

CAMBODIA ENERGY SECTOR

Overview of potential electricity sector opportunities

June 2018

Background

This summary paper has been prepared by Investing In Infrastructure Cambodia (3i) a development program funded by the Australian Government. 3i's mission is to stimulate and drive private sector investment into infrastructure in Cambodia, with a focus on piped water and electricity sectors.

The purpose of this paper is to present a brief overview of the energy sector in Cambodia and highlight potential sector investment opportunities for investors, project developers, operating companies and other entities which comply with global best practices for corporate governance and are seeking energy investment opportunities in frontier growth markets.

Executive summary

The energy sector in Cambodia has grown rapidly over the past decade, driven by the Royal Government of Cambodia's (RGC) key priorities to:

- increase energy access;
- reduce the cost of energy; and
- increase energy security for the country.

Initial development of the energy sector and the legal framework governing the sector has been focused around development of large, centralised generation and transmission infrastructure.

However, the global growth in renewable energy implementation and trend towards smart, distributed energy infrastructure may impact the future development of the energy sector. With its significant private sector involvement, limited legacy infrastructure and significant growth in demand, Cambodia is well positioned to continue to transform its energy sector.

In addition to investments already made, Cambodia plans to develop an additional 5.3 GW of large scale hydro, coal and gas fired generation capacity between 2019 and 2030, developed and financed primarily by the private sector. This presents a significant investment opportunity for investors. However, significant environmental and other development issues must be addressed.

Recently, development of solar power has gained traction in Cambodia with (1) the signing of the Paris Agreement in 2016; (2) solar energy achieving price parity with other traditional generation resources; and (3) a global shift away from fossil fuel generation.

Cambodia's current short-term targets are for development of 100 MW of capacity in a National Solar Park program by the end of 2020 and similar capacity to be developed by additional private sector utility scale and rooftop solar installations.

Additional solar and renewable energy generation could be implemented in future updates to the Energy Sector Development Master Plan. In order for this to happen, RGC's energy price targets must be met by renewable energy. Also, concerns around grid, integration, grid capacity and management of a grid with significant variable generation energy resources must be addressed.

Addressing these challenges are likely going to create significant investment and development opportunities going forward for companies which can provide technologies and services to support this.

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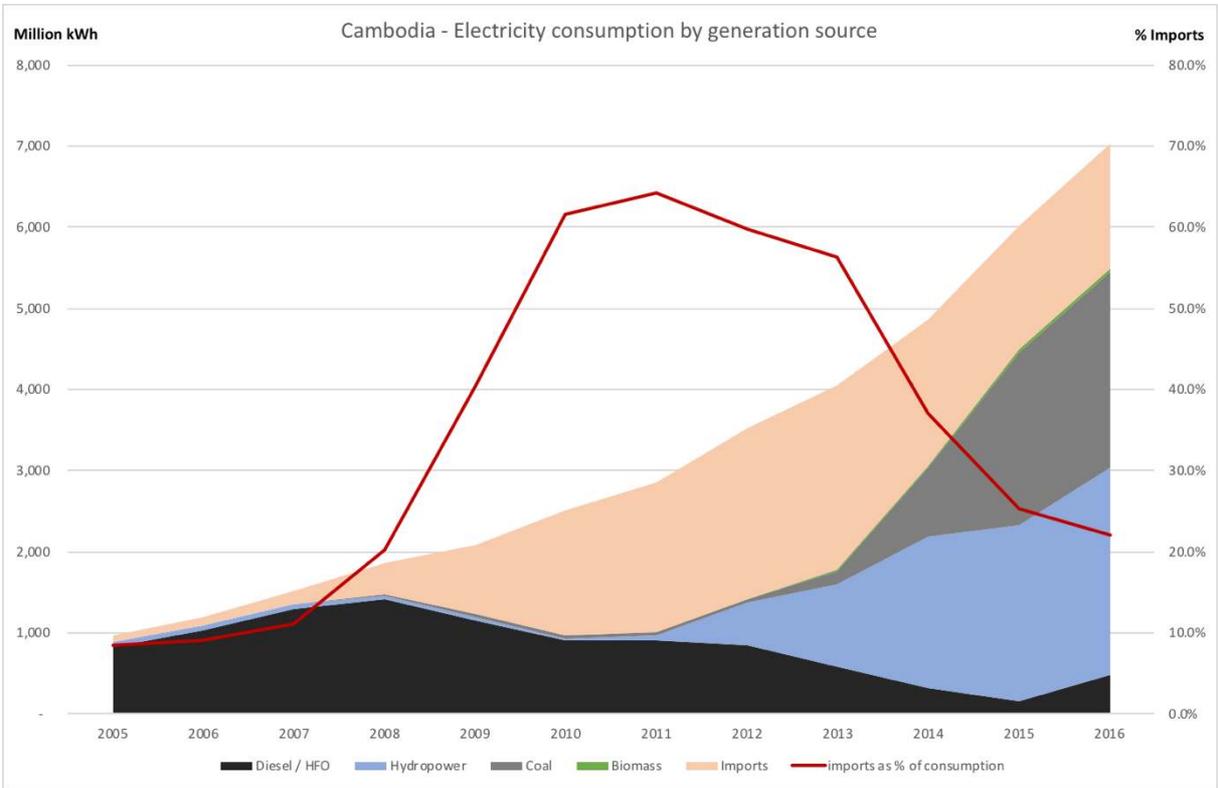
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Sector overview

The energy sector in Cambodia has undergone significant growth and transformation over the past decade. From being a country powered almost entirely by diesel and heavy fuel oil (HFO) generation in isolated mini-grids in 2007 (85% of total consumption), Cambodia has seen a 5-fold increase in consumption over the past 10 years (from 1.5 GWh in 2007 to 8.2 GWh in 2017).

This increase in consumption has been supported by the build-out of a national transmission backbone, expansion of domestic energy generation capabilities and an electrification program which has connected more than 81% of all villages and 68.5% of all households at the end of 2017¹.

Initial increases in electricity demand were met through electricity imports from Vietnam, Thailand and Laos, peaking at 60%+ of consumption during 2010-2012 but imports have since been reduced (20% in 2017) through the buildout of domestic generation capacity.



As of 2016, the Cambodia had total installed generation capacity of 1.68 GW across hydropower (930 MW, 55%), coal (429 MW, 26%), diesel/HFO, (305 MW, 18%); and biomass (18 MW, 1%)². In 2017, an additional 135 MW of coal capacity, 100 MW of hydro capacity (the first phase of the 400 MW Sesan dam) and 10 MW of solar also became operational.

Hydro and coal contribution to total domestic production is at similar levels, 46.8% and 43.7% respectively. While hydro has more than double the installed capacity of coal,

¹ Phnom Penh Post, 05/01/2018, "Kingdom More Energy Independent"
² Electricity Authority of Cambodia. *Report on Power Sector of the Kingdom of Cambodia 2017 Edition*.

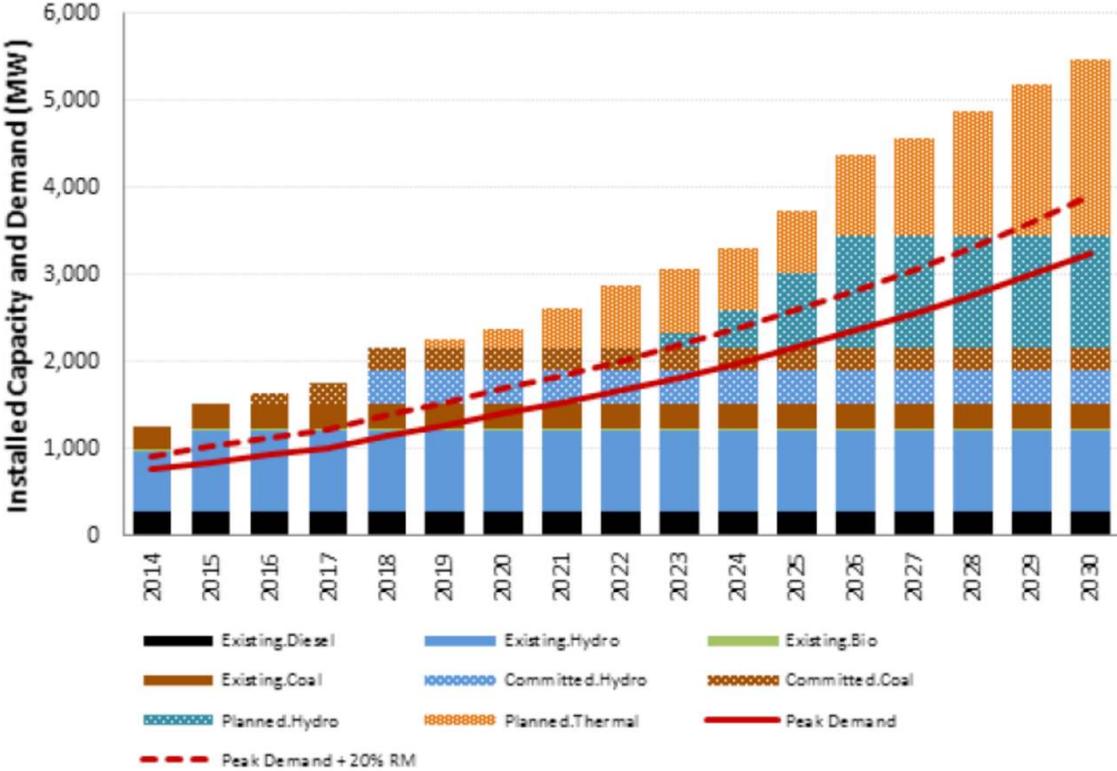
production from hydro dams fall significantly during the dry season when there is less water available in reservoirs³.

In 2017 the country was able to meet demand with domestic generation resources during the rainy season but still relies on imports, mainly from Vietnam during the dry season to cover shortfalls in hydro production, and throughout the year to meet peak daytime demand and for grid stabilization. Approx. 200 MW of diesel and HFO capacity is located in the capital Phnom Penh and used as peaker plants to meet demand in the capital and surrounding areas, which account for more than 70% of overall demand in the country.

³ In 2015, actual output was about half of the rated design output (25% effective plant load factor versus design basis of 50% plant load factor)

Sector outlook

The demand for electricity is projected to grow at an average of 7% annually through 2030. The existing Energy Sector Development Master Plan 2017-2030 (EDMP) seeks development of additional hydro, coal and gas fired power plants to meet this projected demand as detailed in the chart below.



Source: ADB (2017) Towards a National Solar Program in Cambodia: Pre- Feasibility Study Findings

3i believes that the growth in energy demand could potentially be higher than projected, driven by:

- Overall growth in GDP projected at ~7% annually
- Increased electrification of villages and households in rural areas
- Lower electricity prices at both consumer, industrial and wholesale levels
- Rising income levels and an emerging middle class in Phnom Penh and other major population centres
- Development of broader industrial activities in free zones and other industrial clusters

Sector investment opportunities for international investors

Large-scale hydro and thermal power plant development

As of 2016 90.9% of power generation capacity (producing 97.5% of total energy) in Cambodia were owned by independent power producers (IPPs), with a further 2.35% of generation capacity being owned by private companies operating isolated generation and distribution systems. Most IPPs are either fully owned by international investors and developers or set up as JV companies between local companies and international investors/developers. The majority of investment to date has come from China with other investment from Japan, Malaysia and Vietnam.

The EDMP contain plans for significant large-scale hydro, coal and gas fired power plant development, with total new generation capacity of 5.3 GW to be put into operation between 2019 and 2030.

Hydro power

In 2018, the second phase of the already built Sesan hydro power plant is scheduled to come online, adding 300 MW to reach its full 400 MW capacity. An additional 7 hydro power plants sized between 36 MW and 120 MW are scheduled to come into operation in 2022 and 2023 for a total added capacity of 544 MW. In 2025 the first phase (600 MW) of the proposed Sambor hydro dam is scheduled to come into operation with phase 2 and 3 to come online in 2026 and 2027 adding an additional 1,200 MW, although no formal decision to commence construction has yet been announced. Owing to the likely environmental impacts of Sambor a number of stakeholder groups have called for the development of alternative power generation options which would avoid or mitigate adverse impacts.

Thermal power plants

The master plan also calls for expansion of the two existing coal fired coal power plants and the addition of new coal power capacity from 2019 to 2022 with up to 885 MW to be added, and an additional 400-500 MW to be added in 2024. From 2026-2030 an additional 5 coal or natural gas power plants with a total capacity of 1,500 MW are planned.

However, according to the SREP Revised Investment Plan for Cambodia⁴:

“...key recent developments indicate the need for updating the strategy adopted by the [EDMP] and argue for a greater diversity in the generation mix. RGC’s Industrial Development Policy (IDP) 2015—2025 ... calls for alternate sources of energy to be developed. These alternate sources of energy – mainly domestic renewable resources – should complement installed and planned hydropower-based generation, which has performed well below design output in recent years.”

It is therefore possible that future revisions of the EDMP will replace a portion of planned hydro and thermal power generation capacity with renewable energy sources, in particular solar, which is a key priority in the SREP Investment Plan.

⁴ Scaling up Renewable Energy Program (SREP) – Revised Investment Plan for Cambodia, 20 July 2017.

Solar and other renewable energy

Up until 2017, development of renewable energy resources in Cambodia was focused on biomass energy as an alternative to diesel generation in rural off-grid areas. Development of solar power was limited; solar was not included in the EDMP (a critical step in the path to obtaining a license for a project); and there was no regulatory or tariff framework in place to support the development of grid-tied solar power. In the absence of a regulatory framework, a small number of solar installations for self-consumption have been developed for industrial facilities and rural distribution networks. 3i has identified approximately 8 MW of solar generation capacity which has been installed and is operational.

In 2016 the RGC launched a tender process to develop a 10 MW grid-tied solar farm to be built in Svay Rieng province. The tender was awarded to Sunseap, a Singapore based developer of solar power, with Schneitec, a local firm, as JV partner. The solar farm started operating in late 2017.

In July 2017 the SREP Revised Investment Plan for Cambodia was approved, where the RGC proposed to sharpen the focus for developing renewable energy to a national solar parks program with total investment need of \$137 million and further private sector solar development focused on rooftop solar and utility scale solar with a total investment need of \$104 million.

National Solar Park Program

In late 2017, the RGC with support from ADB started an initial feasibility study for the development of a 100 MW solar park. The solar park is to be developed in two phases of approximately 30 MW and 70 MW. The pre-qualification process is expected to start in 2H 2018.

Private sector development of rooftop and utility scale solar

To support further development of private sector solar, the RGC issued a draft regulation (Prakas) for grid-tied solar for comments in late 2017, with the final regulation coming into effect in January 2018⁵. The related tariff for solar users has been circulated for comments and is expected to come into effect in May 2018.

The Prakas also allows for approval of grid-tied solar farms outside of the EDMP planning process based on price and efficiency criteria. Such development is likely to be focused on solar farms at the end nodes of the transmission network in order to reduce transmission losses and help with voltage stabilisation at the end of the transmission network.

Smart grid and distributed infrastructure

In order for solar and other decentralised renewable energy generation to be implemented at greater scale in future updates to the Energy Sector Development Master Plan, the RGC's concerns around adding significant variable generation energy resources must be addressed.

⁵ "Regulations on General Conditions for connecting Solar PV Generation sources to the Electricity Supply System of National Grid or to the Electrical System of a Consumer connected to Electricity Supply System of National Grid" issued on Jan. 26, 2018

The list of issues includes, but is not limited to:

- Using renewable energy technologies to reduce the overall cost of energy production
- Addressing the variable and intermittent production characteristics of solar and other renewable generation in the context of 24/7 power systems
- Establishing and embedding regulatory and technical best practices for grid integration of distributed generation resources
- Addressing capacity constraints of existing transmission and distribution grid, including substations
- Developing capabilities to manage a grid with significant variable generation energy resources
- Integrating and utilising future distributed production and storage infrastructure at the end user level
- Taking advantage of excess production from end-user renewable energy installations to reduce overall cost of energy production at a national level

Companies which can provide technologies and services to address these challenges may be well positioned to identify emerging local market opportunities going forward.