



# Technical Assistance Report

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Transaction Technical Assistance (TRTA)  
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## Kingdom of Cambodia: Capacity Development in the Electric Utility Industry

Financed by the Republic of Korea e-Asia and Knowledge  
Partnership Fund

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Asian Development Bank

## CURRENCY EQUIVALENTS

(as of 29 March 2019)

Currency unit	–	riel (KR)
KR1.00	=	\$0.00025
\$1.00	=	KR4,017

## ABBREVIATIONS

ADB	–	Asian Development Bank
EDC	–	Electricite du Cambodge
kWh	–	kilowatt-hour
MW	–	megawatt
SCF	–	Strategic Climate Fund
TA	–	technical assistance

## NOTE

In this report, “\$” refers to United States dollars unless otherwise stated.

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## **I. THE PROPOSED PROJECT**

1. The proposed National Solar Park Project will support the expanded deployment of solar photovoltaic power plants in Cambodia, and address the country's need to: (i) expand low-cost power generation; (ii) diversify the power generation mix with an increase in the percentage of clean energy, in line with its stated greenhouse gas emissions reductions targets; and (iii) expand the use of competitive tenders and other global best practices in the sector. The project will support the national electricity utility, Electricite du Cambodge (EDC), in constructing a 100 megawatt (MW) capacity solar power park (comprising civil works including access roads, fencing, and drainage systems) and associated substation in Kampong Chhnang Province and a transmission interconnection system to the Phnom Penh demand center to supply power to the national grid.<sup>1</sup> Through a transaction advisory services agreement between the Asian Development Bank (ADB) Office of Public–Private Partnership and EDC, the project also aims to assist EDC to design and conduct a competitive tender for procuring the first private sector-led solar power plant within the park.<sup>2</sup>

2. The impact will be that the cost of electricity in Cambodia is lowered, as reflected in the Cambodia Industrial Development Policy 2015–2025.<sup>3</sup> The outcome will be an increase in private sector investments in solar photovoltaic plants facilitated. The outputs will be (i) solar park and transmission interconnection constructed, and (ii) capacity of EDC in solar power plant construction and operation, project design and supervision, grid integration, and competitive procurement strengthened. The indicative amounts of the proposed program are (i) a concessional loan of \$7,640,000 from the ordinary capital resources of ADB, (ii) a concessional loan of \$11,000,000 provided by the Strategic Climate Fund (SCF),<sup>4</sup> and (iii) a grant of \$3,000,000 provided by SCF. The government will provide counterpart financing of \$2.94 million to finance taxes and duties (through exemptions) and EDC will provide financing of \$2.13 million for land acquisition and resettlement costs.

## **II. THE TECHNICAL ASSISTANCE**

### **A. Justification**

3. Cambodia has long been reliant on large hydropower and coal power plants contracted through unsolicited bids and business-to-business deals with independent power producers that include long-term, take-or-pay arrangements. This has left the government with sub-optimal solutions for clean and affordable electricity for its citizens. At the same time, Cambodia's solar resource potential is one of the highest in the region, and studies have shown that solar-based electricity generation could complement Cambodia's existing hydropower by helping to meet daytime peak demand and improving hydropower performance during the dry season. Additionally, recent reductions in the cost of solar photovoltaic generation, coupled with the high cost of imported coal and the associated social and environmental impacts of large coal and hydro plants, is making solar photovoltaic generation more attractive to the government.

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<sup>1</sup> The project is included in ADB. 2017. *Country Operations Business Plan: Cambodia, 2018–2020*. Manila.

<sup>2</sup> The solar power plants will be tendered to private developers in two phases. The first phase will be for 60 MW. The second phase will procure the remaining capacity for a total of 100 MW.

<sup>3</sup> Government of Cambodia. 2015. *Cambodia Industrial Development Policy, 2015–2025: Market Orientation and Enabling Environment for Industrial Development*. Phnom Penh.

<sup>4</sup> Under the Scaling Up Renewable Energy Program in Low-Income Countries financed by the SCF.

4. The Government of Cambodia has been considering solar photovoltaic generation as an alternative to large hydropower and coal-fired power plants since 2013, following a pre-feasibility study on the development of a 100 MW solar power project, supported by the Ministry of Trade, Industry and Energy of the Government of Korea,<sup>5</sup> in partnership with ADB.<sup>6</sup> The study indicated that the cost of electricity from a solar photovoltaic plant in Cambodia would be around \$0.12 per kilowatt-hour (kWh) compared to EDC's average generation cost of \$0.157/kWh (in 2014) from diesel power plants. In February 2016, the government tendered a 10 MW solar plant at Bavet in Svay Rieng Province.<sup>7</sup> The project, financed by ADB's Private Sector Operations Department, was commissioned in October 2017. The price of electricity to the grid by the winning bidder was \$0.091/kWh compared to EDC's generation cost of \$0.145/kWh (in 2015) from diesel power plants. Building on the success of this project, the government, with ADB support, is currently developing a 100 MW capacity solar park. Construction of the first power plant in the solar park was tendered to private developers in February 2019. The government formally requested financing for the project from ADB and requested ADB's assistance to access cofinancing for the project through a combination of concessional loan and grant resources from the SCF.

5. ADB has also been assisting EDC to develop a solar generation master plan. In 2017, ADB developed a preliminary national solar photovoltaic grid integration study and roadmap for EDC.<sup>8</sup> In this study, low, medium and high solar penetration scenarios were considered. Results show that with currently available technologies, 150 MW of solar can be added to the grid by 2020 (100 MW in Phnom Penh and 50 MW near other load centers in Cambodia), with no major impact on the grid and no additional technical upgrades to the existing transmission system required. Following this study, in June 2018, ADB completed a country-wide solar generation master plan for EDC that includes impacts and recommended actions to prepare the grid for solar penetration scenarios of greater than 1,000 MW by 2030.<sup>9</sup> The plan has identified additional solar park locations that could replace fossil fuel generation capacity that would be needed through 2030. Cambodia is also developing regulations for rooftop solar and contemplating the development of floating solar power plants.

6. The integration of variable renewable energy into the power system contemplated under these scenarios requires knowledge of a wide range of technical issues and new technologies. In association with the loan-funded National Solar Park Project, the government has requested ADB to support a transaction technical assistance program to build capacity and knowledge regarding the development of solar photovoltaic technology, solar park planning, distributed energy systems, energy storage systems, grid codes for solar energy integration, and management of corresponding challenges in the deployment of renewable energy, in order to manage the sharp increase in solar power generation capacity anticipated in the country.

7. For example, to support large-scale integration of renewable energy into its grid, EDC would need to have access to the latest knowledge on energy storage technologies, which can help to better integrate Cambodia's electricity system and can play a crucial role in energy system decarbonization by: (i) improving electricity system resource use efficiency; (ii) helping to integrate

<sup>5</sup> The Ministry of Trade, Industry and Energy financed pre-feasibility studies in two countries (Afghanistan and Cambodia) in 2012 on a grant basis.

<sup>6</sup> Korea Photovoltaic Industry Association; KC Cottrell Co., Ltd.; and Sun Business Development (for ADB and the Government of the Republic of Korea, Ministry of Trade, Industry, and Energy). 2013. *Pre-feasibility Study in the Kingdom of Cambodia: Identification of Feasible Sites and Conditions for the Development of 100 MW Photovoltaic Power Project*. Unpublished.

<sup>7</sup> ADB. [Cambodia: Cambodia Solar Power Project](#).

<sup>8</sup> This national solar photovoltaic grid integration study was prepared by ADB on a confidential basis for EDC.

<sup>9</sup> ADB. 2018. *Cambodia Solar Master Plan, Final Report*. Currently under review by EDC for adoption.

higher levels of variable renewable resources and end-use sector electrification; (iii) supporting greater production of electricity where it is consumed; (iv) increasing energy access; and (v) improving electricity grid stability, flexibility, reliability and resilience. Increased deployment of solar photovoltaic generation capacity will also require the use of innovative forecasting techniques, advanced inverters, maximum power point tracking, and expanded information and communication technology applications. Ultimately, this knowledge will help Cambodia bolster its energy security while also addressing its climate change goals.

8. The proposed TA will help facilitate capacity building of EDC (the executing agency of the proposed National Solar Park Project).<sup>10</sup> A targeted, medium-term training program will be implemented over a 2-year period to cover all aspects of large-scale solar energy deployment, including siting, design, storage technologies, dispatch and grid management techniques.<sup>11</sup> A separate TA program is proposed to deliver a broad capacity development initiative that will help support the government in implementing the proposed project, and prepare the government for the next phase of solar photovoltaic projects to achieve the national solar photovoltaic master plan, and to fully realize the solar photovoltaic potential in the country.<sup>12</sup>

## **B. Outputs and Activities**

9. **Output: The capacity of Electricite du Cambodge for integration of renewable energy into the national grid, including adoption of advanced technologies such as energy storage, strengthened.** EDC will select up to six of their staff (including at least three women) to participate in a specialized and intensive training course on solar photovoltaic and grid technologies to be held at an appropriate research facility or utility in the Republic of Korea.<sup>13</sup> The TA will provide specialized training and instruction in solar photovoltaic site planning and design; grid codes for renewable energy integration; distributed energy systems, including solar pumping for irrigation; energy storage technologies; selection of inverters; and maximum power point tracking and smart metering. The training will also include field visits to project and test sites. In addition, three workshops will be held in Phnom Penh on distributed energy systems, grid codes and energy storage technologies for a wider audience of EDC staff (with proportional participation of female staff).

## **C. Cost and Financing**

10. The TA is estimated to cost \$550,000 of which, \$500,000 will be financed on a grant basis by the Republic of Korea e-Asia and Knowledge Partnership Fund and administered by ADB. Fund financing will not be used for (i) civil works, (ii) procurement of large-scale equipment, (iii) permanent staffing costs, or (iv) the hiring of staff consultants. The key eligible expenditure items are listed in Appendix 1.

11. The government will provide counterpart support in the form of counterpart staff, office and workshop space, office supplies, secretarial assistance, local communication facilities, domestic transportation, and other in-kind contributions. The government was informed that approval of the TA activity does not commit ADB to finance any ensuing project.

<sup>10</sup> Other stakeholders such as staff from the Electricity Authority of Cambodia may also be involved in the trainings.

<sup>11</sup> The TA first appeared in the business opportunities section of ADB's website on 1 April 2019.

<sup>12</sup> TA subproject under ADB. [Regional: Southeast Asia Energy Sector Development, Investment Planning and Capacity Building Facility.](#)

<sup>13</sup> This may be done under an existing institutional memorandum of understanding or as another cooperation arrangement with a development partner. Potential partners include the Korea Energy Agency.

## D. Implementation Arrangements

12. ADB will administer the TA. The Energy Division of the Southeast Asia Department will select, supervise, and evaluate consultants, and organize workshops. As the implementing agency, EDC will support the implementation and monitoring of the training program; including (i) developing and reviewing the selection criteria of the candidates and the training program agreements; (ii) maintaining financial accounts and keeping records to be incorporated into financial statements; and (iii) adopting adequate policies, systems, and procedures to assess and monitor the performance of the training program.

13. The implementation arrangements are summarized in the table.

Implementation Arrangements			
Aspects	Arrangements		
Indicative implementation period	July 2019–June 2021		
Executing agency	Electricite du Cambodge		
Implementing agencies	Electricite du Cambodge		
Consultants	To be selected and engaged by the Asian Development Bank		
	Firm: Quality and cost-based selection (90:10)	International expertise: 9 person-months	\$385,400
	National: Individual consultant selection	National expertise: (12 person-months)	\$72,000
Procurement	Report and communication services are to be procured by consultants based on prior approval of the Asian Development Bank user division.		
Advance contracting	Advance contracting is proposed for consulting services under the technical assistance.		
Disbursement	The technical assistance resources will be disbursed following the Asian Development Bank's <i>Technical Assistance Disbursement Handbook</i> (2010, as amended from time to time).		
Asset turnover upon technical assistance completion	All equipment procured under the activity will be turned over to the executing agency upon technical assistance completion.		

Note: Lump sum payments and/or output-based contracts for consulting services will be considered in line with ADB. 2014. *Midterm Review of Strategy 2020 Action Plan*. Manila, Actions 2.9.2. and 2.10.2.

Sources: Asian Development Bank estimates.

14. **Consulting services.** The consultants will have extensive experience in solar photovoltaic design, operation and deployment; distributed energy systems, energy storage technologies; power system planning and engineering; grid codes, and energy regulation development. It is estimated that a total of 21 person-months of consulting services, comprising 9 person-months of international consulting services and 12 person-months of national consulting services, are required to undertake this work. One contract package for \$385,400 will be used to recruit an international firm through quality-and cost-based selection with a simplified technical proposal. The individual consultant will be recruited using individual consultant selection, for a contract package totaling \$72,000. ADB will engage the consultants following the ADB Procurement Policy (2017, as amended from time to time) and its associated staff instructions and guidance notes.<sup>14</sup>

<sup>14</sup> Terms of Reference for Consultants (accessible from the list of linked documents in Appendix 2).



15. **Cofinancier requirements.** The Republic of Korea e-Asia and Knowledge Partnership Fund requires annual monitoring and progress reports.

### COST ESTIMATES AND FINANCING PLAN (\$'000)

Item	Amount
<b>A. Republic of Korea e-Asia and Knowledge Partnership Fund<sup>a</sup></b>	
1. Consultants	
a. Remuneration and per diem	
i. International consultants	180.0
ii. National consultants	72.0
b. Out-of-pocket expenditures	
i. International and local travel	30.6
ii. Reports and communications	4.0
2. Trainings, seminars, workshops, forum and conferences <sup>b</sup>	150.8
3. Miscellaneous admin and support <sup>c</sup>	20.0
4. Contingencies	42.6
<b>Total</b>	<b>500.0</b>

Note: The technical assistance (TA) activity is estimated to cost \$550,000, of which contributions from the Republic of Korea e-Asia and Knowledge Partnership Fund are presented in the table above. The government will provide counterpart support in the form of counterpart staff, office and workshop space, office supplies, secretarial assistance, domestic transportation, and other in-kind contributions. The value of government contribution is estimated to account for 10% of the total TA cost.

<sup>a</sup> Administered by the Asian Development Bank.

<sup>b</sup> Includes airfare, hotel accommodation, daily subsistence allowance, miscellaneous travel expenses, and land transport for workshop participants, to and from ADB member countries, field visits, job training, cross-learning visits, and other interactions. It also includes the cost of travel of ADB staff to assist in the implementation of technical assistance activities, e.g., as part of a secretariat or in any administrative support in workshops and seminars.

<sup>c</sup> Includes costs for printing, translation and interpretation services.

Source: Asian Development Bank estimates.

### **LIST OF LINKED DOCUMENTS**

<http://www.adb.org/Documents/LinkedDocs/?id=51182-001-TARreport>

1. Terms of Reference for Consultants