

SECTOR ASSESSMENT (SUMMARY): ENERGY

A. Sector Road Map

1. Sector Performance, Problems, and Opportunities

1. **Significant development leading to lower middle-income status in 2015.** Cambodia's population is about 15.3 million and continues to increase by 1.3% on average each year.¹ Per capita gross national income grew on average 7.1% per annum, from \$950 in 2013 to \$1,230 in 2018.² Strong economic growth was mainly driven by urban-based industries such as garment exports, tourism, and, more recently, construction and real estate. The government aspires to attain middle-income status by 2030.

2. **Economic growth propels electricity demand.** Between 2010–2019, electricity consumption grew on average 18.8% annually from 2,254 gigawatt-hours (GWh) to 10,287 GWh.³ During the same period, household connections increased from 22.9% to 74.8%. Due to economic contraction in 2020, EDC forecasts electricity sales to grow only by 5% in 2020 from the 2019 level, however before rebounding in 2021 and reaching 24,606 GWh by 2025.⁴ At this rate, Cambodia's per capita electricity consumption is set to reach 2,932 kilowatt-hours by 2030, which would be consistent with the level experienced by other regional middle-income economies.

3. **Electricity supply to enhance economic productivity.** With rapidly growing electricity demand, electricity supply increased on average by 19.1% annually during 2010–2019, from 2,515 GWh to 12,015 GWh. Most electricity (86.5%) is generated domestically from hydro (50.2%), coal (32.3%), renewable energy (0.7%), and diesel fuel (3.3%). In 2019, 98.5% of power generated domestically was provided by independent power producers. Power imports from neighboring countries contributed 13.5% to electricity supply.

4. **ADB supports Cambodia's sustainable energy transition.** In 2017, at the government's request, ADB developed a national solar photovoltaic (PV) grid integration study and road map. It contributed to the government's plan to increase solar PV generation capacity from 155 MW in 2019 to 415 MW by 2022. It includes the construction of a 100 MW National Solar Park which ADB helped to structure as a public-private partnership.⁵ This project also exemplifies the one-ADB approach. Sovereign financing has been provided to help reduce private investment risk by building the solar park and transmission infrastructure. ADB's Office of Public-Private Partnership helped EDC in designing and conducting a competitive tender for procuring the first private sector-led 60 MW solar power plant (Phase 1) within the park. It resulted in a competitive tariff of \$0.03877 cents per kilowatt-hour (kWh), the lowest tariff for a solar project so far recorded in Southeast Asia and below Cambodia's average cost of supply \$0.083 per kWh in 2019. ADB's Private Sector Operations Department is currently undertaking due diligence for a proposed loan to the winning bidder of the first 60 MW phase.

5. **Electricity services still unreliable and of poor quality.** One major pressing concern is that the existing transmission infrastructure is reaching capacity. At the end of 2019, Cambodia's transmission infrastructure consisted of 2,267 kilometers (km) of 115 kV and 230 kV transmission

¹ Government of Cambodia. 2019. *General Population Census of the Kingdom of Cambodia*. Phnom Penh.

² Asian Development Bank (ADB). 2015. *Basic Statistics 2015*. Manila; and ADB. 2019. *Basic Statistics 2019*. Manila.

³ ADB. 2018. *Cambodia Energy Sector Assessment, Strategy, and Road Map*. Manila; and Ministry of Mines and Energy. *Salient Features of Power Development in the Kingdom of Cambodia 2019*. Phnom Penh.

⁴ Economic Analysis (accessible from the list of linked documents Appendix 2).

⁵ ADB. 2019. *Report and Recommendations of the President to the Board of Directors: Proposed Loan and Administration of Loan, Grant, and Technical Assistance Grant to the Kingdom of Cambodia for the National Solar Park Project*. Manila.

lines and 36 substations.⁶ Several substations serving the provinces of Phnom Penh, Kampong Chhnang, Kampong Cham, and Takeo are overloaded, resulting in transmission constraints and disproportionate transmission losses (2.3%). It undermines the provision of adequate power at reasonable cost which severely hampers the quality of life, erodes Cambodia's competitiveness and effort to diversify into a manufacturing destination. Both domestic firms and foreign investors name inadequate electricity supply, in addition to its high cost, as a main constraint to doing business in Cambodia.

6. Transmission infrastructure investment requirement of \$2.27 billion. Electricité du Cambodge (EDC), a wholly state-owned limited liability company, is responsible for electricity supply, transmission, and distribution. It does not receive budgetary support from the government and finances power purchases and transmission infrastructure costs from its operational cash flow. Private domestic and foreign investors are encouraged to invest.⁷ Several have already done so and operate 41.7% of the total length of 115 kV–230 kV transmission lines (945 km) as well as 10 associated substations (27% of operational substations) under build–own–operate–transfer arrangements of 10 years or more.⁸ In addition, Cambodia's rural electricity enterprises represent an important private-sector-based framework for developing, operating, and maintaining the country's distribution network.⁹ However, the estimated transmission investment requirement of \$2.27 billion exceeds the financing available from any one partner. Concessional financing from development partners is therefore a critical supplement to EDC and private financing, and essential for accelerating the development of power infrastructure that can advance economic growth and poverty alleviation in Cambodia.

7. Introducing the battery energy storage system. As costs fall, battery energy storage systems (BESS) are likely to become a valuable asset because it can (i) enable EDC to adapt to uncertain electricity demand and reduce the risk of overbuilding and overinvesting in power generation, (ii) is more modular and can be moved more easily than power plants, and (iii) helps integrate intermittent renewable power generation capacity and can thus contribute to achieving Cambodia's target of a 16% reduction in energy greenhouse gas emissions by 2030 from 2010 level.¹⁰ EDC and Cambodia's electricity regulator, Electricity Authority of Cambodia, must start now to understand how the large-scale deployment of low-cost battery energy storage can be used to (i) plan and operate Cambodia's future grid and (ii) reduce systemwide costs. A pilot project coupled with on-the-job training is ideal for understanding the performance of an emerging technology such as the BESS, and for assessing different business models.

2. Government's Sector Strategy

8. The provision of adequate and reliable electricity at reasonable cost underpins equitable development. The government, in its Socio-Economic Policy Agenda for 2018–2023, recognizes the importance of developing the energy sector to increase competitiveness, ensure sustained economic growth, and thereby continue to reduce poverty.¹¹ Its key policy objectives call for (i) expanding supply coverage, (ii) enhancing power reliability by extending and upgrading the transmission network infrastructure, (iii) further lowering systemwide costs to enable a tariff

⁶ 1,730 MVA of 115 kV / 22 kV substation transformer capacity and 1,330 MVA of 230 kV / 115 kV / 22 kV substation transformer capacity.

⁷ The promotion of private participation in electrification is anchored in Cambodia's Electricity Law (2001).

⁸ Electricity Authority of Cambodia. 2019. *Power Sector Report of the Kingdom of Cambodia*. Phnom Penh.

⁹ Rural electricity enterprises are private operators of small, isolated distribution systems in remote parts of Cambodia.

¹⁰ As set forth in the agreement with the United Nations Framework Convention on Climate Change (adopted at the Paris Climate Conference in 2015), which deals with greenhouse gas emissions, adaptation, and finance.

¹¹ Royal Government of Cambodia. 2018. *Rectangular Strategy for Employment, Equity and Efficiency: Building the Foundation toward Realizing the Cambodia Vision 2050*. Phnom Penh.

reduction, and (iv) providing access to electricity from 74.8% in 2019 to 95% of all households by 2030.

9. Substantial increases in transmission investment can cause small rate increases, unless they are wholly offset by savings from low-cost generation, fewer transmission and distribution losses, and congestion cost control. EDC and the Ministry of Mines and Energy are making progress in strengthening sector development planning with direct support from the Asian Development Bank (ADB).¹² This includes technical assistance to improve probity, efficiency, and adequate service delivery, and avoid excessive costs (footnote **Error! Bookmark not defined.**). Concessional financing from development partners will also help minimize the impact of the substantial transmission investments on end-user tariffs.

10. Cambodia's average monthly household income of KR1,456 (\$349) means that many people benefit when fewer transmission losses reduce the cost of power purchases and result in lower tariffs. Between 2015 and 2020, EDC has been implementing a tariff reduction plan to pass through to customers the benefits of falling power purchase costs while maintaining cost recovery and a regulated return. Under the plan, residential tariffs were reduced by 10%–40%, commercial rates by 11%, and industrial rates by 18%. The current average retail tariff is \$0.154 per kilowatt-hour.

B. Major Development Partners: Strategic Foci and Key Activities

11. Since the private sector, both domestic and foreign, is predominantly investing in large-scale power generation, development partners involved in Cambodia's electricity agenda focus on supporting the government's objectives by providing financing for the extension of high-voltage (230 kV and 115 kV) and medium-voltage (22 kV) transmission lines and introducing the application of innovative technologies such as battery energy storage and remote sensor systems. Cambodia's major development partners in the energy sector are ADB, Agence Française de Développement (AFD), German development cooperation through KfW, and the Japan International Cooperation Agency (JICA). The table lists their recent key activities.

Major Development Partners

Development Partner	Project Name	Year Approved	Amount (million)
Energy sector			
ADB	Provincial Power Supply	2000	\$18.60
	Develop a Strategy for Management of Provincial Supply (TA)	2000	\$0.15
	Greater Mekong Subregion Transmission Project	2003	\$44.30
	Capacity Building of Electricity Authority of Cambodia (TA)	2003	\$0.24
	Second Power Transmission and Distribution Project	2006	\$20.00
	Institutional Strengthening of the Cambodian National Petroleum Authority (TA)	2006	\$1.00
	Cambodia Power Transmission Lines Power Transmission Project	2007	\$32.00
	Capacity Building for the Cambodian National Petroleum Authority (TA)	2010	\$0.40
	Preparing the Rural Electrification Project (TA)	2010	\$1.30
	Medium-Voltage Sub-Transmission Expansion Sector Project	2012	\$46.00
	Rural Energy Project (grant from Government of Australia)	2013	\$6.10
	Medium-Voltage Sub-Transmission Expansion Sector Project – Additional Financing	2015	\$1.00
	Support for the National Power Development Plan	2019	\$1.40

¹² ADB. 2018. *Technical Assistance for Southeast Asia Energy Sector Development, Investment Planning and Capacity Building Facility*. Manila.

Development Partner	Project Name	Year Approved	Amount (million)
	National Solar Park Project	2019	\$7.64
AFD	Provincial Power Supply (cofinanced with ADB)	2000	\$2.50
	REEs' Access to Finance	2014	\$18.70
	Green Microfinance ("Good solar")	2014	\$10.00
	EDC Grid Extension	2015	\$87.00
	EDC Capacity Building Program	2015	\$1.30
	EDC Grid Modernization	2019	€29.00
	Potential for Energy Efficiency Measures in Biomass Consuming Industries	2017	
Government of Australia	Investing in Infrastructure (3i)	2016	\$37.00
	ISO certification of EAC testing facility	2018	\$0.10
	Renewable Energy Master Plan for Cambodia	2018	\$0.50
European Union	Capacity Development for Independent Evaluation and Update of Energy Efficiency Strategies Based on Data Analysis	2016	€0.70
JICA	Rehabilitation and Upgrading of Electricity Supply Facilities for Phnom Penh	2005	\$31.00
	Second Power Transmission and Distribution (cofinanced with ADB)	2006	¥2,632.00
	Phnom Penh City Transmission and Distribution Line Expansion Project (Phase 1)	2014	\$65.00
	Phnom Penh City Transmission and Distribution Line Expansion Project (Phase 2)	2015	\$130.00
	Southern Economic Corridor Distribution Expansion Project	2016	\$9.00
	The Project for Enhancement of Operation and Management of Cambodia Transmission System (TA)	2017	
	Phnom Penh City Transmission and Distribution System Expansion Project (Phase 2) (Stage II)	2018	\$84.23
German development cooperation through KfW	Transmission Line (Takeo to Kampot)	2005	€12.20
	Grid Efficiency and Strengthening Project (TA)	2017	
	Energy Efficiency in Rural Grids	2019	€32.00
NDF	Greater Mekong Subregion Transmission Project (cofinanced with ADB)	2003	€10.00
OFID	Medium-Voltage Sub-Transmission Expansion Sector Project (cofinanced by ADB)	2012	\$10.00
USAID	Clean Power Asia Program (TA)	2016	\$16.00
World Bank	Rural Electrification and Transmission Project	2003	\$16.00

ADB = Asian Development Bank, AFD = Agence Française de Développement (French Development Agency), EAC = Electricity Authority of Cambodia, EDC = Electricité du Cambodge, ISO = International Organization of Standardization, JICA = Japan International Cooperation Agency, NDF = Nordic Development Fund, OFID = OPEC Fund for International Development, REE = rural electricity enterprise, TA = technical assistance, USAID = United States Agency for International Development.

Source: Asian Development Bank.

12. AFD, JICA, and KfW support the expansion of medium- and high-voltage transmission lines, and AFD also funds a program to promote the financing of rural electrification enterprises. KfW conducted a study on energy efficiency in rural grids and also provides support to the Rural Electrification Fund for its rural electrification programs. As regards technical assistance, the World Bank conducted an energy access review, while JICA is supporting capacity development activities to strengthen transmission management and planning at EDC, including training on software, as well as dispatching and procurement processes. AFD and the Government of Australia support the deployment of solar home systems for households in rural areas. AFD commissioned a grid modernization study and supported a capacity building program to strengthen EDC's capacity for financial management, engineering and construction supervision,

procurement, maintenance, and operation of the supervisory control and data acquisition system. Australia supports the preparation of a renewable energy master plan, while ADB helps prepare the national power development plan for 2020–2040.¹³

C. Institutional Arrangements and Processes for Development Coordination

13. Development partner coordination in Cambodia’s energy sector is facilitated by the formal Government–Development Partners’ Energy Sub-Technical Working Group, while the main partners in the sector have also been meeting regularly since 2017 in informal working group sessions to deepen coordination and technical discussions. Coordination across the Greater Mekong Subregion takes place through the Regional Power Trade Coordination Committee (RPTCC). Established in 2002, the RPTCC focuses on strengthening regional transmission networks, promoting cross-border investments in energy resources, and developing a regional electricity market in a phased manner. ADB, AFD, JICA, and the World Bank regularly participate in biannual RPTCC meetings, and ADB and the World Bank also provide technical support to its two working groups (on regulatory issues, and performance standards and grid codes).¹⁴

D. ADB Experience and Assistance Program

14. Since 1994, ADB has awarded nearly \$200 million in loans and grants to Cambodia’s energy sector and provided \$6 million in technical assistance. ADB funding has focused on (i) transmission and distribution network expansion and (ii) support for sector reforms and institutional capacity building. Experience from ADB’s previously financed transmission infrastructure projects shows that implementation delays can be mitigated by (i) a high degree of project readiness, (ii) advance procurement, and (iii) project implementation support. ADB will apply this experience to the proposed project. More recently, since 2016, ADB has supported the development of solar PV generation. The one-ADB approach applied in the National Solar Park project could enhance the value of ADB support to the sector by bringing a wider range of solutions with very low transaction cost.

15. ADB’s validation of the country partnership strategy final review, 2014–2018, emphasized that limited power reliability is becoming a critical binding constraint on growth in Cambodia.¹⁵ Investment requirements, notably for transmission, exceed the financing available from ADB, bilateral development and private sector partners.¹⁶ With the proposed project, ADB will add considerable value to Cambodia’s energy sector by (i) improving physical infrastructure that strengthens power transmission capacity and reduces losses, (ii) introducing the BESS as an innovative technology application, (iii) enhancing project management capacity, and (iv) supporting EDC in taking a leading role as an inclusive equal opportunity employer in Cambodia’s energy sector. Coupled with ADB’s ongoing assistance to EDC and MME with power system planning to ensure efficient and sustainable subsector growth, ADB’s support underpins reforms to ensure that adequate, reliable, and environmentally sustainable power supply can be provided at reasonable cost, which in turn enables equitable development. ADB’s energy sector strategy is integrated into ADB’s country partnership strategy, 2019–2023 for Cambodia.¹⁷

¹³ ADB. 2018. *Technical Assistance for Southeast Asia Energy Sector Development, Investment Planning and Capacity Building Facility*. Manila.

¹⁴ ADB. 2014. *Technical Assistance for Harmonizing the Greater Mekong Subregion Power Systems to Facilitate Regional Power Trade*. Manila; ADB. 2007. *Technical Assistance for Facilitating Regional Power Trading and Environmentally Sustainable Development of Electricity in the Greater Mekong Subregion*. Manila.

¹⁵ ADB. 2019. *Cambodia: Validation of the Country Partnership Strategy Final Review, 2014–2018*. Manila.

¹⁶ Development Coordination (accessible from the list of linked documents in Appendix 2).

¹⁷ ADB. 2019. *Country Partnership Strategy: Cambodia, 2019–2023—Inclusive Pathways to a Competitive Economy*. Manila.

Problem Tree for Energy Sector

