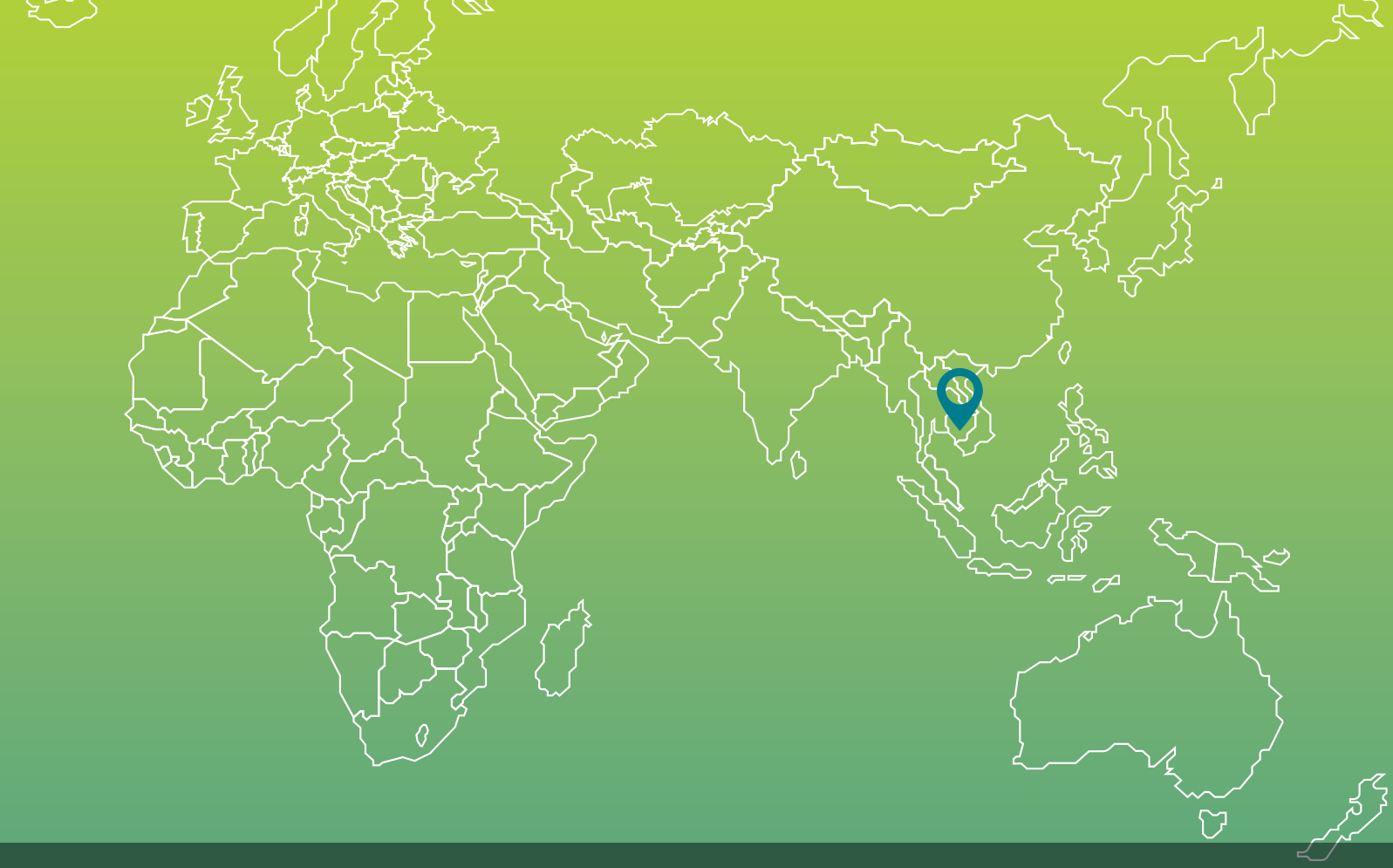
From Carbon to Competition: Cambodia's Transition to a Clean Energy Development Pathway

ELECTRIFICATION VIA CLEAN AND AFFORDABLE ENERGY GENERATION

CIF-GDI DELIVERY CHALLENGE CASE STUDY - JUNE 2020

CIF
CLIMATE INVESTMENT FUNDS



PROJECT DATA

PARTNER ORGANIZATION
Climate Investment Funds' (CIF) Scaling Up Renewable Energy Program in Low-Income Countries and the Asian Development Bank (ADB)

DELIVERY CHALLENGES
- Grid stability, efficiency concerns and the national utility
- Transparency, risk and the private sector

DEVELOPMENT CHALLENGES
- High electricity costs
- Growing energy demand vs. supply-side constraints
- Reliance on imported fossil fuel generation
- Reliance on imported energy

COUNTRY
Cambodia

Cover Photo: ADB

ESTIMATED TOTAL COST
US$26.71 million, including:
- *US$7.64 million (ADB, concessional loan)*
- *US$11 million (CIF concessional loan via the ADB))*
- *US$3 million (CIF grant via the ADB)*
- *US$2.94 million (government, via exemptions on taxes and duties)*
- *US$2.13 million (Electricite du Cambodge [EDC], for land acquisition and resettlement costs)*
- *US$40.23 million (financing of the first power plant by the private sector)*

PROJECT DURATION
23 May 2019–December 2021

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CONTENT

Photo: ADB

EXECUTIVE SUMMARY

Cambodia is a country of 16 million people, with a GDP per capita of US$ 1,510 (Lower-Middle Income), and CO_2 emissions of 0.44 metric tons per capita (tCO_2e)[1]. In the face of recent burgeoning economic growth, power demand in Cambodia has also surged, rising from 742 GWh in 2004 to 6,229 GWh in 2016, a combined annual growth rate of 20%[2]. With traditional thermal generation vulnerable to shifting global coal prices, and hydro proving unreliable in the face of climate volatility, solar has offered the brightest light: an abundantly available, vastly untapped and increasing price-competitive option to bridge demand and supply, Cambodia's year-round irradiation presents a mammoth potential of 30,090 GWh per year.[3]

With an aim to incentivize an entry into solar, the Climate Investment Fund's (CIF) Scaling Up Renewable Energy Program in Low Income Countries (SREP) drafted an Investment Plan for Cambodia in June 2016, introducing concessional and grant financing facilities that could trigger pilot projects in a sector with, at the time, no installed capacity. **The development objective: improve supply and utilization of renewable energy sources to all categories of consumers including the rural poor in remote areas.** In 2017, in consort with the Asian Development Bank (ADB), the CIF revised its Investment Plan, adding provisions for **a National Solar Park Program that would kick-start large scale solar generation in Cambodia**. With 3 years of concerted and foundational work, the country's **first National Solar Park of 100MW has now been established, with the first competitively auctioned 60MW plant securing a record low tariff in the South-East Asian region**—US$0.039/kWh, nearly a third of what the nation was previously paying. The project has also had above-par knock-on effects, triggering other regional counterparts to also approach the ADB for similar competitive international solar auctions, **a brave new frontier for renewable energy transitions in the ASEAN**. The last months have seen Vietnam sign a mandate for ADB support in developing a 200 MW floating solar auction, and similar discussions have kicked off with Indonesia, Myanmar and Timor-Leste. In efforts to maximize the demonstrative power of these successes and discussions, the ADB is initiating a new regional program—the ASEAN Scaling up Renewables Plus Storage Initiative (ASSURE). It will work with ASEAN countries to deploy renewables and energy storage on a large scale by supporting project development and facilitating private sector participation, thereby making way for an exponential green energy transition in the region.

The project's impact in Cambodia alone, however, is markedly catalytic: the country is now proceeding to Phase II of the project, auctioning the remainder of the Park's solar capacity; is deliberating the deployment of the same solar park model, even without the support of concessional finance; is deploying competitive infrastructure tendering in sectors even outside of solar; and has a new **Power Development Plan, approved in early 2020, that for calls for up to 1.8 GW of solar in Cambodia by 2030**.[4] Where previously cautious about integrating solar, the Cambodian government has maximised the project's potential as a market-sounding and technical-testing exercise, and is now exploring yet more frontier integration technologies, including new-to-the-market energy storage options. Early this year, the state utility Electricite du Cambodge agreed to host a pilot battery energy storage system within the National Solar Park substation, also partly financed by an SREP grant and executed by the ADB. The project team hopes that this will pave the way for a larger, nation-wide battery energy storage systems program in 2022–2023. **In sum, the project has demonstrated the immense potential of concessional climate finance, and of efforts of dedicated climate champions, to realise emerging economies' and regions' ambitions for greener and more sustainable low-carbon development trajectories.**

1 World Bank Data, 2018

2 Cambodia Solar Master Plan Study, 2018

3 Ibid.

4 This plan was developed by Chugoku, a Japanese organization advising the Government of Cambodia.

INTRODUCTION

Photo: ADB

This case study takes a deep dive into Cambodia's multidimensional energy sector transition, a joint effort by the government of Cambodia and the Asian Development Bank (ABD) to reformulate how the nation approaches power generation: moving from thermal and large hydro to scalable, low-cost renewables; from bilaterally negotiated power purchase agreements to competitive international tendering; and from binary public or private operating and ownership structures to complex blended risk-sharing modalities.

The end result: the Cambodia National Solar Park, an ambitious new venture that saw 26 high-level international power producers from more than 11 countries bid for first-mover advantages in developing large-scale renewable energy assets in Cambodia. The subsequent two-step reverse auction process secured a final tariff-per-kilowatt-hour (kWh) that was roughly one-third of what Cambodia was paying on average. An innovative risk-sharing model was designed that, at the time of writing, the government was redeploying on its own without the need for grant or concessional financing—a sign that the market had matured sufficiently to generate independent replication.

The outcomes were hard earned. Both the country and the immediate region had experienced little success in overcoming institutional and economic barriers to competitive private participation in low-cost renewable energy generation. In response, the project, partly funded by the Climate Investment Funds' (CIF) Scaling Up Renewable Energy in Low-Income Country Program (SREP), provided scope for the Asian Development Bank (ADB) to deploy a broad suite of financial products and technical expertise to enable the genesis of a new approach. This case study examines the challenges and trajectories in delivering each of these solutions within a complex ecosystem of competing and complementary risks and priorities. The study also examines the drivers of each solution, extracting lessons about delivering lasting clean energy transformations that effectively align global climate change objectives with national development needs.

IMPORTANT OR URGENT? THE PARIS AGREEMENTS, THE NDCS AND THE FUTURE OF POWER

July of 2008 saw the establishment of the CIF, a US$8.3 billion first-of-its-kind, fast-tracked climate finance vehicle. Its creation signified an international recognition, both by emerging and advanced economies, of the urgency of rapidly scaling up low-carbon technologies that could mitigate existing carbon loading patterns. To date, the fund has supported global renewable energy capacity additions of over 26,000 megawatts (MW). The CIF's work has been emboldened by the 2015 Paris Agreement, where 196 countries pledged to work toward low-carbon development trajectories that would limit global temperature change to 1.5 to 2 degrees Celsius above pre-industrial levels. The commitments are transcribed through Nationally Determined Contributions (NDCs), in which each country defines ambitious climate action plans that would, in concert and if upheld individually, address 94.6 per cent of the required CO_2 reductions.[5] Pivotal within the NDCs are commitments to low-carbon energy generation, with an intended goal of zero new energy emissions. The 2018 special report by the United Nations' Intergovernmental Panel on Climate Change notes that the midrange scenario to meet the 1.5 C target requires a share of 70 percent to 85 percent renewables in total energy generation by 2050.[6]

Cambodia's commitment to the 2015 Paris Agreement includes an NDC target of reducing energy-specific emissions by 1.8 million metric tons equivalent of CO_2 (tCO_2e) by 2030.[7] It presents an important and ambitious goal-setting by the nation, but one requiring significant groundwork: to set the country on a pathway to substantial renewable energy capacity additions, to see the abatement of new thermal capacity additions and to accelerate the retirement of existing thermal generation assets. The CIF SREP's 2017 National Implementation Plan for Cambodia aimed to support the addition of at least 150 MW of new solar capacity, resulting in an estimated reduction of 183,412 of tCO_2e emissions per year, and providing 684,375 people (around 136,875 households) improved access to electricity. These targets are now set to be surpassed through the National Solar Park Project. This case study looks at these ambitious efforts, and the challenges related to delivering such a project within Cambodia's nascent renewable energy sector.

SOLAR: AN INFINITE BUT VARIABLE RESOURCE

Within the search for renewable energy resources, and in seeking to find a source that has minimal environmental or social disruption, solar holds the brightest light—enough sunlight strikes the Earth every two hours to meet the planet's energy demand for an entire year.[8] By 2016, the rate of solar capacity additions was greater than any other fuel source, growing by 50 percent, and accounting for two-thirds of net new energy generation capacity globally.[9]

On the supply side, the plummeting costs of solar technology has spurred solar growth, with solar photovoltaic (PV) becoming one of the most affordable generation sources—the price of crystalline silicon PV modules dropped from US$79 per watt in 1976 (in 2018 dollars) to $0.37 per watt in 2017.[10] On

5 United Nations Framework Convention on Climate Change, Nationally Determined Contributions. See https://unfccc.int/process-and-meetings/the-paris-agreement/nationally-determined-contributions-ndcs#eq-4.

6 Intergovernmental Panel on Climate Change, 2018, "Summary for Policymakers," in Global Warming of 1.5°C. An IPCC Special Report on the impacts *of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*, World Meteorological Organization, Geneva.

7 Kingdom of Cambodia, 2015, Cambodia's Intended Nationally Determined Contribution, https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Cambodia%20First/Cambodia%27s%20INDC%20to%20the%20UNFCCC.pdf.

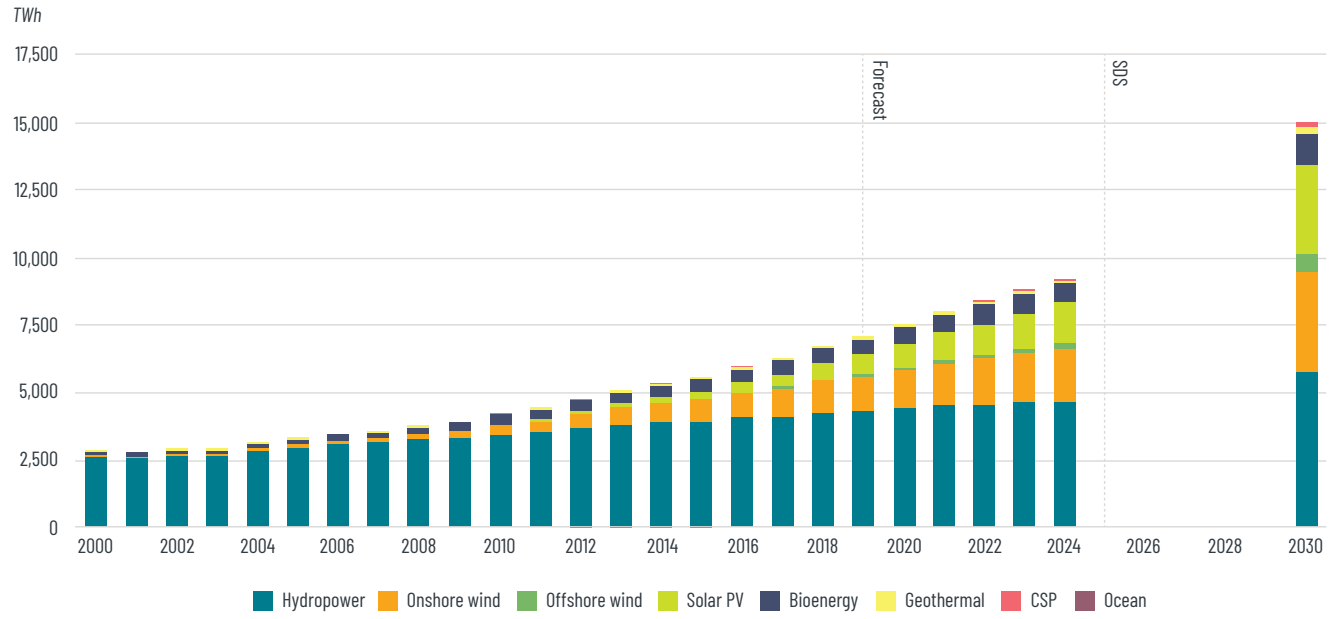
8 International Energy Agency, 2019, *Solar Energy: Mapping the Road Ahead.*

9 International Energy Agency, 2017, *Renewables 2017: Analysis and Forecasts to 2022.*

10 Bloomberg NEF, 2019, *The Clean Technology Fund and Concessional Finance: Lessons Learned and Strategies Moving Forward.*

the demand side, accelerating deployment and stiff private sector competition have triggered record low auction prices on solar power purchases, with tariffs falling as low as US$0.03 per kWh by 2016, comparable to or lower than that of fossil fuel-based generation. In sum, solar represents a shining way forward in power generation, producing energy at low-cost, with minimal negative externalities and through use of an abundantly available natural resource. It offers particular promise in the global South and between the Tropics, where high irradiation coincides with mostly emerging economies. The International Energy Agency finds that solar PV, increasing 32% in 2018, is on track to meet its Sustainable Development Scenario for 2000-2030, the path to meet energy market transition and air pollution goals in full and in line with the Paris Agreement (see figure 1).

Figure 1.
RENEWABLE POWER GENERATION BY TECHNOLOGY IN THE SUSTAINABLE DEVELOPMENT SCENARIO, 2000-2030



Source: IEA, Renewable power generation by technology in the Sustainable Development Scenario, 2000-2030

WHY PUBLIC PARTICIPATION? THE ROLE OF SOVEREIGN ENGAGEMENT IN OPTIMIZING RISK

Unlike thermal generation, which is often partly or solely financed by governments, wind and solar energy are often financed by the private sector (see table 1). Despite plummeting costs, however, solar energy expansion still depends largely on policy makers setting ambitious targets and implementing sound policies, market designs, and regulatory frameworks for a variety of enabling aspects, including technological research, market development, and project deployment.

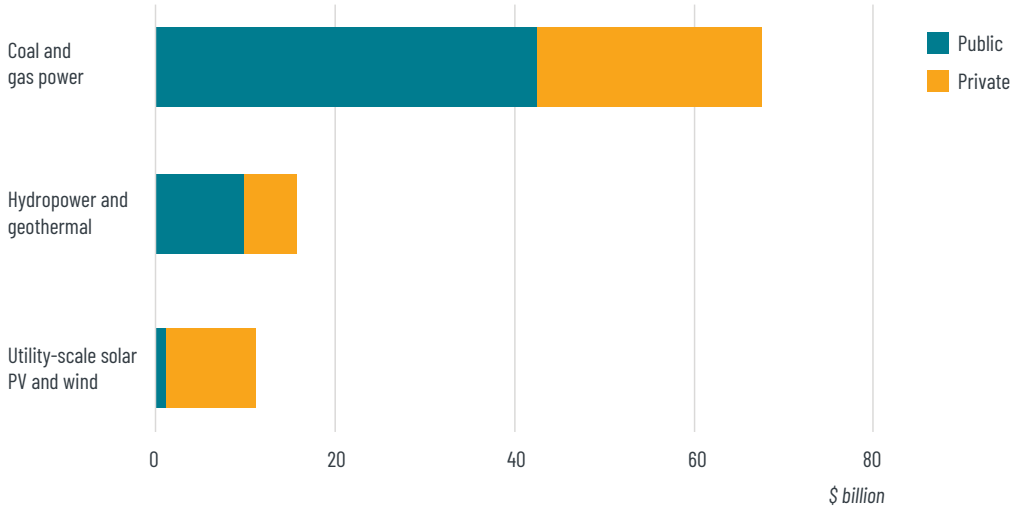
Public sector spearheading of solar expansion is important in anchoring and engendering lasting energy transitions due to several foundational factors: (1) the need to manage gradual renewable integration into national grids, particularly vis-à-vis the need for output smoothing and forecasting to ensure grid stability; (2) the need to create transparent and enabling environments for private investment, including the managing of perceived and real risk factors and their distribution; (3) the need for regulation and management of investment by national utilities, and ministries of energy and finance; (4) the need for centralized gauging, management and dissemination of accurate statistics; and (5) the responsibility to allow for and participate in constructive and open discourse in the public domain, ensuring informed buy-in, adaptiveness and maximal gains for both industries and citizens.

These factors considered, the study analyses project scenarios that hinged on government involvement, expertise, and agency, and how the various priorities, responsibilities and forms of engagement affected the outcomes of the Cambodia project.

WHY CONCESSIONAL FINANCE? THE CAMBODIAN CONTEXT AND THE CATALYTIC POWER OF CLIMATE FUNDING COMMITMENTS

Traditionally, concessional finance has played a pivotal role in managing both technical and sovereign risks associated with renewable energy projects, thereby opening markets for uptake of new technologies. With the costs of solar PV plummeting substantially, most projects, particularly in advanced economies, are now cost-competitive and financially viable without subsidies. In emerging economies, however, transitioning from business-as-usual energy

Table 1.
SOURCES OF FINANCE FOR POWER GENERATION INVESTMENT IN SOUTHEAST ASIA BY YEAR OF FINAL INVESTMENT DECISION, 2014–2018



Notes: FID = final investment decision. Includes only utility-scale projects ≥ 25 megawatts. Public finance includes the participation of the state-owned enterprises, development finance institutions, export-credit agencies and other public entities.

Source: International Energy Agency, 2019, Southeast Asia Energy Outlook.

procurement practices to competitive energy auctions, while putting into place institutional capacities necessary for integrating variable renewable energy (VRE) sources, carries significant costs coupled with either insufficient or non-apparent incentives. Alongside these run the risks particular to individual countries themselves—political instability, local currency volatilities, creditworthiness of state-run utilities, etc. In scenarios where up-front costs are a restricting factor and where the cost of capital may be high, enabling VRE uptake may require the testing of new business or risk-sharing models.

In such contexts, concessional finance can help balance incentives and enable pilot projects that kick-start a country's trajectory toward low-carbon, and eventually, net-zero-emissions generation. This has proved particularly true for Cambodia, on several fronts, with concessional financing acting to: (1) provide a vehicle for the ADB to approach a challenging project with a cautious government; (2) provide the national utility with a financial buffer with which to undertake an untested venture, thereby bridging risk and incentive gaps; (3) allow the piloting of an innovative solar park business model; and (4) provide the space to deploy in-depth market assessments and capacity building, such that risks and rewards were accurately predictable, and the strategies devised had long-term goals and viability. Where relevant, the study underscores the role of concessional finance, including the nature of its deployment, and its role in catalyzing the uptake and scaling of solar power in Cambodia.

CHAMPIONING CLIMATE CHANGE: THE STORY OF ANCHORS

Often, catalysts act within the folds of institutions to lay groundwork and provide thought leadership that engenders transformational change. Woven into the story of change in Cambodia is the commitment of forward-looking and deeply committed climate change proponents, both within the ADB and the government, who worked to gain a panoptic understanding of challenges and concerns, and to address them in nuanced, transparent, and durable ways. While impacts of individual commitments to climate action are not easily quantified, particularly in complex governmental or organizational structures, their role is important, even often pivotal, as is regularly stressed by government and private sector counterparts in projects that required long, dedicated, and good-faith efforts to realize. This notion was reiterated during consultations with the government and the ADB. While the study focuses on the technical, economic and procedural challenges encountered in igniting a large-scale solar transition, we remind the reader that key change-makers within the government and development organizations worked relentlessly to make the related solutions possible.

CONTEXT

Photo: ADB

From 2011 to 2017, government efforts to increase electrification rates through the expansion of distribution networks and diversification of national generation capacity helped in lowering power prices and meeting high annual growth rates in energy demand, with a combined annual growth rate of 16 percent. While Cambodia saw high economic growth and substantial poverty reduction over this period, the country's gross domestic product per capita, estimated at US$1,427 in 2017, was still among the lowest in Southeast Asia. Cambodia's Industrial Development Policy (2015–2025) pointed to electricity tariffs and interrupted supply as major impediments to manufacturing competitiveness.[11] A reliable, affordable and sustainable supply of energy would improve the environment for business, investment and economic growth.[12]

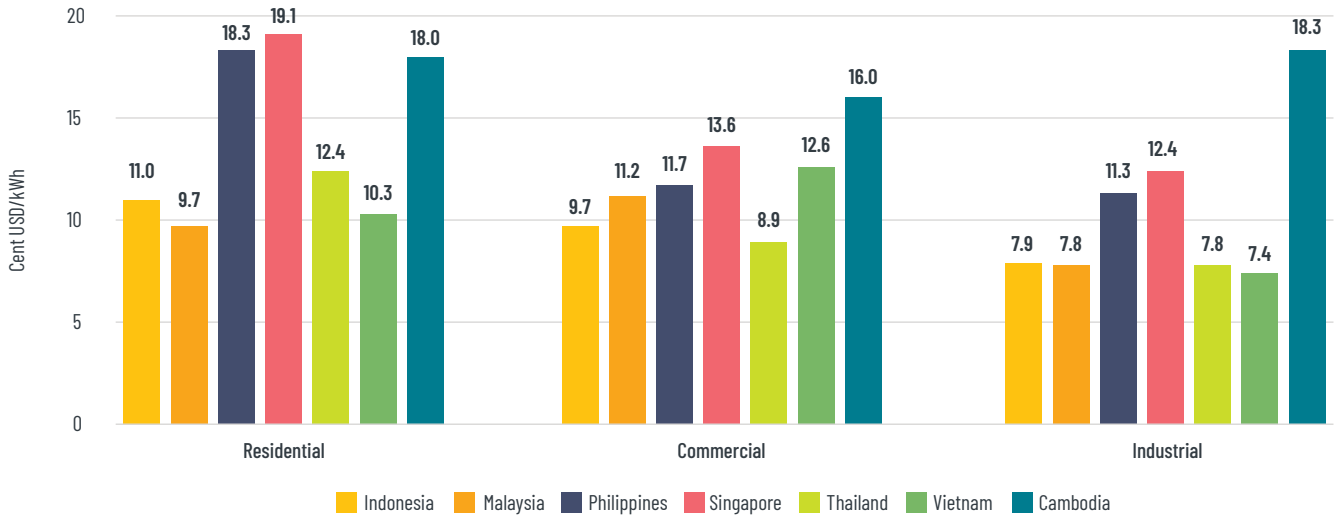
Nearly all of the energy feeding into Cambodia's national grid had been secured via bilaterally negotiated power purchase agreements, in lieu of an open competitive bidding procedure. The Government deemed the bilateral procedure simpler and more time efficient. This way of operating was also in line with the established business culture of working via familiar and trusted counterparts, with expected and manageable risks. The process, however, offered limited assurances for price competitiveness, and in 2019, Cambodia's average electricity tariff was well above those of its regional counterparts (see figure 2).

In recent years, Cambodia has imported around 20 percent of its energy requirements from fossil fuel-based generation in neighboring countries. For example, in 2019, the largest share of its imports came from Vietnam, totaling 1,311 gigawatt hours (GWh) at a cost of US$144 million. In a shift away from thermal generation and toward energy independence, domestic hydro generation capacity increased from 930 MW to 1,330 MW over the 2016–2018 period. A protracted dry season in 2019, however, caused the Mekong River to reach its lowest levels in more than

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

12 World Bank, 2014, *Where have all the poor gone? Cambodia poverty assessment 2013*, second edition.

Figure 2.
POWER TARIFFS IN MAJOR SOUTHEAST ASIAN ECONOMIES, 2019



Source: ESDM 2019, EIA 2020

100 years. This led to extensive load-shedding from mid-March to the end of May 2019. Electricite du Cambodge (EDC) had to protect the grid by imposing blackouts that mostly affected the capital city, Phnom Penh, where most industries and businesses are located. During this period, blackouts could last for up to five hours per day.

The government was keen to explore alternative sources of generation that were cleaner, more cost-efficient, and supported a stable, year-round supply. In tandem, Phase IV of the national Rectangular Strategy for Growth, Employment, Equity and Efficiency (2018–2019) included increasing renewable energy generation to ensure long-term energy security with a particular focus on solar energy, an abundantly available but underutilized renewable energy source that could supplement daytime peak demand during the dry season when hydro capacity was at a shortfall.[13]

DEVELOPMENT CHALLENGE

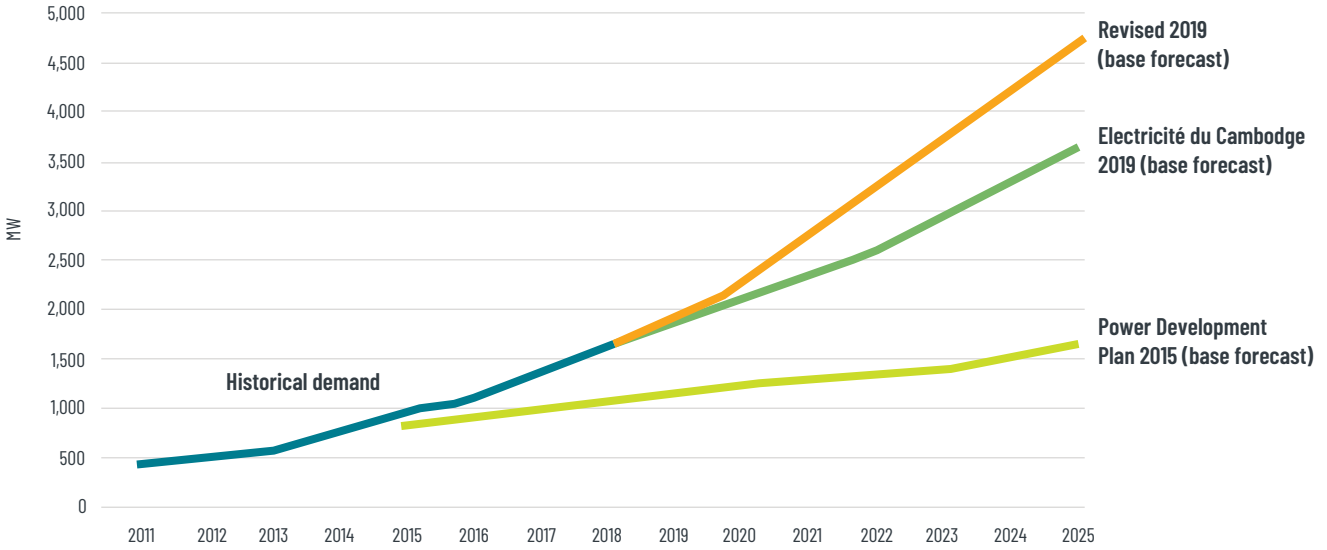
Cambodia had a shortage of electric power. At project conception in 2017, nearly 5 million Cambodians lacked access to electricity: only 82 percent of villages and 69 percent of households were connected to the national power supply. The country's installed generation capacity totaled 1,878 MW. In that, hydropower accounted for 980 MW (52 percent), coal-fired generation for 564 MW (30 percent), diesel for 295MW (16 percent), biomass for 29 MW (less than 2 percent), and solar for 10 MW (less than 1 percent).[14] In the same year, about 18 percent of total electricity supply was imported from Thailand and Vietnam. High electricity tariffs of US$0.14 to US$0.17 per kWh constrained economic competitiveness. Rapid growth in demand, currently well above forecasts of the 2015 Power Development Plan[15], require rapid capacity additions in response (Figure 3).

13 Government of Cambodia, 2018, *Rectangular Strategy for Growth, Employment, Equity and Efficiency: Building the Foundation Toward Realizing the Cambodia Vision 2050, Phase IV of the Royal Government of Cambodia of the Sixth Legislature of the National Assembly*, Phnom Penh.

14 ADB, 2019, *Proposed Loan and Administration of Loan, Grant, and Technical Assistance Grant Kingdom of Cambodia: National Solar Park Project.*

15 Chugoku Electric Power Co., Inc., 2015, "The Project on Revision of Cambodia Power Development Master Plan," presentation prepared for the Government of Cambodia

Figure 3.
ENERGY DEMAND FORECASTS AS OF EARLY 2019



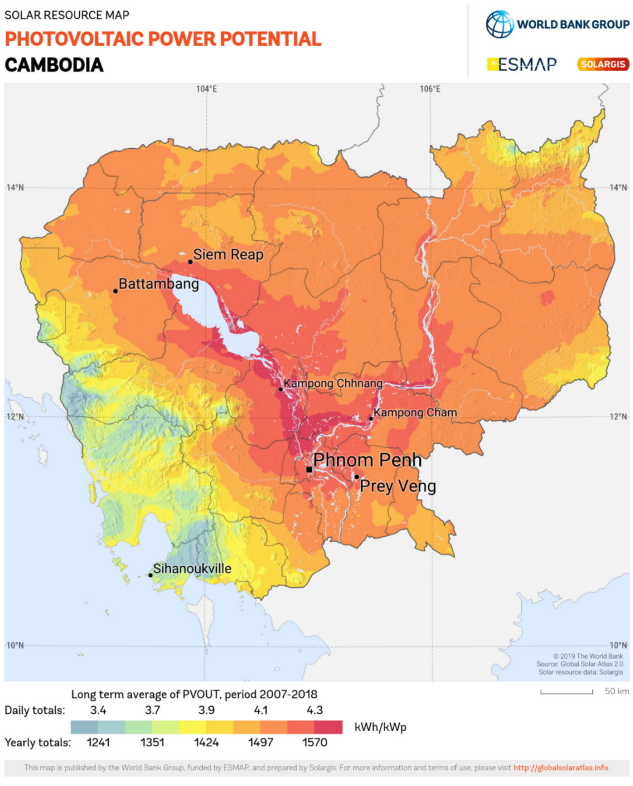
Source: 2020, ADB, Cambodia's National Solar Park (Case Study)

Coal and hydro were the two primary sources of power in 2017, together accounting for 81 percent of Cambodia's total installed electricity generation capacity. While the national Power Development Plan called for major additions of large hydropower and coal-fired generation plants through 2030,[16] social opposition to such projects had triggered a moratorium on hydropower, while carbon-intensive coal generation exposed the country to price shifts and rising coal costs in the international market. Cambodia has a solar potential of 30,090 GWh, well distributed across the country, and with concentrations coinciding with high-demand centers such as Phnom Phen (figure 4).

THE INTERVENTION

The CIF's revised SREP investment plan of 2017 took an ambitious stance in offering concessional and grant financing for introducing renewable energy in Cambodia's energy mix. This in hand, the same year, the ADB embarked on a plan to pilot large-scale solar PV generation in Cambodia. The concept was not new to the country. Regional counterparts such

Figure 4.
PHOTOVOLTAIC POWER POTENTIAL



Source: 2017 The World Bank, Solar resource data: Solargis.

16 ADB, 2019, "GDI Delivery Lab Presentation-Cambodia Solar Park."

as Thailand had implemented solar energy projects, and the price of solar technology was dropping fast, even as coal costs rose in the global marketplace. In 2016, Cambodia ventured into solar with Bavet, a small, 10MW plant, tendered to the private sector, and securing a tariff of US$0.91 per kWh, below the country's average of US$0.95 per kWh cost of supply. The plant was located in the special economic zone of Bavet, where half of energy demand was met via imported energy from Vietnam.[17]

While the small-scale Bavet plant was a success, Cambodia had serious reservations about the technical challenges in integrating large-scale VRE generation into the grid, and about the efficacy of competitive tendering in procuring power in step with accelerating energy demand. In a context where affordably priced, grid-conducive, large-scale solar generation had no proven business models, the CIF and the ADB aimed to demonstrate the viability of large-scale PV generation in producing energy at competitive prices. The ADB also wanted to demonstrate the potential for gradually scaling up capacity in step with the tested ability of the national grid. This then would create a pathway for substituting current plans for more carbon-intensive (coal) and climate-vulnerable (hydro) capacity additions with clean and reliable sources, namely, solar.

The ADB's efforts were synergistic with government priorities. Its plans for a cost-competitive tendering of scaled-up solar to the private sector aligned with national objectives to: (1) expand low-cost power generation; (2) diversify the power generation mix and increase the share of clean energy in its generation mix; and (3) expand the use of competitive bidding and other global best practices in the sector.

17 See https://www.pv-tech.org/news/adb-back-cambodias-first-ever-large-scale-solar-farm.

DELIVERY CHALLENGES

Photo: ADB

While the objectives of the government, CIF and ADB aligned on the need and importance of introducing more renewable sources into the energy mix, transitioning from traditional forms of production (such as hydro and coal) to a mix with more privately generated, solar-based energy posed two major delivery challenges.

CHALLENGE 1: BUILDING CONSENSUS: GRID STABILITY, EFFICIENCY CONCERNS AND THE NATIONAL UTILITY

The government of Cambodia had to deliver more energy capacity, quickly, while ensuring reliability and affordability of supply. Accomplishing this via solar energy posed several significant hurdles. The government had well-founded **concerns regarding the stability of the grid in the face of large-scale VRE integration.** Since solar is an intermittent energy supply source, generated only during the day and dependent on the weather, integration into the national grid required measures to predict and manage a smooth changeover to alternate sources in times of low generation, preventing a discontinuity in supply.

Managing time constraints and technical capacity needs posed another concern. Since a large-scale project would require private investment, and

because, per the ABD's recommendation, securing low prices required an international competition that would drive down prices, the deployment of a large-scale solar project hinged on executing an open tender. This then required significant groundwork in regulatory, financial and procedural structuring, a process that the government had deemed as having too large a lead time, and too great a dependency on international investor appetite that was hard to gauge and had thus far seemed inadequate. To boot, the technical management of solar, the commercial management of a tender process, and all the related regulations and procedures required significant know-how that was not available in-house, exacerbating concerns that the venture would require too much time and pose too much risk.

CHALLENGE 2: FORMULATING AN ENABLING BUSINESS ENVIRONMENT: RISK, PRICING, TRANSPARENCY AND THE PRIVATE SECTOR

For the private sector, and particularly for international investors, Cambodia presented a nascent energy market with **limited demonstration of the capacity to execute transparent, open-door tendering practices**, and in a region where procurement costs are high. There were also reservations about **balancing costs and pricing versus risk**. For the state, renewable energy was seen as an expensive power source at entry—cost-intensive if not at adequate scale, needing significant upfront investment volume, and requiring a multitude of auxiliary processes to manage forecasting and grid-stabilization. In the face also of grid risks and time expense, the gains from solar pricing were not seen as sufficient to offset overall costs. For private sector bidders, several factors contributed to the project carrying a high risk profile. While the national utility, EDC, a state-owned enterprise, was considered financially sound, the country's sovereign credit rating—the first threshold through which to bring in investors—was less than favorable. In tandem, the government did not offer sovereign guarantees, often a mechanism to reduce exposure to losses from political volatility, legal changes, debt serviceability, economic and currency fluctuations, etc. Second, with many international bidders new to the country, unpredictable and lengthy procedures for land acquisition posed a challenge. Geographic familiarity and bargaining advantages skewed competition towards potential local bidders and made the auction less attractive to international participants. The harder it was for international players to be competitive, the weaker the competitive tensions that would drive down price.

TRACING THE IMPLEMENTATION PROCESS

Photo: iStock

→ Nov 2016: Launching dialogue with the government

The ADB first approached the Cambodian government about renewable energy in late 2016, in the wake of Cambodia's Revised Power Development Plan. It forecast an annual electricity demand of 18,000 GWh in 2030, to be met primarily via coal, gas or large hydro capacity additions.[18] In 2016, however, global prices for solar technology were plummeting, and solar capacity additions were fast expanding.

Published two years prior in 2014, the government's National Strategic Development Plan for 2014–2018 had prioritized renewable energy additions to meet the target of electrifying 100 percent of Cambodia's villages by 2020.[19] With solar prices dropping and the price of imported coal rising, the ADB, led by its regional public sector energy team, sought to work with the government to enable a transition to cleaner and more affordable energy generation. The strategy proposed promised positive economic prospects in the long term, increased energy security and reduced

18 Chugoku Electric Power Co., Inc., 2015, "The Project on Revision of Cambodia Power Development Master Plan," presentation prepared for the Government of Cambodia.

19 Government of Cambodia, Ministry of Planning, 2014, *National Strategic Development Plan, 2014–2018.*

risks linked to fossil fuel imports, and eventually, on the tail of the nation's 2015 electricity tariff subsidy scheme for low-income households, the provision of low-cost energy to all households.

While solar offered an attractive clean energy option, however, attempts to establish the project soon brought to the fore a host of challenges to transitioning the national energy mix. Overcoming these challenges came via a dedicated effort by the ADB project team to create conditions conducive for solar uptake, and via the commitment of climate champions willing to advocate for clean energy within both the ADB and the government. Close collaboration between and genuine pledges by both parties allowed for step-by-step formulation of sound solutions to the challenges encountered. The ADB's "One ADB" approach, a deployment of a custom-made suite of interlinked financial products—debt financing, advisory support, and grant and concessional funds—helped close gaps on all levels. The government brought a sound rationale and openness to solutions, partnerships, and the judicious but deliberate testing of new frontiers. Figure 4 maps the timeline of the engagement, the challenges faced, and the solutions devised.

→ **May 2017: Creating an enabling environment for government participation**

CHALLENGE 1: BUILDING CONSENSUS: GRID STABILITY, EFFICIENCY CONCERNS AND THE NATIONAL UTILITY

Grid stability vis-a-vis large scale VRE integration

For countries new to renewable technologies, integrating solar into the national grid poses significant challenges. Unlike fossil fuel-based generation assets that can run continuously, except when offline for maintenance, solar power plants depend on the irradiation available on a given day, making power output both variable and only partly predictable, and feeding the grid only during daylight hours. While favorable for countries with daytime peak demand, such as Cambodia, this variability can pose significant threats to the stability of a nationally integrated grid. Incorporating solar into the energy mix therefore requires a host of arrangements to manage the intermittency of supply. These range from a robust understanding of irradiation patterns, to wide-ranging system flexibility and responsivity to fluctuations, to cost-efficient storage options that help regularize the supply to the grid.

Action becomes increasingly more urgent as the share of variable generation increases. While integration challenges are relatively modest for VRE shares of 10 percent or less, a share greater than 10 percent requires complex solutions. This is more so for sources with low capacity factors such as solar,[20] with relatively greater shifts in output capacity between the maximum and the annual average. It requires integrating energy storage options, ramping up demand-side response capabilities, increasing grid interconnections, and balancing solar additions with flexible hydro and thermal capacities.

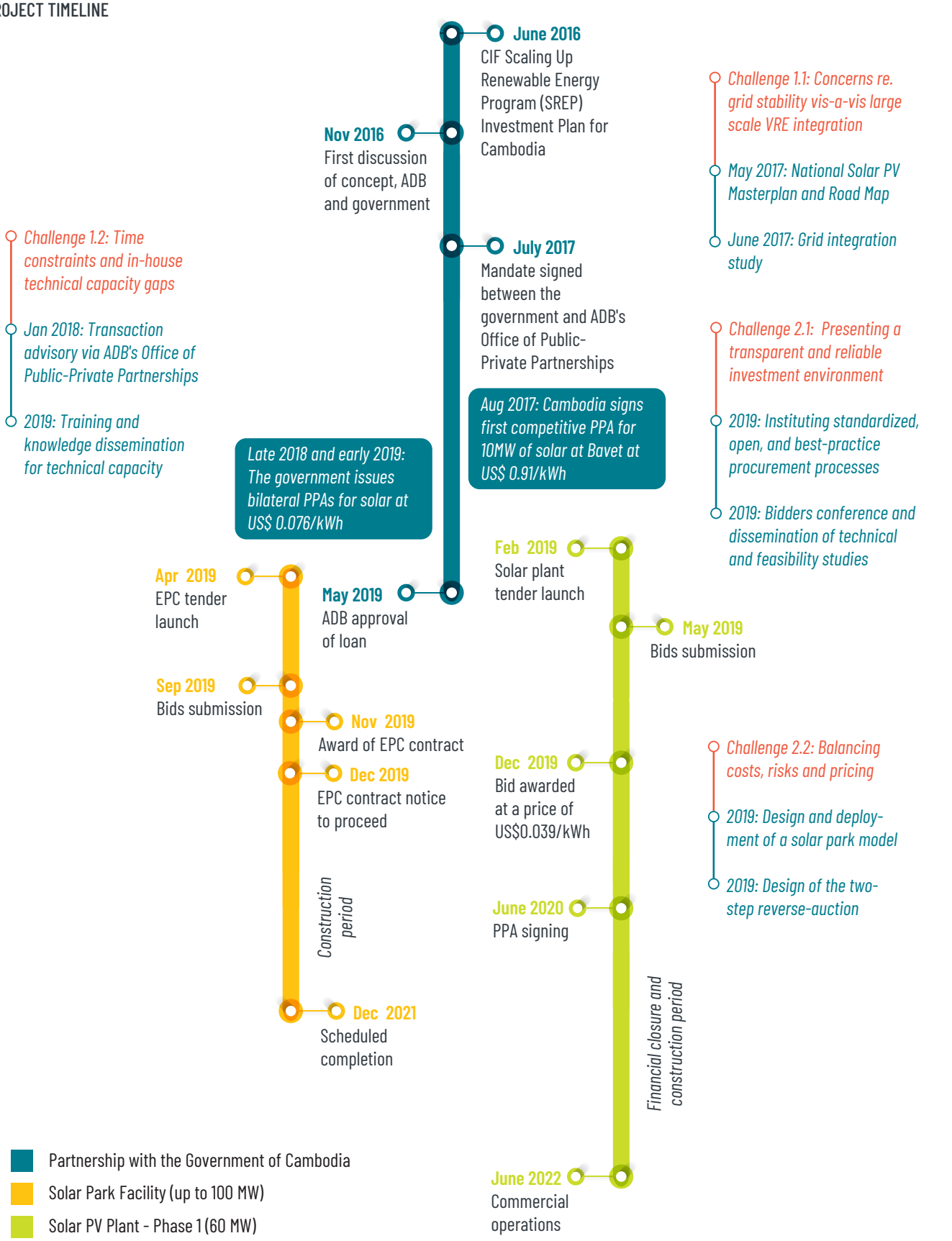
The task of ensuring the stability of the entire national grid was carried out wholly by EDC. Technical concerns around the intermittency of solar made the utility cautious about integrating a large capacity in a short time frame. A failure in one part of the distribution network could trigger failure across the entire system, with significant costs to grid-connected transition equipment at the local level, and profound economic and social costs at the national level, with the possibility of inducing rolling blackouts. At a time where the government was working to create an enabling environment for investment and economic growth, and where public confidence and overall safety were at stake, a large-scale solar integration strategy presented very high risks.

Solution: Across-the-board cost-to-benefit and scenario analyses of VRE integration, and a model for step-wise capacity additions

The solution was a multifold, step-by-step process addressing gradually evolving concerns, but centered on providing the government with robust information

20 International Energy Agency, 2018, Will system integration of renewables be a major challenge by 2023? https://www.iea.org/articles/will-system-integration-of-renewables-be-a-major-challenge-by-2023.

Figure 4.
PROJECT TIMELINE



and tools to assess the relative risks and rewards of undertaking a solar integration strategy. The process included in-depth analyses of solar's commercial viability, reliability of supply, overall cost-to-benefit ratios, and, most pivotally, the design and feasibility of grid integration strategies.

In June 2017, the ADB's public sector energy team prepared the National Solar PV Masterplan and Road Map, commissioned a grid integration study, and predicted the extent of solar penetration in the medium term (2018–2030). The team also provided analyses of low, medium, and high solar uptake scenarios; identified potential locations for future solar parks, with considerations also of grid integration requirements; and provided EDC with a detailed feasibility report that would allow the utility to make informed decisions about a solar strategy best suited to Cambodia's grid infrastructure.

Once the concept had been affirmed as technically feasible, the team focused on the EDC's concerns about integrating a large solar electricity production capacity into the grid, including the management of electricity supply fluctuations. The ADB proposed an unconventional approach: a phased solar park model, in lieu of a single plant, allowing for piecemeal increases in generation capacity in line with increases in both consumer demand and EDC's familiarity with the technology.

The park model would also capture economies of scale, with the entire park and all related infrastructure built via a single investment process. The park would have a total capacity of 100MW, but EDC would auction smaller mega-wattages of plants and bring capacity online in step with grid enhancements and readiness. In discussions with EDC, Praing Chulasa, the deputy managing director, noted that this model abated concerns regarding grid stability in the face of total additions of 100MW. The project has thus far moved forward on successfully auctioning 60MW of capacity in the first phase of development.

→ July 2017: Mandate signed between the government and ADB's Office of Public Private Partnerships: building the tendering architecture

Time constraints and in-house technical capacity gaps

In 2017, the Cambodian government faced imminent power shortages and public pressure to bring more capacity online as swiftly as possible. Large hydro, while sound under heavy rainfall conditions, was not dependable in extended dry seasons. Further, the socioeconomic and environmental impacts of these projects had triggered significant opposition from local communities, resulting in the government's 2016 moratorium on new hydro developments. Viable and timely capacity additions were a pressing concern.

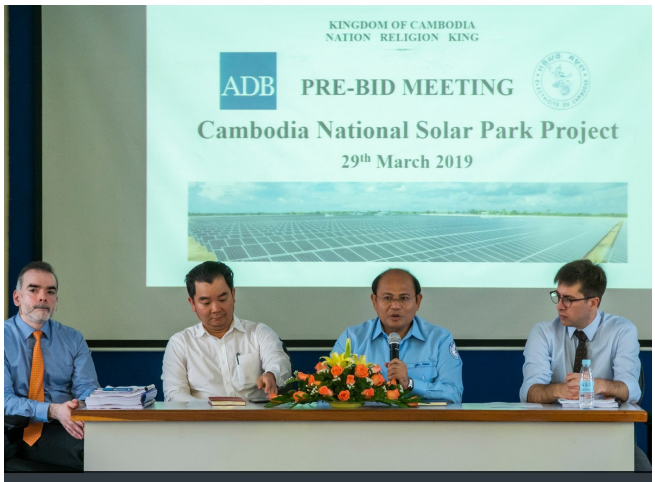
The government's established practice for entering into large-scale power purchase agreements was largely via closed-door bilateral negotiations with familiar and trusted large independent power producers capable of developing sizable fossil fuel and hydroelectric power plants. The government saw bilateral negotiations as far more time efficient than competitive tendering, with the benefits of the latter deemed insufficient to trigger an entire shift in established business practice. The government had previously attempted competitive tendering for a much smaller-scale solar plant tender, Bavet, in 2015, but had seen just five companies express interest and four reach prequalification. It was only a moderate signal of private sector interest, and not sufficient to motivate investing time in a much larger and more complex tender process.

The introduction of new transaction structures and production technologies would also require that the EDC, the Ministry of Mining and Energy, and the energy regulator (the Electricity Authority of Cambodia) acquire expertise in instituting and managing technical standards, operating requirements, and regulatory arrangements for the production of solar energy by independent power producers. On the financial front, ministries were inexperienced in setting up commercial arrangements necessary for launching and managing a competitive, international

tender process, with price auctions rather than negotiated feed-in tariffs.

Solution: Transaction advisory for designing the financial and regulatory architecture of an auction, alongside technical capacity development

At this stage, the ADB's involvement transitioned to what is often termed "transaction advisory" services, led by the bank's Office of Public-Private Partnerships. These entailed providing technical advice to address challenges surrounding various components of the procurement process. The challenges included but were not limited to: concerns regarding geographic placement and land availability relative to the primary energy demand centers; considerations around including battery storage capacities in the project design, and the related cost implications; accommodating and balancing EDC payment risks for the private sector, particularly vis-à-vis the lack of a government guarantee; coordinating with and between different ministries and their approval processes; negotiating power purchase agreements with the successful bidder; and overall considerations regarding relative cost- and/or time-efficiencies of bilateral processes versus a competitive tender.



Cambodian officials and ADB staff respond to bidders' questions during a pre-bid meeting in March 2019. L-R: Pradeep Tharakan (Project Lead and Principal Climate Change Specialist ADB), Nget Sokhan (Deputy Managing Director of Finance and Business, EDC), Praing Chulasa (Deputy Managing Director of Planning and Techniques, EDC), and Ferran Vila Planas (Public-Private Partnership Specialist, ADB)

To address technical capacity gaps, both the ADB's public-sector and public-private partnership (PPP) teams focused on developing EDC's in-house analytical and operational capacities to oversee solar additions and integration, including managing land acquisition and safeguards; training on engineering aspects for integrating solar to the grid; and trainings on procuring solar PV capacity and managing commercial contracts.

→ **Feb 2019: Launching the tender for the first 60MW of capacity: creating an enabling environment for private sector participation and competitive pricing**

CHALLENGE 2: FORMULATING AN ENABLING BUSINESS ENVIRONMENT: TRANSPARENCY, RISK, PRICING AND THE PRIVATE SECTOR

Presenting a transparent and reliable investment environment

The success of the project hinged on significant investor interest in the Cambodian energy market, which would thereby create competition that lowered prices in the bidding process. A competitive tender process (as opposed to the established practice of closed-door bilateral agreements) required establishing investor confidence in the transparency of both the process and the information available. This was particularly important for investors outside the Association of Southeast Asian Nations (ASEAN), who were unfamiliar with Cambodia's political, cultural, and procedural environment. The lack of transparency could stifle potential interest from larger, international investors, who stood to add significant value if successful in entering or winning the auction—through size and expertise, they were less risk averse, and offered significant technical and operational know-how.

Solution: Instituting standardized, open, and best-practice procurement processes

Through their transaction advisory services agreement, the ADB's Office of Public–Private Partnership team worked with EDC to design and conduct a competitive tender for procuring an

independent power producer to build the first solar power plant within the park. Where investor confidence about market conditions and feasibility may previously have been lacking, the ADB made available its extensive feasibility analyses, including a bankable solar resource survey, thereby providing information and assurances on key viability factors so that potential investors could make informed and appropriate decisions regarding their bids.

The bidders conference, intended to elevate investor confidence and appetite, also allowed for direct engagement between bidders, EDC and ADB, resulting in a clear understanding and agreement among all parties regarding risk allocation and key project parameters. EDC also used the forum to present its financials, and to field questions regarding its US dollar payment obligations, the detailed analysis of which acted to build further confidence regarding EDC's creditworthiness.

Where government capacities in managing such a large-scale competitive procurement process were still nascent, the ADB worked with EDC to deploy standardized and best-practice transaction documents and tender processes to create confidence among local and international bidders, and foster a climate of transparency around the technical and financial architecture of the project, allowing participants to assess and price bids with confidence. Operating procedures and roles and responsibilities of EDC and the power producer were formally defined, reducing risks of incongruence in expectation or delivery. The technical specifications required for the project were clarified, emphasizing output-based specifications rather than specific inputs, thereby allowing bidders to make decisions regarding key design elements such as the mounting structure and evacuation facilities, module type and size, inverter type, and direct current voltage, as best suited for delivering the agreed power volumes which were tethered to a take-or-pay power purchase agreement. Protocols for legal or remedial recourse were also clearly defined, setting transparency and predictability as cornerstones of the related agreements (figure 6).

Balancing risk and pricing

For the state, the levelized cost of renewable energy (the average cost over the life to the project) was deemed too high when not produced at scale, and the advantages of scaled-up solar in Cambodia were not yet fully apparent. While the ADB's market analyses (solar road map, feasibility studies, and scenario analyses) provided some confidence in the soundness of the concept, the government still had reservations about securing a bid-price that would effectively offset the costs associated with the necessary technical, regulatory and operational reforms. A cost-compensatory level of private sector demand for solar projects in Cambodia's nascent energy market was not fully apparent.

The only solar plant thus far tendered by the government, Bavet, had captured a market price of US$0.091 per kWh, which, while lower than the nation's average cost of US$0.097 per kWh, was not low enough to offset costs associated with establishing a new large-scale, tendered project. A subsequent bi-lateral solar tender in 2018 had secured a tariff of US$0.076 per kWh, further challenging the cost-to-benefit proposition of a lengthy tender process. Alongside this concern, the intermittency of solar was seen as requiring significant investments in back-up generation capacity to allow output smoothing and smooth changeovers, particularly as solar generation went offline at night.

For the private sector, when signing power purchase agreements, EDC would be the state-side counterparty. The utility was financially sound. Were it to stand alone, it would have a higher rank than Cambodia's sovereign credit-rating. The latter, however, raised the investment's risk profile, but the government approach to the project did not include a sovereign debt guarantee, often seen as offsetting the significant political and currency risks often inherent to emerging economies, and more so for a first-time venture. Further, while acquiring land was a key cost and process determinant in establishing a large-scale solar plant close to high-demand centers such as Phnom Penh, land ownership was often quite fragmented, and land acquisition by the

private sector would involve managing a large number of parties via somewhat indeterminable procedures and unpredictable pricing. The credit risk for international investors, in short, would be high under a conventional procurement model for establishing a solar plant, thereby raising costs and pricing.

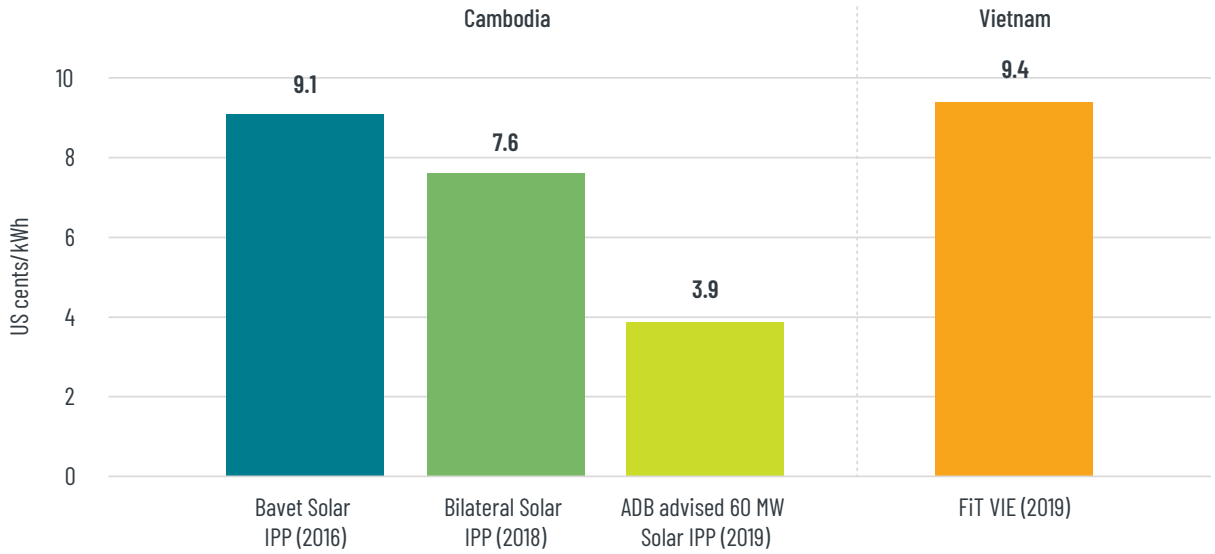
Solution: The reverse-auction, the solar park PPP model, and the effective distribution of risk

The project deployed several strategies that in sum spurred significant private sector interest and secured a bid price of US$0.039 per kWh, a record low for Southeast Asia (figure 5). Primary among these strategies was ADB's deployment of a solar park model and a PPP, rather than a solar plant developed solely by an IPP, significantly de-risking the project in critical areas.

Within this model, the government carried country-specific risks that would otherwise deter new investors but were in fact manageable commitments for the state, with risk-taking buttressed by the availability of concessional and grant financing. By ensuring that the responsibility for land acquisition and park and transmission infrastructure are borne by the government, and thereby allocating the risks of providing grid connectivity and other ancillary services to EDC who stood better suited to carry them, the model substantially raised the project's risk–reward profile for the private sector. This ignitor strategy spurred investor entry and appetite, making the project accessible to international bidders with limited or no exposure to the Cambodian market. This then contributed to lower bid prices, which in turn balanced the capital-cost outlay and risk-bearing of the government.

In tandem, to enhance the Cambodia's prospects for securing the lowest possible price point, the ADB worked closely with the government to implement a highly effective two-step reverse-action process. In brief, this was an iterative bidding process, allowing for a first-round selection of choice candidates, signaling priorities, followed by a second round of bidding. Each iteration enhanced competitive tensions to drive down price. Bolstered by robust market and technical analyses, efforts to ignite international investor interest were met with success. Over 150 firms attended a bidders' conference convened in Phnom Penh in early 2019. Among these firms, 148 purchased the bid documents, and 26 submitted expressions of interest. Final bids were received from 26 firms in 11 countries. Consultations with the Ministry of Economy and Finance have since affirmed an interest to redeploy the auctioned solar park model in the near future, without concessional finance.

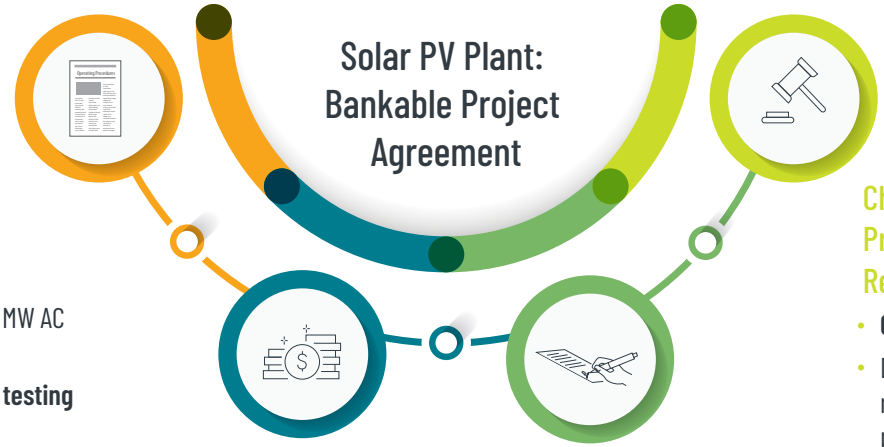
Figure 5.
PRICE COMPARISON



→ **Sep 2019: Bid awarded to Prime Roads Road Alternative Company Limited with a regional record low tariff of US$ 0.039 per kWh**

In the project's designing of the Power Purchase Agreement (PPA), the energy payments mechanism was refined, including several aspects that enhanced the project's bankability and financial resilience: tariffs were entirely defined in US dollars so as to provide protections from local currency fluctuations, and a detailed payment regime covered invoicing mechanisms, liquidated damages, and protocols on late payments, thereby minimizing the risk of recourse via litigation. Figure 6 maps the entire array of instruments put into place to appropriately allocate risks and responsibilities such that the project was both commercially viable and attractive. Upon finalization of the PPA, expected in the summer of 2020, ADB's private sector team will consider providing financing to the private investor, subject to due-diligence and board approval.

Figure 6.
WHAT MADE THE PROJECT BANKABLE?



Technical Requirements

- **Output based specification** - 60 MW AC capacity
- Clear **commission testing procedures**
- Detailed **operating procedures** including metering requirements, segregation of roles and responsibilities between EDC and Project Company within solar park

Payment Regime

- **USD tariff provides FX protection**
- **Detailed payment regime** including details of invoicing mechanism, liquidated damages, interest on late payments, etc.
- **Deemed Commissioning** and **Deemed Generation** provisions included to provided protection to Project Company

Defaults & Termination Regime

- Detailed description of roles and responsibilities for both EDC and Project Company and terms of defaults events for each party
- Detailed remedial provisions for any event
- **Clear Termination Regime** for: (i) Project Company Event of Defaults; (ii) EDC Event of Default; and (iii) Prolonged Force Majeure Event

Change in Law Protection & Dispute Resolution

- **Change in Law** protection
- Detailed dispute resolution mechanism including provision to conduct arbitration in **Singapore** pursuant to the **United Nations Commission on International Trade Law (UNCITRAL) Arbitration Rules 2010**

RESULTS/OUTCOMES

Photo: iStock

OUTPUT 1: THE SOLAR PARK (FIGURE 7)

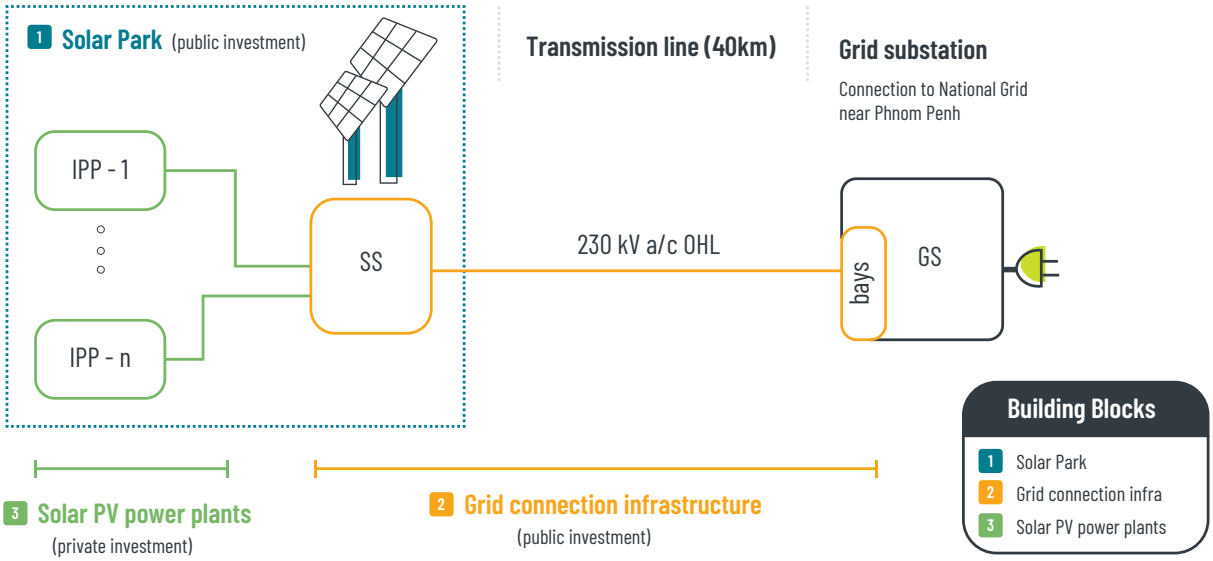
- 100 MW of PV plant capacity has been created, including land acquisition of up to 100 hectares, and fencing, drainage, roads, and plant buildings.

- A transmission interconnection system expansion is under construction, including: (1) the 100 MW capacity pooling substation at the solar park with two 50-megavolt-ampere transformers (and room for two additional transformers), switchgear, an ancillary system, and controls; (2) a supervisory control and data acquisition system compatible with EDC's requirements, advanced forecasting tools, and expanded information and communication technology applications; (3) a dedicated 40-kilometer, 230-kilovolt double circuit overhead transmission line between the solar park substation and grid substation; and (4) two new bays with switchgear at the grid station.

OUTPUT 2: EDC'S ENHANCED CAPACITY VIA A TRANSACTION ADVISORY SERVICES FACILITY THAT HAS:

- Strengthened EDC's capacity to design, construct, and operate solar PV plants and solar parks (including management of environmental and social safeguard issues), and EDC's ability to

Figure 7.
SOLAR PARK OVERVIEW



Source: ADB, 2019

adopt energy storage systems and other measures to integrate intermittent renewable energy into the national grid.

- Strengthened EDC's capacity to procure solar PV generation capacity through the private sector, including designing and executing a competitive tender for the park's first power plant—a 60 MW solar PV generating plant, comprising crystalline-silicon solar arrays and mounting structures, power conversion units (inverters and associated transformers), direct and alternating current plant cabling, power controls, and supervisory control and data acquisition. As the transaction advisor, the ADB performed project due diligence (including legal, technical, financial, environmental and social due diligence) and market sounding, prepared the feasibility study, assisted in developing tender documents and power purchase agreements, and supported the review and selection process. Consultations with the Ministry of Economy and Finance affirmed the importance of the capacity created, while greater capacity building was requested to allow even more autonomy in competitive tendering and technical analysis.

Impact: Increased energy security, affordability, and sustainability

Outcome: Cost of electricity in Cambodia lowered; increased private sector investments in solar PV plants

Output: Solar park and transmission interconnection infrastructure are constructed; EDC's capacity strengthened in solar power plant construction and operation, project design and supervision, grid integration, and competitive procurement.

LESSONS LEARNED

Photo: ADB

ALIGNING OBJECTIVES: DEVELOPMENT BANKS AND THE LONG ROAD

1 **Developing strategies in consort with governments from inception; adapting delivery to align with government priorities, constraints and timeframes; and an orientation to back long-term development strategies over quick wins can create more stable and replicable outcomes.** Meetings with both EDC and the Ministry of Economy and Finance noted the value of the ADB's concerted efforts to understand and meaningfully address the government's concerns about the long-term risks and prospects of renewable energy, and to work in tandem with the government to map and execute a realistic longer-term plan. The significance of transparent and adaptive collaboration by both the government and the ADB, bolstered by the commitment of individual climate champions, was affirmed by the government, the ADB and Prime Roads, and was arguably a cornerstone of the project's success in engendering an accelerated transition.

2 **Clients' graduating from the need for concessional financing must be a cornerstone not only of theoretical conception but also of each step in the engagement.** Apparent within the project's approaches, and also via conversation with the project team, was the intention to enable maturing of the Cambodian energy market such that it no longer needed ADB or concessional financing support. While the ability to create a self-sustaining trajectory or have demonstration effects is a linchpin of all development finance, and often in fact a requirement for project justifications within internal approval processes, in practice, projects are often leveraged to also be gateways to new or knock-on investments. The foundational intention of market maturing, within this and other CIF-funded projects, speaks of an evolution in climate finance, where project teams such as that of the ABD are seeking to maximize the self-sustaining impacts of investments, allowing scarce investment finance to be deployed to address more frontier and complex development challenges.

UNDERSTANDING YOUR CLIENT: ADAPTIVE AND CLIENT-CENTRIC SOLUTIONS

3 **Efforts to astutely and conclusively respond to government reservations with tailored strategies that, while disparate in objectives are cohesive in delivery, can create greater time- and cost-efficiencies, and holistic response packages well suited for replication.** For the ADB, the government's execution of the Bavet tender in 2015 signaled an eagerness for transitioning to renewables, or at least a nascent interest. This was impeded by a broad and evolving set of constraints: a lack of robust analyses of the risk-reward distributions of various financial, technical and climactic scenarios; legitimate technical reservations on the part of implementing agencies; time constraints for the national government vis-a-vis perceived gestation times of large-scale procurement processes; and technical capacity needs for effectively managing the introduction of technologies at scale.

The "One ADB" approach that was the framework for the related responses in essence enabled and maximized joint successes. It's design and delivery offer some foundational lessons on deploying timely, holistic, client-centric, and adaptive development finance packages, formulated to address numerous and intertwined constraints that are often inherent to projects that challenge norms in emerging economic contexts. The approach saw not just the deployment of bespoke technical and financing products—exemplifying a nuanced client centric approach—but also an integration of products and internal knowledge. This meant the governmental counterpart was not working with multiple sources of guidance and development assistance, but was undertaking a singular interaction with a multifaceted development partner that placed weight on eliminating information or time gaps between different project phases—research, development, advisory, financing, etc. The approach, centered around a seamless and coherent process for the client, holds the potential to enable less-fragmented projects, with more aligned objectives and greater efficiency, which are particularly key when deploying untested strategies in challenging contexts.

THE ROLE OF COMPETITIVE PROCUREMENT: ONE SIZE FITS ALL?

4 **Are competitive tenders the panacea for the clean energy gap?** In the international sovereign infrastructure marketplace, competitive auctions are often seen as the gold standard in delivering transparency and price competitiveness. They are used effectively by countries as their projects and energy markets graduate in scale and complexity. A multitude of binding constraints were addressed through the Cambodia National Solar Park's competitive procurement process, alongside support for best-practice due diligence, financial structuring, transparency and auctioning procedures. These contributed to driving down prices and securing a confident bidder that now wants to scale-up operations in Cambodia. In meetings with the government, and in discussing the competitive tender, the process and outcome were seen in a very positive light, and the government was appreciative of the ADB's efforts in designing and deploying the auction.

In discussing future plans, however, the road forks. While the government is planning to deploy, independently and without concessional support, another competitive solar park auction of similar size and characteristics—an affirmation of the value it sees in the process—it has also been developing many other solar projects using the previous bilateral negotiation process, without open and competitive auctions. While this replication is a success story for solar in Cambodia, that it does so without the auction model raises interesting questions about the hierarchies within the modalities of deployment.

5 **While the development finance architecture may often be entrenched, either for efficiency or caution, in delivering boilerplate solutions, allowing countries to use these as and when best suited to their context may yield market-**

driven and market-astute strategies from which to learn. For Cambodia, the successful execution of the National Solar Park auction could have been considered a harbinger of significant change in energy infrastructure procurement practices. The government, however, still perceived the auction process as too long to deploy repeatedly for every asset, particularly in light of pressing energy needs, and compared to established bilateral agreement practices. It holds the opinion that, with a one-time investment of time in the National Solar Park, the gains in terms of price-setting, investor appetite and financial structuring could in fact be firmly secured for a time. Further, the same technical project model could be deployed many more times, in rapid succession, via swift bilateral agreements. In essence, because the National Solar Park Project set a benchmark in the Cambodian solar market, within a certain timeframe and under similar macroeconomic and market conditions, the same structuring and pricing attributes could still be captured without the relatively lengthier auction process.

As technology or market dynamics evolve, and with the passage of time, new and periodic competitive auctions will need to be deployed to take advantage of market competitiveness and to take the pulse of price. This then would set a new benchmark and allow for refining auction documents to accommodate changes in macro parameters. The strategy provides a different angle on how international financial institutions and their national counterparts may approach the diverse cost-to-benefit propositions of large investment projects.

SPILLOVER EFFECTS AND THE FUTURE

Photo: iStock

NATIONAL: ENHANCED INTEREST AND AGENCY IN INTEGRATING SOLAR CAPACITY AND ENABLING TECHNOLOGIES

Increased national agency in solar. To start, the ADB is working with the government to deploy phase two of the solar park, which will include tendering the remaining 40MW of capacity. The Ministry of Energy notes that intended auctions of similar solar park models, although without concessional finance, will build on the transaction structuring and procurement processes developed with the ADB. This is a rapid and stand-alone redeployment of a strategy deemed relevant and effective. The government aims to significantly boost solar additions in the coming years, and the most recent Power Development Plan, approved in early 2020, calls for up to 1.8 GW of solar by 2030.

Propagation of competitive tendering. The National Solar Park Project has demonstrated the attractiveness and effectiveness of competitive tendering in drawing international expertise to develop key projects. It has also provided a testing ground for how such tenders are structured and executed, the parameters that need to be considered, and the ways in which transaction advisory can be leveraged to maximize impacts. With the concept proven, the Ministry of Mining and Energy has expressed interest in deploying competitive tenders across other sectors, including a waste-to-energy project currently being formulated. The Ministry of Economy in Finance is looking to use the project as a case study to assess their existing PPP framework amid the redrafting of PPP laws.

Interest in frontier integration technologies. At the time of the initial project design, the inclusion of demand response mechanisms such as battery storage were not attractive in terms of cost. Despite new understanding of the cost-benefit trade-offs of solar, concerns remained around its viability as a long-term strategy warranting heavy upfront investments, especially in lieu of more easily procurable and integration-ready thermal capacities. Since the project's implementation, however, and due to its successes in capturing low prices and garnering investor endorsement, the government

has gained exponentially greater confidence in the prospect of increasing solar integration. Recent government endeavors to explore more frontier integration technologies, including new-to-the-market energy storage options, show interest in capitalizing on lessons learned from the project, and taking a less risk-averse and more ambitious approach to transitioning to clean energy. Early this year, the EDC agreed to host a pilot battery energy storage system within the solar park substation, also partly financed by an SREP grant and executed by the ADB. The project team hopes that this will pave the way for a larger, nation-wide battery energy storage systems installation program in 2022–2023.

REGIONAL: DEMONSTRATION EFFECTS

A price as low as US$0.039 per kWh was an unanticipated and exceptionally strong outcome for the project, with significant catalytic effects. Aside from setting a very attractive benchmark price for solar in Cambodia, it triggered regional interest in exploring open and competitive bidding as a strategy for allowing the market price for solar at very low tariffs. As a marker of increased regional appetite for exploring more solar capacity additions with innovative market mechanisms, several countries have approached the ADB on the execution of tendered solar capacity addition. Vietnam signed a mandate for ADB support for developing a 200 MW floating solar auction. Similar discussions are kicking off with Indonesia, Myanmar and Timor-Leste.

In efforts to maximize the catalytic power of these successes and discussions, the ADB is initiating a new regional program—the ASEAN Scaling up Renewables Plus Storage Initiative (ASSURE). It will work with ASEAN countries to deploy renewables and energy storage on a large scale by supporting project development and facilitating private sector participation, thereby making way for an exponential green energy transition in the region.

ANNEX 1: ACRONYMS

ADB	Asian Development Bank
ASEAN	Association of Southeast Asian Nations
CIF	Climate Investment Funds
EDC	Electricite du Cambodge
GDI	Global Delivery Initiative
GWh	Gigawatt hour
kW	Kilowatt
kWh	Kilowatt hour
MW	Megawatt
PPP	Public-private partnership
PPA	Power Purchase Agreement
PV	Photovoltaic
SREP	Scaling Up Renewable Energy Program in Low-Income Countries
tCO_2e	Tons equivalent of CO_2
VRE	Variable renewable energy

ANNEX 2: LIST OF INTERVIEWEES

NAME	POSITION	ORGANIZATION
Pradeep Tharakan	Team Lead, Principal Climate Change Specialist	ADB
Christian Ellermann	SREP Focal Point, Senior Climate Change Specialist	ADB
Karan Chouksey	Consultant, Climate Finance Specialist	ADB
Sunniya Durrani-Jamal	Country Director, Cambodia	ADB
Ferran Vila Planas	Public-Private Partnership Specialist	ADB
Zhihong Zhang	Senior Program Officer	CIF
Rafa Ben	Energy Specialist	CIF
Praing Chulasa	Deputy Managing Director of Planning and Techniques	EDC
Rann Seihakkiry	Deputy Director of Corporate Planning and Projects Department	EDC
Nget Sokhan	Deputy Managing Director of Finance and Business	EDC
H.E. Ty Norin	Secretary of State	Ministry of Mines and Energy
H.E. Hem Vanddy	Undersecretary of State	Ministry of Economy and Finance
H.E. Yim Piseth	Chairperson	Electricity Authority of Cambodia
Chanin Srisuma	Regional Business Development Manager	Prime Road (winning bidder)

THE CLIMATE INVESTMENT FUNDS

The Climate Investment Funds (CIF) accelerates climate action by empowering transformations in clean technology, energy access, climate resilience, and sustainable forests in developing and middle-income countries. The CIF's large-scale, low-cost, long-term financing lowers the risk and cost of climate financing. It tests new business models, builds track records in unproven markets, and boosts investor confidence to unlock additional sources of finance.

CIF CLIMATE INVESTMENT FUNDS

www.climateinvestmentfunds.org

Photo: ADB

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