 3: Diffusion of Photovoltaic-Powered Solar LED Lanterns (PVSLs) to Low Income Households **Outcome 3. Increased affordability of photovoltaic solar LED lanterns (PVSLs) for low income households** Output 3.1: Established financial mechanism that includes a credit scheme and buy-down grants Output 3.2: PVSL delivery models that provide product support and credit collection Output 3.3: PVSL certification procedures and quality oversight of diffusion activities	***Component 3. ~~Diffusion~~ ~~of~~ Affordable Photovoltaic Powered ~~solar LED lanterns (PVSLs)~~ ~~to~~ for Low-income Households and associated Livelihood Enhancement*** **Outcome 3. Increased affordability and access to ~~of~~ photovoltaic solar power and associated livelihood benefits ~~LED lanterns (PVSLs)~~ for low income households** Output 3.1 Actionable information on village layout, number and proportion of poor households without electricity or without adequate electricity, and challenges in delivering power to un-electrified households in long-term off-grid areas, namely 1,024 villages identified by the Rural Electrification Board, particularly those 700 or more villages not suitable to mini-grids Output 3.2 Electricity access newly provided to low income households via various forms of PV nano-grids, including: (i) SHS sharing, (ii) roof-top micro-utility, (iii) ground based micro-utility, and (iv) distributed rooftop utility Output 3.3 Program to overcome barriers to affordability and sustainability designed and implemented to achieve purchase of pico-PV systems or small SHSs by lowest income households, as well as to achieve long-term sustainability of these products
Component 4: Renewable Energy Investment Scale-up **Outcome 4. Renewable energy accounts for an increased share of Bangladesh's power generation mix** Output 4.1: RE projects funded by SREDA-operated RE funds	***Component 4: Renewable Energy Investment Scale-up*** **Outcome 4. Renewable energy accounts for an increased share of Bangladesh's power generation mix** Output 4.1 Financial close and construction begun on pipeline utility-scale PV and wind power projects as a result of barrier-removal support by SREDA

Output 4.2: Bankable documents for financing pilot grid-connected RE projects	Output 4.2 Bankable documents for financing pilot grid-connected RE projects in biomass related areas
Output 4.3: Operational pilot rice husk grid-connected RE plants	Output 4.3 Operational ~~pilot rice husk~~ grid-connected ~~RE~~ biomass power generation plants
Output 4.4: Bankable plans for solar or RE nano-grid installations	
Output 4.5: Functioning nano-grid installations	
Output 4.6: Solar irrigation pump investments	Output 4.4 Implemented projects in key, high power consuming areas that demonstrate innovation in the direct use of solar power and strong potential for commercial viability, carried out under the umbrella of the "SREDA Innovation Lab"
Output 4.7: Replication plans for additional RE projects	Output 4.5: Replication plans for additional RE projects

3.3 Project Management and Governance

Project team: As mentioned, the project team consists of three full time persons, a project manager, a monitoring and evaluation officer, and a finance and administrative officer. The project, by the time of the MTR, about 2.75 years into its lifetime, had already had turnover in two of these three positions. The first PM served from Dec. 2014 to Oct. 2016, almost two years. He was reportedly happy with the post, as he had studied renewable energy, and worked long hours. He was transferred to a position involving labor issues. Then, not until February of 2017, about four months later, a new individual was assigned to the position. The first M&E officer left the project for another position and was replaced by the current M&E officer around Oct. 2016. The finance and administrative officer has been with the project throughout and provided important institutional memory during the MTR mission.

The project team faces challenges in implementing the project as designed (or soon to be as re-designed) as the RP, SREDA, makes decisions about project activities that may not be in line with project design. This was the case when the project was asked to fund two PV charging stations for auto-rickshaws and easy riders, even though the payback period is computed to be something like 60 years. Further, the PSC reportedly approves activities on a one-by-one basis at its meetings, despite the full project document having been agreed upon by the BOG and UNDP in 2014.

At the same time, the MTR consultant believes that a very proactive, hard-working, well-organized, and harmonious team could make a tremendous difference in the progress and success of the redesigned project, despite challenges presented by project governance. Via the MTR process, the team should now have a good understanding on the priorities of GEF projects

generally and the redesigned SREPGen in particular. They should understand that the main focus of the project is to be on RE power generation and that launching of major activities, such as the project nano-grid demos, the biomass resource assessment, and the pay-as-you-go SHS distribution efforts, are now top priorities, whereas SREDA promotion activities, which have already received the bulk of the project team's attention over the past three years should not be a major focus going forward. In order to improve the efficacy of the project team and ensure their work is on track, it is recommended that each member keep daily timesheets in excel showing what they have worked on each day and for how long. This measure will also ensure that they put in the full required work hours each day. UNDP CO should check these timesheets every two weeks.

SREDA, the Responsible Partner: While officially the responsible partner, in practice SREDA acts as the project IP. As pointed out by one stakeholder, SREDA has grown up with the project, being launched about the same time as the project was effectively started in late 2014. As mentioned, the MTR consultant was impressed with the SREDA "Learning Hub" event she attended, as it directly addressed barrier removal needs for investments in utility-scale PV power generation. Yet, SREDA faces some challenges that have, in turn, had a negative impact on project progress. For example, the SREDA Chair changes frequently. In the 2.75 years of the project's active lifetime (since Dec. 2014), SREDA already has its third Chair, who also serves as SREPGen's NPD. SREDA further lacks members with strong experience in RE aside from the JS who is the SREDA Member responsible for EE&C. The MTR consultant sees two important areas in which SREDA's capacity can be built with regard to the project governance. First, SREDA should be better educated on the GEF approach generally and SREDA should have a better understanding of the SREPGen project in particular. SREDA should understand that GEF projects, like SREPGen, often aim to demonstrate and promote new approaches so that others will scale them up. Further SREDA should understand that SREPGen is focused on RE power generation, so that activities outside this area, such as building EE, are not acceptable content to be added to the project. Second, SREDA should further understand that once project activities are agreed upon, all efforts should be made to implement those activities. During the MTR process, the MTR consultant found that it was often a problem that activities included in the SREPGen ProDoc, which had already been under active implementation for 2.75 years (since Dec. 2014), were very recently handed to other donors. The MTR consultant also found that SREDA was anxious to carry out at PV mini-grid under SREPGen at a cost of USD600,000 of GEF funds, despite the fact that many of these had been demonstrated by other donors, with many more in the pipeline. The proposed mini-grid initially had no distinguishing features from these other mini-grids. This second example shows a lack of understanding of the GEF approach to project activities. The MTR consultant also found a hesitancy on the part of SREDA to cooperate/ contract out demos to parties other than IDCOL, regardless of the type of demo and IDCOL's suitability to it. It was much later explained that it is easier for SREDA to have IDCOL handle contracting, though the details of this explanation are still not understood.

PSC: The PSC, chaired by the SREDA Chair, has had periodic meetings and plays an active role in project governance. The problems with the PSC, however, are similar to the problem with SREDA. The PSC members, like SREDA, should be educated on the GEF approach as well as on the project objective and main outcome areas, so that they will understand the purpose and scope of the project. Notes from PSC meetings show members bring up ideas like solar water heaters, which are not in the scope of the project. Further, prior to the MTR, the PSC was approving project activities on a case-by-case basis. This practice should stop as an approved project should not require activity-by-activity approval. Only changes to the approved project plan should have to be approved by the PSC.

UNDP: UNDP has provided strong technical support to the project redesign and admirably via its regional headquarters ensured the project did not deviate too extensively from its approved objective and outcomes. Some stakeholders suggest that slow response time from UNDP is the reason for the long period of project stagnation and delay in achieving project redesign. The MTR consultant is concerned, however, that the project team should be more proactive when a response is slow in coming, by sending up follow up requests by email. Frequent follow up requests will ensure that persons who have numerous projects on their plate realize the urgency of an issue being faced. If only one email is sent by the project team and then a three month wait ensues, the responsibility should be on the project team, who should be spending at least 40 hours per week on SREPGen, rather than the UNDP person who may be overseeing 20 or more projects. In retrospect, given the challenges faced by the project, a redesign as has now occurred was the proper solution and probably should have been initiated earlier. Now that the crisis faced by SREPGen is clearly on UNDP's radar, UNDP CO should allocate closer attention to ensure the project team is on track, via review of the aforementioned timesheets submitted every two weeks. Monthly checks of progress as compared to the redesigned project timeline will also be important. Further, one important area in which UNDP CO can improve support is through facilitating a speedier procurement process. The MTR consultant heard mention of four-month long UNDP procurement processes, which are not acceptable for a project that needs to move quickly. UNDP should give this matter its close attention and work to ensure that SREPGen procurement can be achieved with a maximum of six weeks between opportunity posting and contracting signing.

4. Component 1 Progress, Relevance, and Redesign

Component 1, the "RE Policy and Regulatory Support Program," is the component of the project's four components that has had the greatest progress to date. Yet, this progress has not been in the area of formulating or adopting new policy and regulations, but instead in promoting

SREDA, the government agency tasked with promoting RE and EE. The project's most successful and greatest efforts have been in holding SREDA workshops and seminars and in promoting SREDA through the press and other means. In addition, USD1 million in co-financing has been used to refurbish SREDA's rented office space. The project has not, to date, developed any policy, regulatory, or planning proposals for SREDA or GOB.

While the component title does not mention SREDA, the original Outcome 1 statement does: "SREDA evolves into a facilitation center to support private sector RE investment development, enable regulators to determine fair flexible tariff structures, bring confidence to private RE investors, and increase the number of approved RE projects." In general, those involved in the project have so far been seeing the component very much as the "promote SREDA" component, rather than a component meant to generate draft policies, regulations, and plans and to work to get these adopted. To ensure the outcome statement is fully on target, it is suggested the policy and planning aspects of SREDA be elaborated in the statement as follows: "SREDA evolves into a facilitation center to support private sector RE investment development; to enable regulators to determine fair flexible tariff structures, develop RE power plans, and adopt RE power management and incentive regulations; to bring confidence to private RE investors; and to increase the number of approved RE projects."

The original design of Component 1/ Outcome 1 involves four outputs. The first, Output 1.1 was stated as "Completed studies on RE policy and tariffs and grid integration with RE power sources." None of the activities originally proposed under the output were undertaken with support of the project. Stakeholders explained to the MTR consultant that key activities in the original design, a feed-in-tariff (FIT) study and a grid integration study, were no longer needed. BOG is no longer interested in a FIT; and the grid integration study has been undertaken with the support of another donor. As for the FIT, the GOB would instead like to pursue a Net Metering Policy, but the drafting of such a policy has already been supported by the World Bank. Yet, it was proposed by SREDA that the project could provide support to policy formulation and adoption work in the following four areas: (1) Consultation on and finalization of the draft Net Metering Policy and preparation of a Net Metering Action Plan. (2) Design of technical and financial solutions for grid integration of PV mini-grids (typically over 100 kW) and PV agricultural pumps (typically 9 to 15 kW). (3) Preparation of template agreement documents for rooftop solar and its grid-integration, including BOO projects in this area. (4) Design of regulations and guidelines on the quality and disposal of PV system components. These four activities have now been proposed (see Annex 2) as a part of a new Output 1.1 restated as "Regulations, guidelines, and technical solutions to promote distributed renewable energy power generation and its integration into the grid."

As for the original Output 1.2, stated as "SREDA operational rules," the project has done no work in this area; and stakeholders indicate such support is no longer needed, as GIZ long ago

helped develop SREDA operational rules. Based on the need of the project to promote utility-scale RE power generation, needs for policy support in this area were identified during the MTR mission; and a new statement of Output 1.2 is proposed as "Law, regulations, policy, and guidelines to manage and incentivize investment in utility-scale RE power installations." Under this redesigned output, it is recommended the project pursue two main activities, a study of barriers to utility-scale RE power generation investment in each of PV, wind, and biomass and preparation of *Renewable Energy Power Generation Investment Management and Incentive Policy/Regulations and Guidelines* for each of PV, wind, and biomass. For the wind and biomass areas, it is suggested work also include guidelines and template project proposal documents for such projects under unsolicited offer. (Such guidelines and template project proposal documents are already available from GOB for utility-scale PV projects.)

As for Output 1.3, "Trained SREDA staff in RE development," the project has put substantial effort and funds in this area, perhaps more than any other area, if "training" is broadened to include workshops and study tours. It is recommended that the output statement be adjusted slightly to include the private sector ("Trained SREDA and private sector staff in RE development"), as the private sector has been involved in some of the workshops and as the ProDoc's originally proposed activities under this output also emphasized the private sector. So far, the project has conducted a training needs assessment and two or three five-day training sessions on RE and EE for government officials, with perhaps about twenty persons attending each session. The project team envisions about three more trainings. It is recommended these additional trainings include representatives from the private sector and that the scope be limited to RE power generation topics. The output has included numerous workshop and seminar events, some of which are considered the greatest achievements of the project to date. The MTR consultant, as mentioned, attended one event at which private sector utility-scale PV investors were asked to discuss their challenges with high level government officials. Indeed, this type of event appears highly in-line with the results SREPGen targets in the area of RE power generation scale-up. One stakeholder also highly praised an SREPGen/ SREDA workshop on PV solar pump irrigation as being high level, identifying gaps and barriers, and formulating an action plan to address these. As for study tours, the project has already had three such tours, one to each of South Korea, India, and Germany. Combined with the very limited accomplishments of the project to date, the focus on study tours is concerning. For the study tour to Germany, in particular, there is concern that higher priority was put on the travel opportunity than on achieving serious results for the project.

As for Output 1.4, "SREDA-managed RE investment facilitation center," this is another output on which there has already been a lot of focus. Yet, the focus has been mainly on promotion of SREDA rather than on the project supporting the evolution of SREDA as a "one stop shop" for potential investors in RE power generation, as envisioned in the ProDoc. In the area of SREDA promotion, the project has supported: (1) advertisement in the newspaper, (2) roundtable with

Daily Star (an English language newspaper) involving the Deputy Minister, (3) notebook, pens, and other promotional materials including brochure, (4) SREDA exhibit at Expo, and (5) travel to observe lantern distribution by the Prime Minister in an enclave area. There have also been events at local schools to promote SREDA and its mission to promote RE and EE. A second activity under this output has been the development of a SREDA website. The website is operational and, reportedly, different ministries are actively inputting required data on RE into the website. Yet, the website was prepared before SREDA was an active entity. One recommendation is to develop a more dynamic website to which stakeholders can come to comment and debate RE related issues in discussion threads. Thus, the project going forward may wish to support the addition of a dynamic element to the website. During discussions of the project going forward there was support from some stakeholders for the idea of developing a "SREDA Innovation Lab." The MTR consultant is concerned that the innovation lab idea is tied closely with off-course efforts to focus the project on application of PV power (e.g. PV boats, PV freezers, PV backpacks etc.) rather than the core objective of the project, which is to ramp up RE power generation in Bangladesh. Nevertheless, due to the popularity of this idea with UNDP CO and SREDA, the redesigned activities propose two "Innovation Lab" competitions highlighting innovative application of RE power. As such, it is suggested the statement of Output 1.4 be slightly modified to read "SREDA-managed RE facilitation center, including innovation lab."

In the policy and planning area that is Component 1's focus, the mission identified the need for a detailed *RE Action Plan*, which would enumerate specific projects in roadmaps for each of PV, Wind, and Biomass. The idea of SREDA supporting such an action plan is widely supported by key stakeholders, because, while Bangladesh has general targets for RE power generation, there is no plan of how to achieve these. Thus, a new output to be stated as follows is proposed: "Output 1.5 Detailed action plan for RE power generation in Bangladesh."

Looking at Component 1/ Outcome 1 as a whole, then, the project has so far had its greatest achievements in this component, but has focused on non-policy and planning aspects of SREDA promotion and training. Going forward, the project should put the vast majority of its focus for this component on the newly identified/ refined policy and planning activities. Further, any additional SREDA promotion and training activities should focus squarely on RE power generation rather than other areas, such as building EE. Lastly, there should be no more study tours supported with GEF funds.

5. Component 2 Progress, Relevance, and Redesign

Component 2, "Resource Assessment Support Program," has had almost no progress to date, aside from the preparation of a long TOR for a nation-wide biomass resource assessment study. The statement for Outcome 2, the one outcome of this component, is "increased capacities of relevant government agencies to generate, process, obtain and disseminate reliable RE resource information for use by GoB and potential project developers and investors." Thus, it is important to note the capacity building aspect of the outcome – the target is not just data, but also capacity built. Outcome 2 as originally designed has three target outputs: (1) Output 2.2 Wind resource maps, (2) Output 2.3 Investment grade solar resource data, and (3) Output 2.3 Biomass resource data.

As for Output 2.1, the wind resource maps, the project has done nothing at all in this area. As noted, USAID has been carrying out wind resource assessment at nine sites, which SREPGen during its PIF stage had planned to do. During project design, when it was realized USAID would carry out the assessment work, it was decided SREPGen would take the results of the USAID work and come up with bankable wind farm proposals. Yet, during the MTR mission, USAID told the MTR consultant that it had always from the start been USAID's intention to do this work themselves. In assessing whether there is still a role for SREPGen in onshore wind resource assessment at this point, it is worth noting again that the Outcome 2 statement emphasizes "increased capacities" and further noting that the USAID wind resource assessment work did not build local capacity. In addition, the Power Cell official in charge of implementation of the USAID project identified Barisal as an interesting onshore area with wind potential that was not covered by the USAID study. He also noted that the GOB will take possession of the wind towers used for the USAID project (for which field measurements are now complete) and that these could be reused free of charge for additional assessments, thereby cutting the cost of such future assessments. Thus, it is recommended that SREPGen consider carrying out a learning-by-doing wind resource assessment activity in Barisal both to build capacities and get additional data from a promising. Two caveats are noted with regard to this work. If the soon-to-be released analysis of the USAID onshore wind data shows no viable onshore wind farm projects in Bangladesh, SREPGen may not want to pursue the Barisal project unless there is clear reason to believe Barisal will yield better results that the nine previously assessed sites. Second, assuming some results from the USAID study are attractive to investors, the timing of release of the wind masts for use by SREPGen should also be confirmed to be amenable to the timely progress of this redesigned activity.

Generally, the onshore wind resources in Bangladesh are not considered to be very good, though release of the USAID data should provide insights into whether there are viable projects. At the same time, experts suggest that offshore wind resources are very good. Thus, it is recommended that SREPGen consider doing a preliminary offshore wind resource study, conducted with satellite data and/ or data provided by the Navy. One concern is that Bangladesh's ocean areas are crowded; and the western area of its ocean is thus recommended as a more promising area for

having space for an offshore wind farm. The conduct of a preliminary offshore wind resource study will be contingent on availability of satellite data or on access to Navy data. From discussions with a naval officer in the Blue Economy Cell, the MTR team has learned that the Navy continuously gathers 30 m wind data on its ships, yet it does not keep a record of this data. The Navy would probably be willing to cooperate in a study by recording this data, though some stakeholders express concern that coordination with the Navy will be too slow.

Given the proposed focus of Output 2.1 on capacity building and on both onshore and offshore wind resources, a revision of the output statement is recommended as follows: "Output 2.1 Wind resource ~~maps~~ assessment capabilities built in Bangladesh through useful assessments conducted for onshore and offshore areas."

As for Output 2.2, investment-grade solar resource data, the project has done no work at all in this area. The MTR consultant is not sure such work is really needed, as utility-scale PV investors are already actively pursuing land acquisition for projects. It seems that these investors are likely already conducting assessment without the assistance of the project. One developer confirmed to the consultant that assessment work has been done at or near his site. Yet, SREDA indicated that this output is still needed. In light of this situation, the MTR consultant recommends further diligence on the need for this work vis-à-vis what investors are already doing and what the project would do differently. If the need is confirmed, an elaboration of the output statement, to highlight the capacity building aspect is recommended as follows: "Investment-grade solar resource data and relevant capacities built in Bangladesh." Such work might be carried out at five potential project sites.

As for Output 2.3, biomass resource data, as mentioned, the only progress on this so far has been preparation of a detailed TOR by a national biomass expert retained by the project for a nation-wide biomass resource assessment study. Strangely, the ProDoc emphasizes that such a study has already been done and is not needed, but stakeholders emphasize the last such study of good quality was in the 1980s and that, since that time, the situation has changed. (The ProDoc had proposed site specific biomass resource assessments for specific projects.) What is concerning about the proposed nation-wide biomass resource assessment study is that the cost of the study associated with the drafted TOR is unclear but estimated at minimum to be USD 1 million dollars. The TOR is very detailed and may have some areas that could be deleted, such as international comparison work. Because total GEF funds for SREPGen are roughly USD4 million and the project has many other things to achieve, not to mention that the allocation for the resource assessment component was in total just roughly USD100,000, it is recommended the project not spend over USD300,000 on this study. As recommended by the RTA, the study might be divided into two phases and phase one begun with project funds, while co-financing for phase two is sought from sources, such as an ADB TA fund accepting proposals related to RE. At the same time, it is recommended that the TOR be reviewed closely by a second expert with an understanding that the ultimate goal is identification of opportunities for biomass power generation to see whether there is room to delete unnecessary aspects. Upon recommendation of UNDP (and as recommended in this MTR report), the project is seeking to recruit an RE advisor.

This advisor then, once recruited, could be the one to review the TOR with a critical eye to reduce excess activities if possible. Further, this advisor should compare the proposed cost of the study to the cost of similar nation-wide biomass resource assessment studies carried out in other countries. In general, it is recommended that the TOR be modified to emphasize throughout activities and data acquisition that will support the development of biomass power generation projects. In light of the current orientation of this output, it is recommended that the output wording be elaborated as follows "Output 2.3 Nation-wide biomass resource ~~data~~ assessment study focused on availability of resources for biomass power generation and identification of potential project sites."

6. Component 3 Progress, Relevance, and Redesign

Component 3, "Diffusion of Photovoltaic-Powered Solar LED Lanterns (PVSLs) to Low Income Households," has had extremely limited progress to date. The component, the single outcome of which is "Increased affordability of photovoltaic solar LED lanterns (PVSLs) for low income households" (Outcome 3), is fully focused on the distribution of solar PV lanterns, with a partial subsidy covered by GEF funds. As discussed, this component, which represents more than half of the project's GEF budget has been stalled due to the lack of uptake in the Bangladesh market for solar PV lanterns. The original three outputs, as designed, were all meant to be focused on distribution of solar PV lanterns. The original three outputs were as follows: (a) "established financial mechanism that includes a credit scheme and buy-down" (Output 3.1), (b) "PVSL delivery models that provide product support and credit collection" (Output 3.2), and (c) "PVSL certification procedures and quality oversight of diffusion activities." Based on findings from the mission, the MTR consultant believes that the project should shift its focus away from solar PV lanterns and towards other approaches for getting RE power to the poorest and enhancing the quality of their power access. In this vein, it is recommended that the wording of the component and associated outcome be adjusted slightly as follows, while maintaining the original spirit of using PV power to increase power access of low income households: "Component 3. ~~Diffusion of~~ Affordable Photovoltaic Power~~ed solar LED lanterns (PVSLs) to~~ for Low-income Households and associated Livelihood Enhancement." "Outcome 3. Increased affordability and access to ~~of~~ photovoltaic solar power and associated livelihood benefits ~~LED lanterns (PVSLs)~~ for low income households."

An important result of the MTR mission is that it confirmed the low uptake of solar PV lanterns from multiple sources. Further, some sources offered substantial detail on the decline of the solar PV market. In general, two key conclusions are: (1) With the evolution of the PV market in rural areas, solar lanterns are considered too low level a product; and most households are not interested in them, but are instead interested in SHSs. (2) Even the SHS market as accessed by IDCOL's donor supported programs has declined drastically due to the large number of free systems provided by the government, the very low cost Chinese systems that have entered the

market, and the saturation of the market segment of those most easily able to afford the systems. These findings suggest that the redesign of Component 3 to focus on something other than solar lantern distribution with partial subsidy and up-front payment by buyers is justified.

The limited progress that the project has made on Component 3 so far is as follows: The project has signed an agreement with IDCOL for about USD2 million calling for IDCOL to distribute pico-solar systems of 5 to 10 W each with a USD20 subsidy for each system, as provided from the USD2 million agreement. The reason the agreement indicates pico-solar systems, which may have multiple lights instead of the one light of the solar lantern, is that IDCOL did not want to include solar lanterns in its work, as these are mobile and cannot be monitored in the same way as pico-solar systems. IDCOL already has very extensive experience distributing SHSs subsidized by other donors, but this agreement appears to be the first time it has moved into the area of pico solar. Unfortunately, although IDCOL had its partners start marketing these systems in January 2016 (over one year after SREPGen launch), so far, only 1,400 have been sold. This is clearly very slow up-take, especially when considering that at USD20 per system, the USD2 million subsidy represents a target of 100,000 pico PV systems distributed. According to IDCOL, one of the problems is that the price of these systems is close to that of small SHSs that have a larger capacity. IDCOL has suggested that the terms of agreement be changed to include small SHSs with a USD30 subsidy each and total distribution of 14,000 such systems with an allocation of USD250,000. They further propose that SREPGen provide USD600,000 for a fifty percent subsidy for a PV mini-grid (the total cost of which will be USD1.2 million).

The problem with these proposals from IDCOL is that they do not fit the philosophy of GEF project design. So far, other donors have supported the distribution of literally millions of SHSs in Bangladesh with partial subsidies via IDCOL programs. Now that the SHS market has slowed down, the new "hot" area for donors to work with IDCOL on are the PV mini-grids, costing around USD1.2 million each, with 50 percent donor subsidy (or USD600,000), of which 27 have already been completed, or are under construction, or have had funds confirmed with the help of other donors. Donor interviews suggest that some donors are considering adding even more systems to this total.

The recommendation of this report is that SREPGen not get in line to do the same things other donors have already done and are able to do with much larger scale than would be supported by the GEF project. Instead, SREPGen should focus on areas in which it can make contributions to removing a barrier that has not been addressed by demonstrating something new or adding meaningful scale-up to something that has been tested only experimentally. Thus, during the MTR mission, efforts were made to understanding remaining unmet needs in the off-grid market in terms of PV power generation for low-income households. Some key findings are as follows:

- In the areas with the 1,024 long-term off-grid villages, there are only about 100 sites that are suitable to PV mini-grids in terms of population distribution. Each of these sites would cover about three villages or 1,000 persons. As such, there will be over 700 villages in long-term off-grid areas that are not suitable to being supported by PV mini-grids of the scale envisioned by IDCOL.

- Nano-grids (perhaps 1 kW to 10 kW) offer a solution for those areas not suitable to mini-grids. A nano-grid can step up the quality of energy access from an independent SHS, as greater power may be available for productive uses and measures may be taken to ensure reliability.
- An issue with the SHS market is that the poorest households, while they have an interest in acquiring either a small SHS or pico-PV system, lack the funds to pay for such systems up front. While distributors are willing to offer payment plans for larger systems, they find the transaction costs, given the low price of these smaller systems, too high and do not offer payment plans for them. An alternative is pay-as-you-go systems that operate via SIM card and allow automated payment via SIM card top-up. This approach would allow poorer families to purchase small SMSs or pico-PV systems via monthly payments, though this may increase their total costs, as the payment system (requiring a special box and financing fees from the organization handling payments) is relatively expensive as compared to total system cost. So far, only about 1,200 of these pay-as-you-go systems have been distributed in Bangladesh. There may be room for wider promotion and leverage of this approach to reenergize the small SHS market by accessing what may be a relatively large segment of low-income households that cannot afford the upfront costs of small SHSs.
- Another issue with the SHS market is that owners, once their systems break down, often do not have access to persons who can repair the systems.

Based on these and other findings, it is recommended that the original three outputs be replaced with three new outputs: "Output 3.1 Actionable information on village layout, number and proportion of poor households without electricity or without adequate electricity, and challenges in delivering power to un-electrified households in long-term off-grid areas, namely 1,024 villages identified by the Rural Electrification Board, particularly those 700 or more villages not suitable to mini-grids." "Output 3.2 Electricity access newly provided to low income households via various forms of PV nano-grids, including: (i) SHS sharing, (ii) roof-top micro-utility, (iii) ground based micro-utility, and (iv) distributed rooftop utility." "Output 3.3 Program to overcome barriers to affordability and sustainability designed and implemented to achieve purchase of pico-PV systems or small SHSs by lowest income households, as well as to achieve long-term sustainability of these products."

The rationale behind these new outputs is as follows: First, Component 3/ Outcome 3 should continue to focus on providing PV power to lower income households who lack access to electricity or who lack access of sufficient quality. In addition, the greatest focus of this work should be in the 1,024 long-term off grid villages. Yet, as many donors are already supporting PV mini-grids in those areas and as PV mini-grids cannot meet the needs of around 70 percent of the villages in such areas, Component 3 should focus on other aspects besides PV mini-grids. The two aspects identified are PV nano-grids for as few as 20 households, or perhaps up to 60 households or so, and pay-as-you go small SHS or pico-PV systems. The first output proposed will focus on doing a proper survey of those 1,024 villages not suitable to PV mini-grids. The survey should determine which of these villages (or actually clusters within the villages) may be appropriate to PV nano-grids and which of those have relatively higher proportions of

households without electricity. It should also consider the appropriateness of PV nano-grids of different types and the potential of productive use associated with the nano-grids. The survey should also investigate the suitability of pay-as-you-go systems for those households that still do not have electricity and are not in PV nano-grid suitable areas.

The second output will involve designing and installing the nano-grids, with an initial target of 300 nano-grids and preliminary budget of USD1.2 million. The work should also include promotion of productive use activities at the nano-grids and use of EE DC appliances. The nano-grids should show a diversity of forms, so that different approaches can be tested. This may include SHS sharing, where already installed SHS are connected together and neighbors can buy and sell electricity from one another; rooftop micro-utility, in which a large building houses of its roof a large SHS, which provides power to other nearby buildings; ground-based micro-utility, a more standard configuration with PV panels in a central location on the ground; and distributed rooftop utility, where a RESCO may install SHSs on many rooftops and interconnect them, but retain ownership of the SHSs and bill users for their monthly power usage. Interestingly, PV nano-grids were originally proposed as a part of Component 4, but dismissed by the PMU as having been already carried out by others. During the MTR mission it was found that SolShare had carried out five of the SHS sharing systems. Yet, this is very limited scale considering the typical system serves only 20 or so households. With the same budget that could support one PV micro-grid's 50 percent subsidy, the project may be able to support 150 nano-grids and 3,000 instead of 1,000 households. Thus the project could take nano-grids from the experimental scale of five test sites through a preliminary scale-up and commercialization phase. During the MTR, it was found that there are not many if any demonstrations of the other types of PV nano-grids proposed, though it as suggested that some businesses are already informally carrying out a sort of "rooftop micro-utility" model by selling power from their SHSs to neighbors.

The third output will represent an effort to tap the portion of the small SHS and pico solar market that is not being tapped due to lack of ability to pay. It will focus on promoting pay-as-you-go systems for these and target the distribution of 20,000 such systems by providing partial subsidies. This is similar to the target of 14,000 systems proposed by IDCOL, but the distinction is that, while the IDCOL approach will not provide differentiation from the approach used to distribute millions of systems already, the approach for this output will endeavor to address a barrier to getting these systems to the poorest households, a barrier that may be contributing to the stagnancy of the market. As part of this output, training of "solar grandmas" will be carried out to ensure that local service is available to repair systems. Grandmas are selected as a promising demographic, as they will be more likely to stay in their villages than youth, another popular group for such training.

7. Component 4 Progress, Relevance, and Redesign

Progress on Component 4 has been limited and has strayed from the project's original intention. Component 4's title is "Renewable Energy Investment Scale-up." Its outcome (Outcome 4) is stated as "Renewable Energy accounts for an increased share of Bangladesh's power generation mix." Strangely, project team members involved with this project at present and in the past referred to Component 4 as the "innovation component" and firmly believed its purpose was to demonstrate innovative applications of RE power. They seemed unfamiliar with the idea that the component was intended to be about scaling up investment in RE power generation. The main activities carried out for this outcome include one that is in line with the original intention and two that seem off-track, better suiting this new interpretation of the component as an "innovation component." The on-track activity was the preparation of pre-feasibility studies for W2E projects in six different municipalities. The activities that seem more off-track are solar boats and solar charging stations for auto-rickshaws and easy ride vehicles. Below, the original outputs and the proposed redesigned outputs will be discussed sequentially.

The original Output 4.1 reads: "RE projects funded by SREDA-operated RE funds." No work at all has been carried out in this area. According to stakeholders SREDA will not be having funds to support investment in RE projects. Based on the original intention of the component/ outcome (scale-up of RE power generation investment), a redesigned Output 4.1 is suggested to be: "Financial close and construction begun on pipeline utility-scale PV and wind power projects as a result of barrier-removal support by SREDA." The associated redesigned activities proposed are that barriers to such projects be identified through meetings between potential investors and the government and that the project then takes action to remove such barriers, working with the government to do so. Important barriers that may be identified are likely to include accessing international investment and securing land. Lastly, it is recommended that under this output concession bidding projects for both utility scale PV and utility scale wind are designed and carried out. (Currently, GOB is allowing "unsolicited offer" for utility scale solar, whereby investors propose projects one by one, but some proponents note that this approach inhibits "price discovery" that may be stimulated by competitive bidding.)

The original Output 4.2 was "Bankable documents for financing pilot grid-connected RE projects." Because investors are already developing such documents for utility scale PV projects and because USAID plans to develop such documents for utility scale wind projects, it is suggested that this output be slightly modified to read, "Bankable documents for financing pilot grid-connected RE projects in biomass related areas." This is the output under which the six pre-feasibility studies for W2E that have already been carried out may be considered to fall. These studies were completed by an international consulting firm. Stakeholders indicate that these reports suggest the W2E projects assessed are not economically feasible and that there is a problem with the volume of waste not being enough. As part of this output, it is suggested that three additional activities be undertaken: (1) preparation of a feasibility study for a 100 kW grid-connected W2E project (perhaps at Gazipur), (2) preparation of a feasibility study for a grid-

connected rice-husk power generation project, and (3) preparation of a feasibility study for a grid-connected biogas or bagasse power generation project. The first activity is selected in particular, as SREDA wishes to have SREPGen provide partial subsidies for such a W2E project. The original activities in the ProDoc were all focused on rice husk power generation, though this does not seem to be of much interest to SREDA and may have been driven at the time of project design by the involvement of private sector players, who are no longer known to be active in the Bangladesh market.

The original Output 4.3 reads "Operational pilot rice husk grid-connected RE plants." Based on SREDA's interests, it is suggested the output be revised to read: "Operational ~~pilot rice husk~~ grid-connected ~~RE~~ biomass power generation plants." The proposed new activities associated with the redesigned outcome include liaison between biomass power generation investors and the government to identify barriers and the addressing of such barriers. Per SREDA's request, a third activity will include SREPGen subsidization of a 100 kW grid-connected W2E plant.

The original Outputs 4.4 and 4.5 were "Bankable plans for solar or RE nano-grid installations" and "Functioning nano-grid installations," respectively. The original plan was for the project to support six PV nano-grids serving ten households each and including a small irrigation pump. Given that it has been proposed PV nano-grids be a major focus of Outcome 3, their deletion from Outcome 4 is recommended.

The original Output 4.6 was "Solar irrigation pump investments." Since such investments are now being pursued on a large scale by ADB and the World Bank in Bangladesh, it no longer makes sense for SREGen to support work in this area. There is a strong desire, however, on the part of SREDA to support other applications of PV power. Indeed, already, some of the main project activities have been the demonstration of solar boats and of PV charging stations. The MTR consultant is not that enthusiastic about these areas, as it seems critical for the project to focus on its neglected mandate to promote RE power generation. Further, the GEF has a separate category of sustainable transport for which RE transport options are a better fit. Yet, as the project has already carried out these activities and as others of interest have been suggested, it is recommended that the project redesign include an output for PV power applications. A justification offered by one stakeholder for emphasizing these areas is related to the rapid expansion of Bangladesh's grid. If Bangladesh aims to become a solar nation, the argument goes, given the wide expansion of the grid, it will be important to move from areas such as SHSs to special applications of PV power that can be used in both on-grid and off-grid areas alike. The proposed revised statement of Output 4.6, which due to the deletion of some outputs will be Output 4.4, is "Implemented projects in key, high power consuming areas that demonstrate innovation in the direct use of solar power and strong potential for commercial viability, carried out under the umbrella of the 'SREDA Innovation Lab.'" Redesigned activities to be listed under this output include those already implemented and those proposed. For the solar charging stations, two have already been supported by the project, though with a payback period of nearly 60 years, these are not an attractive use of project funds. Given the magnitude of auto-rickshaw and easy rider charging in Bangladesh and its negative impact on the grid, this seems an

attractive area to address if a viable business model, such as a fast charging station that does not require batteries can be implemented. Yet, there may be a problem of fast charging damaging batteries. Thus, an additional charging station is only recommended if technical and business model challenges can be overcome. A second activity area proposed is arsenic and iron removing solar pumps. Already BGEF has demonstrated one of these pumps. The project might demonstrate ten more if they can be demonstrated with a viable business model. Because 30 million Bangladeshis are exposed to toxic levels of arsenic, this is an important undertaking. Other areas that may be supported are solar freezers (which will allow fishermen to get more reasonable prices when they have large catches) and household scale PV pumps, which some stakeholders believe have a strong potential market. Finally, the five solar boats already supported by the project should be indicated under this output. The technology is such that the boats can get about half of their propulsion power from PV and the other half from diesel. SREDA has indicated it would like to support five more of these boats. This does not seem necessary unless the new boats can demonstrate something beyond what the original boats demonstrated. It has been mentioned that the new boats could be produced on a more commercial basis, but that they would still require forty percent subsidy. Thus, it is recommended that further investigation of the attractiveness of this model and the potential for its true scale-up be carried out. Addition funds should be committed to solar boats, only if the rationale is very compelling.

The last output of Component 4 as originally designed is Output 4.7 “Replication plans for additional RE projects.” No work has yet been done on this output, which is reasonable, given the stage of the project. It is recommended this output be maintained, though renumbered as Output 4.5. Improved elaboration of the activities for this output are included in Annex 2. Basically, it is suggested that the output involve the identification of additional potential projects in all areas promoted by the project such as utility-scale PV, utility-scale wind (if relevant), W2E, biogas power generation, rice husk power generation, bagasse power generation, solar PV nano-grids, pay-as-you-go distribution of small SHSs, and any of the PV application areas promoted by the project. As another activity under this output, it is recommended the project carry out outreach to potential investors regarding investment in these projects. As a last activity, it is suggested an attractive online map be prepared to feature these projects.

8. Expenditures, Co-financing, and Cost Efficiency

Exhibit 8-1 shows project expenditures of GEF funds to date as of August 1, 2017. The project shows expenditures in the hundred or two hundred thousand range for each component and project management, aside from the resource assessment component. The resource assessment component has almost no expenditures, though work of the biomass expert in preparing the TOR for the national biomass resource study is not yet included. Of total project GEF funds of USD4,077,272, there was a total of USD3,453,339 remaining as of Aug. 1, 2017.

Exhibit 8-1. Expenditures as of August 1, 2017 by Year and by Outcome

Outcome, etc.	2014	2015	2016	Jan – July 2017	Total as of Aug. 1, 2017
1. Capacity Building and Policy	0	62,301	37,731	14,737	114,769
2. Resource Assessment	0	80	0	0	80
3. RE Power Access for the Poor	0	6,010	108,155	988	115153
4. RE Power Scale-Up	0	5,887	196,565	29,413	231865
Project Management	3,256	48,946	41,767	66,877	160,846
Loss/Gains	0	92	141	987	1220
TOTAL	**3,256**	**123,316**	**384,359**	**113,002**	**623,933**

Exhibit 8-2 shows total expenditures by outcome as a portion of the originally targeted budget in the ProDoc and as a portion of the newly proposed budget in Annex 5. Results show the challenge that project management funds are roughly 80 percent spent. This is a result of the requirement that project management represent no more than 5 percent of GEF funds combined with the fact that no co-financing has been made available for project management. The results also show that the resource assessment and PV for the poor components have had only an extremely limited proportion of spending completed, while Component 1 and Component 4 have had a more substantial proportion of targeted spending achieved, though still less than one third of their allocated amounts.

Exhibit 8-2. Expenditures (as of Aug. 1, 2017) by Outcome as a Portion of Original Targeted Budget and Newly Targeted Budget

Outcome, etc.	Expend-itures as of Aug. 1, 2017 (USD)	Originally targeted allocation (USD)	% of originally targeted allocation	Newly proposed allocation in Annex 5 (USD)	% of newly proposed allocation
1. Capacity Building and Policy	114,769	424,400	27%	373,204	31%
2. Resource Assessment	80	105,520	0%	469,150	0%
3. RE Power Access for the Poor	115,153	2,235,500	5%	2,024,853	6%
4. RE Power Scale-Up	231,865	1,118,980	21%	1,006,202	23%
Project Management	160,846	192,872	83%	203,863	79%
Loss/Gains	1,220	--	--	---	---
TOTAL	**623,933**	4,077,272	**15%**	**4,077,272**	**15%**

Exhibits 8-3 through 8-6 show activity-wise based expenditures for Components 1 through 4, respectively, for major activities or major activity types. This information was provided by the Administrative and Finance Office at the request of the MTR consultant, though some adjustment has been made to consolidate costs under correct component when they are included across components for which the fit is not justified. For example, a learning cost of USD34,500 was included in Component 4 expenditures and has been shifted to Component 1, as it was explained this represents training, workshops, and seminars. And a "direct project cost" of USD41,861 was shifted from Component 4 to Project Management, as it was explained this cost is a "PMU related cost." And, travel of USD29,966 was shifted from Component 4 to the study tour total of Component 1, as this was said to be a part of the South Korea study tour expenses

with per diem of USD450 per day. Thus, these results are meant to reflect the proper categorization of activities by component (or project management costs) even if there is some variation with the actual books of the project. The purpose is to give management a high level view as to where most of the funds are going in terms of activity or activity types. A similar table has been provided for project management in Exhibit 8-7.

Exhibit 8-3. Component 1 – Policy and Capacity Building Activity-Wise Expenditures (USD) as of Aug. 17, 2017

Aggregated activity	Expenditures as of Aug. 17, 2017 (USD)
1. Workshops and seminars	34,800
2. Training sessions	21,200
3. Training, workshops, and seminars (originally included under other components)	39,951
3. Promotion of SREDA – advertisement and press, including Daily Star roundtable	10,602
4. Promotion of SREDA – notebooks, pens, and promotional materials	4,900
5. SREDA booth at Expo	8,575
7. Study tours (one to Korea and one to India)	63,396
Total spent in Component 1 to date	**183,424**

Exhibit 8-4. Component 2 – RE Resource Assessment Activity-Wise Expenditures (USD) as of Aug. 17, 2017

Aggregated activity	Expenditure as of Aug. 17, 2017 (USD)
1. Design of comprehensive TOR for biomass resource assessment (consultant not yet paid as of Aug. 17, 2017)	0.0
Total spent in Component 2 to date	**0.0**

Exhibit 8-5. Component 3 – Making RE Power Accessible to the Poor at Affordable Price Activity-Wise Expenditures (USD) as of Aug. 17, 2017

Aggregated activity	Expenditures as of Aug. 17, 2017 (USD)
1. Pico solar partial subsidy transfer to IDCOL (note: Funds not yet transferred to IDCOL partners. As only 1,400 pico systems sold, this represents an totally subsidy amount of USD28,000.)	100,000
2. Travel (to enclave areas for presentation of free solar lanterns to people there by Prime Minister)	8,037
3. Printing media for enclave visit	3,243
Total spent in Component 3 to date	**111,280**

Review of all five of these tables make it easy to identify the relatively "big-ticket items" of expenditure so far. Component 1 study tours absorbed USD63,396, though this may double after the recent Germany study tour expenditures are added. Component 1 workshops, seminars, and training used USD95,951. For pico solar subsidies, USD100,000 has been transferred to IDCOL,

but only USD28,000 in theory is represented by the 14,000 pico systems distributed so far. As for the solar boats, USD57,580 has been spent so far, though the contract for the first five boats totals USD88,623. SREDA would like to do five more boats. As for the two charging stations that on rough estimate have a 60 year pay-back, USD64,500 was spent. And, USD63,059 was spent on six W2E pre-feasibility studies, which may indicate a lack of feasibility in all locales due to limited waste resources. Salary costs are USD125,667 (including USD41,861 originally charged to Component 4 as direct project costs).

Exhibit 8-6: Component 4 – RE Investment Scale-up
Activity-Wise Expenditures (USD) as of Aug. 17, 2017

Aggregated activity	Expenditures as of Aug. 17, 2017 (in USD)
1. Solar boats (3 hybrid traditional and 2 new modern style boats = 5 boats and related activities) – total amount of contract is USD88,623	57,580
2. Auto-rickshaw/ easy ride solar charging stations (2) (not yet paid, but in process of disbursement as of Aug. 17, 2017)	64,500
3. W2E feasibility studies for six sites	63,059
4. Equipment	2142
5. Printing media	11,400
6. Electronic media	7,856
Total spent in Component 3 to date	**206,537**

Exhibit 8-7. Project Management Category-wise Expenditures (USD) as of Aug. 17, 2017

Aggregated category	Expenditures as of Aug. 17, 2017 (in USD)
1. PMU staff salaries (PM salary's partial amount and Admin Officer salary)	83,806
2.Direct Project Cost – Staff (said to be PMU costs)	41,861
3. Others administrative cost	9,704
Total spent in Project Management to date	**135,371**

While project expenditures as of Aug. 1, 2017 were only 15 percent of GEF funds, cost efficiency might still be ranked low as activities tend to veer off the main focus (solar boats and solar charging stations for vehicles) and there has been an overemphasis on study tours.

As for co-financing, the only reported co-financing is USD1 million to refurbish SREDA's rented offices. The refurbished offices are nice, though it is reported SREDA will now be getting long-term offices near the airport soon.

9. Miscellaneous Topics: Sustainability, M&E, Gender, and Ratings

This section briefly touches on each of the following miscellaneous topics: sustainability, M&E, gender, and project ratings.

Sustainability: As the project has not progressed well on key activities it is difficult to assess sustainability. The project should give strong attention to the PV nano-grids it installs by ensuring proper RESCO management systems are in place. Further, by promoting training of "solar grandmas" in small SHS and pico PV system repair, the project can help to raise the sustainability of its activities in promoting these systems. In addition, the project should put strong emphasis on policy and planning to create a sustainable environment for RE power generation development in Bangladesh. In Component 1, promotion of SREDA without parallel development of policies and plans will likely not be a sustainable result. Finally, not much progress has been made in Component 2, resource assessment. Yet, the redesign strategy to include capacity building in all Component 2 efforts should contribute to sustainability if implemented as designed.

M&E: The project appears to be carrying out M&E, such as preparation of PIRs, though most all indicators are indicated to have no progress at all. A new "Project Results Framework" has been proposed by the MTR consultant and included as Annex 3. Further, recommendations on computing targeted GHG ERs are provided in Annex 6. It is important that the PMU give the Monitoring and Evaluation Officer the time and space needed to finalize and monitor these items.

Gender: Project implementation should give proper attention to gender. Based on MTR consultations, it was found that almost all consultations with professionals were with men, suggesting the RE field (and perhaps professional life generally) is dominated by men. The project team has one very capable woman on the team, which is applauded. The project should endeavor to recruit female consultants if/ when possible. Further, in its nano-grids and small SHS distribution work, a role for rural women should be emphasized. The proposed training of "solar grandmas" in SHS repair will be one way to do this. RESCO management of the PV nano-grids should also involve women. In addition, when the nano-grids promote productive uses, the project should ensure that at least half or more of this work involves productive uses that raise women's incomes.

Project ratings: Exhibit 9-1 below gives the MTR consultant's ratings in various areas for the project, offering an explanation for each. The overall progress towards results rating is Unsatisfactory (U), the implementation rating is Moderately Unsatisfactory (MU), and the sustainability rating is Moderately Unlikely (MU). The MTR consultant is very concerned about this project's lack of progress and issues with project governance and project management that seem to make it difficult for the movement to be seen in the project's best interest, despite the

redesign of activities provided during the August 2017 mission. At the same time, based on the strong input from so many stakeholders, SREDA, UNDP, and the project team, she also sees very strong potential for high impact, if only the will to move the project forward in a way in line with GEF philosophy and the original project objectives and outcomes is undertaken. There does seem to be a problem of competing interests that pull the project in directions not in line with its objectives and outcomes and with the GEF incremental approach. As discussed elsewhere, if the project is unable to turn things around by end of February, 2018, early project close is an option that should be considered so that funds are not wasted. Yet, at the same time, if progress is good by Feb. 28, 2018 and the project has made a strong turnaround, if it is needed, an extension of one year from the original close date in Nov. 2019 to a new close date of Nov. 2020 would be in order.

Exhibit 9-1. Project MTR Ratings

Measure	MTR Rating	Achievement Description/ Explanation
Progress Towards Results	**Unsatisfactory (overall)**	Overall, the project is not making progress towards most of its key targeted results. The project seems to be pulled by competing interests and get off-track with activities that are not in its core area of focus, which should be RE power generation, nor in its outcomes' core areas of focus. And, even with complete re-design suggestions in August 2017, the project as of Nov. 2017 has not been able to achieve a turnaround.
Objective Achievement	Unsatisfactory	The objective should be focused on RE power generation, yet the project seems to veer off the main course of focusing on this objective.
Outcome 1 Achievement	Moderately Satisfactory	Outcome 1 is seen to have two major areas: promotion of SREDA and development of the RE policy, regulatory, and planning framework. The project has done well in the first area and has done nothing in the second area.
Outcome 2 Achievement	Unsatisfactory	As for Outcome 2, focused on resource assessment, the only thing the project has done is retained an expert who has prepared a detailed TOR for one of the Outcome's three outputs.
Outcome 3 Achievement	Unsatisfactory	Outcome 3, which focuses on PV power generation for poor households lacking electricity has faced challenges due to changes in the market. Originally focused on solar lanterns, over a year after project implementation began, the project signed an agreement with IDCOL to distribute pico-solar systems, another product. Yet, while the project had planned to spend over USD2 million on these efforts, so far only USD28,000 worth of subsidies are accounted for in terms of sales (14,000 systems since Jan. 2016 with intended subsidy from the project of USD20 per system.)
Outcome 4 Achievement	Unsatisfactory	Outcome 4, which is RE Investment Scale-up has been misinterpreted to be about "innovation" and focused on things like solar boats and PV charging stations which were not in the original ProDoc.
Project Implementation	Moderately unsatisfactory	There are great challenges with management. The GOB seems to require the project team to carry out activities that are not in line

and Adaptive Management		with the project objective and outcomes and the team also seems to have trouble achieving basic progress on the project.
Sustainability	Moderately Unlikely	Given the lack of progress on the project, at present, there is not so much that could be sustainable. Yet, considering Outcome 1, which has focused on SREDA promotion but done nothing in developing the policy and planning framework, the prospect for sustainability is not good. More emphasis on policy and planning is needed. When component 2 ramps up, if there is a good portion of the effort put on capacity building, that should help with sustainability. And, when component 3 ramps up, it will be important to ensure the nano-grid management model is sustainable and that there are repair capabilities available locally for the small SHSs that are distributed.

10. Recommendations

Overall Strategy and Timeline

1. Major project redesign should be adopted (by Nov. 2017), followed by check on progress (at latest Feb. 2018). If progress is not sufficient, early project close should be considered to ensure funds are not wasted. If progress is acceptable, application to the GEF for a one-year extension from current project close date of Dec. 31, 2018 until Dec. 31, 2019 may be considered if needed. Such application to the GEF for extension could be made in the first quarter of 2018 if needed to be done that soon to comply with GOB parallel processes of approving the redesigned project and should be done no later than six months into the year 2018: During the MTR, it was determined that a good portion of project stagnancy was a result of project activities no longer being an appropriate fit to the RE power situation in Bangladesh. Thus, the overall recommendation of this MTR report is that the project be substantially redesigned. More specific recommendations on the redesign are covered below, by component. A draft of redesigned activities is provided in Annex 2. A draft of redesigned indicators ("Project Results Framework") is included in Annex 3. A draft of redesigned project timeline is provided in Annex 4. A draft of redesigned project budget is provided in Annex 5 (as a separate electronic document in Excel format). All of these draft documents (activities, indicators, timeline, and budget) should be revised and agreed upon by the project team, UNDP, the IP, and the PSC by the end of November 2017. The project is currently scheduled to close in Dec. 31, 2018. Contingent on acceptable progress in the next three months, a request to the GEF for extension until Dec. 31, 2019 may be submitted in the first quarter of 2018 and should be submitted at latest in the middle of 2018. "Acceptable progress" will be defined as contracts being issued or revised versions being signed for major initiatives by at latest end of February 2018, including: (i) contract issued for establishment of 300 PV nano-grids, (ii) contract revised for sale and distribution of 20,000 pay-as-you-go SHSs or pico-PV systems, and (iii) USD300,000 contract issued for phase 1 of nation-wide biomass resource assessment. If acceptable progress is not

achieved by end of February 2018, it is recommended early project close be considered so funds do not go to waste.

Project Redesign - Component 1

2. Policy and planning outputs and activities should be substantially revised to fit needs and should be the main focus of Component 1 going forward.

- Feed-in-tariff work (no longer desired by GOB) should be replaced with work to support GOB efforts to promote distributed grid-connected RE power generation, including:
    - Finalization of Net Meting Policy and development of Net Metering Action Plan (A draft Net Metering Policy has been prepared with support of the World Bank.)
    - Development of technical solutions for grid integration of distributed RE power (including solar water pumps and PV mini-grids)
    - Development of template agreement documents for grid integration of rooftop solar (including build-own-operate agreements, in which outside parties install systems on others' rooftops and sell the power)
    - Development of regulations and guidelines on quality of products related to PV and on their disposal
- Development of SREDA operational rules have been completed with support of GIZ and should be replaced with development of law, policy, regulations, and guidelines to manage and incentivize investment in utility-scale RE power installations, including.
    - A study of barriers to investment in utility-scale RE power installations
    - "Investment Management and Incentive Policy/Regulations and Guidelines" for each of
        - Utility-scale PV
        - Utility-scale wind
        - Utility-scale biomass (including biogas power generation, waste to energy, bagasse power generation, and rice husk power generation)
- Due to needs for planning support, it is recommended a new output be added for development of a detailed Action Plan for RE Power Generation in Bangladesh, 2019-2040. Bangladesh has an RE policy and broad RE targets but no roadmap of how to get there.
    - The action plan will have details on types of projects and their locations and will include roadmaps for each of PV, wind, and biomass power generation.
    - The action plan work may have synergies with the replication plan work proposed under the redesign of Output 4.5 of Component 4. That is, the results of Output 4.5 may feed into the Action Plan. Recommendations for the elaboration of Output 4.5 (replication plans) are as follows:
        - Replication plan work should include identification of additional potential projects in all RE power generational and PV power application areas promoted by the project.[1]

[1] These include utility-scale PV, utility-scale wind (if relevant), W2E, biogas power generation, rice husk power generation, bagasse power generation, solar PV nano-grids, pay-as-you-go small SHSs and pico PV, easy ride and

- Replication plan work should be followed up with outreach to investors to develop the proposed projects.
- Preparation of an online map showing locations and nature of proposed projects and dissemination of link to potential investors is recommended as a way to increase investment outreach for proposed replication projects.

3. While some SREDA promotion activities can be continued, given that this area has already had significant achievement and received significant budget allocation, this work should be secondary to Component 1's policy and planning work and should be adjusted as follows:

- With about three trainings completed, about three more can be carried out if desired. These remaining trainings should focus on RE power generation only and should include the private sector as well as government.
- Workshops and seminars may be continued if desired, but should focus fully on RE power generation and not consume too much time of the project team or too much budget.
- Three study tours have been completed; and no more are needed.
- Press initiatives, promotional materials, and outreach to school children has already been substantial. Efforts can continued if desired but should not consume too much time or budget.
- The SREDA website developed by the project should be improved to enable discussion boards and stimulate discussion on them. Plans should be made for handover and long-term development and maintenance of the website.
- If desired, two competitions can be held to highlight applications of RE power. The competitions can be considered *SREDA Innovation Lab* initiatives.

Project Redesign - Component 2

4. Wind resource assessment work should be redesigned to take into account extensive work already done by USAID and remaining needs. Assuming the results of the USAID wind resource assessment work at nine sites shows some positive results and that its retired towers can be transferred in time for no-cost use, SREPGen can fill in the gaps by carrying out learning-by-doing onshore wind resource assessment in Barisal and carrying out a desk study on offshore wind resource potential.

- USAID's onshore resource assessment program at nine sites did not work to build local capacity in wind resource assessment, so this is a gap that can be filled during the Barisal wind resource work under SREPGen. Further, the towers used in the USAID study can be used cost-free for the SREPGen work. Since there are questions whether onshore wind resources in Bangladesh are attractive, a decision on Barisal may wait until USAID releases its findings. It should also be confirmed that the "free" towers can be accessed in a timely fashion.

auto-rickshaw solar charging stations, solar PV powered arsenic removal pumps, solar freezers/ ice makers for fish, household solar pumps, and solar boats.

- Some wind power experts, as well as officers from the Bangladesh Navy indicate that, while onshore wind resources in Bangladesh have been disappointing, offshore wind potential may be very good. Thus, a preliminary desk study using satellite data and/ or Navy data is recommended. Yet, this study will be contingent on results of a first step that assesses availability/ potential access to such data. The Bangladesh Navy collects offshore wind data at 30 meters from its boats. While they currently do not record results, they have expressed willingness to cooperate by sharing data for this desk study. Recommended best area of offshore study may be west part of Bangladesh's ocean areas as other activities are not being pursued in that area.

5. Nationwide biomass resource assessment, not initially included in the ProDoc, but with TOR design already initiated by a top biomass expert, should be launched as soon as possible. The current scope of work should be divided into two phases, with phase one efforts to be limited to a cost of USD300,000 of project funds, with contracting efforts to be initiated immediately. As the total costs anticipated for the nation-wide study may be roughly USD1 million or more, the other USD700,000 or more of work should be allocated to phase two, for which other donor funds can be pursued in parallel with implementation of phase 1 of the study. The last biomass resource assessment in Bangladesh was in the early 1980s; and experts agree on the need for a new one, due to the many changes in the country. The study should emphasize the identification, by location, of various types of high potential biomass power generation projects, based on findings about resource availability. To maximize impact in terms of biomass power generation project identification, the phase one portion of the study may target the one-third of districts that are considered to have the highest potential for identifying such potential projects. Contract signing for phase one should be achieved by February 2018 at latest.

6. The need for project support of investment-grade solar resource assessment, now being proposed at five sites, should be further vetted and justified, before being contracted. If the project goes forward with this work, it should include a capacity building/ learning-by-doing dimension. There are already several investors pursuing utility scale solar PV projects. As some have pursued solar resource assessment without the help of the project, the question arises of whether such support from the project is needed. Thus, the project team should do an assessment of whether solar resource assessments will proceed with sufficient quality and number without the project, or if project supported assessment is indeed justified.

Project Redesign - Component 3

7. Component 3 work (which aims to address getting PV power to the poor that lack electricity) should put its greatest focus on those villages among the 1,024 identified long-term off-grid villages that are not suitable to PV mini-grids. A survey of the 1,024 villages is recommended (to be commenced promptly by January 2018) in order to: (a) confirm which villages are not suitable for PV mini-grids and which of these have the highest proportion of un-electrified households, (b) determine the best type of PV nano-grids when nano-grids are suitable for such villages, and (c1) identify those cases of villages for which free-standing, unconnected household systems are instead the best option and (c2) determine viability of and strategy for a pay-as-you-go distribution initiative for such villages. Overall, extensive redesign of Component 3 is recommended, replacing the massive USD2.235 million partial subsidy program for solar lantern distribution with a mix of installation of PV nano-grids of different types (majority of funding, see recommendation 8) and a more limited partial subsidy program for small SHSs or pico solar systems sold on a monthly installment basis via pay-as-you-go technology (see recommendation 9).

8. The design and installation of 300 nano-grids for clusters of homes in long-term off-grid villages not suitable to PV mini-grids and with a high proportion of un-electrified households is recommended as the most extensive activity of Component 3, with budget of roughly USD1.255 million. The number of clusters of households in a cluster may be 20 or more.

- It is recommended that PV nano-grids of different types and different "topologies" be pursued including: SHS sharing (for villages that already have a lot of privately owned SHSs), micro-utility with main power source on a large rooftop, micro-utility with main power source on the ground, and distributed rooftop utility (for villages that have few privately owned SHSs already).
- Ideally, two different contractors should be engaged for this work to ensure a diversity of approaches. The contractors should be engaged at latest by end of February 2017.
- Income-generating productive uses of power and energy efficient DC appliances should be facilitated in the 300 PV nano-grids. These may be supported via technical assistance and a small revolving loan fund or grant fund of about USD200,000. The project team has suggested removing this productive use and energy efficient appliance work across all 300 nano-grids and instead developing two SDG villages with e-health facility, biogas cooking, and solar water purifiers. The MTR consultant's view is that the productive use work and EE appliance work are critical to promote across all 300 nano-grids and that if there are to be two demo SDG villages, these should not replace the productive use/ EE appliance work. The productive use/ EE appliance work may be incorporated into the nano-grid contracts. Indeed, one key potential nano-grid contractor has included EE appliances in its initial proposal.

9. Small SHS and pico-solar sold on monthly installment plan implemented via automated pay-as-you-go payment technology is recommended as the second key activity of the re-designed Component 3 to get PV power to the poorest households. A preliminary budget

allocation of roughly USD318,000 is recommended, pending confirmation of the viability of the pay-as-you-go strategy to generate substantial demand for systems.

- This activity is proposed because field work implies that the poorest households desire such systems but are unable to purchase them due to lack of the necessary up-front funds. The survey proposed in recommendation 7 should test the theory that an installment plan with payments facilitated by pay-as-you-go technology will increase demand for these systems among poorer households. If findings are affirmative, the project can proceed to promote distribution of such pay-as-you-go systems, especially in long-term off-grid villages/ households not suitable to PV mini-grids and not selected for PV nano-grids.
- It is recommended that the project include training of "solar grandmas" in the repair of SHSs and pico solar systems. Trainings can take place in off-grid areas or in on-grid areas that have large pockets without electricity. Lack of access to SHS repairs was identified as a problem during field work. As assessment test can be used to ensure that the solar grandmas have mastered the training materials.

Project Redesign – Component 4

10. Re-design of RE power generation scale-up activities is recommended to suit the current needs to achieve actual installations of utility-scale PV, utility-scale wind, and utility scale biomass power generation projects, with re-designed activities as follows:

- For each of utility-scale PV, utility-scale wind, and utility biomass power generation, it is suggested that meetings between key government officials and investors pursuing projects in these areas be held to identify barriers to the launch of such projects. (One such meeting for utility-scale PV has already been held and is considered quite successful.) Based on findings from these meetings, barrier removal work should be carried out.
- For each of utility-scale PV and utility-scale wind, it is recommended that either design of the first concession bidding project be carried out or that a general template for the bidding process be prepared.
- As for the preparation of bankable documents for financing grid-connected RE projects indicated in the ProDoc, it is suggested this work focus on feasibility studies and financing documents for biomass projects, including one project in each of W2E (a 100 kW project), rice husk power generation, and either biogas or bagasse power generation.
- As proposed by SREDA, the project may directly support the 100 kW W2E project, for which bankable documents are prepared under SREPGen, with a partial subsidy. The proposed subsidy support may be about USD200,000.

11. Special applications of RE power is an area less fully in line with the RE power generation objective of SREPGen. At the same time, pursuit of RE power applications as a part of SREPGen are to some extent justifiable. Bangladesh's power grid is expanding rapidly, so that PV power applications represent an important means of increasing use of RE power in both on-grid and off-grid areas. Thus, it is recommended that special PV power applications be considered pending sufficient funding is first allocated to other project initiatives. Relevant sub-recommendations are as follows:

- An additional PV charging station for auto-rickshaws and easy-ride vehicles may be supported by the project if a viable business model using fast-charging technology can be developed. The project has already developed two PV charging stations for such vehicles using slow-charging technology, but the computed payback period, on the order of 70 years, suggest these demos are not suitable for stimulating wide-spread market-based replication. PV charging stations for auto-rickshaws and easy-ride vehicles is a desirable area of work, as such vehicles are estimated to consume 40,000 MWhr per day in Bangladesh and often over-stress the grid, as large numbers of them charge at similar times of day. As a result, the Prime Minister has encouraged this type of demonstration.
- As there are 30 million Bangladeshis being exposed to unacceptably high levels of arsenic in drinking water, the development of a business model and preliminary scale up of arsenic removing solar PV pumps, as demonstrated by BGEF, may be supported by the project. The initial scale-up may include ten arsenic removing (and iron removing) pump sites. These pumps may also be included as a part of the SDG villages being proposed by SREDA as a part of Component 3.
- The project may support development of business model for and demonstration of solar/ freezers / ice makers to preserve fish in off-grid areas. The World Bank has demonstrated solar fridges for vegetables. Initial input suggests solar ice makers have not been demonstrated, but this needs to be confirmed. Stakeholders feel this technology could make a big difference for fishermen in off-grid areas, who are forced to sell large catches at very low prices due to lack of refrigeration. Stakeholders are interested in developing a cold storage chain from fisherman to market. The freezers may be included as a part of the SDG villages being proposed by SREDA as a part of Component 3.
- The project may support the development of household scale solar pumps, for which it is believed there is a substantial unexploited market. The household scale solar pumps may be included as a part of the SDG villages being proposed by SREDA as a part of Component 3.
- The project has already supported demonstration of five prototype solar PV boats, which are powered roughly half by PV and half by diesel. The MTR consultant believes contribution of the project to this area may already be sufficient. SREDA desires, however, to continue with five more additional boats, produced on a more commercial basis. If the project wishes to go forward with the additional five boats, the more commercial basis of this "phase 2" should be assessed to justify the additional work.

Note: The last output of Component 4, a replication output, is covered above under discussion of Component 1's RE Action Plan.

Cross-Cutting

12. The project should recruit part-time experts to support its efforts to implement the re-designed project at a rapid pace. The mix of experts may follow one of two scenarios: (1) a part time expert in PV (most major contract in terms of time), as well as a part-time expert in each of wind and biomass (more limited contracts) or (2) a general RE expert and an expert in TOR preparation and contracting.

13. The project should aim to diversify its partners – the organizations with which is signs contracts to implement project activities. Partners should be chosen based on their capabilities in the relevant re-designed activities.

14. The project team, after finalizing indicators (initial draft provided in Annex 3), should carefully consider achievement of indicators in any further adjustment or re-prioritization of project activities. In particular, attention should be paid to maximizing potential GHG ERs attributable to the project. Removing barriers to utility scale power generation projects will yield the highest ERs for the project. **In the case of utility scale projects, however, it will be important for the project team to carefully monitor developments and provide evidence that SREPGen activities did indeed remove barriers for such utility-scale projects, so that SREPGen can "claim" credit for the GHG ERs.**

15. Measures should be adopted as follows so that each of four key stakeholder groups (the PSC, the Implementing Partner, UNDP, and the project team) are able to increase their effectiveness in promoting project progress:

- The PSC should discuss and approve the re-designed project as a whole by end of Nov. 2017. So far, during the lifetime of the project, the PSC has been approving project activities on a case-by-case basis, although the ProDoc was signed by the GoB signifying approval of all activities. This approach of case-by-case activity approval is counter-productive and should be avoided in the future. Further, PSC members should be made aware (by repeated reminders from UNDP and the project team) that the project objective concerns RE power generation and that the project has four clear outcomes involving (1) policy, planning, and SREDA promotion, (2) RE resource assessment, (3) PV power for the poor, who lack electricity, and (4) RE scale-up (utility scale RE). It is thus RE power generation and these four areas on which the project activities need to focus.
- As with the PSC, the implementing partner/ implementing entity should be reminded repeatedly (by UNDP and the project team) that the project objective concerns RE power generation and has four clear outcomes involving (1) policy, planning, and SREDA promotion, (2) RE resource assessment, (3) PV power for the poor, who lack electricity, and (4) RE scale-up (utility scale RE). It is thus RE power generation and these four areas on which the project needs to focus. The IP should further be educated (by UNDP and the project team) on the GEF incremental strategy that informs project design. That is, the IP should understand that the project should aim to invest money in activities that stimulate replication of RE power generation initiatives on substantial scale and have the potential for commercial viability. Thus, one-off activities that lack replication potential and/or commercial viability are not suitable for SREPGen.
- UNDP should make strong efforts to support the project in faster turnaround of procurement handled through UNDP, with a target of maximum six weeks between opportunity posting and contract signing. Given the urgency of SREPGen implementation, UNDP should make special efforts to be responsive to queries from the project team. At the same time, the project team should recognize the very large load of projects handled by UNDP personnel. Thus, for

urgent items, the project team should be responsible for sending frequent reminders (such as every few days) to UNDP to ensure the urgency is obvious and noticed.

- The performance of the project team should be enhanced and monitored. The project team should move out of the "comfort zone" of Component 1 SREDA promotion activities and put most of their efforts on other areas. In particular, there is a need for them to actively engage in ensuring the re-designed Component 3 is properly launched by February 2018. To ensure the project team's work is on target, each team member should keep a daily timesheet in Excel documenting time spent on various activities. UNDP should review these timesheets every two weeks to ensure the team is putting its full effort in the right areas.

Annex 1. Mid-Term Review Mission and Other Consultations – Realized Schedule

Monday, July 31, 2017 Dallas Time / Tuesday, August 1, 2017 Dhaka Time

MTR launch call with Mr. Arif M. Faisal, Programme Specialist, Environment Sustainability and Energy, UNDP Bangladesh CO

Friday, August 4, 2017 - Travel

MTR consultant departs from Dallas, Texas

Saturday, August 5, 2017 - Travel

MTR consultant arrives in Dhaka, Bangladesh

Sunday, August 6, 2017 - Dhaka

Meeting with UNDP Bangladesh CO: Mr. Khurshid Alam, Assistant Country Director, UNDP Bangladesh; and Mr. Arif M. Faisal, Programme Specialist, Environment Sustainability and Energy, UNDP Bangladesh CO

Meeting with SREPGen Project Team: Ms. Mahsin Hamuda, SREPGen M&E Officer; and Mr. Nural Alam, SREPGen Finance and Administrative Officer

Meeting with SREDA: Mr. Siddique Zobair, Member (EE&C), SREDA, and Joint Secretary to the Government

Meeting with SREPGen Project Team: Dr./ Mr. Md. Taibur Rahman, SREPGen Project Manager

Meeting with SREPGen National Project Director (NPD)/ SREDA: Mr. Md. Helal Uddin, Chairman of SREDA, Power Division, Ministry of Power, Energy, and Mineral Resources, and Additional Secretary, Government of Bangladesh

Interview with Dhaka resident

Monday, August 7, 2017 - Dhaka

Meeting with SREPGen Biomass Expert: Dr./ Mr. Nural Islam

Meeting with Wind Resource Assessment Project: Mr. Mohammed Bazlur Rahman, Joint Secretary and Project Director, Wind Resources Mapping Project, Power Division, Ministry of Power, Energy, and Mineral Resources

Meeting with former Project Manager of SREPGen: Mr. Md. Monwar Hasan Khan

Meeting with World Bank: Dr./ Mr. Amit Jain, Renewable Energy Specialist, World Bank

Meeting with United International University (UIU) and SolShare: Prof. Shahriar Ahmed Chowdhury, Director, Center for Energy Research, United International University and Mr. Sebastian Groh, Managing Director, SolShare

Tuesday, August 8, 2017 - Dhaka

Meeting with Rahimafrooz: Mr. Quazi Ahmad Faruque, Head of Access to Energy, Rahimafrooz Solar, Rahimafrooz Renewable Energy, Ltd.

Meeting with Rural Electrification Board: Deputy Director responsible for Renewable Energy, REB

Meeting with Waste Concern: Mr. Iftekhar Enayetullah, Director and Co-founder

Meeting with ChinaAid: Mr. Qin Jiabin, Second Secretary, Economic and Commercial Counsellor's Office, Embassy of PRC in Bangladesh

Meeting with GIZ: Mr. Al Mudabbir Bin Anam, Officer Responsible for the Commission (Programme Coordinator), Renewable Energy and Energy Efficiency Program (REEEP), GIZ Bangladesh; and Eng. (Mr.) Ratan Kumar Ghosh, Senior Advisor, Energizing Development (EnDev), GIZ Bangladesh

Wednesday, August 9, 2017 - Dhaka

Meeting with UNDP Bangladesh CO: Mr. Mohammed Rezaul Haque, UNDP, Programme Associate, Resilience and Inclusive Growth Cluster, United Nations Development Programme (UNDP)

Meeting with ADB: Ms. Nazmun Nahar, Project Officer, Energy, Bangladesh Resident Mission, ADB

Meeting with USAID: Mr. A.K.D. Sher Mohammad Khan (Sher Khan), Energy Team Leader and Country Coordinator, SARI/EI, Economic Growth Office; Mr. Son Hoang Nguyen, Sr. Environment and Climate Change Advisor, Economic Growth Office; Mr. Shayan Shafi, Project Management Specialist (Energy), Economic Growth Office

Meeting with Mr. Dipal Barua, President, Bangladesh Solar and Renewable Energy Association (BSREA) and Founder and Chairman, Bright Green Energy Foundation (BGEF)

Thursday, August 10, 2017 - Dhaka

Learning Hub event at SREDA at which utility-scale solar-PV investors interacted with Advisor on Energy to the Prime Minister regarding barriers to launch of their pipeline projects

Mini-Interviews during and after Learning Hub Event, including with:

- Mr. Utpal Battacharjee, Capacity Development Specialist for SREPGen; Senior Consultant, INDC Project, Nature Conservation Management; and CLASP (Collaborative Labelling and Appliance Standards Program)
- Amity Solar (developer of utility-scale solar farms in Bangladesh): Mr. Moheuddin Ahmed, Chairman
- Symbior Solar (developer of utility-scale solar farms in Bangladesh): Mr. Farooq Siddiqui, Country Representative Bangladesh
- Paragon (developer of utility-scale solar farms in Bangladesh): Mr. Sarwar Hossain Shaheen, Head of Business Development
- JICA Energy Efficiency Project: Mr. Md. Jahangir Hasan Talukder, EE&C Financing Coordinator, JICA – Technical Assistance for Energy Efficiency and Conservation Promotion Financing Project, Mitsubishi Research Institute

Meeting with IDCOL (Infrastructure Development Company, Ltd.): Mr. Mahmood Malik, Executive Director and CEO; Mr. Md. Enamul Karim Pavel, Head of Renewable Energy; Mr. Md. Mahfuzur Rahman, Manager, Renewable Energy

Sunday, August 13, 2017 - Dhaka

Meeting with Bright Green Energy Foundation (BGEF): Mr. Dipal C. Barua, Founder and Chairman, BGEF; Mr. Naim Din, Manager and Head of R&D, BGEF; and group of female staff members (for part of meeting), BGEF

Meeting with UNDP: Mr. Khurshid Alam, Assistant Country Director, UNDP Bangladesh; and Mr. Arif M. Faisal, Programme Specialist, Environment Sustainability and Energy, UNDP Bangladesh CO; also, for brief meeting, Mr. Sudipto Mukerjee, Country Director, UNDP Bangladesh

Meeting with SREDA: Mr. Siddique Zobair, Member (EE&C), SREDA, and Joint Secretary to the Government

Tele-meeting with PV applications expert: Mr. Naimul Islam, Managing Director, Solar E Technology Australia Pty Ltd

Monday, August 14, 2017 - Dhaka

Meeting with Bangladesh Energy Regulatory Commission (BERC)

Wednesday, August 16, 2017 - Dhaka

Meeting with former Project Manager of SREPGen: Mr. Md. Monwar Hasan Khan

Meeting with SREDA: Mr. Siddique Zobair, Member (EE&C), SREDA, and Joint Secretary to the Government

Meeting with SREPGen Project Manager: Dr./ Mr. Md. Taibur Rahman

Thursday, August 17, 2017 - Dhaka

Meeting with SREPGen Financial and Administrative Officer: Nurul Alam

Meeting with Blue Economy Cell: Commodore (Mr.) A. A. Mamun Chowdhury, Blue Economy Cell, Energy and Mineral Resources Division, Ministry of Power, Energy, and Mineral Resources; Mr. Ashok Kumar Debnath, Joint Secretary, Blue Economy Cell, Energy and Mineral Resources Division, Ministry of Power, Energy, and Mineral Resources; and one other official, Blue Economy Cell

Tele-meeting with JICA: Mr. Mr Zaki Mohammed Ziaul Islam ("Zia Zaki"), responsible for sustainable energy at JICA Bangladesh

Friday, August 18, 2017 – Field Trip to Gazipur

Drive from Dhaka to Gazipur

Note: Mr. Md. Mahfuzur Rahman, Manager RE, IDCOL, accompanied mission team, including MTR consultant, SREPGen M&E Office, and SREPGen Finance and Administrative Officer on Solar PV aspects of the mission

Meeting with SolarEn Foundation (an IDCOL SHS and pico solar distributor): Md. Amanat Ullah Rubel, Regional Manager, Gazipur Region, Kapasia, Gazipur, SolarEn Foundation; Md. Mozammel Haque, Senior manager, Operations, Progati Sarani, Vatara SolarEn Foundation; and three other local SolarEn staff

Site visit to and interview with dentist in town who has purchased pico solar system from SolarEn Foundation

Site visit to Damusala Village

- Interview with Family #1 – purchaser of pico solar system from SolarEn Foundation
- Interview with Family #2 - has no pico solar system or SHS
- Interview with Family #3 – using a second hand SHS system that is not working well

Site visit to Village #2

- Interview with household #1 – has no SHS or pico solar system
- Interview with household #2 – has no SHS or pico solar system
- Interview with household #3 – has no SHS or pico solar system

Brief meeting with engineer regarding potential Waste2Energy project

Return from Gazipur to Dhaka

Sunday, August 20, 2017 - Dhaka

Mission Debrief with SREDA (Mr. Md. Helan Uddin, Chairman of SREDA, Mr. Sidiqque Zobair), UNDP (Mr. Khurshid Alam, Mr. Kazuyoshi Hirohata), SREPGen Team (Mr. Taibur Rahman, Ms. Mahsin Hamuda, Mr. Nurul Alam)

MTR consultant departs Dhaka for Dallas

Friday, September 22, 2017 - Dallas

Tele-meeting with Mr. Roland Wong, International Consultant for Design of SREPGen Project Document

Annex 2. Proposed Redesign of SREPGen Outputs and Activities

SREPGen Project Objective, Outcomes, and Outputs/ Activities

November 10, 2017

Color code:

Black text: Used for original objective, outcome, and outputs as stated in the ProDoc. For some outputs that will be revised, the original output is listed in black font with "*revised as follows*" added in italics, and with revised output then offered in red. Black text is also used for activities that are similar to activities already carried out and/or originally stated in the project document ("ProDoc"). To save space and reduce confusion, however, not all of the activities stated in the ProDoc and/or and not all of the long descriptions of those activities are included here.

Red text: Used for revised outputs or new outputs. Also used for suggested minor wording revision of objective and of one outcome to improve clarity/ precision.

Blue text: Used for suggested revised activities.

Objective: Reduction in the annual growth rate of GHG emissions (as compared to business as usual) from fossil fuel-fired power generation through the exploitation of Bangladesh's renewable energy resources for electricity generation.

Component 1: RE Policy and Regulatory Support Program

Outcome 1: SREDA evolves into a facilitation center to support private sector RE investment development; to enable regulators to determine fair flexible tariff structures, develop RE power plans, and adopt RE power management and incentive regulations; to bring confidence to private RE investors; and to increase the number of approved RE projects.

Output 1.1 Completed studies on RE policy and tariffs and grid integration with RE power sources -> *revised as follows* ->

Output 1.1 Regulations, guidelines, and technical solutions to promote distributed renewable energy power generation and its integration into the grid.

Activity 1.1.1 Finalizing of net metering policy and development of action plan, including:

Activity 1.1.1A Holding of public consultations on *Net Metering Policy* prepared by

SREDA with Power Cell/ Power Division support. Revisions and finalization of policy based on consideration of public comment.

Activity 1.1.1B Preparation of detailed *Net Metering Action Plan*, including consultation, workshop, FGD, and vetting with policy makers. The *Action Plan* will be a road map showing how net metering will be implemented in various sectors and how much uptake of distributed RE power can be accepted.

Activity 1.1.2 Preparation of technical and financial solutions for grid integration of distributed RE power, including the following sub-activities:

Activity 1.1.2A Development of technical and financial solutions for how to integrate solar water pumps, which are typically 9 to 15 kW capacity, into the grid during their off-season when the pumps are not being used.

Activity 1.1.2B Development of technical and financial solutions for how to integrate solar PV mini-grids, which are typically over 100 kW and have battery backup, into the grid.[2] This work should also provide assessment of reduced battery needs of the mini-grids once integrated to the grid.[3]

Activity 1.1.3 Development and finalization of template agreement documents to promote rooftop solar and its grid integration. This will include preparation and finalization of policy and draft template agreement document for large-scale BOO (Build Own Operate) rooftop solar projects and their grid integration. The policy and agreement document will allow providers to install a system on a customer's premises and sell the power to the customer and back to the grid.

Activity 1.1.4 Development of regulations and guidelines that promote the use of quality equipment in distributed PV applications and ensure proper disposal of wastes, including the following two sub-activities:

Activity 1.1.4A Development of a regulation for standardization of solar PV system parts, including solar panels, solar inverters, charge controllers, batteries, and solar cells. The standards should be based on parameters set by the Bangladesh Standards and Testing Institution (BSTI).

Activity 1.1.4B Development of detailed guidelines on preferred solar PV system related products, including solar panels, solar inverters, charge controllers, batteries, and solar cells. Guidelines should propose specifications consistent with standards, so that users will have greater awareness of products that meet national standards.

[2] While mini-grids are being developed in long-term off-grid areas, it is expected many of these areas will eventually be reached by the grid.
[3] Typically, battery costs are 60 percent of mini-grid cost; so grid integration may lower battery costs substantially.

Activity 1.1.4C Development of regulations for and institutional plan to enforce the proper disposal of PV system wastes, including batteries and panels.

Output 1.2 SREDA operational rules -> *revised as follows* ->

Output 1.2 Law, regulations, policy, and guidelines to manage and incentivize investment in utility-scale RE power installations.

Activity 1.2.1 Research and preparation of concise study on the barriers to utility-scale RE investment (both on and off-grid) and how to address these barriers. Findings will serve as input to the design of the *Management and Incentive Policy/Regulations* prepared as part of Activity 1.2.3, as well as inform adaptive management of the SREPGen project (so that activities can be adjusted to best remove relevant barriers).

Activity 1.2.2 Drafting and promotion of detailed *Renewable Energy Power Generation Investment Management and Incentive Policy/Regulations and Guidelines*, including each of the sub-activities listed below. Findings of Activity 1.2.1 will be considered in preparing these regulations. Various options of incentive regulations will be considered, such as favorable business tax policy and favorable policy for import of relevant equipment and parts. In particular, the possibility of developing a concession policy, whereby the government identifies sites for large-scale RE power generation of certain types (e.g. PV or wind) and has prospective investors bid on their development, will also be assessed and considered for incorporation into the regulations.

Activity 1.2.2A Preparation of *Utility-Scale PV Investment Management and Incentive Policy/Regulations* to promote utility-scale PV following consultation with PV investors.

Activity 1.2.2B Preparation of *Biomass Power Generation Investment Management and Incentive Policy/Regulations and Guidelines* to promote utility scale biomass power generation. These will include (a) (i) biogas to electricity policy/regulations, (ii) waste-to-energy policy/regulations, (iii) bagasse[4] to electricity policy/ regulations, and (iv) rice husk power generation policy/ regulations and (b) guidelines and template project proposal documents for biomass/biogas to electricity projects under unsolicited offer.

Activity 1.2.2C Preparation of *Utility-Scale Wind Power Investment Management and Incentive Policy/Regulations and Guidelines* to promote utility-scale wind power. These will include (a) wind power policy/regulations and (b) guidelines and template project proposal documents for wind power projects.

Output 1.3: Trained SREDA and private sector staff in RE development

[4] Bagasse is the matted cellulose fiber residue from sugar cane that is processed in sugar mills.

Activity 1.3.1 Carrying out of six, week-long training sessions for government officials and private sector investors in RE power generation, covering technical side, management side, and financial/ investment sides, with at least ten relevant persons in attendance per session. (Note: *Three trainings have been completed already; and there are three more to go. The remaining sessions will include a test at the end to show mastery of training materials.*)

Activity 1.3.2 Conducting of workshops and seminars to build the knowledge base of professionals in the RE power generation area, to generate new ideas and promote exchange between government and the private sector. Some workshops may overlap with the efforts to promote exchange between government and the private sector as a part of Activity 1.1.1A and Activities 4.1.1A, 4.1.2A, and 4.3.1. (*Note: Several workshops and seminars already conducted. More will be carried out in second half of project. Given project objective of promoting RE power generation, this should be the focus of workshops and seminars carried out by the project.*)

Activity 1.3.3 Travel of high level policy makers to countries with advanced RE promotion policies to learn about policies and observe results. Includes the following sub-activities:

Activity 1.3.3A Travel of high level policy makers to South Korea to learn about Korea's RE power promotion policies and results of these policies. (*Note: Completed*.)

Activity 1.3.3B Travel of high level policy makers to India to learn about India's RE power promotion policies and results of these policies. (*Note: Completed*.)

Activity 1.3.3C Travel of high level policy makers to Europe to learn about RE power promotion policies and results in those countries. (*Note: Completed in Oct. 2017.*)

Output 1.4: SREDA-managed RE facilitation center, including innovation lab

Activity 1.4.1 Promotion of SREDA via initiatives with the press, development and distribution of promotional materials, and outreach to school children. (*All of these sub-activities have already been carried out and will continue in the second half of the project.*)[5]

Activity 1.4.2 Development of SREDA website and ensuring of ongoing updates that provide RE resource assessment information and potential RE investment project information. Incorporation into SREDA website of active discussion board on RE power development in Bangladesh (both on-grid and off-grid). Activity will also ensure that a system is set up within SREDA for ongoing

[5] PMO has recommended recruitment of communications specialist for promotion of SREDA under Activity 1.4.1. International MTR Consultant, however, suggests that SREDA promotion to date as carried out by PMO team has been adequate and that more emphasis and funding needs to be put on Components 2, 3, and 4, as so far the project team has focused mainly on Component 1. Thus, funding for such a specialist was not included in the budget prepared by the International MTR Consultant.

maintenance and development of website. (*Note: Website has been set up; and government agencies are active in submitting data. More work will be done to develop interactive topical discussion board and ensure resource assessment data and potential investment projects are included in the site.*)

Activity 1.4.3 Carrying out of SREDA Innovation Lab activities. Activities will include two competitions on highlighting the new applications of RE power generation in Bangladesh followed by a seminar for the development of such applications in each case.[6]

Output 1.5 Detailed action plan for RE power generation in Bangladesh *(Note: new output)*

Activity 1.5.1 Preparation of detailed *Renewable Energy Power Generation Action Plan for 2019-2040. RE Action Plan* will include details on types of projects and their locations. It will include *PV Roadmap*, *Wind Power Roadmap*, and *Biomass Power Generation Roadmap*. The last will build on the nationwide biomass resource assessment conducted as part of Component 2.

Component 2. Resource Assessment Support Program

Outcome 2. Increased capacity of relevant government agencies to generate, process, obtain, and disseminate reliable RE resource information for use by GOB and potential project developers and investors.

Output 2.1. Wind resource maps -> *revised to* ->

Output 2.1 Wind resource assessment capabilities built in Bangladesh through useful assessments conduced for onshore and offshore areas.

Activity 2.1.1 Carrying out of wind resource mapping study in Barisal onshore areas to determine wind energy potentials.[7] The work will build local capacity and may make use of the retired USAID-supported wind resource assessment towers now in storage at the BPDB (Bangladesh

[6] The PMU has proposed putting the costs of a long-term RE specialist advisor to the project under this activity. The MTR consultant suggests, instead, that the costs of this advisor either be put under Component 3 (rural PV demos) or spread across the various areas where the expert's help will be most needed (Components 2, 3 and 4).

[7] An island had earlier been recommended by one stakeholder for wind resource assessment with a view to minimizing the battery storage capacity required for an off-grid PV mini-grid project planned there by adding in some wind capacity. This, it was suggested, might reduce the overall cost of the mini-grid. Yet, it was also noted that it would not be feasible to get MW scale turbines to the island. Thus, it may be more appropriate to focus investment grade wind resource assessment efforts on locations that have may have potential for placement of MW scale turbines, such as onshore areas of Barisal. For this reason, the activity has been revised to focus on mainland/ onshore areas only, rather than also on islands. At the same time, the project team may wish to wait and see the results of the USAID wind resource assessment work in other locations in Bangladesh (and whether attractive investment projects are identified) before deciding whether to move forward with this activity. They will also need to ensure that the USAID towers are available to be used by this activity in a timely fashion.

Power Development Board). New data logger and software will probably need to be acquired. Activity will entail engaging experts to carry out the wind resource assessment work combined with training-by-doing. This activity will be contingent on two items: (1) at least some positive results coming out of the USAID wind resource assessment data and (2) the towers becoming available in a timely fashion.

Activity 2.1.2 Carrying out of preliminary study and training-by-doing experiences for relevant Bangladesh officials and private sector investors in offshore wind resource assessment. The study will utilize available satellite data (and/ or possibly Bangladesh Navy data) to get an overall impression of the potential of offshore wind resources in Bangladesh, particularly in areas south of the western coastal area of the nation, where ocean activity is less busy.[8] As a prerequisite step to this activity, the availability of satellite data or potential cooperation with the Navy on procuring offshore data will be assessed.

Output 2.2 Investment-grade solar resource data and relevant capacities built in Bangladesh

Activity 2.2.1 Identification of five high potential utility scale PV sites and carrying out of investment-grade resource assessment at the sites.[9] This will give a clear understanding about net power generation in each particular area, so as to determine the PV power tariff as well as the economic viability of the projects. Work will involve training-by-doing experiences for relevant Bangladesh officials and private sector investors.

Output 2.3 Biomass resource data. *->to be revised to->*

Output 2.3 Nation-wide biomass resource assessment study focused on availability of resources for biomass power generation and identification of potential project sites.[10]

[8]This activity has been revised from earlier proposed cooperation with the Navy on offshore wind data to use of satellite data and/or use of Navy data, as stakeholders indicate cooperation with the Navy may not yield data in a timely enough fashion to allow the project to deliver on time. Review of satellite data as a first step towards off-shore wind resource assessment has been recommended in a recent study supported by the Netherlands Enterprise Agency. (Wind Minds, *Wind Energy Potential Bangladesh: A Baseline Study*, April 13, 2017, accessible at https://www.rvo.nl/sites/default/files/2017/05/baseline-study-wind-energy-bangladesh.pdf.)

[9]The need for such assessments requires further clarification. As there are several investors proposing utility scale PV projects, the question arises as to whether these investors have already done investment grade solar resource assessments. If so, the next question is whether the government needs to do such studies or if there is already a good pattern of investors taking care of such work. It may make more sense for the government to pursue such assessments if the government wishes to pursue a concessional model for future solar PV sites, rather than the current unsolicited offer model.

[10]Note: The original version of this output in the ProDoc indicates "Significant biomass resource data collection is not envisioned in this project." Instead, the original output focused on project-specific studies. Yet, there is strong stakeholder consensus that the government needs a comprehensive nationwide biomass resource assessment (the last one was done in the 1980s) to develop plans and incentive regulations related to biomass power generation. This is the reason for revision of this output to a more specific statement of its nature.

Activity 2.3.1 Preparation of TOR for nation-wide biomass resource assessment study in Bangladesh, with ultimate focus on biomass power generation resource availability. (*Note: Activity completed*.)

Activity 2.3.2 Preparation of implementation/ action plan for carrying out of nation-wide biomass resource assessment study in Bangladesh that has ultimate focus on biomass power generation resource availability. Work will include determination of manpower and qualifications needed as well as costing. Work will involve refinement of TOR prepared under Activity 2.3.1 to ensure costing is as tight as possible and to distinguish two phases of development of the nation-wide biomass resource assessment, where the first phase is within the boundaries of available project funds for this activity. While the project can start carrying out phase 1 of the biomass resource assessment in the short term/ immediately, work will also include in parallel securing of co-financing for the second phase of the assessment.[11]

Activity 2.3.3 Conducting phase 1 of nation-wide biomass resource assessment, with ultimate focus on biomass power generation resource availability[12].

Component 3. ~~Diffusion of~~ Affordable Photovoltaic Powered ~~solar LED lanterns (PVSLs) to~~ for Low-income Households and associated Livelihood Enhancement

Outcome 3. Increased affordability and access to ~~of~~ photovoltaic solar power and associated livelihood benefits ~~LED lanterns (PVSLs)~~ for low income households.[13]

Output 3.1 Established financial mechanism that includes a credit scheme and buy-down grants.
Output 3.2 PVSL delivery models that provide product support and credit collection.
Output 3.3 PVSL certification procedures and quality oversight of diffusion activities -> *all three of original outputs to be changed to between two and three of the following preliminarily proposed outputs ->*

Output 3.1 Actionable information on village layout, number and proportion of poor households without electricity or without adequate electricity, and challenges in delivering power to un-electrified households in long-term off-grid areas, namely 1,024 villages identified by the Rural Electrification Board, particularly those 700 or more villages not suitable to mini-grids.

[11]Potential co-financing sources under investigation include ADB USD16 million TA fund that is openly accepting and vetting proposed TORs from the Power Cell.
[12] At this time, the project is considering allocating up to USD300,000 to phase 1 of the study, but a very rough estimate offered by one expert is that the full study will cost USD1 million or more in total. PMU will need to undertake more work to understand why the cost would be so great and whether the level of detail envisioned for such a high cost will make a meaningful impact on the future capacity of biomass power generation in the country beyond what a less detailed study might achieve.
[13] Note: In consultation with UNDP-GEF Regional Headquarters, it has been decided not to formally change the outcome, but instead to respect the general spirit of the outcome, while revising the technology choices used to reach the outcome. To make things clearer, if it will be allowed, a minor alteration to refer to PV power generally rather than PVSLs specifically is suggested.

Information will be used to select villages with the highest number/ share of un-electrified households, but that are not suitable to mini-grids, for implementation of various nano-grid models (see Output 3.2). For those villages in which nano-grid models are not implemented, information may also be used to revamp the project's pico-solar program (see Output 3.3), perhaps combining pico-solar with small SHSs, if new pay-as-you-go approaches to distribution are assessed to be viable means of providing electricity access to the poorest households on an individual household system basis. It is envisioned that this study will be a relatively quick one, but will provide enough information to ensure activities for subsequent outputs (Output 3.2 and Output 3.3) are effectively designed.

Activity 3.1.1 Carrying out of survey focused mainly on the 1,024 villages in long-term off-grid areas to determine which villages are not suitable to mini-grids (if not already known). Selection of villages for nano-grid implementation and (possibly) selection of different villages for pico-solar/ mini SHS distribution. Among those villages not suitable to mini-grids, the survey will determine how many households lack electricity in each village and what proportion these households are of the total in the village. Those villages with the largest number of un-electrified households will be the priority for work associated with Output 3.2 and Output 3.3 (if pursued). The survey will also look at the layout of identified villages with high potential for nano-grids to determine the type of nano-grids most suitable to each village.

Output 3.2 Electricity access newly provided to low income households via various forms of PV nano-grids, including: (i) SHS sharing, (ii) roof-top micro-utility, (iii) ground based micro-utility, and (iv) distributed rooftop utility. Installations will focus on those long-term off-grid areas that are not suitable to mini-grids due to layout of households/ villages. Installations will cover at least 3,000 households that did not have access to electricity before.[14] Total number of nano-grids installed under the project will be about 300, with perhaps 20 households on average per nano-grid. The work should include a relatively equal mix of the four different types of nano-grids, at least at first, so an assessment of their results can be made. The different nano-grid models may be combined in some places. SHS sharing refers to interconnection of SHS systems in a village or cluster of homes, so that homes with greater need for electricity (or that lack an SHS) can purchase electricity from SHS homes with an excess of electricity. A roof-top micro-utility refers to a business operation utilizing a large rooftop system and connection to nearby homes to sell electricity to those homes. A ground based micro-utility refers to a business utilizing a ground based PV system (usually in the watt or low kilowatt range) with home connections that sells electricity to the homes. A distributed rooftop utility refers to a business that installs rooftop systems of various sizes (as appropriate) on the rooftops of its future customers. It interconnects these rooftop systems and then sells the electricity to all established system nodes with or without rooftop solar in a pre-determined territory.

[14] This is a rough target to be further elaborated. The main point, however, is that it is recommended the nano-grid activity be pursued on substantial scale (e.g. 50 to over 100 locations) if pursued at all, as initial demonstration has already been achieved and scale-up/ commercialization is what is now needed. For rough estimates of targeted number of households, a figure of 20 households per nano-grid might be used.

Activity 3.2.1 Design of PV nano-grid systems for villages selected based on Activity 3.1.1 Nano-grids to include at least 3,000 households that do not yet have access to electricity. Number of nano-grids will be about 300, with an average of 20 household each. Among these nano-grids, there should be an equal mix of the four different types of nano-grids (sharing, roof-top micro-utility, ground-based micro-utility, and distributed rooftop utility), at least in the early stages, to determine the benefits/ challenges of each type. Design will include financial sustainability mechanism and determination of level of grant or soft loan required, if any. Plans will be made for systems to be operated by RESCOs which invest in the project, collect monthly payments for power used, and ensure sustainable operation and maintenance. Ideally, two or more contractors will be selected to carry out nano-grid work to ensure capabilities are present in more than one organization. Given that some contractors may already have knowledge of suitable villages, nano-grid work may be initiated before the survey of Output 2.1 is completed.

Activity 3.2.2 Among the various forms of PV nano-grid designed, at least two of moderate size will be selected to incorporate various options of smart technologies, like an e-health facility, clean cooking facility from bio-gas, solar pure drinking water supply system, etc. This will facilitate the achievement of various SDGs (Sustainable Development Goals), promoting energy as a link to other key SDGs and promoting the vision in Bangladesh of "SDG village" with sustainable energy at its core. The SDG villages may incorporate the arsenic removing solar pump, the solar household pump, and the solar freezers to be carried out as a part of Outcome 4.4.

Activity 3.2.3 Installation of nano-grid systems for villages selected based on Activity 3.1.1 and with designs based of Activity 3.2.1. Ideally, two or more contractors will be selected to carry out nano-grid work to ensure capabilities are present in more than one organization. (This activity will be carried out under the same contracts as activity 3.2.1)

Activity 3.2.4 Training of local people, at least 50 percent of whom are women, in the maintenance of nano-grid systems to support the RESCOs in their work, so they do not have to travel as often to remote places.

Activity 3.2.5 Operation and maintenance of nano-grids and ongoing billing based on amount of electricity used.

Activity 3.2.6 Support of productive uses at installed nano-grids, through technical assistance for development of electricity using business activities and, possibly, partial grant and / or low-interest loan support for the purchase of relevant equipment. Introduction of super-high efficiency appliances and machines when possible, cooperating with donor energy efficiency projects, such as JICA and CLASP, and with Rahimafooz efforts.

Activity 3.2.7 Monitoring of operation and experience with nano-grids. Carrying out of comparison of issues and successes with different models, as well as assessment of financial viability of each model. Making of recommendations of best models for remaining un-electrified

villages that are not mini-grid suitable, also taking results of findings of Output 3.1 into consideration to determine locations for future proposed nano-grids. The activity make also take into consideration the need for nano-grids as options for "grid areas" that are still off-grid and identify additional potential nano-grid sites, if connections (or reliable power) are not expected in the long term for such "on-grid" areas. Preparation of replication plans for identified additional sites.

Output 3.3 Program to overcome barriers to affordability and sustainability designed and implemented to achieve purchase of pico-PV systems or small SHSs by lowest income households, as well as to achieve long-term sustainability of these products.

Activity 3.3.1 Development and implementation of a "pay-as-you-go" business model for distribution of pico-PV systems and more attractive battery size for such systems and small SHSs that reaches the poorest households. The pay-as-you go business model will allow low income households to make monthly payments of perhaps 100 to 150 taka per month.[15] Getting a pico product on the market with a larger battery size will address the chief complaint about the pico systems that battery life at night or in inclement weather is too short. Implementation will include targeting of the poorest households in appropriate long-term off-grid areas as relevant and other areas in grid areas, but lacking electricity or lacking reliable electricity. Program will target distribution of 15,000 pico PV and/ or small SHS systems with a subsidy of USD20 to USD30 for each system.[16]

Activity 3.3.2 Development of a corps of solar grandmothers and mothers – women with long-term commitment to staying in their villages, who are trained in the assessment and repair of malfunctioning pico-systems and SHSs. This will be arranged by training of women living in remote off-grid areas or even in on-grid areas without electricity, where a large number of households have such systems. Training will include hands-on test to certify mastery.[17]

Component 4. Renewable Energy Investment Scale-up

Outcome 4. Renewable energy accounts for an increased share of Bangladesh's power generation mix

[15] The pay-as-you-go business model is needed for two reasons: (1) The poorest households desire lighting/ pico-PV systems/ small SHSs, but many cannot come up with the full purchase price (currently USD30 for a 10W system after subsidy). (2) Vendors are not willing to use an installment payment model for pico systems such as they allow for SHSs, since their transaction costs (via in-person collection of payments) are too high as compared to the payment size. The pay-as-you-go model introduces transaction fees from the electronic payment processor (perhaps the telecom company), using SIM card and top-up payments at local stores, but removes the high cost of collection of the PV vendors.

[16] About 1,200 pay-as-you go systems have been installed in Bangladesh. This activity will look for ways of stimulating greater, more sustained uptake of and ensuring the pay-as-you-go option reaches the poorest households and is available for pico PV systems.

[17] Note: During the field trip, preliminary information was gathered that suggests repair services are not readily available for pico systems and SHSs, particularly if these systems are out of warranty.

Output 4.1 RE projects funded by SREDA-operated RE funds -> *This output will be removed as no SREDA-operated RE funds will be set up during the life of the project. The new Output 4.1 is given below. It retains the spirit of achieving grid-scale RE projects, but focuses instead on SREDA's ability to remove barriers to enable investment projects to move forward.* ->

Output 4.1 Financial close and construction begun on pipeline utility-scale PV and wind power projects as a result of barrier-removal support by SREDA.

Activity 4.1.1 Identification and removal of barriers and stimulation of utility-scale PV projects via the following three sub-activities:

Activity 4.1.1A Organization and facilitation of exchange between SREDA/ key government officials and utility-scale solar PV project investors to identify barriers to investment projects moving forward and to propose solutions that SREDA/ the government can help with. (*Note: First such exchange already completed. It was held on Aug. 10, 2017. More such exchanges are envisioned*.)

Activity 4.1.1B Based on identified barriers to the progress of utility-scale solar projects (via Activity 4.1.1A and Activity 1.2.1), design and carrying out of barrier removal support for such projects. Support may include identification of / liaison with international investors for such projects and assistance in the securing of land.

Activity 4.1.1C Design and implementation of first utility-scale solar PV concession bidding project and/or a general template for RE utility scale bidding processes for the Government. This design will enable the government to select a promising site, secure the land, and organize investors to present bids. Bids will include both the investor's proposed power purchase price and the technology/equipment/ expertise it plans to use.

Activity 4.1.2 Identification and removal of barriers and stimulation of utility-scale wind projects via the following three sub-activities[18]:

Activity 4.1.2A Organization and facilitation of exchange between SREDA/ key government officials and potential utility-scale wind project investors to identify barriers to investment projects moving forward and to propose solutions that SREDA/ the government can help with.

Activity 4.1.2B Based on identified barriers to the progress of utility-scale wind projects (via Activity 4.1.2A and Activity 1.2.1), design and carrying out of barrier removal support for such projects. Support may include identification of / liaison with international investors for such projects and assistance in the securing of land.

[18]Note: Decision of whether to pursue this activity may be delayed until release of USAID supported wind resource assessment for nine onshore sites and consultation with experts to determine whether any of the sites are attractive to investors. If, indeed, good potential for investment projects is found, it will make sense to continue with this activity.

Activity 4.1.2C Design and implementation of first utility-scale wind concession bidding project and/or a general template for RE utility scale bidding processes (as in Activity 4.1.1C) for the Government. This design will enable the government to select a promising site, secure the land, and organize investors to present bids. Bids will include both the investor's proposed power purchase price and the technology/equipment/ expertise it plans to use.

Output 4.2 Bankable documents for financing pilot grid-connected RE projects in biomass related areas.[19]

Activity 4.2.1 Preparation of pre-feasibility studies for W2E at six municipal sites. (*Note: Work completed*.)

Activity 4.2.2 Preparation of feasibility study, other bankable documents, and financing proposals for 100 kW W2E project. Project will likely be for one of the six sites for which pre-feasibility has already been conducted (as part of Activity 4.2.1) or for a site in Gazipur, which is considered to have good potential.[20]

Activity 4.2.3 Preparation of feasibility study, other bankable documents, or financing proposals for rice husk power generation project. Project will likely be carried out in most productive rice regions of the country. Ideally, this activity will support both a "captive" project, in which the investor has control over the rice husk resources, and a "market purchase of raw materials" project, in which the investor will sign a long term contract with local farmers for supply of rice husks.[21]

Activity 4.2.4 Preparation of feasibility study, other bankable documents, or financing proposals for biogas or bagasse power generation project.[22]

Output 4.3 Operational grid-connected ~~rice husk~~ biomass power generation plants.[23]

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[19] Note: This output focuses on biomass power generation projects, especially W2E, biogas power generation projects, and rice husk power generation projects. Yet, there is some question of financial viability of these projects, which SREPGen will need to investigate. The new work below is contingent on positive findings with regard to potential financial viability.

[20]Note: There is some lack of clarity as to whether the pre-feasibility studies for the six sites present a promising picture of the financial viability of the proposed W2E sites. Further work may be needed to determine whether the Gazipur site can represent a better situation or if certain incentives (such as attractive power purchase price) can make these projects financially viable. If, after this additional work, W2E projects still do not seem financial viable, this activity may be eliminated.

[21]Note: Some sources suggest a lack of financial viability of rice husk power generation projects. Yet, during the mission, it was determined a major rice producer is pursuing such a project. Further work will be needed to determine the attractiveness of carrying out rice husk power generation feasibility studies or related work, before determining whether or not to go ahead with this activity.

[22]Note: Carrying out of this activity will depend on potential financial viability of biogas or bagasse to power generation projects.

[23] Note: This output focuses on biomass power generation projects, especially W2E, biogas and bagasse power generation, and rice husk power generation projects. Yet, there is some question of financial viability of these

Activity 4.3.1 Organization and facilitation of exchange between SREDA/ key government officials and potential utility-scale W2E, biogas power generation, bagasse power generation, and rice husk power generation project investors to identify barriers to investment projects moving forward and to propose solutions that SREDA/ the government can help with.

Activity 4.3.2 Based on identified barriers to the progress of utility-scale W2E, biogas power generation, bagasse power generation, and rice husk power generation investment projects (via Activity 4.3.1 and Activity 1.2.1), design and carrying out of barrier removal support for such projects. Support may include identification of / liaison with investors for such projects and assistance in the securing of land.

Activity 4.3.3 Implementation of 100 kW W2E project for which documentation is prepared under Activity 4.2.2. SREPGen may provide partial subsidy to the equity portion of the investment needed for the 100 kW W2E project.[24]

Output 4.4 Bankable plans for solar or RE nano-grid installations
Output 4.5 Functioning nano-grid installations->
The main elements of these two outputs have been shifted to Output 3.2 and thus will no longer be included here. They are appropriately shifted to Outcome 3, as the focus of the nano-grids will be on providing electricity access/ affordable electricity to the lowest income households.

Output 4.6 Solar irrigation pump investments ->*This output will be revised as follows ->*

Output 4.4 Implemented projects in key, high power consuming areas that demonstrate innovation in the direct use of solar power and strong potential for commercial viability, carried out under the umbrella of the "SREDA Innovation Lab."[25]

projects, which SREPGen will need to investigate. The work proposed under the output is contingent on positive findings with regard to potential financial viability.

[24]This subsidization of a 100 kW W2E project is included per the input of the PMU in their Sept. 29, 2017 budget. This item was originally included in Activity 4.2.2, but as it fits Output 4.3 better, has been moved here to a new activity, Activity 4.3.3. The budget prepared on Oct. 22 2017 includes this demo as part of Activity 4.2.2, so next revision of the budget should move the "equipment" allocation under Activity 4.2.2 (currently USD200,000) to Activity 4.3.3.

[25] Note: These projects will be carried out subject to availability of projects funds and/or co-financing. Given that the main focus of the SREPGen Project is power generation, these "power application" initiatives are in some ways out of the main focus of the project. Yet, based on findings of the mission, some work on direct applications of solar power is considered important in working towards Bangladesh's goal of going 100 percent renewable energy by 2050 and/or becoming a "solar nation." The grid is rapidly expanding in Bangladesh and off-grid areas are expected to be reduced to 1,024 villages and perhaps less than 2 percent of the population in the medium term. Thus, a focus on off-grid power generation alone to promote RE is not appropriate. Further, the preciousness of land presents challenges to utility-scale projects that use a lot of land, such as utility-scale solar PV. At the same time, certain direct use of PV power applications present the promise of solutions to burning problems. For example, the surge in power demand created by the charging of electric three-wheelers ("easy rides") and similar vehicles at night causes problems for the grid, so that a direct solar solution, if it could be achieved cost-effectively, will be very important. The Prime Minister's office has recognized this and urged support of solar PV charging of such vehicles. As another

Activity 4.4.1 Design and implementation of demonstration of one economically viable demo solar PV charging station for electric "easy ride" (three-wheeler) vehicles This work will include investigation of technologies and business models, including the possibility of fast charging during the day when sunlight is available to reduce the costs of the PV charging stations by eliminating the need for large battery systems.[26] (Two charging stations have been completed already under this activity, though the payback period and capacity in terms of number of vehicles that can be charged are not at all attractive, so that any additional stations supported will require a new approach.)

Activity 4.4.2 Design and implementation of demonstration of arsenic and iron removing solar PV pumping system. Such technology has already been demonstrated at one site. The next steps will be to promote the technology at an additional ten sites and develop the operation and financing model for sustainable replication.[27] This arsenic and iron removing pump may be incorporated into the SDG village work of Activity 2.2.2.

Activity 4.4.3 Design and implementation of demonstration of solar freezers/ ice makers to preserve fish in off-grid areas. This work will include development of viable business model/ payback period estimates.[28] This solar freezer/ ice maker may be incorporated into the SDG village work of Activity 2.2.2.

Activity 4.4.4 Design and implementation of dissemination of household scale solar pumps.[29] This household scale solar pump may be incorporated into the SDG village work of Activity 2.2.2.

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example, 30 million Bangladeshis are exposed to water with unacceptable arsenic levels. A 24 hour solar pumping device that exposes water to oxygen can remove the arsenic.

[26] Note: To date, the project has already supported two solar PV easy ride charging stations carried out by the Rural Electrification Board, REB. Yet, the stations lack economic viability; and, due to the use of standard slow charging, only a handful of vehicles can be charged each night. REB would like the SREPGen Project to support two more of these stations and has already initiated work on one of these additional stations. In terms of achieving targeted project outputs and outcomes, it does not seem useful to support these additional stations. In sum, support of this activity as described (with fast charging or other business model/ technology to achieve financial viability) will depend on whether a viable business model and viable technical solution are apparent and whether enough project funds are available. Yet, all other things being equal, this activity is a top priority under the "SREDA Innovation Lab" output (Output 4.4), as its potential replication and impact is very high.

[27] Support of this item will depend on whether a viable business model is apparent and whether enough project funds are available. It will also depend on a review of the other options available for removing arsenic from water. Yet, assuming findings on these topics are positive for the identified technology, this activity is a relatively high priority under the "SREDA Innovation Lab" output (Output 4.4), as its potential replication and potential impact is very high, considering that 30 million Bangladeshis are exposed to drinking water with unacceptable levels of arsenic.

[28] Support of this item will depend on whether a viable business model is apparent and whether enough project funds are available. Yet, all other things being equal, this activity is of substantial interest given potential demand and livelihood impact on off-grid fishing areas.

[29] Support of this item will depend on whether a viable business model is apparent and whether enough project funds are available. So far this item is considered lower priority than some of the other items above. Yet, a review of the potential market and financial viability of this item should be considered and fair comparison made accordingly with the other options above, before a decision is made of which items to support.

Activity 4.4.5 Design and implementation of demonstration of solar boats. (*The project has already completed demonstration of 5 prototype solar boats.)*[30]

Output 4.5 Replication plans for additional RE projects

Activity 4.5.1 Identification of additional potential projects in the areas promoted by the project: utility-scale PV, utility-scale wind (if relevant), W2E, biogas power generation, rice husk power generation, bagasse power generation, solar PV nano-grids, expanded distribution of pay-as-you go small SHSs, easy ride (three-wheeler) solar charging stations, solar PV powered arsenic removal pumps, solar freezers/ ice makers for fish, household solar pumps, and solar boats. Preparation of documentation summarizing these potential pipeline projects.

Activity 4.5.2 Outreach to investors/ the private sector to develop RE power projects and RE power application projects identified under Activity 4.5.1.

Activity 4.5.3 Preparation of an attractive online map (or multiple maps, one for each technology area), showing the proposed RE power generation and RE power generation application investment opportunities in Bangladesh as identified in Activity 4.5.1. The map may have symbols at each potential project site, such that when the cursor of the computer is put over the relevant symbol, the key details of the project at that site are revealed. Work will be done to ensure that the link for this map is widely disseminated and reaches potential investors.

[30] The business model proposed for the boats going forward includes a 40 percent grant. The inventor of this product has also suggested a demo of solar PV power for lighting and fans for large passenger boats, which may be of interest. Yet, the project already has a contract of USD70,000 with the inventor's company. Due to the need to pilot other applications, it is suggested that no more additional funding beyond the current contract go to the PV boats.

ANNEX 3: PROPOSED REVISED PROJECT RESULTS FRAMEWORK – NOV. 10, 2017 VERSION

Primary applicable Key Environment and Sustainable Development Key Result Area (same as that on the cover page, circle one): 1. Mainstreaming environment and energy OR 2. Catalyzing environmental finance OR 3. Promote climate change adaptation OR 4. Expanding access to environmental and energy services for the poor.
Applicable GEF Strategic Objective and Program: GEF-4 CC4 Strategic Program SP3: Increased production of renewable energy in electricity grids
Applicable GEF Expected Outcomes: Total avoided GHG emissions from on-grid RE electricity generation
Applicable GEF Outcome Indicators: Market penetration of on-grid renewable energy (% from renewables); GHG emissions from electricity generation (tons CO_{2eq}/ kWh); and $/ tons CO_{2eq}

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
Project Objective: [31] Reduction in the annual growth rate of GHG emissions from fossil fuel-fired power generation through the exploitation of Bangladesh's renewable energy resources for power generation	Cumulative direct and indirect CO_2 emission reductions by end of project (EOP) resulting from project RE technical assistance and investments, Mtons CO_2 MW of RE power generation in Bangladesh, including on and off grid	0 200 [32]	1,032,407[33] 1,000[34]	Project final report and assessment of annual CO_2 emission reductions stimulated by project (directly and indirectly) via on-grid and off-grid RE power generation installations	Economic growth in the country will continue Government support for RE development and utilization will not change
Outcome 1:[35] SREDA evolves into a facilitation center to support private sector RE investment development; enable regulators to	Number of kW of net metering projects either approved or in the pipeline awaiting approval Number of MW of utility scale RE projects either approved or in the	0 100[36]	10,000 2,000	SREDA records of submitted net metering projects SREDA records on project status of submitted utility-	Political will for net metering and utility scale RE projects is realized Capacity of government does not substantially delay approval of RE policies/regulations and guidelines

[31] *Objective (Atlas output) monitored quarterly ERBM and annually in APR/PIR*

[32] Need to insert value at start of MTR. Current amount is a rough guess.

[33] The original figure in this table represented direct post project emission reductions in the ten years following the project. Generally, the project results framework (PRF) should focus on indicators that can be assessed at end of project. Thus, it is suggested that we replace the old figure, which shows projected project emission reductions ten years after project close, with a figure that shows project emission reductions achieved by end of project. Since such a number was not initially provided, the new one is based on the new design of the project at the time of mid-term review. A preliminary estimate is provided here based on preliminary work by the MTR consultant. The project team should work on providing an improved figure that correlates with their finalized targeted activities and what can be achieved. At the same time, it has been suggested by the RTA that we may need to stick with the DPP figure for ten years following the project. While not appropriate for an EOP target, since this is the amount approved by GEF, there may be a need to reinstate it. It is recommended the project team discuss further with the RTA to come to a final discussion on whether to use the 10-year DPP or to use a new EOP figure.

[34] Need to insert end of project targeted value based on all activities and expected operating installations at end of project, including those facilitated by the project and those without project facilitation. Current amount is a rough guess

[35] *All outcomes monitored annually in the APR/PIR.*

[36] This number needs to be confirmed. MTR consultant's understanding is that some or at least one utility scale PV project(s) have approval, but that no utility scale wind or biomass projects already have approval.

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
determine fair flexible tariff structures, develop RE power plans, and adopt RE power management and incentive regulations; bring confidence to private RE investors; and increase the number of approved RE projects	pipeline awaiting approval in the areas of utility scale PV, utility scale wind, and utility scale biomass power generation Number of unique persons exposed to SREDA and renewable energy power generation knowledge via "live" participation in SREDA events, including training, workshops, seminars, events for school children, and innovation contests	0	3,000	scale PV, wind, and biomass power generation projects Project logs of all live events	
Output 1.1 Regulations, guidelines, and technical solutions to promote distributed renewable energy power generation and its integration into the grid.	Number of new policies, regulations, plans, guidelines, and templates in the pipeline for adoption. One point should be assigned for each of the following in the approval pipeline: (1) finalized Net Metering Policy, (2) Net Metering Action Plan, (3) Technical Guidelines for Grid Integration of Solar PV Water Pumps, (4) Technical Guidelines for Grid Integration of Solar PV Mini-grids, (5) Template Agreement Document for Grid Integration of Rooftop Solar PV Projects (including Build-Own-Operate Projects), (6) new standards for solar PV system parts, (7) detailed guidelines on preferred specifications for solar PV system parts, and (8) institutional plan for disposal of PV system wastes (including batteries and panels) Number of projects submitting applications for net metering	0 0	8 10	SREDA records of status of various proposed policies and guidelines SREDA records of submitted proposals for distributed RE power generation projects pursuing net metering	Political will for net metering is realized Capacity of government does not substantially delay entry of RE policies/regulations and guidelines into the approval pipeline

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
Output 1.2 Law, regulations, policy, and guidelines to manage and incentivize investment in utility-scale RE power installations.	Number of grid-scale renewable energy Investment Management and Incentive Policy/Regulations adopted and new associated guidelines and template documents adopted. One point should be assigned for the adoption of each of the following: (1) Utility-Scale PV Investment Management and Incentive Policy/Regulations, (2) Biomass Power Generation Investment Management and Incentive Policy/Regulations and Guidelines, (3) guidelines and template project proposal documents for biomass/biogas to electricity projects under unsolicited offer, (4) Utility-Scale Wind Power Investment Management and Incentive Policy/Regulations and Guidelines, (5) guidelines and template project proposal documents for wind power projects	0	5	SREDA records of status of various proposed policies and guidelines	Political will for utility-scale RE continues for PV and is realized for wind and biomass Capacity of government does not substantially delay approval of RE policies/regulations and guidelines
Output 1.3: Trained SREDA and private sector staff in RE development	Number of trainees passing test to show mastery of RE power generation training materials Cumulative number of participants of SREDA workshops and seminars	0 0	45 600	Project records on results of tests administered at trainings conducted after mid-term review Project records of SREDA workshops and seminars	Trainees have basic capacity and motivation needed to study and master RE power generation materials presented
Output 1.4: SREDA-managed RE facilitation center, including innovation lab	Number of articles on SREDA in the press (print and online); number of television shows featuring SREDA Number of discussion entries on project website entered by non-PMU personnel	0; 0 0	30; 5 200	Information collected by project team Project website	

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
	Number of entries in SREDA innovation contests	0	60	Project records of SREDA innovation contest events	Capacity and interest exists among civil society to development contest entries for innovation in renewable energy power generation
Output 1.5 Detailed action plan for RE power generation in Bangladesh	Status of Renewable Energy Power Generation Action Plan for 2019-2040. (Adopted = 1; not adopted = 0) Number of specific projects (with locations) included in draft Renewable Energy Power Generation Action Plan	0 0	1 75	SREDA records of status of various proposed policies, guidelines, and plans Text of Renewable Energy Power Generation Action Plan	Political will for RE continues Capacity of government does not substantially delay approval of RE Power Generation Action Plan
Outcome 2: Increased capacities of relevant government agencies to generate, process, obtain and disseminate reliable RE resource information for use by GoB and potential project developers and investors	Number of Bangladeshi nationals trained in wind resource assessment by actual hands-on involvement in full process of assessment Number of potential utility scale biomass power generation sites identified in nationwide biomass resource assessment study Number of MW of financially viable potential PV power generation confirmed via PV resource assessment at sites	0 0 0	20 30 250	Project records of participants in wind resources work Nationwide biomass resource assessment documents Project solar resource assessment documentation	Domestic stakeholders have capacity and willingness to be trained through learning-by-doing wind resource assessment activities; relevant organizations have willingness to allocate these individuals' time to participate
Output 2.1 Wind resource assessment capabilities built in Bangladesh through useful assessments conduced for onshore and offshore areas	Number of sites with new wind resource assessment data of at least one year	0	5	Project results of wind resource assessment studies in Barisal	---
Output 2.2 Investment-grade solar resource data	Number of sites with potential of 50 or more MW PV for which	0	5	Project results of solar resource assessment	---

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
and relevant capacities built in Bangladesh	quality solar PV resource assessment data of at least one year is collected				
Output 2.3 Nation-wide biomass resource assessment study focused on availability of resources for biomass power generation and identification of potential project sites	Number of districts with quality assessment of biomass power generation potential	0	64	Project nation-wide biomass resource assessment study	---
Outcome 3: Increased affordability and access to photovoltaic solar power and associated livelihood benefits for low income households	Number of households that previously had no electricity that now have access to electricity via PV power generation	0	18,000[37]	Project records of nano-grid activities combined with results of initial project survey of off-grid villages; project records of distribution of pay-as-you-go small SHSs and pico-PV systems	Consumers in off-grid villages have demand for access to power or increased access to power and capability to pay for this on an as needed or pay-as-you-go basis.
	Number of households that previously had electricity but now have improved access to electricity via PV nano-grids, so that they can use larger amounts of power or electricity when needed	0	3,000[38]		Nano-grid (pay as you use) and small SHS/ pico-PV pay-as-you-go options release pent up demand for electricity that was inhibited by high up-front costs of SHSs
	Number of households whose incomes have increased substantially (10 percent or more) due to new access to electricity or increased access to electricity via PV power generation	0	1,000[39]	Project records of productive use activity in project nano-grid villages	
Output 3.1 Actionable information on village layout, number and proportion of poor	Number of villages in off-grid areas for which quality information is collected on number of households, share of	0	1,024	Project report on survey of Bangladesh's off-grid villages	---

[37] An estimated 3,000 households will gain access to electricity via the project's nano-grids, of which there will be 300 depending on average nano-grid size. Another estimated 15,000 households will gain access to electricity via the project's pay-as-you-go small SHSs or pico-PV systems.

[38] An estimated 3,000 households that already have SHSs will gain improved access to electricity via sharing nano-grids or other types of nano-grids that increase the power level to which they have access.

[39] Of the 6,000 households gaining new access to electricity through nano-grids or gaining increased access to electricity through nano-grids, it is estimated that at least one in six, or 1,000 households, will be able to increase their incomes through productive uses, in part stimulated by the support for productive uses offered by the project.

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
households without electricity or without adequate electricity, and challenges in delivering power to un-electrified households in long-term off-grid areas, namely 1,024 villages identified by the Rural Electrification Board, particularly those not suitable to mini-grids	households without electricity, and suitability to nano-grids versus mini-grids versus pay-as-you-go SHS/ pico-PV initiatives.				
Output 3.2 Electricity access newly provided to low income households via various forms of PV nano-grids, including: (i) SHS sharing, (ii) roof-top micro-utility, (iii) ground based micro-utility, and (iv) distributed rooftop utility	Number of PV nano-grids installed under project Number of different types of nano-grids installed under project, with one point accorded for each of: (i) SHS sharing, (ii) roof-top micro-utility, (iii) ground based micro-utility, and (iv) distributed rooftop utility Number of different types of productive uses and of new types of super-efficient appliances installed under project (number of types of productive uses, number of types of appliances)	0 0 0, 0	300 4 10, 4	Project report on nano-grid installations Project reporting on productive uses and energy efficient appliances at nano-grid sites	Consumers in off-grid villages have demand for access to power or increased access to power and capability to pay for this on an as needed or basis Nano-grid (pay as you use) options release pent up demand for electricity that was inhibited by high up-front costs of SHSs
Output 3.3 Program to overcome barriers to affordability and sustainability designed and implemented to achieve purchase of pico-PV systems or small SHSs by lowest income households, as well as to achieve long-term sustainability of these products	Number of villages in which households benefit from project promoted pay-as-you-go payment system for pico-solar or small SHS systems Number of women in rural areas passing hands-on test for repair of SHSs	0 0	300 100	Project records on distribution of pico-PV or small SHS systems via pay-as-you-go payment system Project records on results of mastery test for SHS repair training program	Consumers in off-grid villages have demand for access to power and capability to pay for this on a pay-as-you-go basis. Small SHS or pico PV pay-as-you-go options release pent up demand for electricity that was inhibited by high up-front costs of SHSs
Outcome 4:	MW of utility-scale PV, wind, and biomass projects that have	0	500	SREDA records of status of pipeline projects	Capacity of government does not substantially delay approval of RE

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
Renewable energy accounts for an increased share of Bangladesh's power generation mix	received approval and begun construction Number of different types of RE power direct application technologies newly demonstrated and showing commercial potential MW of RE power generation represented by replication projects included in online map targeting investors	 0 0	 5 3,000	 Project records of RE power direct application projects Project replication plan documents and online map of investment opportunities	policies/regulations and guidelines and of RE projects Financial institutions find risk of power projects in Bangladesh acceptable and are willing to provide debt and equity to utility scale RE power projects
Output 4.1 Financial close and construction begun on pipeline utility-scale PV and wind power projects as a result of barrier-removal support by SREDA	Number of utility scale PV projects that achieve financial close after SREDA-supported barrier removal Number of utility scale wind projects that move forward to financial close after SREDA-supported barrier removal	0 0	7 2	SREDA records on progress of utility scale PV projects SREDA records on progress of utility scale wind projects	Capacity of government does not substantially delay approval of RE policies/regulations and guidelines and of RE projects Financial institutions find risk of utility scale PV and wind projects in Bangladesh acceptable and are willing to provide debt and equity to such projects
Output 4.2 Bankable documents for financing pilot grid-connected RE projects in biomass related areas	Number of W2E utility scale prefeasibility studies Number of types of utility scale biomass power generation projects for which full feasibility studies and financial proposals have been prepared, including one point for each of the following types of projects: (1) W2E, (2) rice husk power generation, (3) biogas power generation	0 0	6 3	Consultancy reports submitted to project Project records of biomass power generation related feasibility studies and financial proposals	Capacity of government does not substantially delay approval of RE policies/regulations and guidelines and of RE projects Financial institutions find risk of biomass power generation projects in Bangladesh acceptable and are willing to provide debt and equity to such projects
Output 4.3 Operational grid-connected biomass power generation plants	Number of utility-scale W2E, biogas power generation, bagasse power generation, and rice husk power generation investment projects that move forward to financial close after	0	8	SREDA records on progress of utility scale biomass projects	Capacity of government does not substantially delay approval of RE policies/regulations and guidelines and of RE projects

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
	SREDA-supported barrier removal				Financial institutions find risk of biomass power generation projects in Bangladesh acceptable and are willing to provide debt and equity to utility scale RE power projects
Output 4.4 Implemented projects in key, high power consuming areas that demonstrate innovation in the direct use of solar power and strong potential for commercial viability, carried out under the umbrella of the "SREDA Innovation Lab	Number of easy rider vehicles charged per 24 hour period by solar PV charging stations (in aggregate) Number of arsenic removing PV pumps implemented with commercial model Number of PV solar freezers, household pumps, and PV boats implemented in total with commercial model	0 0 0	50 10 47[40]	Project records	Partners, such as filling stations or schools, willing to host solar PV charging stations and arsenic removing pumps, respectively Market receptive to benefits of solar freezers, households pumps, and PV boats
Output 4.5 Replication plans for additional RE projects	Number of replication projects identified Number of investors reached out to regarding replication projects Number of areas in which replication projects are identified including 1 point for each of: utility-scale PV, utility-scale wind (if relevant), W2E, biogas power generation, rice husk power generation, bagasse power generation, solar PV nano-grids, easy ride (three-wheeler) solar charging stations, solar PV powered arsenic removal pumps, solar freezers/ ice makers for	0 0 0	50 20 6	Project records	Financial institutions/ investors find risk of RE power projects in Bangladesh acceptable and are willing to provide debt and equity to utility scale RE power projects

[40] Initial estimates are based on: 30 household PV water pumps with commercial model, 5 PV boats with commercial model (does not include initial number of five carried out in the first half of project without commercial mode), and 12 PV ice maker carried out with commercial model.

	Indicator	Baseline at time of MTR	Targets End of Project	Source of verification	Assumptions
	fish, household solar pumps, and solar boats				

Annex 4. Proposed Targeted Timeline for SREPGen Revised Activities – Post MTR: November 1, 2017 – Dec. 31, 2019[41]

Nov. 11, 2017 version

Key of abbreviations or shorthand in timeline:
TP = TOR Provided/Posted
CS = Contract Signed
DC = Demo commissioned (where there are multiple demos, this refers to the last demo in the group)
When an activity includes multiple events, such as multiple workshops, training sessions, or trips post MTR, these are numbered as 1, 2, 3, etc. during the month in which they are proposed to occur. Further elaboration might include: 1W (for 1st workshop) or 1T (for first field trip) or 1C for first week-long class

Current project close date is Dec. 31, 2018, 13 months from now. In order to be able to request a project extension (perhaps of one year for a revised close date of Dec. 31, 2019), the project should first show good progress. If good progress can be demonstrated as delineated in MTR Report Recommendation 1, a project extension can be requested from GEF during the 1st quarter of 2018 if there is a urgency to request the extension at such an early date in order to sync with approval of the redesigned project by the GOB. If there is no urgency for such an early confirmation of extension, it is recommended the project wait until the middle of 2018 to request an extension from GEF, as more information will be available at that time on progress and extension needs. If progress by the end of February 2018 is not satisfactory, project closure may be considered to ensure that funds are not wasted.

Activity	2017		2018												2019											
	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1.1.1A Public consultations on existing Net Metering Policy and revisions	TP	CS 1W																								
1.1.1B Net Metering Action Plan (by sector and with consultation and vetting)	TP	CS			1W																					
1.1.2A Technical and financial solutions for grid integration of solar PV water pumps	TP	CS	1T																							
1.1.2B Technical and financial solutions for grid integration of solar PV mini-grids	TP	CS	1T																							
1.1.3 Template agreements for rooftop solar and its grid integration	TP	CS																								
1.1.4A Regulations for standards for PV system parts	TP	CS																								
1.1.4B Guidelines for preferred PV system parts							TP	CS																		
1.1.4C Regulations and institutional plans for disposal of PV systems wastes (e.g. panels, batteries)	TP	CS																								
1.2.1 Study on barriers to utility-scale RE investment and how to address them	TP	CS																								

[41] Project document signing of this five year project is said to have occurred in November 2014, so that the close date will be sometime in November 2019. The exact signing date and thus the exact close date is still awaiting confirmation from the Project Team.

1.2.2A Consultation/ preparation of Utility-Scale PV Investment Mngmt and Incentive Policy/Regs					TP	CS 1T	1W																			
1.2.2B Consultation/ preparation of Utility-Scale Biomass Invstm't Mngmt and Incentive Policy/Regs					TP	CS	1T 1W			2W																
1.2.2C Consultation/ preparation of Utility-Scale PV Invstm't Mngmt and Incentive Policy/Regs					TP	CS	1T 1W			2W																
1.3.1 Six one-week RE training program for government officials and private sector persons	TP	CS	C1			C2			C3																	
1.3.2 Workshops and seminars related to RE power generation	TP	CS		W1			W2			W3																
1.3.3A Study tour to South Korea (DONE)																										
1.3.3B Study tour to India (DONE)																										
1.3.3C Study tour to Germany (DONE)																										
1.4.1 Promotion of SREDA to press, via materials and outreach to school children																										
1.4.2 SREDA website	TP	CS																								
1.4.3 Two SREDA Innovation Lab competitions		TP	CS					W1					W2													
1.5.1 RE Power Generation Action Plan for 2019-2040 (incl. PV, wind, and biomass roadmaps)	TP	CS							W1	W2	W3															
2.1.1 Wind resource mapping study in onshore areas of Barishal			TP	CS	T1			T2			T3															
2.1.2 Preliminary offshore wind resource assessment			TP	CS	T1			T2			T3															
2.2.1 Investment grade PV resource assessment at five sites			TP	CS	T1			T2			T3															
2.3.1 TOR for nation-wide biomass resource assessment (DONE)																										
2.3.2 Action plan for nation-wide biomass resource assessment																										
2.3.3 Nationwide biomass resource assessment, first phase (2nd phase once additional finance secured)	TP		CS																							
3.1.1 Survey of 1,024 villages	TP	CS																								
3.2.1 Design of 300 PV nano grid systems including roof-top micro-utility, ground based micro-utility, distributed roof-top utility, and SHS sharing	TP	CS																								
3.2.2 Deployment of SDG technologies in nano-grids												TP	CS				DC									
3.2.3 Installation of 300 PV nano-grids, 150 by each of two contractors	TP	CS									DC 1			DC 2												
3.2.4 Training of local people, at least 50% women, in O&M of PV nano-grids and RESCO business												TP	CS													
3.2.5 O&M of nano-grids, including billing																										
3.2.6 Productive use for income generation and use of high EE appliances at PV nano-grids													TP	CS	T1	T2	T3	T4	T5	T6	T7	T8	T9			
3.2.7 Monitoring and assessment of various nano-grid types; replication plans												TP	CS	T1	T2	T3	T4	T5	T6	T7	T8	T9	T 10	T 11		
3.3.1 Development of pay-as-you-go business model and distribution of 15,000 pico PV and small SHSs				TP	CS	T1	T2	T3		T4		T5														

3.3.2 Development of corps of solar grandmas to repair pico PV and small SHSs						TP	CS	T1	T2	T3	T4	T5	T6	T7	T8	T9	T 10	T 11	T 12	T 13	T 14	T 15				
4.1.1A Exchange between government officials/ utility scale PV investors/ identification of barriers/ solutions	TP	CS	W1																							
4.1.1B Barrier removal support for utility scale PV projects	TP	CS T1		T2		T3																				
4.1.1C Design and implementation of Bangladesh's first utility scale solar PV concession bidding project			TP	CS	T1																					
4.1.2A Exchange between government officials/ utility scale wind investors/ identification of barriers/ solutions	TP	CS	W1																							
4.1.2B Barrier removal support for utility scale wind projects	TP	CS T1		T2		T3																				
4.1.2C Design and implementation of Bangladesh's first utility scale wind concession bidding project			TP	CS	T1																					
4.2.1 Prefeasibility studies for W2E at 6 sites (DONE)																										
4.2.2 Preparation of feasibility study, other bankable documents, or financing proposals for W2E project		TP	CS																							
4.2.3 Preparation of feasibility study, other bankable documents, or financing proposals for rice husk power generation project				TP	CS																					
4.2.4 Preparation of feasibility study, other bankable documents, or financing proposals for biogas or bagasse power generation project						TP	CS																			
4.3.1 Exchange between government officials/ utility scale biomass (of various types) investors/ identification of barriers/ solutions			TP	CS	W1		W2		W3																	
4.3.2 Barrier removal support for utility scale biomass projects of various types			TP	CS	T1		T2		T3																	
4.3.3 100 kW W2E project implemented									DC																	
4.4.1 Economically viable PV charging station										TP		CS			DC											
4.4.2 Arsenic removing solar PV pumps										TP		CS					DC									
4.4.3 Solar freezers/ ice makers													TP		CS					DC						
4.4.4 Household scale solar pumps													TP		CS							CS				
4.4.5 Solar boats (mostly DONE)																										
4.5.1 Identification of potential projects; preparation of project summaries																TP	CS									
4.5.2 Outreach to investors																		TP	CS							
4.5.3 Preparation of online map																		TP	CS							

Annex 5: Proposed Revised Budget

Oct. 23, 2017 Version

Please see separate electronic Excel file

Annex 6. SREPGen GHG Emission Reductions Preliminary Guidance and Estimates for Project Redesign

October 24, 2017

Background and required next steps by project team: This document provides an overview of how to calculate GHG emission reductions that SREPGen may achieve both during its lifetime and during the lifetime of equipment installed as a result of SREPGen initiatives. The document also provides some very initial assumptions related to calculating GHG emission reductions and some very initial estimates. To improve this work, it will be important for the project team to do the following:

(1) Determine which RE power generation demos SREPGen will actually be doing and what their scale will be.
(2) Determine what other RE power generation installations (besides SREPGen demos) will occur as a result of project activities (such as barrier removal, feasibility studies, etc.) that would not have occurred without SREPGen. Determine what their scale will be.
(3) Confirm the expected commissioning date for all the above installations, referring to the SREPGen timeline, once it has been finalized by the project team.
(4) Review and improve upon assumptions in Exhibit 1, such as the number of MWh expected annually from each installation. This may depend on hours per day operated and percent capacity utilized, on average, when operated. So, these assumptions should be considered carefully and adjusted to be as realistic as possible.
(5) Research and provide better estimates of various key variables, such as liters diesel per kWh for diesel small generators in Bangladesh, g CO2 per liter diesel burned for small diesel generators in Bangladesh, and g CO2 per kWh for grid electricity in Bangladesh. Provide estimates for w1, w2, w3, w4, and w5 (of Exhibit 2), based on plans for demos related to applications of PV.
(6) Check and improve upon all DER (direct emission reduction) estimates as in Exhibit 3.
(7) Recalculate totals in Exhibit 3, especially the total for DERs that will occur during the lifetime of SREPGen and can be considered a target of the project.

Direct emission reductions of the project: Direct emission reductions (DERs) are defined as those GHG emission reductions (GHG ERs) that are influenced directly by project activities. This will include any project demos. It will also include any RE installations for which installation financing was fully from other sources, but for which the project provided critical support, without which the installation would not have been realized. Thus, if the project is able to remove critical barriers for any utility scale PV, utility scale wind, or utility scale biomass power generation projects that allows them to occur, the GHG ERs from these projects will be part of the DERs of SREPGen. RE installations that are stimulated by feasibility studies supported by SREPGen could also be considered to generate DERs if evidence suggest these

projects would not have moved forward without SREPGen. The same is true of RE installation projects that are facilitated by the resource assessment work of the project.

It is recommended that, as a part of its redesign work, that the project team calculate the two types of DERs mentioned above ((a) those from the project demos and (b) those from installations invested by others, but made possible by barrier removal, feasibility studies, or other work of SREPGen) for both the duration of SREPGen (2014 – 2019) and for the lifetime of any equipment installed. For the former (DERs during SREPGen implementation), it will be important to estimate when each installation promoted by SREPGen (either via demo or barrier removal/feasibility study/ etc.) is launched, so we can see how long it operates during SREPGen. GHG ERs achieved during the duration of SREPGen can be used for the end of project (EOP) GHG indicator in the Project Results Framework.

Best guess list of RE installations of the project that will yield DERs: Exhibit 1 is a very preliminary "best guess" list of RE installations directly facilitated by the SREPGen. It provides necessary information for computing GHG emission reductions including: capacity of installation, MWh per year generated, type of fossil fuel replaced/ substituted, estimated date of commissioning of installation, and expected lifetime of installation. It should be noted that these initial "guesses" are quite optimistic and may need to be pared down by the project team based on what they believe the project can realistically achieve. Further, during implementation, it will be important for M&E work to determine which installations, besides the project demos, which are obviously due to SREPGen, the project can take credit for due to barrier removal, feasibility study preparation, etc. Evidence that the project can take credit for these should be documented and shared with the terminal evaluation team.

In Exhibit 1 below, the demos of Outcome 3 and Outcome 4 are included, as well as installations resulting from barrier removal, concession design, and feasibility study work of Outcome 4. An argument may also be made that the resource assessment work of Outcome 2, should it identify new project opportunities and serve to convince investors to move forward with investments, can lead to DERs. The project team should thus keep an eye on this possibility (so that they will identify any relevant ERs the project could take credit for as related to resource assessment work) with two caveats: (1) Given the timeline of resource assessment work, these DERs may not occur during the project's lifetime. (2) It's possible that projects benefiting from SREPGen resource assessment work will overlap with those benefiting from SREPGen barrier removal work and already included in Exhibit 1 below. Exhibit 1 is very rough and provided mainly for guidance. It is hoped the project team will go deeper into the analysis to ensure assumptions/ numbers in the table reflect the real situation and to provide assumptions/ numbers when they are missing.

Exhibit 1. RE Installations to be Directly Facilitated by the Project – Preliminary "Best Guess"

Installation	Reason for Inclusion	Capacity	MWh per year	Fuel Replaced	Installation Date	Lifetime (and operational time during project)
300 nano-grids	SREPGen demo	8 kW*x300 = 2,400 kW	5,256 MWh (assumes 8 hr/day pwr at 75%)	Diesel**	On average, Sept. 2018	20 years (1.33 years)
15,000 pico PV or small SHS systems	SREPGen demo	30Wx15,000 = 450 kW	986 MWh (assumes 8 hr/day pwr at 75%)	Diesel**	On average, Feb. 2019	20 years (0.91 years)
1 W2E installation	SREPGen demo	150 kW	875 MWh (assumes 16 hr/day operation)	Standard grid mix of fossil fuels in Bangladesh	Jan. 2019	40 years (1 year)
Utility scale PV projects	SREPGen barrier removal	200 MW	657,000 MWh (assumes 12 hr per day at 75%)	Standard grid mix of ffs in B	Nov. 2018 on average	20 years (1.16 years)
PV concession project	SREPGen concession design	100 MW	328,500 MWh (assumes 12 hr per day at 75%)	Standard grid mix of ffs in B	May 2019 on average	20 years (0.58 years)
Utility scale wind projects	SREPGen barrier removal	75 MW	229,950 MWh (assumes 35% capcty)	Standard grid mix of ffs in B	Nov. 2018 on average	20 years (1.16 years)
Wind concession project	SREPGen concession design	100 MW	306,600 MWh (assumes 35% capcty)	Standard grid mix of ffs in B	May 2019 on average	20 years (0.58 years)
Rice husk power generation project	SREPGen support for project preparation	15 MW	87,600 MWh (assumes 16 hr/day operation)	Standard grid mix of ffs in B	Jan. 2019	40 years (1 year)
Biogas or bagasse power generation project	SREPGen support for project preparation	10 MW	58,400 MWh (assumes 16 hr/day operation)	Standard grid mix of ffs in B	April 2019	40 years (0.75 years)
2 easy ride PV slow charging stations	SREPGen demo	tbd	tbd	Standard grid mix of ffs in B	August 2017	20 years (2.42 yrs)
1 easy ride PV fast charging station	SREPGen demo	tbd	tbd	Standard grid mix of ffs in B	Jan. 2019	20 years (1 year)

10 PV arsenic removing pumps	SREPGen demo	10 x 1.5 kW = 15 kW	49.5 MWh (assumes 12 hr/day @75%)	Diesel	April 2019	20 years (0.75 years)
5 PV freezers / ice makers	SREPGen demo	tbd	tbd	Diesel	June 2019	20 years (0.59 years)
50 PV household pumps	SREPGen demo	Tbd	tbd	Diesel	August 2019	20 years (0.42 years)
5 PV boats	SREPGen demo	tbd	tbd	Diesel	August 2017	20 years (2.42 years)
Replication projects implemented	SREPGen replication plans	tbd	tbd	Varies based on project type as above	Most likely to begin after project close	Varies as above

*It is assumed the average capacity of the nano-grids is 12 kW, but that about 4 kW of that on average (averaged overall all systems, those that include sharing and those that do not) is capacity that was already being used via existing SHSs.

**Ideally, GHG ERs related to these two items might be calculated by a mix of 25% of power replacing kerosene and 75% of power replacing diesel. This would then require two different calculations. To simplify matters, diesel only is used in these preliminary calculations

Methodology for estimating DERs for each relevant installation: Exhibit 2 shows the formula that will be used to estimate the DERs for each relevant installation during SREPGen and also for the lifetime of the equipment installed. At present, these formulas have some variables that require further determination in order for the estimates to be computed. They have also used assumptions from Exhibit 1 that, as mentioned, require further refinement.

Exhibit 2. Method of Roughly Estimating DERs during Project and during Lifetime of Equipment Involved

Installation	Calculation of ERs during SREPGen project (kg CO2) (*Calculation of ERs during lifetime of installation*)	Needed data
300 nano-grids (average 12 kW each)	5,256 MWh/yr x 1.33 years x q liters diesel/MWh x z kg CO2/liter* (*same, but replace 1.33 years with 20 years*)	q=liters diesel used per MWhr; z=kg CO2 per liter diesel burned
15,000 pico or small SHS (average 30 W each)	986 MWh/yr x 0.91 yrs x q liters diesel/MWhr x z kg CO2/liter* (*same, but replace 0.91 years with 20 years*)	q, z (both as above)
100 kW W2E installation	875 MWh/yr x 1 yr x v kg CO2/ MWh Bang grid power (*same, but replace 1 year with 40 years*)	v=avg. kg CO2 per MWh Bang grid power
Utility scale PV projects (200 MW)	657,000 MWh/yr x 1.16 yrs x v kg CO2/MWh Bang grid power (*same, but replace 1.16 year with 20 years*)	v (as above)
PV concession project (100 MW)	328,500 MWh/yr x 0.58 yrs x v kg CO2/MWh Bang grid power (*same, but replace 0.58 year with 20 years*)	v (as above)
Utility scale wind projects (75 MW)	229,950 MWh/yr x 1.16 yrs x v kg CO2/MWh Bang grid power (*same, but replace 1.16 year with 20 years*)	v (as above)
Wind concession project (100 MW)	306,600 MWh/yr x 0.58 yr x v kg CO2/MWh Bang grid power (*same, but replace 0.58 year with 20 years*)	v (as above)

Rice husk power generation project (15 MW)	87,600 MWh/yr x 1 yr x v kg CO2/MWh Bang grid power (*same, but replace 1 year with 40 years*)	v (as above)
Biogas or bagasse power generation project (10 MW)	58,400 MWh/yr x 0.75 yr x v kg CO2/MWh Bang grid power (*same, but replace 0.75 year with 40 years*)	v (as above)
2 easy ride PV slow charging stations	w1 MWh/yr x 2.42 yrs x v kg CO2/MWh Bang grid power (*same, but replace 2.42 years with 20 years*)	w1=MWh/yr used at 2 stations v (as above)
1 easy ride PV fast charging station	w2 MWh/yr x 1 yr x v kg CO2/MWh Bang grid power (*same, but replace 1 years with 20 years*)	w2=MWh/yr used at 1 stations v (as above)
10 PV arsenic removing pumps	49.5 MWh/yr x 0.75 yrs x q liters diesel/MWh x z grams CO2/liter x 1 kg/1000 g (*same, but replace 0.75 years with 20 years*)	q, z (both as above)
5 PV freezers / ice makers	w3 MWh/yr x 0.59 yrs x q liters diesel/MWh x z grams CO2/liter x 1 kg/1000 g (*same, but replace 0.59 years with 20 years*)	w3=MWh/yr used by 5 freezers; q, z (both as above)
50 PV household pumps	w4 MWh/yr x 0.42 yrs x q liters diesel/MWh x z grams CO2/liter x 1 kg/1000 g (*same, but replace 0.42 years with 20 years*)	w4=MWh/yr used by 50 household pumps; q, z (both as above)
5 PV boats	w5 MWh/yr x 2.42 yrs x q liters diesel/MWh x z grams CO2/liter x 1 kg/1000 g (*same, but replace 2.42 years with 20 years*)	w5=MWh/yr used by 5 PV boats; q, z (both as above)
Replication projects implemented	tbd: depends on projects; calculations similar to methods above	as above

*As mentioned above, this item may more ideally consist of two calculations, one for 25% of the power replacing kerosene and the other for 75% of the power replacing diesel

Preliminary estimates of key variables: While further verification is needed, preliminary estimates of key variables identified in Exhibit 2, are as follows:

q=liters of fuel used per kWh in small diesel generator=0.33 to 0.4 liters, say 0.36 liters/ kWh

z=grams CO2 per liter diesel burned in small diesel generator=2,680 g CO2/liter (or 2.68 kg CO2/ liter)

v=avg. kg CO2 per MWh of Bangladesh grid electricity = 670 kg CO2 per MWh (This is the official government figure as of 2013. Research should be conducted to see if there is a more recent one.)

w1, w2, w3, w4, and w5: These variables are each MWh/yr for various demos of applications of PV power (under Output 4.4) and need to be determined by the project team based on the scale of these demos.

Preliminary computation of DERs: Based on the above variable values, there is enough information for a very preliminary calculation of DERs for ten of the sixteen installations or installation categories given in Exhibits 1 and 2. For now, we calculate the DERs for these ten items, both during the project only and also for the entire lifetime of the installed equipment. In addition, we sum over the ten items to come up with a rough initial estimate of DERs during SREPGen and during the full lifetime of the involved equipment. Results are shown in Exhibit 3 below.

Exhibit 3. Preliminary Computation of DERs for 10 of the 16 Installation/ Installation Categories and Preliminary Estimates of Total DERs

Installation	Estimate of DERs during project (kg CO2) = A	Estimate of DERs during lifetime of installation
300 nano-grids (average 12 kW each)	5,256 MWh/yr x 1.33 years x 360 liters diesel/MWh x 2.68 kg CO2/liter* = 6744 tons CO2	A x 20/1.33 = 101,420 tons CO2
15,000 pico or small SHS (average 30 W each)	986 MWh/yr x 0.91 yrs x 360 liters diesel/MWh x 2.68 kg CO2/liter* = 866 tons CO2	A x 20/0.91 = 19,033 tons CO2
100 kW W2E installation	875 MWh/yr x 1 yr x 670 kg CO2/ MWh = 586 tons CO2	A x 40/1 = 23,440 tons CO2
Utility scale PV projects (200 MW)	657,000 MWh/yr x 1.16 yrs x 670 kg CO2/MWh = 510,620 tons CO2	A x 20/1.16 = 8,803,800 tons CO2
PV concession project (100 MW)	328,500 MWh/yr x 0.58 yrs x 670 CO2/MWh = 127,655 tons CO2	A x 20/0.58 = 4,401,897 tons CO2
Utility scale wind projects (75 MW)	229,950 MWh/yr x 1.16 yrs x 670 kg CO2/MWh = 178,717 tons CO2	A x 20/1.16 = 3,081,328 tons CO2
Wind concession project (100 MW)	306,600 MWh/yr x 0.58 yr x 670 kg CO2/MWh = 119,145 tons CO2	A x 20/0.58 = 4,108,448 tons CO2
Rice husk power generation project (15 MW)	87,600 MWh/yr x 1 yr x 670 kg CO2/MWh = 58,692 tons CO2	A x 40/1 = 2,347,680 tons CO2
Biogas or bagasse power generation project (10 MW)	58,400 MWh/yr x 0.75 yr x 670 kg CO2/MWh = 29,346 tons CO2	A x 40/0.75 = 1,565,120 tons CO2
2 easy ride PV slow charging stations	NA (need w1)	NA (need w1)
1 easy ride PV fast charging station	NA (need w2)	NA (need w2)
10 PV arsenic removing pumps	49.5 MWh/yr x 0.75 yrs x 360 liters diesel/MWhr x 2.68 kg CO2/liter = 36 tons CO2	A x 20/0.75 = 960 tons CO2
5 PV freezers / ice makers	NA (need w3)	NA (need w3)
50 PV household pumps	NA (need w4)	NA (need w4)
5 PV boats	NA (need w5)	NA (need w5)
Replication projects implemented	NA (need info on projects, which will be known later in SREPGen)	NA (need info on projects)
Total (*not including NAs*)	**1,032,407 tons CO2 (during project) – to be included as an SREPGen objective indicator**	**24,453,126 tons CO2 (during lifetime of installed equipment)**

Indirect emission reductions: Indirect GHG emission reductions (IERs) are generally estimated in the GHG annex of the project document. Two methodologies are usually used. One is called the bottom up approach. For this approach, we might estimate a replication factor to be applied to the DERs. That is, if a certain number of installations occur as a direct result of the project, it is assumed these will stimulate a greater number of installations not directly associated with the project due to the good examples set by the project, combined with policy improvements facilitated by the project. A typical replication factor is 3. Thus, we might assume that roughly 73.5 million tons CO2 (which is three times the initial estimate of the lifetime DERs of 24.5 million tons CO2) are achieved as IERs in the bottom up scenario. The other methodology is the top-down scenario. This approach is more macro in orientation. Instead of applying a replication factor to the project's expected DER achievements, it looks at the whole market and/or applies an annual growth factor to RE installations. The top-down approach also includes an influence factor, to determine what proportion of the annual installations are due to the project's influence.

Cost of emission reductions: GEF climate change mitigation project documents also often estimate the cost per ton of CO2 avoided based on the total GEF funds to be allocated to a project. Based on the rough estimates above, we might compute that total emission reductions and the cost per ton of CO2 avoided are as follows:

Total Emission Reductions = DERs + ERs = 24.5 million tons CO2 + 73.5 million tons CO2 = 98 million tons CO2

Cost per ton of CO2 avoided = (GEF funds allocated to project) ÷ (total tons CO2 avoided)
= USD4,077,272 ÷ 98 million tons CO2
= USD0.04 per ton CO2 avoided

This is quite a low cost per ton of CO2 avoided. It benefits from the optimistic assumption that the project will remove barriers for utility scale PV, wind, and biomass projects that would not be able to occur without the project. As a result, in this optimistic scenario, the project is able to "claim credit" for the associated ERs of these large, utility-scale projects. If the estimates are more conservative and include only the project demos in the direct emission reductions (and not the utility scale projects) and if we again assume indirect ERs are three times direct ERs, total ERs are 579,412 tons CO2 and cost per ton CO2 avoided is about USD7.