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# Accelerating Renewable Energy Investments in Sri Lanka

## Drivers, Risks, and Opportunities

Arjun Dutt

Report | July 2020

Sri Lanka's *Soorya Bala Sangramaya* programme envisions the deployment of 1 GW of rooftop solar capacity by 2025.

Image: Dileepa Karunarathna

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Cover image: Dileepa Karunarathna. Wind power plants as seen from the ash yard of Lakvijaya Coal Power Plant in Puttalam district, North Western Province, Sri Lanka.

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CEEW-CEF acts as a non-partisan market observer and driver that monitors, develops, tests, and deploys financial solutions to advance the energy transition. It aims to help deepen markets, increase transparency, and attract capital in clean energy sectors in emerging economies. It achieves this by comprehensively tracking, interpreting, and responding to developments in the energy markets while also bridging gaps between governments, industry, and financiers.

The need for enabling an efficient and timely energy transition is growing in emerging economies. In response, CEEW-CEF focuses on developing fit-for-purpose market-responsive financial products. A robust energy transition requires deep markets, which need continuous monitoring, support, and course correction. By designing financial solutions and providing near-real-time analysis of current and emerging clean energy markets, CEEW-CEF builds confidence and coherence among key actors, reduces information asymmetry, and bridges the financial gap.

**Financing the energy transition in emerging economies**

The clean energy transition is gaining momentum across the world with cumulative renewable energy installation crossing 1000 GW in 2018. Several emerging markets see renewable energy markets of significant scale. However, these markets are young and prone to challenges that could inhibit or reverse the recent advances. Emerging economies lack well-functioning markets. That makes investment in clean technologies risky and prevents capital from flowing from where it is in surplus to regions where it is most needed. CEEW-CEF addresses the urgent need for increasing the flow and affordability of private capital into clean energy markets in emerging economies.

**CEEW-CEF's focus: analysis and solutions**

CEEW-CEF has a twin focus on markets and solutions. CEEW-CEF's market analysis covers energy transition–related sectors on both the supply side (solar, wind, energy storage) and demand-side (electric vehicles, distributed renewable energy applications). It creates open-source data sets, salient and timely analysis, and market trend studies.

CEEW-CEF's solution-focused work will enable the flow of new and more affordable capital into clean energy sectors. These solutions will be designed to address specific market risks that block capital flows. These will include designing, implementation support, and evaluation of policy instruments, insurance products, and incubation funds.

CEEW-CEF was launched in July 2019 in the presence of H.E. Mr Dharmendra Pradhan and H.E. Dr Fatih Birol at Energy Horizons.

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*"Solar and wind energy are a means for Sri Lanka to advance its national priorities of affordable electricity and reduced dependence on imported fuels for power generation. While these sources have thus far played a minor role in serving the country's energy needs, the deployment of suitable business models and financial structures could accelerate their adoption. This report presents a broad-ranging perspective on challenges hindering investments and solutions - including learnings from other emerging economies - for unlocking investments at scale."*

# Contents



Image: Dileepa Karunarathna

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# Acronyms

| | |
|---|---|
| CEB | Ceylon Electricity Board |
| CEEW | Council on Energy, Environment and Water |
| CEEW-CEF | Centre for Energy Finance at the Council on Energy, Environment and Water |
| CGC | Credit Guarantee Corporation Malaysia |
| CRMM | Common Risk Mitigation Mechanism |
| DBSA | Development Bank of Southern Africa |
| FIT | feed-in tariff |
| GHG | greenhouse gas |
| GW | gigawatt |
| IPP | independent power producer |
| IREDA | Indian Renewable Energy Development Agency |
| kVA | kilovolt-ampere |
| kWh | kilowatt-hour |
| LKR | Sri Lankan Rupee |
| LTGEP | Long-Term Generation Expansion Plan |
| MoF | Ministry of Finance |
| MW | megawatt |
| NDC | nationally determined contribution |
| PPA | power purchase agreement |
| PUCSL | Public Utilities Commission of Sri Lanka |
| RE | renewable energy |
| SAGAR | Security and Growth for All in the Region |
| SLSEA | Sri Lanka Sustainable Energy Authority |
| SPPA | standardised power purchase agreement |
| TOE | tonnes of oil equivalent |
| USD | United States Dollar |

The attainment of Sri Lanka's 2030 RE ambitions requires investments of nearly USD 9 billion between 2020 and 2030.

Image: iStock

# Executive summary

The world is undergoing an energy transition with the decarbonisation of power generation driving a progressive greening of the global energy mix. However, this transition has been far from homogenous across the world, with domestic priorities and challenges dictating the scale and pace of each economy's energy transition. To accelerate the greening of the global energy mix, it is essential to systematically analyse risks and opportunities in each economy before devising solutions to advance its energy transition. This also offers opportunities for economies to collaborate and collectively apply lessons learnt to facilitate the flow of capital into clean energy. This report is part of a series that analyses constraints to the flow of capital into renewable energy[1] (RE) markets in emerging economies and potential solutions that could accelerate this flow.

Sri Lanka is an emerging economy characterised by a per capita electricity consumption that is considerably below the world average. However, with steady, long-term economic growth prospects and near-universal electrification, the country is expected to experience a rapid rise in electricity consumption. Sri Lanka's overarching priority with respect to electricity planning and implementation is providing low-cost electricity to power the country's economic growth . As codified in the president's *National Policy Framework*, this entails reducing the country's reliance on expensive fuel oil–based generation and increasing the share of renewables in the generation mix. The country is also striving to lower its dependence on imported fossil fuels—coal and fuel oil (which collectively accounted for 55 per cent of electricity generation in 2018)—to boost its energy security.

> **Sri Lanka's priority is to provide low-cost electricity to power the country's economic growth by reducing its reliance on expensive fuel oil–based generation and increasing the share of renewables in the generation mix.**

A stronger push towards renewable power can help the country attain the aforementioned priorities. Utility-scale RE generation costs in Sri Lanka have dipped to USD c 7/kWh, which are considerably lower than the average fuel oil–based generation cost of USD c 17/kWh. RE generation costs can dip further under more conducive market conditions, as evidenced by even lower tariffs achieved in some international jurisdictions. Further, renewables are particularly well-suited to cater to the shifting electricity demand patterns in Sri Lanka. With rising industrial demand and increasing demand for air conditioning across segments, the country will experience a rapid rise in the daytime demand for power. Solar energy, with its overlapping generation profile, could help cater to these shifting demand patterns.

RE generation can help bolster Sri Lanka's energy security and macroeconomic stability. Currently, the Ceylon Electricity Board (CEB), the state-owned integrated power utility, procures expensive fuel oil–based generation from independent power producers (IPPs) during shortfalls in large hydro generation. Greater RE deployment can help reduce this reliance on fuel oil–based generation. Further, given the challenging macroeconomic conditions prevailing in Sri Lanka, lower fuel oil imports would facilitate the management of the current account deficit. Lastly, greater RE deployment can also help lower power sector greenhouse gas (GHG) emissions and fulfil the country's climate change mitigation commitments under the *Paris Agreement*.

Under current regulatory and market conditions, several barriers hinder RE deployment in Sri Lanka. For utility-scale generation, one major barrier is the limited bankability of current power purchase agreements (PPAs) signed by the CEB, the offtaker for RE generation, which has precluded the flow of international capital. Concerns around currency risk, offtaker risk, change in law risk, and small project sizes have made investments unattractive to foreign investors. Challenges associated with land acquisition and the unavailability of transmission infrastructure are other barriers to setting up large RE projects. While domestic investors backed by domestic lending institutions have driven the majority of RE deployment, the domestic financial system does not

1. Throughout this report, renewables (RE) exclude large hydro.

have the capacity to finance projects at the scale envisioned by Sri Lanka's 2030 ambitions (80 per cent generation from large hydro and RE).

Compared to utility-scale solar, Sri Lanka has made considerable headway in rooftop solar deployment. However, current regulatory and market conditions may be limiting its pace. Current rooftop solar tariffs, while remunerative for system owners, are higher than the CEB's average power purchase costs and exacerbate the existing financial burden on the utility. In addition, the existing deployment in Sri Lanka has been through the capex (capital expenditure) model, which places the burden of upfront capital expenditure and securing access to suitable roof spaces on the consumer. The rising financial burden on the CEB and the limitations of existing business models could be slowing the pace of deployment.

Attaining Sri Lanka's 2030 RE ambitions would require investments of around USD 9 billion. In order to mobilise capital flows of this magnitude, policy- and market-based solutions must systematically mitigate risks associated with RE investments. In case of utility-scale generation, this entails creating bankable project structures in line with international best practices to reallocate risks currently borne by investors to actors best equipped to bear them. Residual risks may be mitigated through market instruments. Offtaker risk can be mitigated through guarantees for the obligations of the CEB and explicit termination payment provisions in PPAs. PPAs must reallocate change in law risks to government entities. Where sovereign guarantees underwrite risks, they may be supplemented by international funds geared towards risk mitigation. Setting up green banks, which are institutions dedicated to underwriting risks to crowd in private sector investments, could help channel international funds for this purpose.

Besides contractual provisions, business models that offer a plug-and-play model such as RE parks to developers could mitigate land- and transmission-related constraints. Such models also facilitate the deployment of capacity in larger project sizes. Further, generating a pipeline of projects through a regular tendering schedule enables investors to plan for the long term. These measures - RE parks and a credible pipeline of projects - have facilitated international investments in India's RE sector. Currency risks prevailing for investments in Sri Lanka may be mitigated through international market instruments.

> **Attaining Sri Lanka's 2030 RE ambitions would require investments of around USD 9 billion.**

While utility-scale generation requires considerable investments to set up transmission infrastructure, these are minimal for rooftop solar. Given the CEB's indebtedness and the challenging macroeconomic conditions constraining government finances, rooftop solar could be a more effective means of advancing solar energy deployment. From the perspective of accelerating rooftop solar addition, rationalising of tariffs in line with current market realities could create headroom for the CEB to absorb more rooftop solar deployment. Further, the implementation of new business models under the operating expenditure (opex) model could expand rooftop solar penetration to less creditworthy consumers.

> **Utility-led rooftop solar business models from India could expand the penetration of rooftop solar in Sri Lanka to consumers with inferior creditworthiness and lack of access to roof spaces.**

In this context, rooftop solar models deployed in India that enable consumers without suitable roof spaces and with inferior creditworthiness to access rooftop solar may be adapted to the Sri Lankan setting. Further, the implementation of grid interconnection between the two countries could be another area of collaboration. A larger combined grid would facilitate greater RE integration for the two countries. In addition, it would also facilitate the import of cheaper electricity from India, which would lower average generation costs in Sri Lanka. While rooftop solar and grid interconnection can be the starting points for collaboration, given the scale of the clean energy ambitions of both countries, more areas of collaboration may be identified in the future.

# 1. Introduction

The ongoing global energy transition is characterised by considerable differences in pace and scale across economies. To accelerate the global transition, it is necessary to address the challenges constraining the energy transitions of individual economies.

## 1.1 Motivations for the project

Electricity is of prime importance in the global energy mix, considering that power sector–related investments accounted for the largest share (43 per cent) of all energy investments in 2018 (which stood at USD 1.8 trillion) for the third year in a row (International Energy Agency 2019). Among investments in power generation, renewable energy (RE)[2] dominates; the 2018 global RE investments of USD 273 billion were around thrice those in coal- and gas-based generation combined (Frankfurt School of Finance and Management and UNEP 2020). Higher RE investment flows have been driven by the increased cost-competitiveness of solar and wind generation as a result of favourable market developments and policy support in several geographies.

Developing and emerging economies[3] now account for a larger share (54 per cent in 2018) of global RE investment flows than developed economies. However, the distribution of these flows among developing economies remains heavily skewed (Frankfurt School of Finance and Management and UNEP 2020). China and India are the recipients of the largest RE investment flows among developing economies, accounting for two-thirds of these flows (Frankfurt School of Finance and Management and UNEP 2020). Investment flows in several other developing countries lag behind; they are constrained by risks pertaining to RE investments in these jurisdictions or those plaguing economies at large.

Developing economies are expected to drive the global incremental growth in energy demand up to 2040. While primary energy demand from developing countries is set to increase from around 8 billion tonnes of oil equivalent (TOE) in 2020 to 12 billion TOE by 2040, the demand from developed economies is expected to remain static at around 6 billion TOE over the same period (BP 2019). Thus, decarbonising the energy mixes of developing economies will be crucial to the success of global climate change mitigation efforts. Systematically identifying the major risks constraining RE investments in these countries is essential to this process. These risks may then be mitigated through a combination of policy- and market-based interventions. Lessons learnt from developing countries at a more advanced stage of their energy transition may be applied to other developing countries to accelerate their energy transitions. Towards this end, the Centre for Energy Finance at the Council on Energy, Environment and Water (CEEW-CEF) analyses the risks associated with RE investments in developing countries .

> **This report is a guide to understanding the major challenges constraining RE investments in Sri Lanka as well as recommendations, informed by the energy transitions of other emerging economies, to address these challenges.**

This study focusses on Sri Lanka's energy transition. The analysis focusses on solar and wind energy, which are the major components of global RE investments. This report captures the findings of CEEW-CEF's analysis of the drivers, risks, and opportunities associated with accelerating RE investments in Sri Lanka; it is part of a series of similar assessments of India, Indonesia, and South Africa. The analysis presented in the report would be useful for both policymakers and market participants. For policymakers, the report is a useful guide to understanding the major challenges constraining RE investments in Sri Lanka and potential measures to address these challenges. These recommendations draw on lessons from other economies but are made keeping Sri Lanka's policy and regulatory ecosystems in mind. Policymakers could consider these recommendations while devising interventions to accelerate RE investments in Sri Lanka. For market participants, this report is an extensive guide to

2. Throughout this report, the term "renewables" (RE) excludes large hydro.
3. Developing and emerging economies are collectively referred to as "developing" in this section.

understanding the opportunities and pitfalls in the Sri Lankan RE market, so that they may plan their investments accordingly.

This broad-ranging report is a precursor to more granular analyses geared towards addressing specific challenges in Sri Lanka's RE ecosystem.

## 1.2 Structure of the report

The report commences by describing the methodology adopted to perform the study. Before diving into a detailed analysis of the Sri Lankan RE ecosystem, the report provides a broad overview of Sri Lanka's power sector. This covers national priorities pertaining to electricity planning and implementation, key generation and demand characteristics, and a description of the major actors in Sri Lanka's RE ecosystem. The report then proceeds to elaborate on the role of renewables in furthering Sri Lanka's electricity planning and implementation efforts. Building from this, the report presents a detailed analysis of the major challenges constraining RE investments in Sri Lanka. Next, it identifies potential interventions necessary to mitigate risks and accelerate RE investments. The report concludes by elaborating on existing and potential areas of collaboration for India and Sri Lanka to accelerate Sri Lanka's energy transition.

# 2. Methodology

The analysis presented in this report is based on a combination of extensive secondary research and stakeholder consultations carried out in Sri Lanka. The secondary research helped develop familiarity with key players in Sri Lanka's power sector, regulations relating to RE, and the challenges constraining RE investments. The secondary research was followed by a round of stakeholder consultations in Sri Lanka. These stakeholders included representatives from two financial institutions, the Ceylon Electricity Board (CEB), the Sri Lankan Sustainable Energy Authority (SLSEA), the Public Utilities Commission of Sri Lanka (PUCSL), and the Indian Mission to Sri Lanka. The stakeholder consultations were useful for seeking clarifications, developing a more refined understanding of the political economy of electricity in Sri Lanka, and identifying the major interventions needed to accelerate RE investments.

# 3. The political economy of the Sri Lankan RE ecosystem

The importance of renewables in fulfilling Sri Lanka's energy needs becomes clear upon examining key national priorities pertaining to the power sector. Further, an overview of the existing and potential RE deployment and the major players in Sri Lanka's RE ecosystem sets the context for a deeper analysis of the sector.

## 3.1 Major priorities pertaining to electricity planning and implementation

Sri Lanka is a middle-income country with a per capita electricity consumption that is far below the world average of 3,100 kWh (see Table 1) (The World Bank 2020). However, the country is close to full electrification, and grid electricity has limited interruptions (see Table 1) (Ceylon Electricity Board 2019a).[4] Steady long-term economic growth prospects and near-universal electrification are expected to translate into sustained long-term growth in the demand for electricity.

> **The importance of renewables in fulfilling Sri Lanka's energy needs becomes clear upon examining key national priorities pertaining to the power sector.**

4. Based on stakeholder consultations.

**Table 1** Key electricity demand–related statistics

| Parameter | Value |
|---|---|
| Peak demand (MW) | 2,616 |
| Per capita electricity consumption (kWh) | 650 |
| Grid-electricity coverage (per cent) | 99 |
| Average selling price per unit (USD c/kWh) | 9 |
| Average cost of supply at selling point (USD c/kWh) | 11 |

Note: USD figures factor in a USD–LKR exchange rate of 181.

*Sources: Ceylon Electricity Board (2019a) and Ceylon Electricity Board (2019b)*

The overarching objective of electricity planning in Sri Lanka is to provide low-cost electricity to power Sri Lanka's economic growth (Ministry of Finance, Government of Sri Lanka 2019). The Sri Lankan government's strategy to attain this objective includes evolving the electricity generation mix to include lower-cost sources of generation, with a specific focus on renewables. This entails reducing the reliance on expensive fuel oil–based generation. As a complementary objective, the country is also striving to boost its energy security by reducing its reliance on imported fossil fuels (coal and fuel oil) for electricity generation.

## 3.2 Focus on renewables

The president's *National Policy Framework* provides direction and broad cues for policymaking pertaining to the power sector. It envisions growing the contribution of large hydro and renewables to 80 per cent of electricity generation by 2030 (Ministry of Finance, Government of Sri Lanka 2019). This is a steep increase from the prevailing 45 per cent share of large hydro and renewables in Sri Lanka's generation mix (see Table 2). It also specifically identifies the development of both utility-scale generation (solar and wind) as well as rooftop solar as integral in the country's push for RE capacity expansion. In addition, it envisions an increase in the share of gas-based generation to replace expensive fuel oil–based generation.

## 3.3 Renewables installed capacity, potential, and procurement

### 3.3.1 Installed capacity

Non-fossil fuel–based sources account for around 50 per cent of the existing installed capacity while renewables (excluding large hydro) account for around 15 per cent of the overall capacity. Table 3 provides the breakup of Sri Lanka's existing utility-scale power generation installed capacity.

Besides utility-scale renewables, Sri Lanka also has 250 MW of rooftop solar installed capacity as of February 2020.[5] While grid connected, this capacity is not included in the installed capacity figures summarised in Table 3.

**Table 2** Large hydro accounted for the largest share of generation in 2018

| Conventional (%) | | | | Renewables (%) | | | Overall (%) |
|---|---|---|---|---|---|---|---|
| Large hydro | Fuel oil | Coal | Total conventional | Mini hydro | Other RE | Total RE | |
| 33.5 | 23.6 | 31.0 | 88.1 | 8.0 | 3.9 | 11.9 | 100 |

*Source: Ceylon Electricity Board (2019b)*

**Table 3** Non-fossil fuel–based generation accounts for half of Sri Lanka's installed capacity

| Conventional (MW) | | | | RE (MW) | | | | | Overall (MW) |
|---|---|---|---|---|---|---|---|---|---|
| Large hydro | Fuel oil | Coal | Total conventional | Mini hydro | Solar | Wind | Biomass | Total RE | |
| 1,399 | 1,137 | 900 | 3,436 | 394 | 51 | 128 | 37 | 610 | 4,046 |

Note: Installed capacity figures are for 2018.

*Source: Ceylon Electricity Board (2019b)*

5. Based on stakeholder consultations.

Sri Lanka's *Soorya Bala Sangramaya* programme, introduced in 2016, envisions the deployment of 1 GW of rooftop solar capacity by 2025 (Sri Lanka Sustainable Energy Authority 2020). Rooftop solar in Sri Lanka is driven by the net-metering scheme introduced in 2010 and continued under the *Soorya Bala Sangramaya* programme. It is also supported by two additional schemes introduced under the *Soorya Bala Sangramaya* programme.

Three schemes currently support rooftop solar deployment in Sri Lanka (Ministry of Power & Energy, Government of Sri Lanka 2020):

- *Net-metering* scheme: Under this scheme, net-metered rooftop solar system owners receive credits on future electricity bills for exporting excess electricity to the grid.
- *Net-accounting* scheme: Under this scheme, excess electricity exported to the grid through net-metered connections can be encashed at a tariff of LKR 22/kWh (USD c 12/kWh) for the first seven years and LKR 15.5/kWh (USD c 8.6/kWh) for the next 13 years.
- *Net-plus* scheme: This scheme provides for a gross-metering arrangement, under which the utility compensates the rooftop solar generator in cash for all electricity supplied to the grid.

While all consumer categories are eligible for all schemes, the *Net-accounting* and *Net-plus* schemes are geared towards encouraging industrial and small residential consumers to set up rooftop solar systems. The motivations of the schemes can be easily understood if one considers the prevailing electricity tariffs in Sri Lanka (see tables A1 and A2 in the annexures).

The tariff structure features considerable escalation in variable electricity tariffs for domestic consumers (those consuming over 90 units per month) and high tariffs for general-purpose consumers (including offices and other commercial spaces). The variable tariffs set for industrial consumers are relatively modest in comparison. While avoiding high grid tariffs is a strong incentive for commercial and large residential consumers to set up rooftop solar systems, cash payments that exceed variable electricity tariffs under the *Net-accounting* and *Net-plus* schemes make rooftop solar an attractive proposition for the industrial and small residential segments too.

### 3.3.2 Sri Lanka's RE potential

Existing solar and wind deployment in Sri Lanka constitutes only a minuscule fraction of the country's potential (see Table 4).

**Table 4** Considerable scope for scaling up solar and wind energy deployment

| Technology | Existing capacity (MW) | Potential (MW) |
|---|---|---|
| Solar PV (photovoltaic) | 301 | 16,000 |
| Wind energy | 129 | 15,000 |

Note: Installed solar capacity includes both the utility-scale and rooftop solar segments.

*Sources: Ceylon Electricity Board (2019a) and Asian Development Bank (2017)*

### 3.3.3 RE procurement

Before 2016, the rights to develop utility-scale RE capacity were awarded on a first-come-first-serve basis. The applicable tariff differed according to the capacity of the project:

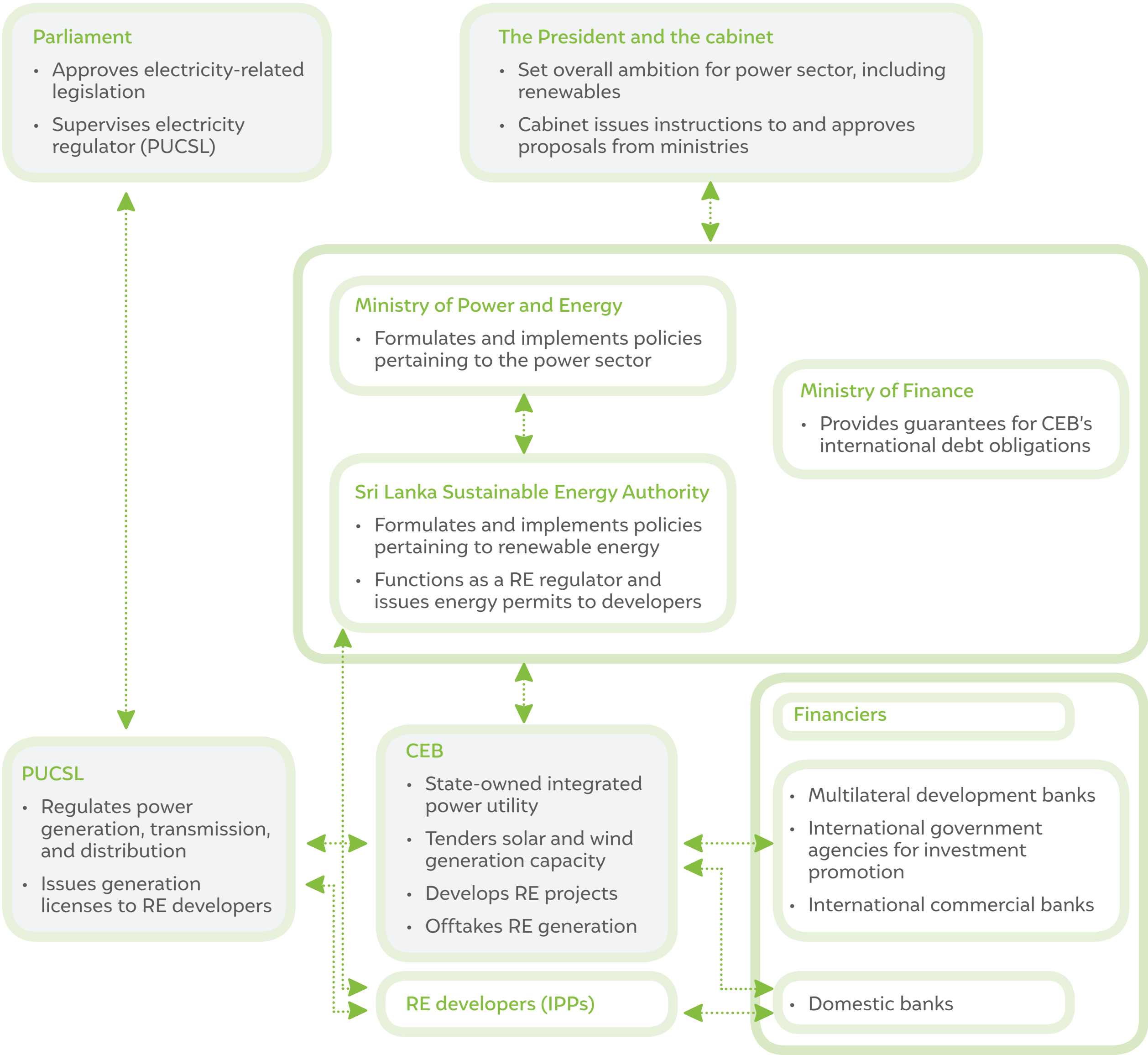
- A feed-in tariff (FIT) was applicable to projects below 10 MW (see Figure 3).
- For capacities over 10 MW, tariffs were negotiated between the developer and the government. In addition, projects above 25 MW required the provision of a free equity stake to the government.

This method of tariff determination and capacity allocation changed to a competitive auction method in 2016 (Ceylon Electricity Board 2017). Figure 3 illustrates the trajectory of tariffs in Sri Lanka.

## 3.4 Key actors in Sri Lanka's RE ecosystem

This section elaborates on the role of key actors in Sri Lanka's RE ecosystem, as illustrated in Figure 1.

**Figure 1** Key actors in Sri Lanka's RE ecosystem




*Source: Author's analysis*

### The president and the cabinet

The president in consultation with the cabinet (including the prime minister) determines the broad contours of the plan for Sri Lanka's power sector. President Gotabaya Rajapaksa's vision has been codified in the *National Policy Framework*, which informs power sector planning in Sri Lanka (elaborated on in Section 3.1). Further, the cabinet issues directions to and approves proposals from relevant ministries.

### The parliament

The parliament approves all electricity-related legislation. It also oversees the electricity regulator.

### The Public Utilities Commission of Sri Lanka (PUCSL)

Under the Sri Lanka Electricity Act No. 20 of 2009, the PUCSL is the economic, technical, and safety regulator for the electricity industry (Public Utilities

Commission of Sri Lanka 2020). The PUCSL regulates the generation, transmission, and distribution of electricity. It approves electricity tariffs and the CEB's generation capacity expansion plans. It also grants generation licences to RE projects.

**Ministry of Power and Energy**

The Ministry of Power and Energy is responsible for the formulation and implementation of policies pertaining to the energy sector, including those related to power.

**Sri Lanka Sustainable Energy Authority (SLSEA)**

The SLSEA is a government agency that reports to the Ministry of Power and Energy; it plays a key role in the development and implementation of programmes pertaining to RE and energy efficiency. The SLSEA also functions as the regulator for renewables—all RE developers require an energy permit from the SLSEA to exploit RE resources for electricity generation. The energy permit is granted after the developer obtains land and environmental clearances.

**Ceylon Electricity Board (CEB)**

The CEB is a state-owned integrated power utility. It has a monopoly on transmission and directly covers roughly 90 per cent of Sri Lanka's electricity consumers (Ceylon Electricity Board 2017). The remainder of the country's consumers are served by Lanka Electricity Corporation (Pvt.) Ltd. (LECO), a CEB subsidiary that caters to customers in select urban areas. CEB accounts for 77 per cent of overall electricity generation in the country; the remainder is generated by assets owned by independent power producers (IPPs) (Ceylon Electricity Board 2017). CEB has played a limited role in RE generation so far, having set up only one 25 MW mini hydro plant. However, it is currently building a 100 MW wind plant, which will be commissioned in 2020.

**Ministry of Finance (MoF)**

The MoF provides support for the CEB to mobilise international finance. This is primarily in the form of guarantees for the CEB's borrowings from development and commercial banks (The World Bank 2019).

**RE developers**

IPPs currently account for nearly all of the existing RE installed capacity, except for a 25 MW mini hydro plant (Ceylon Electricity Board 2019a). Most of these developers are domestic Sri Lankan entities, as the small project sizes and limited bankability of projects (by international standards) limit the participation of international equity investors.

**Financiers**

IPP-sponsored RE projects in Sri Lanka have largely been financed by domestic banks. However, international development and commercial banks have sponsored a wind project developed by the CEB.

# 4. Why accelerate RE deployment?

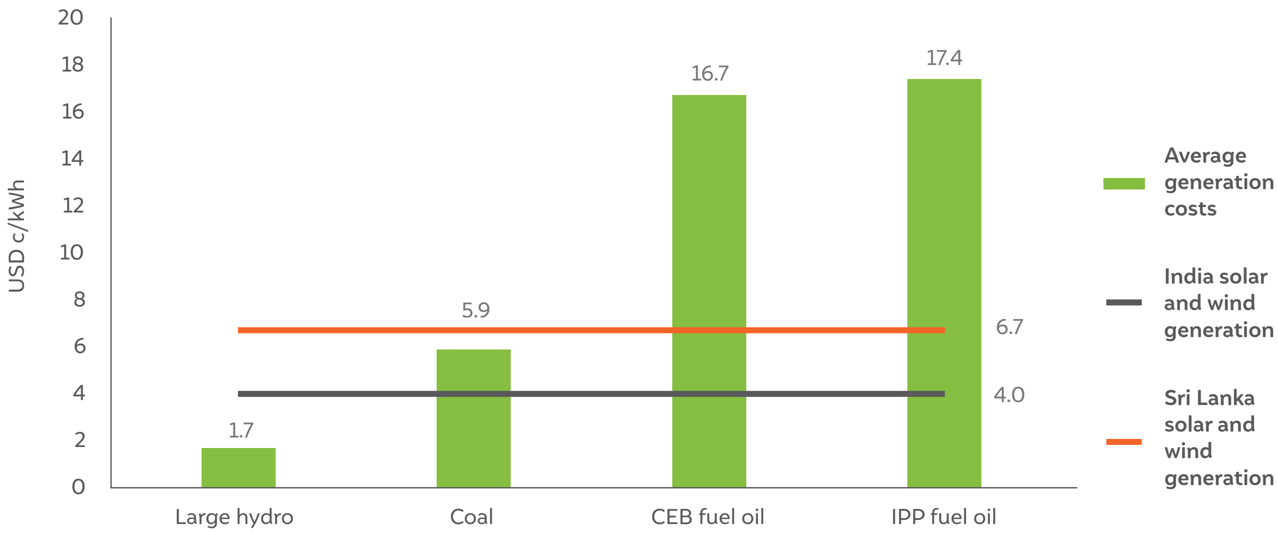
Greater RE deployment is a means to advance a number of Sri Lanka's priorities pertaining to electricity planning and implementation. These priorities include lowering electricity generation costs and enhancing energy security. Further, greater RE deployment could also translate into better management of public finances and attainment of the country's climate change mitigation commitments. RE deployment could also translate into better management of public finances and attainment of the country's climate change mitigation commitments.

## 4.1 Lowering generation costs

Renewables, particularly solar and wind, have become considerably more competitive over the years. Figure 2 compares utility-scale RE tariffs in India and Sri Lanka with the average power generation costs of the installed capacities across technologies in Sri Lanka.

> **Greater RE deployment is a means to advance a number of Sri Lanka's priorities pertaining to electricity planning and implementation.**

**Figure 2** Generation costs of solar and wind compare favourably with those of fuel oil

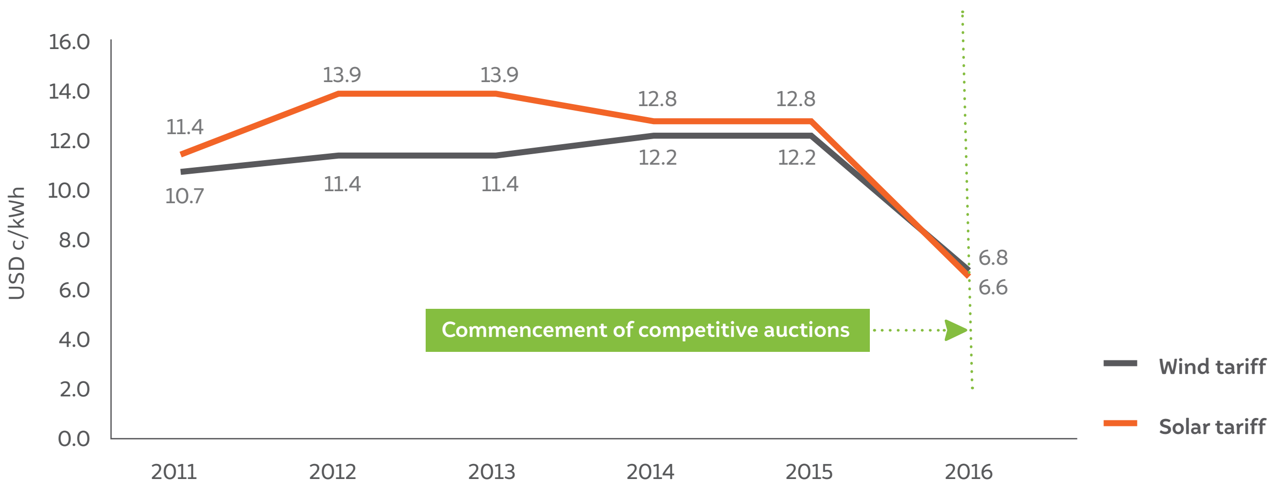



Note: Generation costs for solar and wind refer to the latest competitive auction–determined tariffs and not to average values.

*Source: The World Bank (2019), Ministry of Power and Renewable Energy Government of Sri Lanka (2017), CEEW-CEF market intelligence*

The lowest competitively determined global tariffs have dipped below USD c 2/kWh for solar and USD c 3/kWh for wind (CEEW Centre for Energy Finance 2020). While a number of these tariff bids benefitted from developers with access to cheap sources of finance (often sub-sovereign entities) and varying levels of policy support, utility-scale solar and wind tariffs in India have stabilised at around USD c 4/kWh without significant subsidy support (see Figure 2). Rooftop solar generation costs under the operating expenditure (opex) model have also dropped to USD c 6–7/kWh.[6]

**Figure 3** Competitive auctions facilitated sharp declines in Sri Lanka's solar and wind tariffs




*Sources: Public Utilities Commission of Sri Lanka (2010), Public Utilities Commission of Sri Lanka (2012), Ceylon Electricity Board (2016b), and Ministry of Power and Renewable Energy, Government of Sri Lanka (2017)*

6. CEEW-CEF market intelligence.

While these figures are indicative of the levels of viable tariffs in markets with more favourable conditions for RE investments, competitively determined solar and wind tariffs in Sri Lanka are also significantly lower than the average generation costs for fuel oil–based generation (see Figures 2 and 3). A change in the RE procurement methodology to auctions from the previous FIT regime led to a significant decline in tariffs (see Figure 3). The sharp decline in tariffs following the shift to a market-determined procurement methodology reflects the cost-competitiveness of solar and wind generation. With falling unit equipment costs, particularly in the case of solar, tariffs could decline further if risks constraining RE investments are addressed (see Section 6). Thus, solar and wind generation represent a means to further reduce generation costs.

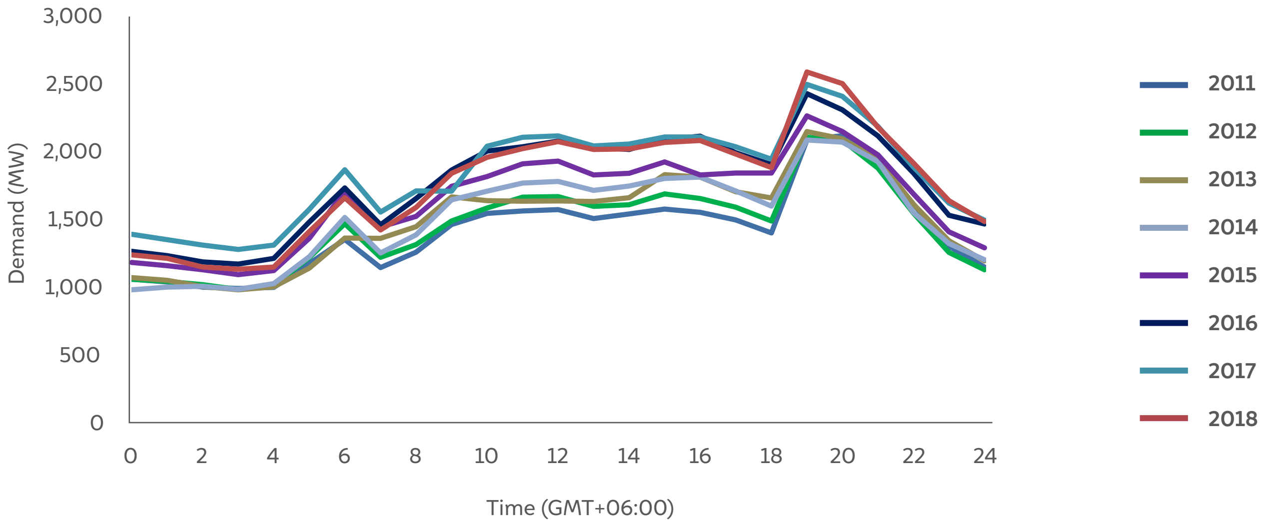
## 4.2 Catering to shifting demand patterns

Sri Lanka's average annual electricity demand plateaus during daytime and has an evening peak that occurs between 1800 and 2000 hours (see Figure 4).

The demand curve can be explained by the current energy demand profile, which is dominated by the residential segment (see Figures 5 and 6), thus resulting in an evening demand peak. However, steady economic growth is expected to result in higher commercial and industrial demand (these segments have the highest per capita electricity demand, as is evident from Figures 5 and 6), and increased penetration of air conditioners across consumer segments. This is expected to prompt a considerable increase in the daytime demand for power, leading to the development of a daytime peak that is expected to surpass the evening peak by 2027 (Ceylon Electricity Board 2019a). Solar energy, which has a generation profile that significantly overlaps with this emerging demand profile, could help cater to this shift in demand patterns.

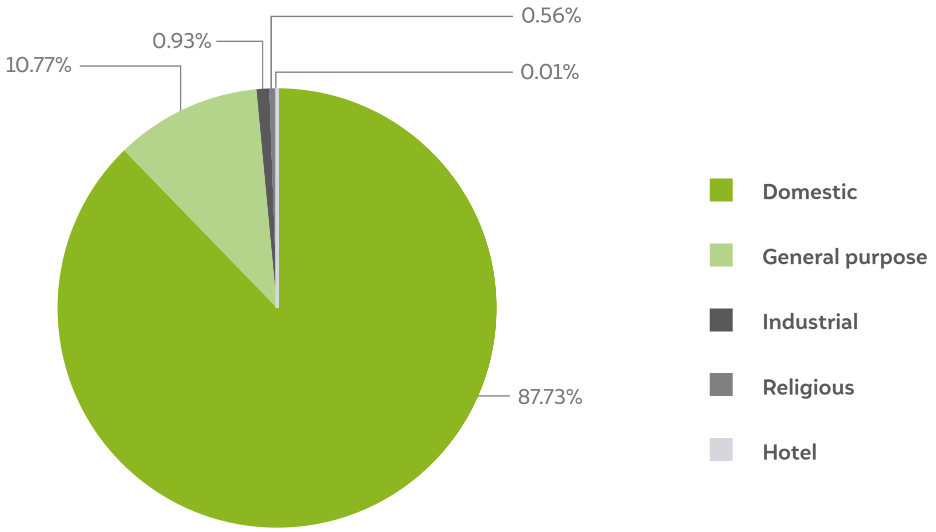
**Solar energy can cater to the shifting electricity demand patterns in the form of an emerging daytime peak that is set to surpass the evening peak by 2027.**

**Figure 4** Sri Lanka's power demand peaks between 1800 and 2000 hours



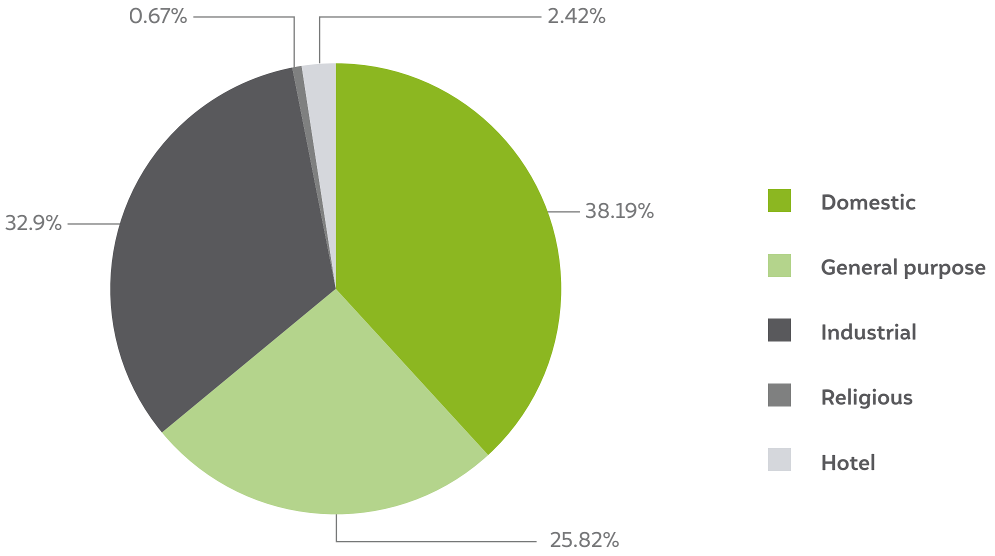

*Source: Ceylon Electricity Board (2019a)*

**Figure 5** **The domestic segment accounts for the majority of Sri Lanka's electricity consumers**




*Source: Public Utilities Commission of Sri Lanka (2017)*

**Figure 6** **Industrial and commercial consumers drive Sri Lanka's electricity consumption**




*Source: Public Utilities Commission of Sri Lanka (2017)*

## 4.3 Enhancing energy security

Large hydro accounts for the largest share of installed capacity and generation (see Tables 2 and 3); therefore, Sri Lanka's electricity generation is susceptible to variations in monsoon rainfall. This is exemplified by Figure 7, which illustrates the year-to-year variations in the share of large hydro in Sri Lanka's generation mix.

During years with poor rainfall (2012, 2014, and 2016), compared to years with normal rainfall, there were considerable declines in the share of hydro generation in Sri Lanka's electricity mix (see Figure 7). This variability has adversely impacted the CEB's profitability (see Figure 7). The utility compensates for shortfalls in hydro generation by procuring expensive fuel oil–based generation from IPPs, as indicated by the increase in the share of thermal generation in those years (see Figure 7).

Greater deployment of solar and wind energy could be a means to lower the country's dependence on fuel oil–based generation in years with low hydro generation.

## 4.4 Managing an adverse macroeconomic situation

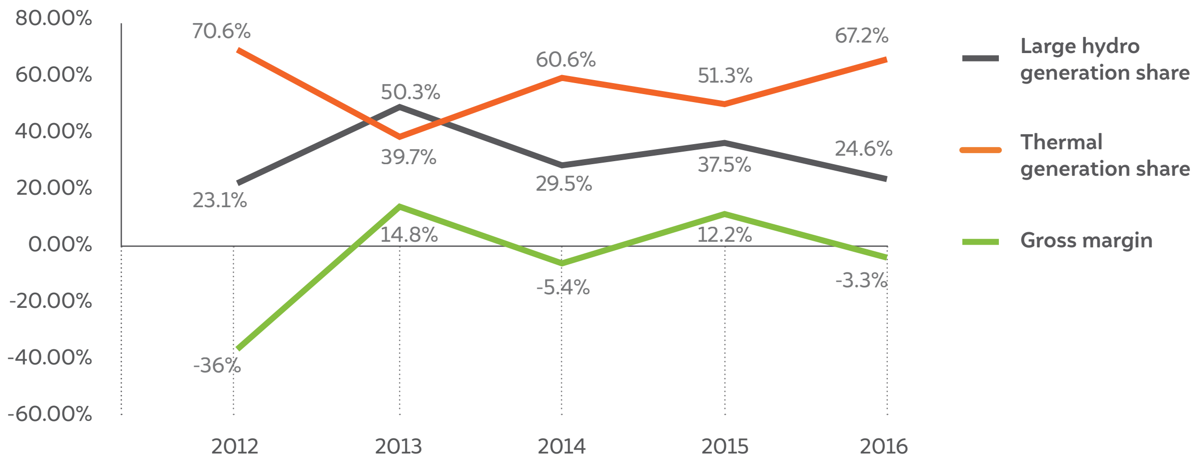
The CEB's average realised tariff is lower than its average cost of supply (see Table 1). Accumulated losses over the years have left the utility deep in debt; it relies on support from the Ministry of Finance for debt repayment. The Sri Lankan economy is currently characterised by weak economic growth and reduced public spending under an IMF-supervised public debt management programme (International Monetary Fund 2020). Thus, the central government is limited in its ability to provide additional support for debt management.

Further, Sri Lanka relies on imports for all of its coal and fuel oil requirements (The Ceylon Chamber of Commerce 2019). Crude oil and coal imports comprise 25–50 per cent of Sri Lanka's overall import bill, depending on fuel prices and volumes imported in a particular year. While these figures refer to requirements across all sectors, around one-fifth of the country's oil imports and nearly all of its coal imports are used for power generation (Pathfinder Foundation 2020). Thus, reducing Sri Lanka's import dependence is vital for managing the current account deficit and preserving foreign exchange reserves.

The adverse macroeconomic situation heightens the need to rapidly lower average generation costs and energy-related imports, thus providing an even more compelling reason for the large-scale adoption of renewables.

Greater deployment of solar and wind energy could be a means to lower the country's dependence on fuel oil–based generation in years with low hydro generation.

**Figure 7** Low shares of large hydro generation adversely impact the CEB's profitability




Notes:
- The figure captures data only through 2016, as CEB annual reports are available in the public domain only until 2016.
- Thermal generation includes both coal and fuel oil–based generation. The separate share for each of these two sources was not available.

*Source: Ceylon Electricity Board (2019a), Ceylon Electricity Board (2017), and Ceylon Electricity Board (2016a)*

## 4.5 Fulfilling climate change mitigation commitments

As a part of its nationally determined contributions (NDCs) under the *Paris Agreement*, Sri Lanka has promised a 20 per cent (4 per cent unconditional and 16 per cent conditional on international support) reduction in power sector greenhouse gas (GHG) emissions against the business-as-usual scenario between 2020 and 2030 (Ministry of Mahaweli Development and Environment, Government of Sri Lanka 2016). While the NDC originally envisioned increasing the share of hydro and RE in the country's generation mix to 60 per cent, the president revised this target to 80 per cent by 2030. Hydro and RE sources jointly account for only around 45 per cent of generation (see Table 2); therefore, considerable deployment is needed to meet the 80 per cent target. Moreover, as Sri Lanka has already exhausted most of its large hydro potential, renewables (primarily solar and wind) are expected to account for the bulk of this non-fossil fuel–based capacity addition (Ceylon Electricity Board 2019a).

> **Greater RE deployment could lower Sri Lanka's reliance on imported fuel-oil for generation, and thereby help manage the country's current account deficit.**

# 5. What plagues RE investments in Sri Lanka?

The bulk of Sri Lanka's present installed RE capacity, particularly solar and wind, has been developed by domestic equity investors supported by debt capital flows from domestic banks.[7] The limited bankability of contracts in the RE sector has constrained participation by foreign equity investors. International debt capital flows in Sri Lanka's RE sector have typically been conditional on sovereign guarantees for the CEB's offtake obligations.

## 5.1 Factors impacting the bankability of projects

### 5.1.1 Currency risk

Payments from the CEB to developers under RE standardised power purchase agreements (SPPAs) are denominated in Sri Lankan Rupees. Hedging options for the Sri Lankan Rupee are prohibitively high due to a poorly developed hedging market; therefore, the cost of hedging the Sri Lankan Rupee adds 6–7 per cent to borrowing costs and is a major deterrent to the inflow of foreign capital (The World Bank 2019).

### 5.1.2 Offtaker risk

Given the CEB's severe indebtedness, investors associate high risks of delays or defaults in repayment with it as an offtaker in the absence of sovereign guarantees for its contractual obligations (The World Bank 2019). The current RE SPPAs do not include provisions for sovereign guarantees of the CEB's payment obligations. Further, current SPPAs also do not contain specific termination provisions to cover for developers' losses in case of sudden termination in payments by the CEB (The World Bank 2019).

### 5.1.3 Change in law risk

Current SPPAs transfer the risks stemming from change in law to developers (The World Bank 2019). Such an allocation of risks adversely affects the bankability of projects.

### 5.1.4 Small project sizes

Utility-scale RE projects tendered out in Sri Lanka have been limited to 10 MW. Small projects are unattractive to international equity investors; they also raise transaction costs for banks.

> **The limited bankability of contracts in the RE sector has constrained participation by foreign equity investors.**

7. Based on stakeholder interactions.

## 5.2 Limitations of domestic debt financing

Most large infrastructure projects in Sri Lanka have been financed through international debt capital flows, either on concessional or commercial terms supported by sovereign guarantees. While domestic banks have financed the bulk of the relatively small-scale existing RE deployment (supported in part by lines of credit extended by multilateral development banks), these institutions lack the capacity to finance RE projects at scale. Some challenges associated with long-term domestic debt financing are as follows:

- Asset–liability mismatches: Given the short-term nature of domestic banks' sources of funds, these institutions struggle to offer loan tenures greater than 10 years (The World Bank 2019). This exposes long-term infrastructure projects (Sri Lanka's RE PPAs span 20 years) to refinancing risks.
- Single borrower exposure limits: Banking regulations limit banks' exposure to single corporate borrowers (companies and related parties) to 40 per cent of their capital base (Central Bank of Sri Lanka 2018). Sri Lanka's banks have limited asset bases, which limit their ability to provide loans for large-scale capital projects. While syndicated loans could be a means to circumvent the banks' single borrower exposure limits, even these arrangements could be insufficient to mobilise finance at the scale needed to meet the 2030 RE ambitions.[8]

Further, as Sri Lanka's corporate bond market is in its nascent stages (market capitalisation of ~2 per cent of the gross domestic product [GDP]), there are limited options for refinancing primary bank debt through the bond market (Asian Development Bank 2016). Thus, to scale RE deployment, it is imperative to devise mechanisms to tap into international capital flows.

## 5.3 Land acquisition risk

Challenges associated with land acquisition, because of limited availability and delays in securing the necessary permits, constitute a barrier to setting up large utility-scale projects (The World Bank 2019). This is further complicated by the fragmented nature of public land holdings – owned or administered by various public authorities, which makes securing contiguous land for large projects a cumbersome process (The World Bank 2019).

## 5.4 Transmission-related constraints

The development of large utility-scale projects requires supporting transmission infrastructure to evacuate the generated power. The CEB has identified sites for the development of large-scale RE parks, but these also require the development of supporting transmission infrastructure before capacity can be deployed. Given the weak financial position of the utility, there have been delays in operationalising plans for the development of this infrastructure.

## 5.5 Barriers to greater rooftop solar penetration

### 5.5.1 Impact of rooftop solar tariffs on the CEB's profitability

The applicable tariffs under the Net-accounting and Net-plus schemes are quite attractive for rooftop solar system owners (see Section 3.3.1). However, the applicable tariffs (USD c 12/kWh for the first seven years) are based on an outdated picture of rooftop solar PV economics. It is also higher than the CEB's average realised tariff from consumers and adds to the utility's financial burden. A worsening financial position could make it challenging for the utility to actively support rooftop solar.

As module prices have declined considerably over the past few years, rooftop solar tariffs should be reassessed. Rooftop solar tariffs stand at USD c 6–7/kWh in India; this points to the possibility of rationalising existing tariffs in Sri Lanka.

### 5.5.2 Existing business models may limit penetration

Existing rooftop solar deployment in Sri Lanka follows the capital expenditure (capex) model. This process involves several drawbacks; for instance, it places the

8. Based on stakeholder interactions.

burden of upfront capital expenditure and securing access to roof space for setting up the system on the consumer. Only a fraction of potential rooftop solar consumers have both the financial resources and access to suitable roof spaces to enable rooftop solar deployment under the capex model. To scale up deployment beyond this limited pool of customers, other business models must be considered; some of these models are described in Section 7.2.

# 6. Accelerating RE investments in Sri Lanka

The attainment of Sri Lanka's 2030 RE ambitions requires investments of nearly USD 9 billion between 2020 and 2030 (see Table 5). This large-scale financing requirement necessitates the mobilisation of international investment flows to supplement domestic sources. In order to accelerate investment flows, it is essential to systematically address the risks constraining RE investments using appropriate policy- or market-based interventions.

## 6.1 Bankable project structures

In order to attract international investors, it is essential to create bankable contractual structures and business models that reallocate risks currently borne by equity investors to actors better equipped to bear those risks. In addition, market-based instruments may be used to mitigate any residual risks.

### 6.1.1 Mitigating land and transmission infrastructure risks

Solar parks are designated zones of project deployment that offer investors a plug-and-play model. Solar parks make land, evacuation infrastructure, and other supporting infrastructure such as roads, water, and drainage available in exchange for a fee. These structures eliminate land- and transmission-related risks for project developers. The solar park model has been instrumental in driving foreign investments in RE projects in India (see Figure 8).

> It is essential to systematically address the risks constraining RE investments using appropriate policy- or market-based interventions.

**Table 5** RE capacity addition from 2020 to 2030 requires USD 9 billion in investments

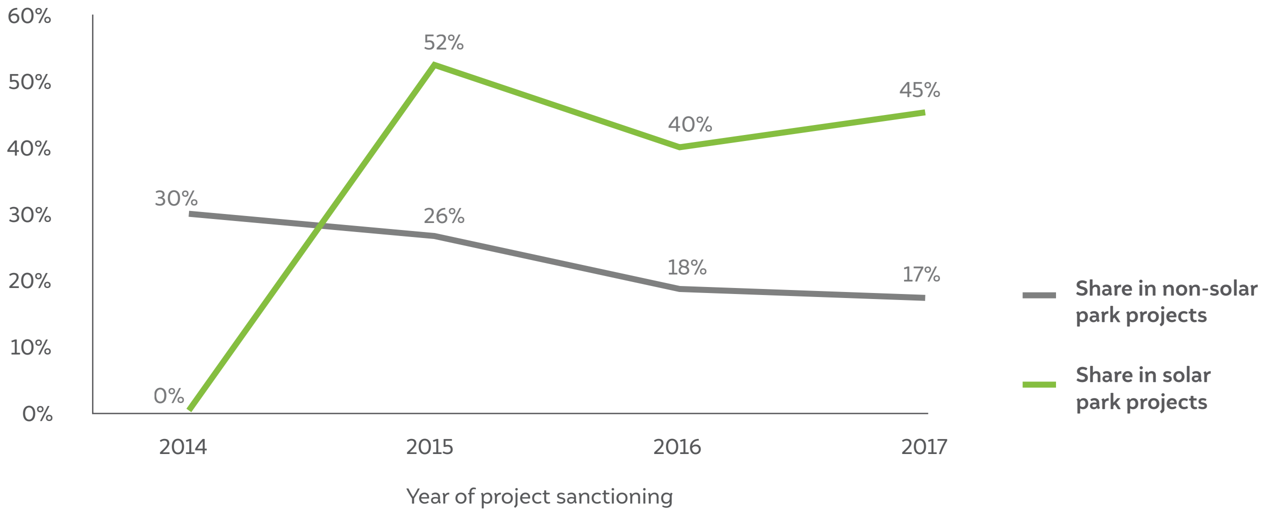
| Target: 80% generation from RE and large hydro by 2030 | Wind | Solar | Mini hydro | Biomass | Total |
|---|---|---|---|---|---|
| Capacity addition needed (MW) | 2,750 | 3,900 | 165 | 55 | 6,870 |
| Unit capital cost (USD/kW) | 1,497 | 1,210 | 1,492 | 2,105 | 6,304 |
| Investments required (USD million) | 4,117 | 4,719 | 246 | 116 | 9,198 |

Assumptions:

- The calculations consider an electricity generation requirement of 30,890 GWh in 2030 as per the CEB's *Long-Term Generation Expansion Plan* (LTGEP), 2020–2039.
- The trajectories of large hydro, mini hydro, and biomass capacity additions are retained as per the LTGEP, whereas solar and wind capacity addition trajectories are adjusted to ensure the attainment of the 2030 target.
- Capacity utilisation factors (CUFs) used in this analysis are either sourced or derived from data presented in the LTGEP. The following CUFs were factored into the analysis—solar (16.30 per cent), wind (34.10 per cent), mini hydro (42.0 per cent), and biomass (54.60 per cent).

*Source: Ceylon Electricity Board 2019a, IRENA 2019*

**Figure 8** International IPPs have favoured solar parks sites in India




*Source: Chawla et al. (2018)*

Implementing RE park projects at sites identified by the CEB (Pooneryn and Monregalla) could help facilitate investments in Sri Lanka. Given that state-owned agencies are best placed to acquire land and are also responsible for setting up transmission infrastructure, they could be well-placed to bear these risks. Setting up land banks complemented by single-window clearances and larger project sizes could accelerate capacity deployment. State entities could either develop solar parks themselves or in collaboration with the private sector. User charges paid by project developers could constitute a new revenue stream for state entities involved in park development.

### 6.1.2 Mitigating offtaker risk

Given the weak financial status of the CEB, it is essential to institute mechanisms that mitigate the risk of delays and defaults in payments. Sovereign guarantees for the obligations of the CEB could lower investors' perceptions of offtaker risk. Given the challenging prevailing macroeconomic conditions, other sources of capital could complement sovereign guarantees for the CEB's obligations (see Section 6.5). These could also be mitigated through market instruments such as the *Common Risk Mitigation Mechanism* (CRMM) (see Box 1).

### 6.1.3 Other provisions

SPPAs must include other provisions to improve their bankability. These include specific provisions for termination payments and those that offset change in law risk for developers.

### 6.1.4 Larger project sizes

RE parks allow the aggregation of land to support larger project sizes. This renders projects more attractive to international investors looking to make investments at scale.

## 6.2 Mitigating currency risk

Since Sri Lanka does not have a liquid market for hedging long-term local currency exposure, alternate market instruments may be considered to mitigate currency risk. The CRMM (see Box 1) is designed to help mitigate currency risk while also addressing other risks, including counterparty and political risks.

> **Guarantees for the contractual obligations of CEB, either from the Sri Lankan government or international funds, could improve the bankability of SPPAs by mitigating offtaker risk.**

**BOX 1**

**Common Risk Mitigation Mechanism (CRMM)**

The CRMM is a one-stop guarantee for underwriting the political, offtaker, and foreign currency risks associated with solar projects in emerging economies. A version of this called the *Solar Risk Mitigation Initiative* is currently being piloted by the World Bank in countries in West Africa. The development of the CRMM began in May 2017; many national governments entrusted an international multi-stakeholder taskforce with the mission of defining and structuring a common mechanism aimed at de-risking solar energy investments under the aegis of the International Solar Alliance (CEEW, CII, TCX, TWI 2017).

## 6.3 Creating greater certainty in RE procurement and demand

A credible long-term pipeline of projects facilitates investment planning and the participation of international investors. Long-term RE capacity addition targets, complemented by a regular tendering schedule, have facilitated RE capacity addition in India (Aggarwal and Dutt 2018). The announcement of a predictable tendering schedule could facilitate long-term investment planning in Sri Lanka as well.

## 6.4 Greater focus on distributed renewables

### 6.4.1 Readily implementable mode of RE deployment

The scale of Sri Lanka's clean energy ambitions necessitates investments across both utility-scale and distributed RE segments. However, while utility-scale generation requires setting up complementary transmission infrastructure, distributed RE generation may be installed in the existing distribution network. Given the challenging macroeconomic situation in Sri Lanka and the CEB's indebtedness, setting up capital-intensive transmission infrastructure to support utility-scale generation could be challenging. Thus, distributed generation may present a more readily implementable means of increasing solar penetration.

### 6.4.2 Rationalisation of existing tariffs

In order to minimise the financial burden of rooftop solar deployment, the tariffs under the *Net-accounting* and *Net-plus* schemes should be rationalised in view of declining PV (photovoltaic) module prices. The deployment of larger rooftop solar systems could also make installations at lower tariffs viable. Some new business models described in Section 6.4.3 could help realise the deployment of larger system sizes.

### 6.4.3 New business models to scale up deployment

New modes of deployment may be considered to expand rooftop solar penetration beyond the limited set of customers who are able to bear the upfront costs and access suitable roof spaces. Rooftop solar deployment under the opex model could help eliminate the burden of upfront capital expenditure. However, other challenges such as access to suitable roof spaces and the creditworthiness of offtakers may arise. These may be resolved by implementing systems using suitable business models that reallocate and mitigate risks among the actors involved (see Section 7.2).

## 6.5 Green banks for de-risking private investments

Catalytic finance refers to the use of a pool of capital (usually public money) to underwrite risks in order to crowd in private sector investments into financially underserved sectors. Catalytic finance can be instrumental in mobilising RE investments, particularly international capital, at scale.

While some of the structural challenges constraining RE deployment discussed previously need to be addressed before investments can flow, catalytic finance could be instrumental in accelerating the existing flow of finance. Specific use cases include creating bankable project structures through guarantees for the CEB's contractual obligations, bolstering the creditworthiness of rooftop solar projects with private sector offtakers, and mitigating currency risk.

Currently, there are no domestic organisations that offer catalytic finance solutions for clean energy. However, catalytic financing solutions geared towards accelerating the flow of finance towards clean energy exist in a number of developed and developing countries. Organisations that offer such services are usually referred to as green banks. Often, existing financial institutions also contain dedicated facilities for clean energy investments. Among developing countries, India, Malaysia, and South Africa have dedicated catalytic finance facilities championed by existing financial organisations to accelerate clean energy investments in financially underserved segments. These catalytic finance facilities are listed in Table 6.

As evident from Table 6, catalytic finance facilities have a variety of funding mechanisms, including exclusive financing from government entities (Malaysia) to a mix of government capital and external agencies. Given Sri Lanka's challenging prevailing macroeconomic situation, a number of suitable sources—including philanthropic foundations and multilateral and development finance facilities—may be considered to complement government equity investments in such facilities.

Catalytic financing solutions geared towards accelerating the flow of finance towards clean energy exist in a number of developed and developing countries.

**Table 6** **Catalytic finance facilities may be funded by a variety of sources**

| Country | Host institution | Name | Size | Funding |
|---|---|---|---|---|
| **India**  | Indian Renewable Energy Development Agency (IREDA) | *Green Window* | USD 100 million | USD 20 million comes from IREDA; the balance is sourced from other agencies |
| **South Africa**  | Development Bank of Southern Africa (DBSA) | *Climate Finance Facility* | USD 122 million | USD 40 million comes from DBSA; USD 56 million comes from the Green Climate Fund; the balance comes from a local institution |
| **Malaysia**  | GreenTech Malaysia and Credit Guarantee Corporation Malaysia (CGC) | *Green Technology Financing Scheme* | Financing projects totalling USD 467 million | Government of Malaysia; Bank Negara Malaysia; CGC |

Note: Local currency figures were converted to USD using the following exchange rates:

- US Dollar–South African Rand = 16.36
- US Dollar–Malaysian Ringgit = 4.28
- In the case of India, the size of the facility was denominated in USD itself.

*Sources: Press Information Bureau Government of India (2019), Development Bank of Southern Africa (2018), and Green Tech Malaysia (2020)*

# 7. India and Sri Lanka: partners in the energy transition

India and Sri Lanka are not only geographically proximate and share close bilateral relations, they also both have ambitious RE commitments. India has made considerable strides in solar and wind energy deployment, and there is considerable potential for collaboration between the two countries to address specific aspects of Sri Lanka's energy transition. This cooperation can mutually benefit the two nations.

## 7.1 Closer bilateral cooperation with Sri Lanka

The Indian government has prioritised close bilateral relations with countries in South Asia through its *Neighbourhood First* approach and the *SAGAR (Security and Growth for All in the Region)* doctrine; its focus is on deepening economic ties and cooperation on matters of national security (Press Information Bureau, Government of India 2019). Consistent with its foreign policy stance, India has taken steps to deepen its economic cooperation with Sri Lanka. These steps include extending a USD 400 million line of credit to Sri Lanka for infrastructure development (Press Information Bureau, Government of India 2019). In addition, clean energy is a specific area of cooperation between the two countries.

*Clean energy-specific cooperation*

In the clean energy sector, India has extended a concessional USD 100 million line of credit to Sri Lanka for the development of rooftop solar projects (Press Information Bureau, Government of India 2019). This line of credit is to be apportioned between support for setting up rooftop solar systems for low-income families (USD 50 million) and the deployment of rooftop solar in government schools, colleges, hospitals, and other establishments (USD 50 million) (High Commission of India, Sri Lanka 2018).

> Utility-led rooftop solar business models from India may be adapted to the Sri Lankan context to increase the penetration of rooftop solar and lower generation costs.

## 7.2 New rooftop solar business models

Consistent with the push by the two governments for greater rooftop solar penetration in Sri Lanka, new business models may be considered to help circumvent barriers to the uptake of rooftop solar. In partnership with CEEW, discoms in New Delhi are piloting utility-led rooftop solar models to increase the penetration of rooftop solar in the residential segment (Kuldeep, Saji, and Chawla 2018). These business models may be adapted to the Sri Lankan context to facilitate the uptake of rooftop solar in both residential and non-residential segments.

**1. Community solar model**: This model enables consumers without access to suitable roof spaces, such as households in high-rise or multi-storey buildings, to benefit from rooftop solar. In this model, a group of consumers either collectively owns the community solar system or buys electricity from the plant at a predetermined tariff. Therefore, consumers can either subscribe to a share of the electricity generation by paying for a portion of the upfront cost or by paying a subscription fee. This model is based on virtual net metering.

**2. On-bill financing model**: This model circumvents barriers to rooftop solar deployment caused by the burden of upfront capital expenditure. The capital cost for setting up the rooftop solar plant is offered as a loan, which consumers repay through their monthly electricity bills. The threat of disconnection on non-payment of bills reduces the risk of loan defaults. The savings from reduced grid-electricity consumption could be used to make monthly loan repayments.

**3. Solar partners model**: In this model, the utility plays the role of a demand and supply aggregator. On the supply side, the utility aggregates rooftop spaces in its distribution area, tenders the capacity through a competitive reverse auction mechanism, and signs power purchase agreements (PPAs) with developers that install systems on the aggregated rooftop space. Electricity generated from these rooftop solar plants is made available to residential consumers via an electricity exchange platform. This model allows consumers and flat owners (without roof access) to avail of solar electricity by paying an annual subscription fee.

## 7.3 India–Sri Lanka transmission grid interconnection

The interconnection of transmission grids in India and Sri Lanka offers potential advantages to both countries:

- The balancing of RE generation in the combined grid over a larger area enables the integration of greater RE capacity.
  - India has built dedicated transmission infrastructure connecting RE-rich states to load centres across the country (the Green Infrastructure Corridor) to facilitate the evacuation of RE generation and greater RE integration. Grid interconnection between India and Sri Lanka could facilitate the integration of greater RE capacity in the combined grid than in the two grids separately, thus benefitting both countries.
- The import of cheaper RE generation into Sri Lanka can lower the average power procurement costs.
  - The cost of imported power in Sri Lanka is expected to be USD c 8.76–8.95/kWh, which is considerably lower than the country's average cost of supply (see Table 1) (The World Bank 2019).

Feasibility studies on grid interconnection, of sites in Tamil Nadu, India, and those in the Northern Province in Sri Lanka via submarine cables, have been conducted (The World Bank 2019). These studies indicate that the capital investments needed to achieve grid interconnection range between USD 670 million and 1.1 billion (The World Bank 2019). India and Sri Lanka could consider jointly financing the required capital investment.

Rooftop solar and grid interconnection could be the starting points for closer clean energy–related cooperation between the two countries. However, given the scale of the clean energy ambitions of both countries, more areas of collaboration in the domain of clean energy are highly likely. Mutual cooperation could accelerate energy transitions in both countries and that of the world at large.

> **Mutual cooperation could accelerate energy transitions in both countries and that of the world at large.**

# Annexures

### Table A1 Domestic electricity tariffs in Sri Lanka

| Level of monthly consumption (kWh) | Consumption block | Units consumed (kWh) | Unit charge (LKR) | Fixed charge (LKR) |
|---|---|---|---|---|
| 0–60 | Block 1 | 0–30 | 2.50 | 30 |
| | Block 2 | 31–60 | 4.85 | 60 |
| Above 60 | Block 1 | 0–60 | 7.85 | NA |
| | Block 2 | 61–90 | 10 | 90 |
| | Block 3 | 91–120 | 27.75 | 480 |
| | Block 4 | 121–180 | 32 | 480 |
| | Block 5 | >180 | 45 | 540 |

*Source: Ceylon Electricity Board (2019b)*

### Table A2 Commercial and industrial electricity tariffs in Sri Lanka

| | | | General purpose | | Industrial | |
|---|---|---|---|---|---|---|
| | | | GP 1–1 | GP 1–2 | IP 1–1 | IP 1–2 |
| Supply at 400/230 V, Contract demand ≤ 42 kVA | Unit charge (LKR/kWh) | | ≤300 kWh/month | >300 kWh/month | ≤300 kWh/month | >300 kWh/month |
| | | | 18.30 | 22.85 | 10.80 | 12.20 |
| | Fixed charge (LKR/month) | | 240 | 240 | 600 | 600 |
| Supply at 400/230 V, Contract demand > 42 kVA | Unit charge (LKR/kWh) | Day (0530–1830) | 21.80 | | 11.00 | |
| | | Peak (1830–2230) | 26.60 | | 20.50 | |
| | | Off-peak (2230–0530) | 15.40 | | 6.85 | |
| | Demand charge (LKR/kVA) | | 1,100 | | 1,100 | |
| | Fixed charge (LKR/month) | | 3,000 | | 3,000 | |
| Supply at 11 kV and above | Unit charge (LKR/kWh) | Day (0530–1830) | 20.70 | | 10.25 | |
| | | Peak (1830–2230) | 25.50 | | 23.50 | |
| | | Off-peak (2230–0530) | 14.35 | | 5.90 | |
| | Demand charge (LKR/kVA) | | 1,000 | | 1,000 | |
| | Fixed charge (LKR/month) | | 3,000 | | 3,000 | |

*Source: Ceylon Electricity Board (2019b)*

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