

Cover Page for Project/Program Approval Request			
1. Country/Region:	Cambodia	2. CIF Project ID#:	(Trustee will assign ID)
3. Source of Funding:	<input type="checkbox"/> FIP	<input type="checkbox"/> PPCR	<input checked="" type="checkbox"/> SREP
4. Project/Program Title:	National Solar Park Program		
5. Type of CIF Investment:	<input checked="" type="checkbox"/> Public	<input type="checkbox"/> Private	<input type="checkbox"/> Mixed
6. Funding Request in million USD equivalent:	Grant: \$3 million		Non-Grant: \$11 million
7. Implementing MDB(s):	Asian Development Bank		
8. National Implementing Agency:	Electricite du Cambodge (EDC)		
9. MDB Focal Point and Project/Program Task Team Leader (TTL):	Headquarters- Focal Point: Christian Ellermann (cellermann@adb.org)	TTL: Pradeep Tharakan (ptharakan@adb.org)	
10. Project/Program Description (including objectives and expected outcomes):			

The SREP Investment Plan for Cambodia was originally endorsed in June 2016 with total indicative SREP financing of \$30 million. Upon the request of the Royal Government of Cambodia (RGC), a revised version was endorsed by the SREP Subcommittee members in August 2017. The revised IP shifted investment operations from ADB's Private Sector Operations Department (PSOD) to ADB's public sector window; and solar home systems, mini-grids, and biomass power projects have been dropped, as there are no viable project concepts under active development in the near-term. The revised indicative financing plan as endorsed is shown below.

Projects / Program	Sector	SREP	ADB	Private Sector	Gov't	Total
1. Solar Energy Development						
1.1 National Solar Park Program	Public	14.65	20.0	100.0	2.5	137.15
100 MW – Public-Private Partnership		14.00	20.0	100.0	2.5	136.5
Project preparation grant		0.65				0.65
1.2 Private Sector Solar Development Program	Private	12.05	20.0	72.0	0.0	104.05
Utility-scale / parks		5.0	12.0	40.0	0.0	57.0
Rooftop solar		6.0	8.0	32.0	0.0	46.0
Project preparation grant		1.05				1.05
2. Policy Support and Public Awareness	Public	3.0	-	-	-	3.0
TOTAL		29.7	40.0	172.0	2.5	244.2

This proposal refers to the \$14 million 'National Solar Park Program' of the revised SREP IP.

The **proposed National Solar Park Project ('Project')** will support the national electricity utility, Electricite du Cambodge (EDC), in expanding access to clean energy and increasing solar energy generation in Cambodia. It will have two main outputs:

- (i) a solar park facility able to accommodate up to 100 megawatts (MW) of solar power generation on 150-200 hectares of land in selected provinces; and

- (ii) a 30-40-kilometer (km) 115 kilovolt (kV) transmission line connection to an existing substation (grid substation 6 or GS6). The transmission interconnection system expansion will include a solar park substation with two transformers (one additional for redundancy), switchgear, controls, and a supervisory control and data acquisition (SCADA) system compatible with the EDC's SCADA requirements. It will have a new bay with switchgear at the existing GS6 substation.

Under a transaction advisory services (TAS) agreement, ADB's Office of Public Private Partnerships (OPPP) is assisting EDC to design and conduct a tender for procuring the first power plant (30-50 MW) that will be built by the private sector using commercial sources of finance, and located within the solar park. Additional power plants supplying the remaining 50-70 MW are expected to be tendered out to the private sector by EDC in a subsequent phase.

The Project is the first of its kind in Cambodia, and builds on lessons learnt from EDC's tendering and ADB PSOD's financial support of a 10 MW solar farm at Bavet, Svay Rieng Province in 2016, the first non-sovereign utility-scale solar project in the country and the first competitively tendered renewable energy project with an independent power producer (IPP).

The proposed Project has an estimated direct financing cost of \$36.5 million.

Table 1: Proposed Financing Plan

Source	Amount (\$ million)	Share of Total (%)
Asian Development Bank	20.0	54.8
SCF-SREP (concessional loan)	11.0	30.1
SCF-SREP (grant)	3.0	8.2
Government	2.5	6.9
Total	36.5	100.0

The Project will help address the country's need to: (i) expand low-cost power generation, (ii) diversify the power generation mix and complement its existing base of coal and hydropower plants, and (iii) increase the percentage of clean energy in its generation mix in line with its stated greenhouse gas (GHG) emissions reductions targets.

The Project is aligned with ADB Cambodia Country Partnership Strategy (CPS) 2014-2018 under its strategic pillar of rural-urban-regional links, and represents an adaptation to the evolving requirements of the energy sector of Cambodia. The Project is included in the country operations business plan (COBP), 2018-2020, published in August 2017. The Project also supports the Government of Cambodia's National Strategic Development Plan 2014-2018 and Rectangular Strategy Phase III (2013-2018) which prioritize the development of renewable energy in order to meet the growing demand for electricity in Phnom Penh and address the country's electrification target of 100% of villages electrified by 2020.¹ The Project is fully consistent with the mitigation targets in Cambodia's Nationally Determined Contribution under the Paris Climate Accord.

¹ Royal Government of Cambodia. 2014. *National Strategic Development Plan 2014–2018*, Phnom Penh, Ministry of Planning; Royal Government of Cambodia. 2013. *Rectangular Strategy Phase III (2013–2018)*. Phnom Penh.

Country Background

Cambodia's economy has grown quickly over the past decade, averaging annual growth of 7.0% from 2006 to 2016, and poverty has fallen substantially, from 47.8% in 2007 to 13.5% in 2014.² Nonetheless, gross domestic product (GDP) per capita, estimated at \$1300 in 2016, remains among the lowest in Asia. An underdeveloped energy sector is a key constraint to the further improvement of Cambodia's economic competitiveness and the welfare of its peoples.

Cambodia's energy sector is faced with several strategic challenges. Access to reliable energy is the most pressing one in the short and medium term, while broader and longer-term issues of energy security, affordability, and environmental sustainability also need to be addressed. Annual per capita consumption of electricity in the country at about 400 kWh in 2015 is low. Further, about 6.9 million out of the country's 16 million people do not have access to electricity, and are reliant on wood and other traditional fuels for energy.³ Historically, the high cost of power, dependence on conventional energy sources, and limited transmission and distribution networks, coupled with intermittent power supply, have hindered economic competitiveness and discouraged private sector investments. .

Annual electricity demand growth in Cambodia averaged 18% from 2011 to 2015. In 2015, Cambodia's energy supply was 6015 gigawatt-hour (GWh), of which 36% was hydro, 35% coal, 3% diesel, 1% biomass and 25% power imports from neighboring countries. The hydropower and coal-fired plants are owned by the private sector and operated under long-term power purchase agreements with take-or-pay arrangements. The current Power Development Plan (PDP), revised in 2015, projects demand growth to average about 7% through 2030. As stipulated in the PDP, the Royal Government of Cambodia (RGC) forecasts meeting ongoing growth in demand through further investment in thermal generation (coal-fired in the short term, and either coal or gas in the long term) and large hydropower. Power imports, which have been a significant source of meeting domestic demand since 2007, are being substantially reduced and replaced with domestic generation.

11. Consistency with Investment Criteria:

Increased RE capacity and increased access to energy via RE: The expansion of solar energy will help diversify Cambodia's power generation mix and complement the existing hydropower plants to meet daytime peak demand (especially during the dry season), as well as increase the percentage of clean energy supply.

² ADB. 2016. *Country Economic Indicators 2016*. Manila.

³ WWF (2016). *Power Sector Vision. Towards 100% Renewable Electricity by 2050 Greater Mekong Region, Cambodia Report*. Phnom Penh.

The proposed project will construct a solar power park with common facilities, infrastructure (e.g. roads, drainage, water supply), and a transmission interconnection system which will be able to accommodate up to 100 MW of solar capacity with expected output of approximately 200 GWh annually when completed. The first stage generating plant that will be tendered out will have a minimum of 30 MW capacity and up to 70 MW will be installed in a follow-on stage.

Using the country's 2015 annual per capita consumption of electricity of 400 kWh, the additional output will be able to supply clean energy to about 500,000 people (Male: 242,500 and Female: 257,500) or 108,700 households.^{4,5}

Table 1: Generation Output and Beneficiaries Installed capacity	Generation Output (GWh/year)	No. of Household Beneficiaries
Phase I: 30 MW	60	32,600
Phase II: 70 MW	140	76,100
100 MW	200	108,700

Low-emissions development: The Project directly supports Cambodia's Nationally Determined Contribution, which commits to a 16% reduction in GHG emissions from a business as usual scenario by 2030 from the energy sector.⁶ By demonstrating the viability of large-scale solar to improve electricity supply and stability of the national grid, the Project will help mobilize future commercial investments for replication and scale up, which will stimulate economic growth and facilitate the long-term transition to low-carbon development.

The Project will displace a mix of imports, coal and diesel in electricity generation.

Table 2: Greenhouse Gas Emission Reduction

Installed capacity	Annual avoided emissions (tCO ₂ e)	Lifetime avoided emissions (tCO ₂ e)
Phase I: 30MW	50,000	1,250,000
Phase II: 70 MW	115,000	2,875,000
100 MW	165,000	4,125,000

As shown in the table above, the first stage of the project will avoid at least 50,000 tons of carbon dioxide-equivalent (tCO₂e) annually. The 100 MW capacity will result in at least 165,000 tCO₂e annual emission savings or approximately 4.125 million tCO₂e over a 25-year project lifetime.

Affordability and competitiveness of RE: Solar resource development is still at a nascent stage in Cambodia. The country's first 10 MW utility-scale project in Bavet was commissioned in 2017. The Project will demonstrate the technical, financial and environmental viability of large-scale solar generation in the country's national grid. The proposed Project is intended as the first in a series under the "National Solar Park program". It will serve as a prototype for expanding solar PV generation which will benefit Cambodia by reducing generation costs and pollutant emissions including greenhouse gases. Through increased access to renewable and reliable energy, the proposed project will reduce the cost and improve the supply of electricity for the Phnom Penh service area.

Cambodia has some of the most attractive solar resources in the lower Mekong region with solar irradiance measuring 1400-1800 kWh/m² per year throughout the country. In the middle of

Cambodia, including the load center of Phnom Penh, which accounts for approximately 70% of national demand, the peak solar resource measures over 1900 kWh/m² per year. Existing and planned transmission networks are also well aligned with high solar resource potential and demand centers across the country.

A 2013 technical study for the government and ADB by the Korea Photovoltaic Industry Association helped investigate the scope for development of a 100 MW solar power plant in Cambodia.⁷ In 2015, a United States Agency for International Development-funded study explored the viability of using various solar energy applications to enhance Cambodia's energy security.⁸ In 2017, ADB developed a preliminary national solar PV grid integration study and roadmap for EDC⁹ which considered low, medium and high solar penetration scenarios. 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 in other areas throughout Cambodia), with no major impact on the grid and no extraordinary transmission investments; 100 MW of solar capacity will actually help stabilize the grid in the Phnom Penh service area by helping meet afternoon demand. Solar generation can complement hydropower by helping to meet daytime peak demand and improving hydropower storage performance during dry season. The study found that uptake of solar will result in savings from avoided thermal generation and imports, as well as the deferred construction or complete avoidance of 300 MW of coal-fired generation by 2030 in medium and high scenarios.

Coal-fired expansion has become less advantageous as the price of imported coal has gone up during the period of 2015–2017. In addition, the siting of coal and large hydropower plants is increasingly facing opposition from local communities and civil society. The government recently announced a moratorium on the construction of large hydropower plants until 2020.

The Project will minimize imports of fossil fuel and displace other sources of power, thereby benefiting EDC from the savings in power purchases from other supply sources that the solar plant enables rather than from any increase in final sales. Table 3 presents avoided cost per kWh by generation source.

Table 3: Assumed avoided costs of other supply sources

Supply source	Avoided cost (USc/kWh)	Notes
Coal (Cambodia)	3.9	Newcastle coal price of \$80/t, as advised by EDC adjusted for heating content plus transport costs
Hydro (Cambodia)	0.0	
Diesel (Cambodia)	13.9	Diesel price of \$0.50/litre
Biomass (Cambodia)	0.0	
Thailand imports	12.0	EDC assumption. Includes import duties and VAT.

⁴ Average household size 4.6 members

⁵ The National Solar Park Program will support grid connected solar PV projects.

⁶ Royal Government of Cambodia. 2015. *Cambodia's Intended Nationally Determined Contribution*. Phnom Penh.

⁷ *Pre-feasibility study in the Kingdom of Cambodia: Identification of Feasible Sites and Conditions for the Development of 100 MW Photovoltaic Power Project*, Korea Photovoltaic Industry Association, KC Cottrell Co., Ltd. and Sun Business Development (for the Ministry of Trade, Industry, and Energy, Republic of Korea, and the Asian Development Bank), 2013

⁸ *Switching On: Cambodia's Energy Security in a Dynamic Technology Cost Environment*, R. de Ferranti, D. Fulbrook, J. McGinley, S.Higgins, Mekong Strategic Partners, Phnom Penh, January 2016.

⁹ This national solar PV grid integration study was prepared by ADB on a confidential basis for EDC.

Vietnam imports	11.0	EDC assumption. Includes import duties and VAT.	
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The successful experience from the implementation of the first utility scale 10 MW Bavet project sets the momentum for renewable energy development in Cambodia. The build-own-operate transaction project went through an international competitive bidding process to foster transparency and competitiveness. Early engagement of ADB PSOD ensured that bidders had the opportunity to optimize their proposals by leveraging the involvement of international financial institutions. This tendering process resulted in a competitive and sustainable tariff of \$0.091 per kWh, which is below EDC's average cost of supply (which was \$0.095 per kWh in 2015).

Building on these learning experiences, the proposed National Solar Park is expected to be catalytic as it will demonstrate the viability of progressively larger-scale solar parks to improve electricity supply through increased renewable energy capacity and sustainable provision of competitively priced, reliable electricity by the private sector. The project will also provide technical benefits to the national grid, and substitute for planned fossil fuel and hydropower generation in the future. The proposed solar park will provide better working knowledge within EDC about the costs, operational requirements, and performance of solar PV technology, which will in turn inform further policy development, and improve EDC expertise for negotiating with private developers for subsequent projects. These early projects will also build experience among grid operators on management of the variable power produced by utility-scale solar PV plants.

Productive use of energy: The project will provide modern energy services, increase energy security, and improve system stability. The solar park will reduce transmission losses given its location closer to the demand center of Phnom Penh and ability to displace more remote generation sources (mainly hydro and coal generation). It will improve the quality of electricity to existing household and commercial consumers encouraging more business and microenterprise development.

Economic, social, and environmental development impact: The proposed investments in solar parks and transmission lines will deliver solar capacity to the country's energy mix and displace energy imports from neighboring countries, which will help the country achieve energy security, and increase access to quality, affordable and reliable electricity supply. It will create economic, social, and environmental benefits in Cambodia.

Economic impact: Substantial economic benefits will accrue mainly from the displacement of fossil fuel use, which will help improve the country's foreign exchange earnings. A reliable, affordable and sustainable supply of energy will improve the business environment in Cambodia and encourage additional investment and economic growth.¹⁰ International experience has shown that electricity is a prerequisite for growth in industry and manufacturing sectors. Cambodia's Industrial Development Policy 2015–2025 recognizes that current electricity tariffs and limited supply are major impediments to the competitiveness of the country's manufacturing sector and calls for alternate sources of energy to be developed.¹¹ The project will facilitate market growth for solar industries. More investments will provide more job opportunities and higher incomes for local Cambodians.

¹⁰ World Bank. 2014. Where have all the poor gone? Cambodia poverty assessment 2013. Second edition.

¹¹ Royal Government of Cambodia. 2015. *Cambodia Industrial Development Policy 2015–2025: Market Orientation and Enabling Environment for Industrial Development*. Phnom Penh.

Social impact: The reliable and more affordable electricity supply will improve social service provisions of hospitals, schools, and other social infrastructure.

Environmental impact: The Project will help displace fossil fuel emissions including GHG and conventional pollutant emissions.

Economic and financial viability:

An initial financial analysis of the Project shows that to be financially viable, the required solar plant tariff depends on the combination of site, size and technology selected. The required off-take tariff reflects the expected benefits of economies of scale, continuing capital cost and efficiency improvements for PV hardware, and proactive development by EDC to reduce investment risks. The current cost estimates incorporate allowances for significant uncertainties which will be reduced as additional feasibility analyses and due diligence are conducted. Competitive tendering will facilitate further cost reductions.

The financial returns to EDC on the project as a whole derive from the difference between the costs of the solar plant (both power purchases and EDC's own costs) and the resulting avoided cost savings. Around 40% of displaced generation comes from coal plants in Cambodia, about 25% each from reduced diesel generation and imports from Vietnam, and the remainder from reduced imports from Thailand. A preliminary economic analysis considers the costs and benefits to Cambodia of the entire proposed project (i.e., the solar park site acquisition, construction of common infrastructure and construction and operation of the first solar plant). The benefits of the project are defined as the avoided costs of alternative supplies plus the reduction in carbon emissions resulting from the project's displacement of other supply source. These represent resource savings. The economic returns of the project are positive and exceed the standard ADB hurdle rate of 12%.

Leveraging of other financing: The \$11 million concessional loan and \$3 million grant from SREP will support the construction of solar parks and transmission line. It will directly leverage a \$20 million ADB loan and \$2.5 million from government counterparts.

The Project will demonstrate the commercial and technical viability of developing large-scale projects through partnership between the public and private sectors. By utilizing public sector financing for the development of the solar park and transmission infrastructure, the Project will effectively mobilize private sector investments in generation capacity estimated to be about \$100 million.

Gender: please see item # 13

Co-benefits:

Energy security: The Project will enhance energy security through diversifying energy sources and increasing solar capacity to meet energy demand which will reduce demand for imported fossil fuels.

Employment opportunities: The Project will create job opportunities and will require both unskilled and professional labor during the construction and operation phases.

Improved health: Use of clean energy will avoid conventional pollutants emitted in coal-based generation thus minimize air pollution that could otherwise affect the health of the population.

12. Stakeholder engagement:

The Project's primary stakeholders are Electricite du Cambodge (EDC), Ministry of Mines and Energy, Electricity Authority of Cambodia, Kampong Chhnang and Kampong Speu administration offices, associated districts, communes and villages within the project site and affected households (including those who agree to sell land and/or to exchange for other land or support). Cambodia's SREP Investment Plan and the proposed project have been developed with multiple stakeholder workshops, consistent with SREP guidance and ADB policies.

Going forward, the project will employ a multi-stakeholder engagement approach involving all concerned groups through local consultations and dialogues as early as possible to reduce conflicts with affected people and other stakeholders. The project will work with civil society organizations (CSOs) in the community area to facilitate two-way flow of information.

13. Gender considerations¹²:

The proposed Project will incorporate gender aspects during further development and implementation. Participation of women, and poor and marginalized groups will be ensured during project consultations and development activities. Priority and special care shall be given to the poor, female-headed, and/or excluded households, identified through a socio-economic survey of land owners/occupants. The project will include gender-sensitive employment guidelines to hire equal proportion of female and male workers and staff during construction and operation.

A gender-disaggregated monitoring tool will be developed to verify the extent of the participation and decision-making of affected households.

14. Indicators and Targets (consistent with results framework):

Core Indicator	
(a) Installed capacity from renewable energy, as a result of SREP interventions	100 MW
(b) Annual electricity output from renewable energy as a result of SREP interventions	200 GWh
(c) Number of women and men, businesses and community services benefitting from improved access to electricity and fuels, as a result of SREP interventions	108,700 households or 500,000 people male: 242,500 female: 257,500
(d) GHG emissions avoided i. Annual ii. Lifetime (25 years)	165,000 tCO ₂ e 4.125 million tCO ₂ e
Development indicator(s): - Job opportunities during construction and operation phases	

¹² Ibid.

15. Co-Financing:		
	<i>Amount (in USD million):</i>	<i>Type of contribution:</i>
• Government	2.5	Counterpart
• ADB	20.0	Loan
• Others (private sector)	100.0	Indirect private sector investments in generation capacity
Co-Financing Total:	122.5	
16. Expected Board/MDB Management ¹³ approval date:		
Expected ADB board approval: October 2018		

¹³ In some cases activities will not require MDB Board approval.