ADB

Technical Assistance Report

Project Number: 49103-001
Regional— Capacity Development Technical Assistance (R-CDTA)
December 2016

Promoting and Scaling Up Solar Photovoltaic Power through Knowledge Management and Pilot Testing in Bangladesh and Nepal

(Financed by the Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, and Strategic Climate Fund)

Asian Development Bank

ABBREVIATIONS

ADB	–	Asian Development Bank
ASEI	–	Asia Solar Energy Initiative
BPL	–	below poverty line
CO_2	–	carbon dioxide
COBP	–	country operations business plan
DMC	–	developing member country
HHW	–	household headed by women
NEA	–	Nepal Electricity Authority
O&M	–	operation and maintenance
SPV	–	solar photovoltaic
TA	–	technical assistance

WEIGHTS AND MEASURES

GW	–	gigawatt
kWh	–	kilowatt-hour
MW	–	megawatt
MWh	–	megawatt-hour
MWp	–	megawatt-peak

NOTE

In this report, "$" refers to US dollars.

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CONTENTS

CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE AT A GLANCE

1. Basic Data — **Project Number:** 49103-001

Project Name	Promoting and Scaling Up Solar Photovoltaic Power through Knowledge Management and Pilot Testing in Bangladesh and Nepal	**Department /Division**	SARD/SAEN
Country	REG, BAN, NEP	**Executing Agency**	Asian Development Bank

2. Sector	**Subsector(s)**	**Financing ($ million)**
✓ Energy	Energy efficiency and conservation	0.80
	Energy sector development and institutional reform	0.60
	Renewable energy generation - solar	0.60
Agriculture, natural resources and rural development	Agricultural policy, institutional and capacity development	0.31
Education	Non-formal education	0.31
	Total	**2.62**

3. Strategic Agenda	**Subcomponents**	**Climate Change Information**	
Inclusive economic growth (IEG)	Pillar 2: Access to economic opportunities, including jobs, made more inclusive	Climate Change impact on the Project	Low
Environmentally sustainable growth (ESG)	Eco-efficiency Natural resources conservation		
Regional integration (RCI)	Pillar 4: Other regional public goods		

4. Drivers of Change	**Components**	**Gender Equity and Mainstreaming**	
Governance and capacity development (GCD)	Civil society participation Institutional development Organizational development	Gender equity (GEN)	✓
Knowledge solutions (KNS)	Application and use of new knowledge solutions in key operational areas Knowledge sharing activities Pilot-testing innovation and learning		
Partnerships (PAR)	Civil society organizations Official cofinancing Private Sector		
Private sector development (PSD)	Public sector goods and services essential for private sector development		

5. Poverty and SDG Targeting		**Location Impact**
Geographic Targeting	No	Not Applicable
Household Targeting	No	
SDG Targeting	Yes	
SDG Goals	SDG7	

6. TA Category: B

7. Safeguard Categorization Not Applicable

8. Financing

Modality and Sources	**Amount ($ million)**
ADB	**0.00**
None	0.00
Cofinancing	**1.31**
Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas	0.35
Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas	0.75
Strategic Climate Fund - SREP	0.21
Counterpart	**0.00**
None	0.00
Total	**1.31**

9. Effective Development Cooperation

Use of country procurement systems	No
Use of country public financial management systems	No

Source: Asian Development Bank

I. INTRODUCTION

1. The Asian Development Bank (ADB) actively supports development and use of solar energy. In May 2010, ADB launched the Asia Solar Energy Initiative (ASEI), which aimed to develop and implement 3.0 gigawatts (GW) of solar photovoltaic (SPV) power in Asia and the Pacific by 2014. ASEI achieved this target in late 2014 with the installation of 3.8 GW of SPV power. Overall, ASEI's aim was to create a market for SPV investments in the region while helping bring generation costs down to grid parity. This has been achieved in some developing member countries (DMCs) such as India, where SPV generation has reached less than $0.06/kWh.

2. ASEI met its target through three interlinked components: (i) sharing knowledge on the latest developments in SPV technology and interacting with manufacturers, (ii) supporting project development, and (iii) innovatively financing SPV projects through clean technology funds. Based on these components, the effective exchange of knowledge through cross-country consultations and regional workshops encouraged DMC governments to consider solar energy in their overall energy mix and for improving the security of their energy supply.

3. South Asia has about 300 days of sunshine per year and solar radiation that is generally between 3.6 kilowatt-hours (kWh) and 6.2 kWh per square meter per day. The commercial potential of solar power generation for grid connection is estimated at 3.0 GW in Bangladesh and 2.1 GW in Nepal. Solar energy is therefore an ideal source for meeting the region's growing demand for electricity, improving energy security, and promoting the development of sustainable clean energy in the region.

4. The governments of Bangladesh and Nepal requested ADB support for technical assistance (TA) to promote off-grid and grid-connected solar power solutions to meet the growth in electricity demand. The governments concurred on the TA's scope, impact, outcome, outputs, implementation arrangements, cost, financing arrangements, and terms of reference. The TA's proposed Bangladesh component is included in ADB's country operations business plan (COBP), 2016–2018 for Bangladesh.[1] The COBP prioritizes (i) promoting renewable energy in rural areas, (ii) reducing dependency on imported fossil fuels, (iii) implementing energy efficiency, and (iv) addressing climate change impacts.

5. Although the TA's proposed Nepal component is not included in ADB's COBP, 2016–2018, it is aligned with ADB's country partnership strategy, 2013–2017 for Nepal, which prioritizes developing grid-connected and off-grid electrification solutions in the energy sector.[2] This TA is not included in the regional cooperation operations business plan, 2016–2018 for South Asia.[3]

II. ISSUES

6. The high cost of providing conventional power generation and supplying electricity to large numbers of end-users in remote areas, where the consumption of electricity is low, is the common factor that contributes to energy poverty in South Asia. In most cases, electrifying remote rural areas is not viable without government subsidies. Bangladesh aims to achieve 100%

[1] ADB. 2014. *Country Operations Business Plan: Bangladesh, 2015–2017*. Manila.
[2] ADB. 2015. *Country Operations Business Plan: Nepal, 2016–2018*. Manila; and ADB. 2013. *Country Partnership Strategy: Nepal, 2013–2017*. Manila.
[3] ADB. 2014. *Regional Cooperation Operations Business Plan: South Asia, 2016–2018*. Manila.

access to grid-connected electricity by 2022 from its current level of 65%, and Nepal aims to increase its electrification ratio from 54% to 100% by 2026. In 2015, the per capita electricity consumption was only 390 kWh/year in Bangladesh and 102 kWh/year in Nepal. To achieve their 100% access target, both governments are promoting SPV and other renewable energy solutions to supply electricity in off-grid areas.

7. In Bangladesh, the publicly owned installed power generating capacity is about 6.0 GW against the current peak demand of 8.2 GW. The peak load demand is met through power contracted from short-term private generators. In Nepal, the installed generating capacity is only 0.78 GW, below the peak demand of 1.2 GW. As a result, grid-connected consumers in both countries experience 8–12 hours of seasonal power cuts per day. To address power shortages, Bangladesh plans to install 2.0 GW of renewable energy-based capacity by 2030 and increase electricity imports from India. Although rich in hydropower resources, Nepal still needs to import electricity from India to make up for the shortfall in generation. Nepal is constructing three large storage-type hydropower plants and four run-of-river hydro schemes, but 2019 is the earliest any of them could make power available to the grid.[4] In addition, 70% of the generated electricity would be exported to India and bring much-needed revenue for Nepal. The generated power coupled with the plants planned for private sector investments will help meet the domestic electricity demand of about 2.0 GW by 2020 and 4.5 GW by 2030 in Nepal.[5]

8. Both countries need to complement their energy mix with other clean energy sources to address seasonal water variations, decrease load shedding, reduce fossil fuel consumption, bring down greenhouse gas emissions.[6] This will help to improve energy security and environment protection. Many South Asian countries are scaling up the use of SPV technology, which has become less costly since 2013 and has reached grid parity in some countries. However, even though off-grid and grid-connected SPV power generation capacity has been technically proven worldwide, only 364 megawatt-peak (MWp) is currently installed in Bangladesh and 640 kilowatt-peak in Nepal.

9. Rural electrification will benefit local communities at large and specifically women by reducing their household labor time, improving access to health services, strengthening security, and creating income generating opportunities. Although it is essential to expand and strengthen transmission and distribution networks in rural areas to provide wider electricity coverage, it is important to go beyond the meter (i.e., counting the number of new connections installed) by ensuring that these connections include the poor and disadvantaged communities and provide them with revenue earning opportunities.

III. THE CAPACITY DEVELOPMENT TECHNICAL ASSISTANCE

A. Impacts and Outcome

10. The TA impacts will be (i) increased access of Bangladesh and Nepal to affordable, reliable, clean renewable energy sources and technologies by 2025; (ii) increased innovative

[4] Hydropower plants are being constructed in Arun (900 megawatts [MW]), Upper Karnali (900 MW), and Upper Trishuli (216MW). Negotiations are ongoing for the 600 MW Upper Marshyangdi and 650MW Upper Tamakoshi III hydropower plants.

[5] World Bank. 2015. *Project Information Document (PID) Appraisal Stage: Power Sector Reform and Sustainable Hydropower Development Project in Nepal*. Washington, DC.

[6] In Bangladesh natural gas accounted for about 75% of power generation in 2014, with the balance coming from diesel and fuel oil (21%), coal (2.0%), and hydropower (2.0%). In Nepal, hydropower accounted for 93% of power generation in 2014, with diesel accounting for the balance (7%).

employment and livelihood opportunities for (a) poor households headed by women (HHWs), and (b) women living below the poverty line (BPL) in rural remote off-grid areas of Bangladesh by 2022;[7] and (iii) 92% energy access in Nepal achieved by 2025.[8] The TA outcome will be gender-responsive and regionally replicable SPV technologies promoted as a clean power source in Bangladesh and Nepal.

B. Methodology and Key Activities

11. Based on the lessons learned from programs in the People's Republic of China and India, knowledge management is key to catalyzing the region's solar market growth potential. The TA will promote developing solar power technologies in off-grid and grid-connected areas of Bangladesh and Nepal by building institutional and stakeholder capacity; pilot testing solar pumping systems to increase agricultural production; developing women-led livelihood activities; and showcasing and sharing knowledge on good practices, solutions, and lessons learned.

12. **Bangladesh component.** The TA will be implemented in parallel with and will provide support and capacity development for the beneficiaries of the SPV pumping system for the agricultural irrigation subproject of the Power System Efficiency Improvement Project.[9] The subproject, which has a $20 million budget, will replace diesel-run irrigation with 1,500 off-grid SPV pumping systems for agriculture and aquaculture (with a total capacity of 6 MWp).[10]

13. The TA will provide SPV equipment for learning purposes and demonstrate clean energy's social and gender impacts through testing women-led SPV-based microenterprises in rural off-grid areas, including the development of business models.[11] The TA will also (i) educate women, particularly HHWs and BPL women, on the safe and efficient use of SPV electricity; (ii) organize women-led water management groups; and (iii) implement education and campaign activities to disseminate information on efficiently managing SPV pumps and water systems.

14. The TA will develop a public–private partnership business model for SPV-powered women's enterprises. Vulnerable HHWs and BPL women will be trained on solar-powered enterprises, including operation and maintenance (O&M). At least 120 vulnerable HHWs and BPL women will be trained on formulating SPV pumping system and drinking water-based livelihood plans.

15. The TA has the potential to become a best practice, innovative case study for gender mainstreaming in a sector where social and gender impacts are less known. Good practices and lessons learned from the pilot will enhance the scope of replicating and scaling up SPV-based initiatives with strong social and gender design features in other DMCs in South Asia.

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[7] Government of Bangladesh, Parliamentary Standing Committee on Ministry of Environment and Forests. 2010. *Bangladesh Environment and Climate Resilient Sustainable Development: Vision 2021.* Dhaka.

[8] Government of Nepal, Ministry of Energy. 2016. *Action Plan on National Energy Crisis Prevention and Electricity Development Decade*. Kathmandu.

[9] ADB. 2011. *Report and Recommendation of the President to the Board of Directors: Proposed Loan to the People's Republic of Bangladesh for the Power System Efficiency Improvement Project*. Manila.

[10] During peak season in Bangladesh, 1.30 million diesel-run pumps are operated to irrigate 3.40 million hectares using 0.90 million tons of diesel, emitting 2.87 million tons of carbon dioxide (CO_2) equivalent/year (3,188 kilograms of CO_2 equivalent/ton of diesel). The SPV capacity has a factor of 16.1%; the off-grid emission factor in Bangladesh is 0.6407 tons of CO_2 equivalent/megawatt-hour (MWh)/year. With the subproject's 6 MWp capacity, 8,462 MWh of electricity can be generated, abating 5,117 tons of CO_2 and saving 1,605 tons of diesel yearly.

[11] SPV-based training systems (i.e., SPV pumps, water filters, container-based SPV battery storage) with a 70 kilowatt-peak capacity will generate 99 MWh of energy, abate 60 tons of CO_2, and save 19 tons of diesel yearly. The power system project will help the beneficiaries be more familiar with the business management of rural SPV pumps. TA consultants will conduct the design and procurement for and supervise the implementation of the pilots.

16. The TA will strengthen the technical capacity of the Bangladesh Rural Electrification Board, other government agencies, and civil society organizations on O&M and the management of the new rural SPV water pumps. Bangladesh Rural Electrification Board staff will be trained on gender sensitivity, O&M, and management of SPV pumping and water systems. A gender- and socially inclusive community outreach and preparatory engagement plan will be formulated and implemented. Functional regulations and tariff agenda for promoting SPV pumping and water systems in rural remote off-grid areas will be assessed in coordination with the Bangladesh Energy Regulatory Commission using the existing Feed in Tariff for Wind and Solar Electricity Regulations, 2015 (draft).[12]

17. **Nepal component.** The TA will demonstrate the technical, regulatory, and financial viability of utility-scale solar systems (i.e., rooftop and ground-mounted) to promote the expansion of solar power generation in the country. Under the South Asia Subregional Economic Cooperation Power System Expansion Project, the government requested $20 million additional grant financing from the Strategic Climate Fund to support the installation of additional 25 MWp aggregate utility-scale SPV power capacity.[13]

18. The TA will assist in strengthening the institutional and technical capacity of the Nepal Electricity Authority by (i) formulating a renewable energy policy on SPV feed-in tariff and net metering to promote renewable energy development; (ii) improving the design of utility-scale SPV systems and the capacity of electric utilities to design SPV power initiatives; and (iii) developing innovative business models to address the high up-front costs of renewable energy systems, including project identification, technology screening, financing schemes, and tariffs related to utility-scale SPV systems. The TA will also support technical engineering design and business structures, including a public–private partnership model for SPV-based technical options for one or two SPV plants.

19. **Regional component.** Under the TA, the project team will organize knowledge sharing between Bangladesh and Nepal through field visits, and among South Asian DMCs through regional workshops. The workshop organizers will disseminate the experiences of the countries' implementing agencies to exchange views on operational challenges, tariffs, and regulatory issues; and how these were addressed. Knowledge sharing will enable the replication of off-grid systems in Nepal based on Bangladesh's experiences, including on solar water pumping. From Nepal's experience, Bangladesh can learn how to structure a ground-mounted SPV system connected to the grid, including grid-integration issues.

20. The main risks during TA implementation would be (i) no ownership of gender aspects of the project by the implementing agency officials, including lack of commitment to women-targeted interventions by local government officials and stakeholders; (ii) changes in national political landscapes that could affect the ability of local governments to pursue infrastructure development; (iii) high staff turnover in the implementing agency; and (iv) a change in government priorities for the energy sector, including slow prioritization of access to renewable energy-based power. Measures such as providing capacity building support and creating awareness on the beneficial use of renewable energy sources conducive to climate finance can be considered to mitigate these risks.

[12] Government of Bangladesh, Bangladesh Energy Regulatory Commission. 2015. *Bangladesh Energy Regulatory Commission (Feed in Tariff for Wind and Solar Electricity Regulations) Regulations, 2015 (draft)*. Dhaka.

[13] ADB. 2014. *Report and Recommendation of the President to the Board of Directors: Proposed Loan, Technical Assistance Grant and Administration of Grants to Nepal for the South Asia Subregional Economic Cooperation Power System Expansion Project*. Manila..

21. The TA will be monitored through review missions and lesson-learning workshops. Lessons learned from other development partners will help improve project design. The project team will also prepare and share case studies to document good practices, innovations, lessons learned, and benefits of off-grid and grid-connected SPV based on the experience of and knowledge generated from the TA's Bangladesh and Nepal components.

C. Cost and Financing

22. The TA is estimated to cost $1.31 million equivalent, of which $350,000 will be financed on a grant basis by the Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, $750,000 will be financed on a grant basis by the Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas,[14] and $214,000 will be financed on a grant basis by the Strategic Climate Fund.[15] ADB will administer these grants. The grant funds will be disbursed on a pro rata basis as detailed in Appendix 2.

D. Implementation Arrangements

23. ADB will be the executing agency for the TA. The Sustainable and Renewable Energy Development Authority will be the implementing agency in Bangladesh, while the Nepal Electricity Agency will be the implementing agency in Nepal.

24. ADB will require 17 person-months of international and 21 person-months of national consulting inputs for Bangladesh, and 10 person-months of international and 15 person-months of national consulting inputs for Nepal. The consultants for Bangladesh will be engaged through a consulting firm using fixed-budget selection; a simplified technical proposal; and a full lump sum contract. For Nepal, four international and five national consultants will be engaged using individual consultant selection. The consultants will be engaged by ADB in accordance with the Guidelines on the Use of Consultants (2013 as amended from time to time). ADB will procure goods and services following its Procurement Guidelines (2015, as amended from time to time). The TA proceeds will be disbursed in line with ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time). The TA is expected to start on 1 January 2017 and will be completed by 31 December 2018.

IV. THE PRESIDENT'S DECISION

25. The President, acting under the authority delegated by the Board, has approved (i) ADB administering a portion of technical assistance not exceeding the equivalent of $350,000 to be financed on a grant basis by the Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas; (ii) ADB administering a portion of technical assistance not exceeding the equivalent of $750,000 to be financed on a grant basis by the Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas; and (iii) ADB administering a portion of technical assistance not exceeding the equivalent of $214,000 to be financed on a grant basis by the Strategic Climate Fund, for Promoting and Scaling Up Solar Photovoltaic Power through Knowledge Management and Pilot Testing in Bangladesh and Nepal, and hereby reports this action to the Board.

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[14] The Government of Denmark approved the grants on 29 February 2016.

[15] The grant will be provided under the Scaling Up Renewable Energy Program in Low-Income Countries. The grant was approved on 11 November 2015. Climate Investment Funds. 2015. *Summary of the Co-Chairs Meeting of the Scaling up Renewable Energy in Low Income Countries Program Sub-Committee (November 11, 2015)*. Washington, DC; and Government of Bangladesh, Sustainable and Renewable Development Authority. 2015. *Scaling Up Renewable Energy in Low Income Countries (SREP): Investment Plan for Bangladesh*. Dhaka. p. 4.

DESIGN AND MONITORING FRAMEWORK

Impacts the TA is Aligned with
a) Access of Bangladesh and Nepal to affordable, reliable, clean renewable energy sources and technologies increased by 2025[a]
b) Innovative employment and livelihood opportunities for BPL women and HHWs in rural remote off-grid areas of Bangladesh increased by 2022[b]
c) 92% of energy access in Nepal achieved by 2025[c]

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting	Risks
Outcome Gender-responsive and regionally replicable SPV technologies promoted as a clean power source in Bangladesh and Nepal	**By 2019** a. Technical, financial, and sustainability models for SPV technologies disseminated to DMCs in South Asia (2016 baseline: NA) b. Capacity of women to use safe and efficient electricity, and to be employed at energy-based enterprises increased (2016 baseline: NA) c. Regional SPV promotion plan drafted (2016 baseline: NA) d. SPV replication plans drafted by Bangladesh and Nepal (2016 baseline: NA)	a. Regional knowledge forum reports; e-cluster website page visits b. Pre- and post-training assessment reports c. Regional knowledge forum reports d. BREB and NEA reports	Change in government priorities could weaken support for replicating the pilot project
Outputs **Bangladesh component** 1. Solar-powered local infrastructure pilot tested	**By 2018** 1a. 35 community-based pilot SPV systems (30 SPVs for agriculture and aquaculture and 5 SPVs for drinking water equipment) installed and operational (2016 baseline: 0) 1b. 2 community learning centers (e-clusters) for training, knowledge sharing, and internet access installed and operational (2016 baseline: 0)	1a–b. Project progress reports; final project report	Changes in national political landscape affect local government's ability to pursue infrastructure development
2. Gender mainstreaming in SPV-based initiatives pilot tested	2a. PPP business model for solar-powered women's enterprises developed (2016 baseline: NA) 2b. 100 BPL women and vulnerable HHWs trained on solar-powered microenterprises, including O&M (2016 baseline: 0) 2c. At least 120 BPL women and vulnerable HHWs trained on formulating SPV pumping system	2a–d. Project progress report; GAP quarterly progress report; final project report	Lack of commitment to women-targeted interventions by local government officials and stakeholders

Results Chain	Performance Indicators with Targets and Baselines	Data Sources and Reporting	Risks
	and drinking water-based livelihood plans (2016 baseline: 0) 2d. 100 women, at least 50 of whom are HHWs and BPL, trained on the efficient use of SPV-generated electricity (2016 baseline: 0)		
3. BREB institutional capacity strengthened	3a. 20 BREB staff trained on gender sensitivity, O&M, and management of SPV pumping and water systems (2016 baseline: 0) 3b. Community outreach and preparatory engagement plan formulated and implemented with at least 30% women participants (2016 baseline: NA) 3c. Functional regulations and tariff agenda for promoting SPV pumping and water systems in rural remote off-grid areas proposed and reviewed (2016 baseline: NA)	3a–c. Project progress reports; GAP quarterly progress reports; final project report	Fast turnover of implementing agency staff
Nepal component 4. Capacity of NEA in utility-scale SPV power systems developed	4a. Project identification, technology screening, financing schemes, and tariffs related to utility-scale SPV systems developed (2016 baseline: NA) 4b. Design of technical engineering and business structures, including a PPP model for SPV-based technical options, developed (2016 baseline: 0)	4a–b. NEA annual reports	
5. Solar power capacity increased	5. At least 25 MW utility-scale solar capacity installed and operational (2016 baseline: 0)	5. NEA annual reports	
Regional knowledge exchange 6. Knowledge from Bangladesh and Nepal components shared regionally	6a. 2 regional knowledge sharing workshops conducted (2016 baseline: 0) 6b. At least 1 knowledge product delivered (2016 baseline: 0)	6a–b. Workshop and consultants' reports	
Key Activities with Milestones **Bangladesh component** **1. Solar-powered local infrastructure pilot tested** 1.1 Conduct technical engineering review (Q1 2017)			

1.2 Assist in supervising, commissioning, and testing 35 community-based pilot SPV systems (30 SPVs for agriculture and aquaculture and 5 SPVs for drinking water equipment) (Q2 2017) **Key Activities with Milestones** 1.3 Assist in supervising, commissioning, and testing community learning centers or e-clusters (Q2 2017) **2. Gender mainstreaming in SPV-based initiatives pilot tested** 2.1 Prepare PPP business models for solar-powered women's enterprises (Q1 2017–Q4 2017) 2.2 Prepare training modules for developing BPL women and vulnerable HHWs on solar-powered microenterprises, including O&M (Q1 2017–Q4 2017) 2.3 Train and conduct workshops for at least 120 BPL women and vulnerable HHWs on formulating SPV pumping system and drinking water-based livelihood plans (Q2 2017–Q4 2017) 2.4 Train and conduct workshops for women, at least 50 of whom are HHWs and BPL, on the efficient use of SPV-generated electricity (Q2 2017–Q4 2017) **3. BREB institutional capacity strengthened** 3.1 BREB staff trained on gender sensitivity, O&M, and management of SPV pumping and water systems (Q2 2017–Q4 2017) 3.2 Gender- and socially inclusive community outreach and preparatory engagement plan formulated and implemented (Q2 2017–Q4 2017) 3.3 Functional regulations and tariff agenda for promoting SPV pumping and water systems in rural remote off-grid areas proposed and reviewed (Q2 2017–Q4 2017) **Nepal component** **4. Capacity of NEA in utility-scale SPV power systems developed** 4.1 Design technical engineering and conduct the procurement process related to utility-scale SPV systems (Q2 2017–Q4 2017) 4.2 Design financial schemes, business structures, tariffs, and PPP model for SPV (Q2 2017–Q4 2017) **5. Solar power capacity increased** 5.1 Design technical engineering and conduct the procurement process (Q2 2017–Q4 2017) 5.2 Install at least 25 MW utility-scale solar capacity (Q1 2018–Q4 2018) **Regional knowledge exchange** **6. Knowledge from Bangladesh and Nepal components shared regionally** 6.1 Prepare modules and conduct 2 regional workshops (Q3 2017) 6.2 Publish at least 1 knowledge product (Q4 2017) **TA Management Activities** Recruit consultants by month 1 from approval of TA project Mobilize and orient beneficiaries on loan and TA activities by month 2 and every month thereafter
Inputs Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas: $350,000 Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas: $750,000 Strategic Climate Fund: $214,000
Assumptions for Partner Financing Not applicable.

BPL = below poverty line, BREB = Bangladesh Rural Electrification Board, DMC = developing member country, GAP = gender action plan, HHW = household headed by women, MW = megawatt, NA = not applicable, NEA = Nepal Electricity Authority, O&M = operation and maintenance, PPP= public–private partnership, Q = quarter, SPV= solar photovoltaic, TA = technical assistance.

[a] Defined by the project.

[b] Government of Bangladesh, Parliamentary Standing Committee on Ministry of Environment and Forests. 2010. *Bangladesh Environment and Climate Resilient Sustainable Development: Vision 2021. Dhaka.* http://ext.bd.undp.org/CCED/bgdp/BGDP%20Materials/Review%20Documents/Vision-2021.pdf

[c] Government of Nepal, Ministry of Energy. 2016. *Action Plan on National Energy Crisis Prevention and Electricity Development Decade*. Kathmandu.

Source: Asian Development Bank estimates.

COST ESTIMATES AND FINANCING PLAN

($'000)

Item	Amount
A. Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas[a]	
1. Consultants	
a. Remuneration and per diem	
i. International consultants (10 person-months)	230.0
ii. National consultants (15 person-months)	70.0
b. International and local travel	50.0
2. Equipment[b]	215.0
3. Workshops, training, seminars, and conferences[c]	
a. Training program	45.0
b. Regional workshops	100.0
4. Surveys and miscellaneous administration and support costs	40.0
Subtotal (A)	**750.0**
B. Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas[a]	
1. Consultants	
a. Remuneration and per diem	
i. International consultants (10 person-months)	200.0
ii. National consultants (15 person-months)	75.0
b. International and local travel	40.0
2. Workshops, training, seminars, and conferences	
a. Regional workshops	20.0
3. Contingencies	15.0
Subtotal (B)	**350.0**
C. Strategic Climate Fund[d]	
1. Consultants	
a. Remuneration and per diem	
i. International consultants (7 person-months)	146.0
ii. National consultants (6 person-months)	33.0
b. International and local travel	21.0
3. Workshops, training, seminars, and conferences[c]	7.0
4. Surveys and miscellaneous administration and support costs	7.0
Subtotal (C)	**214.0**
Total	**1,314.0**

Note: The technical assistance (TA) is estimated to cost $1.31 million, of which contributions from the Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, and Strategic Climate Fund are presented in the table above.

[a] Administered by the Asian Development Bank (ADB). Under the Second Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, 94.3% of the grant will fund the Nepal TA component and 5.7% will fund the regional component. Under the Danish Cooperation Fund for Renewable Energy and Energy Efficiency in Rural Areas, 86.7% of the grant will fund the Bangladesh TA component and 13.3% will fund the regional component. ADB will disburse the grants on a pro rata basis as per ADB. 2013. Technical Assistance. *Operations Manual*. OM D12/OP. Manila.

[b] For the learning equipment for Bangladesh, the TA will use the same functional specifications and technical design used in the pilot equipment purchased for the Enabling Poor Women's Benefits from Enhanced Access to Energy in Hatiya Island Technical Assistance. ADB will procure turnkey equipment following ADB 2013. Administering Grant-Financed Technical Assistance Projects. *Project Administration Instructions*. PAI 5.09. Manila. At least three quotations are required to procure equipment for a TA under the shopping method, with a budget accounting for less than 30% of funding from the Government of Denmark. Consultants will assist the equipment provider during commissioning and testing.

Type of Pilot Equipment	No.	Cost Estimate
1. Solar photovoltaic pumps for agriculture and aquaculture (30 systems) and water treatment (5 systems)	35	$90,000
2. Two training e-clusters with low-consumption computer (≤30 watts, Raspberry Pi or its equivalent), internet wiring, pre-payment service, working website, and 20 sets of office furniture (chairs and desks) located in the Khulna aquaculture area in Bangladesh	2	$90,000
3. Local civil and earth works and services to operate the equipment	1	$35.000

[c] This will cover all the costs associated with the implementation of the training activities described in the design and monitoring framework, including (i) training materials, equipment, and transportation; (ii) trainer fees, travel, and per diem; (iii) the publication of learning modules; and (iv) TA funds that can be used for business travel, per diem, and accommodation costs of ADB staff serving as resource persons (i.e., facilitators, speakers, panelists) in meetings, seminars, training courses, conferences, technical exhibitions, and workshops, including those involving ADB member and non-member countries. Any advances provided on this account are liquidated within 30 days after the conclusion of the activity to allow orderly TA financial closure at the time of TA completion.

[d] Under the Scaling Up Renewable Energy Program in Low-Income Countries (SREP). Administered by ADB. The entire grant funding will be allocated for the preparation of additional SREP grant financing for the SPV pumping systems for agricultural irrigation subproject of the Power System Efficiency Improvement Project in Bangladesh. ADB will disburse the grant on a pro rata basis as per ADB. 2013. Technical Assistance. *Operations Manual*. OM D12/OP. Manila.

Source: Asian Development Bank estimates.

OUTLINE TERMS OF REFERENCE FOR CONSULTANTS

1. The Asian Development Bank (ADB) will engage consulting services following its Guidelines on the Use of Consultants (2013 as amended from time to time), and will procure goods and services following its Procurement Guidelines (2015, as amended from time to time). Proceeds of the technical assistance (TA) will be disbursed following ADB's *Technical Assistance Disbursement Handbook* (2010, as amended from time to time). The TA is expected to start on 1 January 2017 and end by 31 December 2018.

A. Scope of Work in Bangladesh

2. The TA will require 17 person-months of international and 21 person-months of national inputs. The experts will be engaged through a consulting firm using fixed-budget selection; a simplified technical proposal; and a full lump-sum contract. The implementing agency for Bangladesh will be the Sustainable and Renewable Energy Development Authority.

3. **Description of outputs.** The consultants will coordinate with the Bangladesh Rural Electrification Board, the implementing agency of ADB's solar photovoltaic (SPV) pumping system for agricultural irrigation subproject of the Power System Efficiency Improvement Project, and the Sustainable and Renewable Energy Development Authority in the following preparatory activities:

(i) conduct assessments to identify agriculture and aquaculture beneficiaries, businesses, and projects financed by other development partners and by the Bangladesh Agricultural Development Corporation to deploy SPV pumping across the country;
(ii) support the survey and drafting of the inventory of selected beneficiaries who have expressed willingness to pay for SPV services, including poor households;
(iii) support the procurement and operation of the TA's pilot equipment; and
(iv) design and implement capacity building programs according to the scope of this TA.

4. Through the $24 million grant from the Strategic Climate Fund under the Scaling Up Renewable Energy Program in Low-Income Countries the consultants will conduct preparatory work for the additional financing of the agricultural irrigation subproject. This includes conducting due diligence on SPV pumping systems, developing practical entrepreneurship business models, a financial model analysis and management plan, social safeguards, and a gender action plan; and creating Board documents.

5. The scope of the agricultural irrigation subproject covers the installation of 1,500 to 2,000 off-grid turnkey SPV pumping systems for agriculture and aquaculture in remote areas of Bangladesh, including an operation and maintenance (O&M) knowledge transfer program; and project implementation management. In addition, the TA will assess Noakhali and Patuakhali districts and adjacent islands where fish and shrimp farming industries are concentrated.

6. A preparatory report, including an inception report, will detail the results of the preparatory work and assessment. The results of TA outputs 1–3 will also be encapsulated in separate reports.

1. International Experts for Bangladesh (17 person-months)

7. **Team leader and renewable energy specialist** (rural energy access, 3 person-months). The specialist should have a university degree, preferably a master's degree in a relevant

discipline (e.g., electrical or power electronics engineering). The specialist should have at least 15 years' experience in rural energy and power electronics systems applied to rural remote areas, including designing innovative control solutions; implementing and commissioning cluster or nano-distribution networks (especially direct current), rural hybrid systems, small and/or nano power substations, and SPV-based rural remote off-grid stand-alone equipment; and designing and configuring the implementation needs for SPV generators, power electronics, the balance of plants and/or systems, and livelihoods related to SPV pumps (i.e., nano-grids, refrigeration, energy clusters).

8. **Power electrical specialist** (solar photovoltaic, 3 person-months). The specialist should have a university degree, preferably a master's degree in a relevant discipline (e.g., electrical or electromechanical engineering), and 10 years' experience in solar engineering, middle- and low-voltage switchgear, and mini-grids. The specialist should demonstrate solid experience in developing SPV projects (off-grid and grid-connected) and will have the following responsibilities: (i) carry out an inventory of potential sites; (ii) conduct preliminary resource assessments using satellite data and model expected outputs; (iii) conduct system simulations and design all SPV, including the configuration of power electronics and balance of plant and system; (iv) elaborate cost estimates; (vi) support procurement and turnkey implementation; (viii) assist the Social Development and Gender Specialist and Business Development Specialist in training BPL and vulnerable HHWs on solar-powered micro-enterprises; and (viii) lead the training of women (and the development of an instrument to measure their resulting capacities) on the safe and efficient use of SPV-generated electricity.

9. **Pumping specialist** (water engineering and water supply and treatment; 2 person-months). The specialist should have a university degree, preferably a master's degree in a relevant discipline (e.g., civil or water engineering), and at least 15 years' experience in water treatment, and water sewage systems, including designing water pumping, aeration, and irrigation systems and related civil works. The specialist will (i) carry out related civil-hydraulic projections and draft technical calculations; (ii) supervise the implementation of the civil aspects of the pilots; and (iii) assist in training BPL and vulnerable HHWs in the formulation of SPV pumping system and drinking water-based livelihood plans.

10. **Financial specialist** (power, 2 person-months). The specialist should have a university degree, preferably a master's degree in a relevant discipline (e.g., engineering or business), with 10 years' experience in the financial appraisal and modeling of solar power in the rural context. The specialist will prepare (i) cost estimates for the SPV schemes for agriculture and aquaculture; (ii) cost estimates for the solar power schemes for distributed grid-connected SPV (i.e., rooftop and ground-mounted); and (iii) for off-grid and grid-connected SPV, power demand, least-cost, and sensitivity and risk analyses; the financial internal rate of return, the weighted average cost of capital; the levelized cost of electricity; O&M; and equipment replacement parts for the project life cycle.

11. **Business development specialist** (rural entrepreneurship, 2 person-months). The specialist should have a university degree, preferably a master's degree in a relevant discipline (e.g., engineering, natural sciences, social sciences, or business administration), and 10 years' experience in rural business and enterprises. The specialist will (i) assess the entrepreneurial and economic benefits of the project, identify risks, design the business rural model, and undertake sensitivity analysis; (ii) analyze useful models for promoting SPV pumping systems for agriculture and aquaculture that exist in the national market and region; (iii) develop and oversee capacity development training programs for beneficiaries on managerial and community development, and (iv) provide inputs to the design of the PPP business model for

solar-powered women's enterprises, to the formulation of SPV pumping system and drinking water-based livelihood plans, and to the development of an instrument for the assessment of the capacity of women to be employed in energy-based enterprises.

12. **Biologist or natural resource manager** (inland fisheries and aquaculture, 5 person-months). The specialists should have a university degree, preferably a master's degree in biology, zoology, or fish culture; and at least 15 years' experience in work related to fisheries and aquaculture (focusing on hatcheries). The specialists will (i) prepare a fisheries and aquaculture management plan for the project; (ii) identify soil and water impacts and relevant mitigation measures as a result of fish farming; (iii) identify and explain the value chain of fish-related products to enhance livelihood opportunities; (iv) guide the start-up process of capacity development and training in biodiversity and climate change adaptation; and (v) propose policy development.

2. National Experts for Bangladesh (21 person-months)

13. **Electromechanical engineer in solar photovoltaics** (4 person-months). The engineer should have a university degree, preferably a master's degree in electrical engineering or a relevant discipline, and 5 years' experience in electrical engineering or middle- and low-voltage switchgear. The engineer will demonstrate solid experience in developing and implementing solar power projects, preferably in the rural context of Bangladesh. He/she will assist in training women and BPL on the safe and efficient use of SPV-generated electricity, and in designing livelihood plans using SPV-generated electricity.

14. **Co-team leader and rural energy project developer** (5 person-months). The specialist should have a university degree, preferably a master's degree in a relevant discipline with a business-related specialization, and 5 years' experience in promoting, designing, and executing rural solar power solutions. It is highly desirable for the specialist to have practical experience in geographic information systems, procuring works and services for solar project implementation, and related logistics. The specialist should have at least 5 years' experience related to the electrification of community-based premises in rural remote areas, and will assist the team to deliver all project outputs.

15. **Civil engineer in water works and irrigation** (3 person-months). The engineer should have a university degree, preferably a master's degree in a relevant discipline, and 5 years' experience in water pumping systems, water infrastructure, water piping, irrigation systems, and related civil works. The engineer will support the (i) international team in carrying out related civil-hydraulic projections and supervising the implementation of the civil aspects of the pilot SPV pumping systems; (ii) project team leader in drafting deliverables, as needed; and (iii) training of BPL and vulnerable HHWs in formulating SPV pumping system and drinking water-based livelihood plans

16. **Social development and gender specialist** (5 person-months). The specialist should have a university degree, preferably a master's degree in social sciences, or other relevant discipline and 5 years' experience in gender mainstreaming across sectors (preferably in the energy and renewable energy sectors), with demonstrated ability to engage in and implement community-driven and/or community-based approaches. The specialist will (i) identify issues related to pro-poor and gender responsive access to energy resources and services in the project area; (ii) document promising and/or emerging practices in Bangladesh for possible incorporation in the projects; (iii) identify modalities through which the projects can effectively promote greater access by vulnerable groups and women to energy resources, services, and

opportunities; (iv) conduct a social compliance audit for the existing facilities to identify past or present concerns related to impacts on land acquisition, resettlement, or indigenous people following ADB's Safeguard Policy Statement (2009); (v) coordinate with the Power Electrical Specialist and Business Development Specialist for the training of BPL and vulnerable HHWs on solar-powered microenterprises and on formulating SPV pumping system and drinking-water based livelihood plans, and for the development of an instrument for the assessment of the resulting capacities of women to use safe and efficient electricity and to be employed at energy-based enterprises; (vi) lead the training of BREB staff on gender sensitivity; (vii) lead the formulation and implementation of a community outreach plan, ensuring the participation of women from poor households; and (viii) conduct a social and gender analysis, identifying pro-poor impacts within the project area, and present the findings in a summary poverty reduction and social strategy for the design of the pilots.

17. **Environmental specialist** (4 person-months). The specialist should have a university degree, preferably a master's degree in environmental sciences, and 5 years' experience in environment-related civil works and energy. The specialist will (i) prepare an environmental assessment for the project following local guidelines and ADB's Safeguard Policy Statement; (ii) identify soil, air, and water impacts and relevant mitigation measures, including on climate change; (iii) consult with project stakeholders; (iv) assess the institutional capacity of the project proponent and relevant regulatory agencies involved with implementing the project's environmental management plan; (v) draft related terms of reference for capacity building; (vi) draft an initial environmental examination and environmental management plan, following ADB's Safeguard Policy Statement; and (vii) prepare an environmental impact assessment and management for the project administration manual.

B. Scope of Work in Nepal

18. The TA will require 10 person-months of international and 15 person-months of national consulting inputs. The team of four international and five national consultants will be engaged using individual consultant selection. The implementing agency for Nepal will be the Nepal Electricity Authority (NEA). The consultants will (i) assess (a) the capacity of NEA and other stakeholders to design and implement SPV power-driven projects, (b) O&M, (c) the efficient use of SPV electricity, and (d) SPV-related technical and commercial issues; and (ii) facilitate (a) dialogue and consultation between the Government of Nepal and the private sector, and (b) procurement.

1. Individual International Experts for Nepal (10 person-months)

19. **Solar energy policy expert** (5 person-months). The expert should have a university degree in engineering, economics, business, or a related field; at least 10 years' international experience in the technical, financial, and economic aspects of energy sector regulation; and 5 years' experience in solar-related policy development. The expert will assist the Government of Nepal in reviewing and analyzing the current solar-related policy and developing a new policy to accelerate solar project development. The international expert will work with the national consultant to provide technical guidance on international regulatory practices and experience on solar-related policy and regulations. The expert will (i) review and evaluate the existing renewable energy and solar policies issued by the Government of Nepal, as well as internationally accepted norms and standards; (ii) provide technical advisory support to the Ministry of Energy on developing an appropriate solar policy; and (iii) advise the Ministry of Energy and NEA on the appropriate rates for solar technology.

20. **Financial advisor** (solar, 3 person-months). The advisor should have a university degree in finance or a relevant field, preferably at postgraduate level or its equivalent; at least 10 years' relevant professional experience in the energy sector; and international experience working in developing countries and with multilateral development institutions. The advisor will (i) review and assess comprehensive proposals based on an evaluation sheet that the executing agency will provide, and contact the developers during the initial screening process to clarify issues that are not clear in their proposals or not acceptable to the executing agency or ADB; (ii) prepare an evaluation report; (iii) develop financing models for accelerating utility-scale build–own–operate SPV systems; and (iv) identify the resulting impact of enterprise cash flow and investment payback.

21. **Legal advisor** (solar, 2 person-months). The advisor should preferably have at least 10 years' extensive international experience as a legal advisor for a corporation, preparing legal documents and directing renewable energy project transactions. A university degree in legal studies is preferable. The advisor will assist the executing agency in undertaking legal due diligence on the solar projects and related areas, including (i) collecting and reviewing project developers' corporate documentation; (ii) reviewing authorizations; (iii) reviewing, amending, and negotiating if necessary all project documents; (iv) drafting, advising, and assisting on the negotiations; and reviewing and finalizing the financing agreements; and (v) coordinating and managing the closing of legal transactions, working closely with ADB's in-house counsel.

2. Individual National Experts for Nepal (15 person-months)

22. **Solar power engineer** (4 person-months). The engineer should have a degree in engineering, with a minimum of 10 years' experience in power electronics engineering, with a specialization in SPV technologies. The engineer will (i) carry out an inventory of potential sites in Nepal with NEA, (ii) conduct resource assessments using satellite data and model expected outputs, (iii) conduct system simulations and design SPV schemes, (iv) elaborate technical calculations and cost estimates, and (vi) support the procurement process.

23. **Civil engineer** (2 person-months). The engineer should have a degree in civil engineering, with 5 years' experience in implementing infrastructure projects. The engineer will (i) support the team in drafting an inventory of potential sites; (ii) draft static requirements for selected sites, i.e., solar rooftops; (iii) elaborate technical calculations; (iv) prepare detailed cost estimates for civil works; and (v) support the procurement process.

24. **Procurement specialist** (4 person-months). The specialist should have a university degree in engineering, economics, or a related field; and 10 years' experience in bidding processes and guidelines and working with multilateral development banks. The specialist will (i) finalize draft bidding documents following ADB guidelines; (ii) together with the team, review technical and financial evaluation reports; and (iii) review draft contracts.

25. **Project analyst** (5 person-months). The analyst should (i) have a university degree in economics, accounting, or a relevant field; (ii) have the ability to work independently and achieve timely outputs; (iii) be proficient in Microsoft Word, Excel, and PowerPoint; and (iv) have previous professional experience in power and/or infrastructure. The analyst will (i) monitor the project implementation progress against the expected SPV project development; (ii) conduct document reviews of solar projects related to the Scaling Up Renewable Energy Program in Low-Income Countries, such as power purchase agreements, and monitor the completion of solar project outputs; and (iii) create a database to monitor the progress of proposed SPV projects under the 25 megawatt-peak capacity goal.