
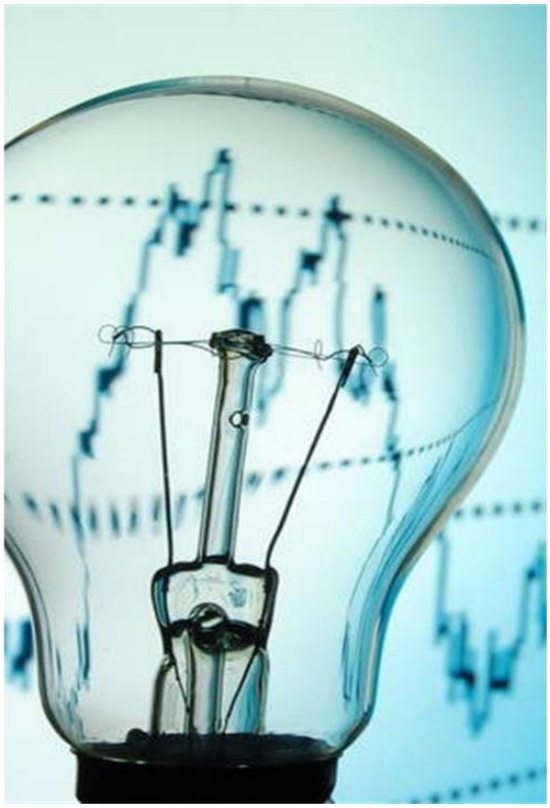



Study on "Power Pricing for Cross- Border Electricity Trade in South Asia"

SAARC Energy Centre

Foreword

Acknowledgement

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List of Acronyms

Accelerating Sustainable Private Investment in Renewable Energy (ASPIRE) .....
Bangladesh Power Development Board (BPDB) .....
Bhutan Electricity Authority (BEA) .....
Bhutan Power Corporation (BPC). .....
Bhutan Power System Operator (BPSO) .....
Central Electricity Regulatory Commission (CERC).....
Cross Border Electricity Trade (CBET) .....
Department of Hydropower & Power Systems (DHPS).....
Department of Renewable Energy (DRE) .....
DESA (Dhaka Electric Supply Authority) .....
Discussion Paper on Market Based Economic Dispatch (MBED).....
Distribution Companies (DISCOM).....
Druk Green Power Corporation Limited" (DGPC) .....
Finance, Own and Operate (FOO).....
Hydro-electric Power HEP.....
Independent Power Producers (IPPs). .....
Inter-Governmental Framework Agreement (IGFA) .....
Maldives Energy Authority (MEA).....
Ministry of New and Renewable Energy (MNRE).....
Ministry of Power (MoP).....
National Hydro Power corporation (NHPC) .....
National Load Dispatch Centre (NLDC) .....
National Thermal Power Corporation (NTPC) .....
orway's liberalization and the new energy act of 1991. It is jointly operated by two transmission system operators (TSO).....
Power Exchanges (PXs) .....
Power Grid Corporation of India (PGCIL) .....
Power Purchase Agreement (PPA).....
Power Trade Department (PTD).....
Power Trading Corporation of India (PTC) .....
Pumped Storage Plant (PSP .....
REB (Rural Electrification Board).....
SAARC Energy Centre (SEC).....
SAARC Member States (SMS).....
SAARC power market for electricity (SAME) .....
Satluj Jal Vidyut Nigam (SJVN) .....
State Electric Company Limited (STELCO) .....
State Electricity Regulatory Commissions (SERC).....
Sustainable Development Goals (SDG) .....
Tata Power Trading Company (TPTC).....

Executive Summary

The South Asia (SA) Region is one of the fastest growing regions in the world and is home to nearly to one fourth of the world's population. During the last two decades, SA Region has experienced robust economic growth on an average of 6% per year (Asia foundation 2016) (Ali, 2016) (). Rapid economic growth combined with rapid industrialisation, modernisation, and urbanisation led to the rising energy demand across all the countries of the SA region. The installed electricity generation capacity of the SA Region has increased substantially over the years and currently it is around 456 GW. India, Pakistan and Bangladesh are large power systems whereas Afghanistan, Bhutan, Nepal, Sri-Lanka and The Maldives are small power systems. India is the largest country in the SA region and has an installed capacity of around 388 GW followed by Pakistan, the next largest power system, with installed capacity of 37 GW. As of 2019, around 94.4 % of the population in SA has access to electricity (World Bank, 2019). Though the annual electric power consumption of SA has increased to 1,015 kWh per capita (Panda, 2021), it is still much less than the global average of around 3,000 kWh per capita.

SA Region is blessed with diverse energy resources viz. coal, hydro and other renewables abundant in nature and offers large opportunities for Cross Border Electricity Trade (CBET), which can underpin and fulfil the vision of adequate supply of energy/electricity to all and enhance economic growth of the region. SA country governments have been taking steps to advance CBET in the region. Currently around 3,700 MW is being traded among BBIN countries and as per estimates, it will grow to 12,200 MW in 2030 (Ministry of External Affairs, 2021). Around 17,497 GWh of electricity is being traded between BBIN countries in 2021 which was approximately ~7705 GWh in the year 2014, i.e., an increase of 127 %.

Bilateral trade of electricity is the first step to move in the direction of creating a regional power market and power pool. Recognizing the benefits of electricity trade, multilateral power trade is likely to increase gradually by manifold in the future. Currently, the region has different power pricing mechanisms that govern cross border trade of electricity. For reasonable certainty to the investors/ developers/traders involved in cross-border trade, a uniform, transparent and a competitive power pricing mechanism will facilitate in development of competitive power market structure in the region, which in turn will encourage developers/investors to invest in the cross-border power projects and to encourage more countries in the region to opt for cross border trade of electricity.

In the above context, the objective of the study is to develop and establish a uniform, transparent power procurement and pricing mechanism for CBET in South Asia consistent with the dynamics of the domestic power sector as well as with regional requirements to promote grid connectivity, investment, and trade of electricity in the South Asian region. As such, the study mapped existing power pricing mechanisms, acts/policies relevant to power pricing/ tariff framework, challenges/barriers, international experience/learning on power

procurement & pricing framework. Based on the detailed mapping and analysis, the study suggests uniform, transparent power procurement and pricing mechanism along-with implementation strategy/plan for the region.

The study report has four chapters as follows:

Chapter -1: Introduction & Scope: Explains the background, introduction, scope, rationale, objectives, approach and methodology adopted in the study.

Chapter -2: Existing Electricity Pricing Mechanism of SAARC: Covers the country wise existing electricity pricing mechanism of CBET viz. background, sector reform and key institutions, existing power pricing/procurement framework prevailing & relevant acts, policies and regulations. This chapter also elaborate shortcomings, barriers and prevailing challenges with respect to CBET from the point of view of all stakeholders, essential for devising an electricity pricing framework.

Chapter3: **Recommended Electricity Pricing Mechanism**: Based on the detailed analysis of power pricing mechanism prevailing in the region and in view of the future prospect of more countries opting for grid interconnectivity & multilateral power trade, this chapter provides detailed recommendations/suggestions on power pricing mechanism for import/export of Electricity in SAARC region, supported with examples/ explanatory memorandum/ global best practices/learnings etc. This chapter also gives relevant references to international best practices on power procurement & pricing for South African Power Pool (SAPP), European Electricity Market, Nord Pool, and Greater Mekong Power Market respectively.

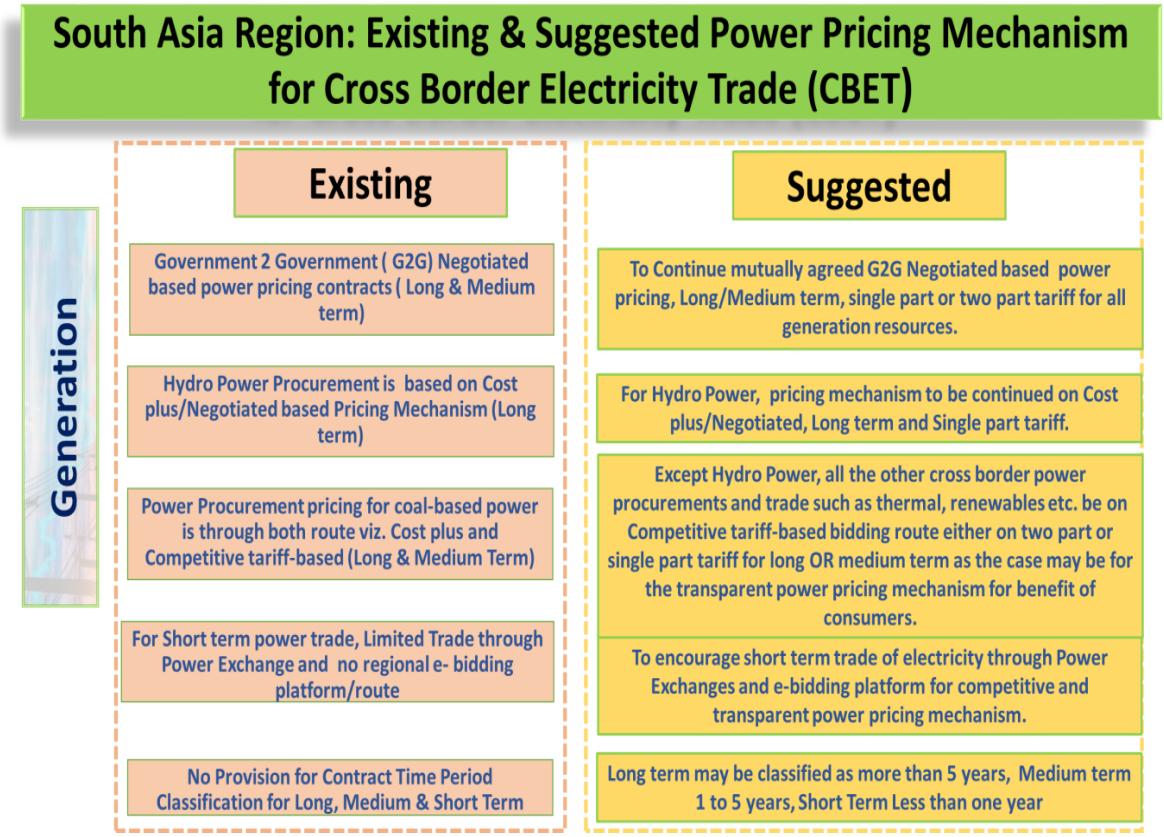
Chapter 4: **Implementation of the Recommended Power Pricing Mechanism**: This chapter provides a holistic approach, a suggested implementation plan including a suggested time frame at country level and regional level for moving towards a competitive & transparent Power pricing framework.

The existing trend of electricity trade in South Asia as well as in other regional power integration/power pools in the world has shown that there should be a win-win situation for the countries to promote cross border trade of electricity for the economic growth and development of their country/region. The report finds that competitive power pricing mechanism discovered on a transparent way to facilitate smooth trade of electricity and will help to attract investment for building cross border infrastructure projects for the sustainable development required for the entire electricity value chain. Global learnings also show that initially the countries in the regions such as South African Power Pool, European Power Market have commenced CBET on bilateral, long- and medium-term contracts, cost plus, negotiated contracts, firm contracts, non-firm-based contracts etc. For example, in SAPP, about 90-95% cross border trade of electricity is on bilateral, cost plus negotiated basis for a duration of 1 to 5 years or longer. European Power Market has issued various directives right from the year 1996 onwards for developing cross border competitive power market in the region. Global learnings also show that they have moved for trade of electricity by adopting transparent power pricing mechanisms such as competitive bidding, trading on power

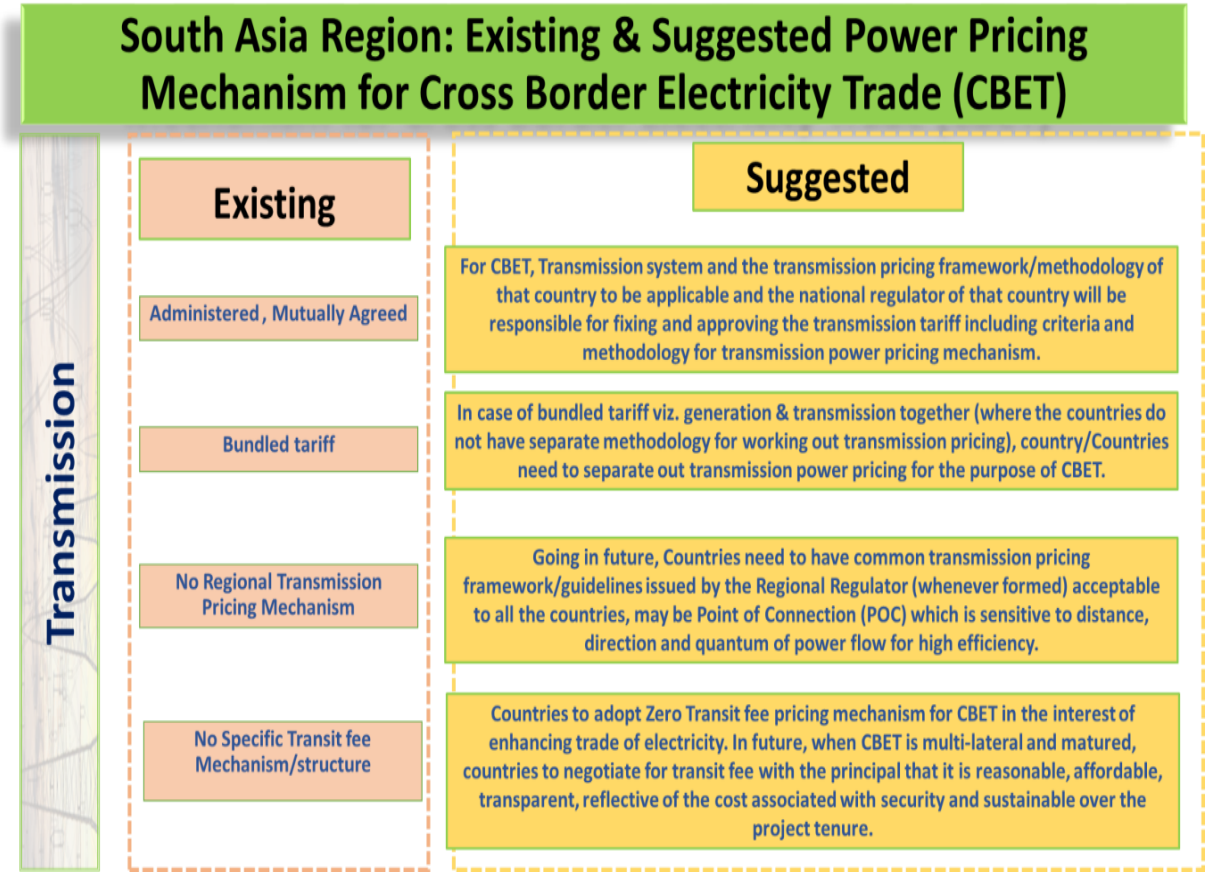
exchanges, ancillary services contracts, balancing market etc. From the lenders/financial Institution's perspective, long term contracts are preferred as the repayments are assured in such contracts.

From the learning of existing trend of electricity trade in the South Asia and International experience the report concludes that there should be a mix of power pricing mechanism such as.

A. Continue to procure cross border power on long term (more than 5 years), medium term (1 to 5 years) PPAs on bilateral, government to government (G2G), negotiated basis, two part or single part contract as the case may be.
B. Procurement of hydro power on cost plus, negotiated, single part tariff and on long term basis. However, considering importance of transparent & competitive power pricing structure, region may take steps to award hydro power projects on competitive tariff -based bidding.
C. In future, move towards procurement of thermal, gas, renewable power etc. on competitive tariff-based bidding for procurement on long-term and medium-term basis.
D. To promote new dedicated joint venture between the country governments/ joint ventures between power utilities government/ private power developers for cross border power projects on long-term, cost plus, negotiated based contracts
E. For optimum utilization of all power resources, short-term (less than 1 year) trade of electricity on e-platform, power exchanges etc. needs to be implemented/preferred. Regional institution viz.

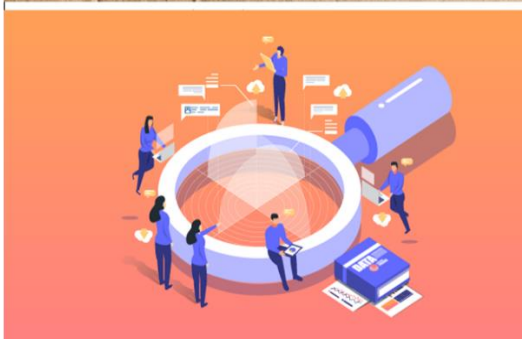


A graphical representation of the key recommendations/suggested framework on power pricing mechanism for import/export of electricity for CBET (both for generation and transmission in the SAARC is given below:



The report notes that SAARC can play a vital role by developing an action plan to implement power pricing mechanism in the region. However, efforts should be taken to move step by step from cost plus basis to competitive tariff-based bidding and short-term trade of electricity on power exchanges/ e-bidding platform. Further, for transparent power pricing mechanism, there should be clear-cut roles and responsibilities to be defined for various stakeholders viz. government, regulators, power utilities etc.

Chapter 1



Introduction & Scope of Work

1. Introduction and Scope of work

1.1 Introduction

a) Brief Profile:

The South Asia (SA) region covers about 3.5 % of the world's total land surface area and its population is about one fourth of the world's population, which shows that region is densely populated (Wikipedia, 2021). Further, SA is one of the fastest growing regions in the world. During the last two decades, SA Region has experienced robust economic growth on an average of 6% per year (Ali, 2016). The strong growth has enabled the region to reduce their poverty and gain impressive improvements in human development. The region consists of eight Countries viz. Afghanistan, Bangladesh, Bhutan, India, Nepal, The Maldives, Pakistan and Sri-Lanka. Briefly the Profile of SAARC Member States (SMS) covering Land Area, Population, GDP etc. is given below in a tabular form:

Table 1: Brief Profile of South Asia (As of 2018)

Country	Surface Area (1000s km^2)	Population (Million)	Population Density (per km^2)	GDP per capita (US$)
Afghanistan	653	37	57	494
Bangladesh	147	161	1,240	1,698
Bhutan	4	0.75	20	3,243
India	3,287	1,353	455	2,006
The Maldives	0.3	0.51	1719	10,277
Nepal	147	28	196	1,039
Pakistan	796	212	275	1,482
Sri-Lanka	66	22	350	4,080
Source: World Bank [1] (numbers have been rounded-off)				

[1] https://databank.worldbank.org/source/world-development-indicators

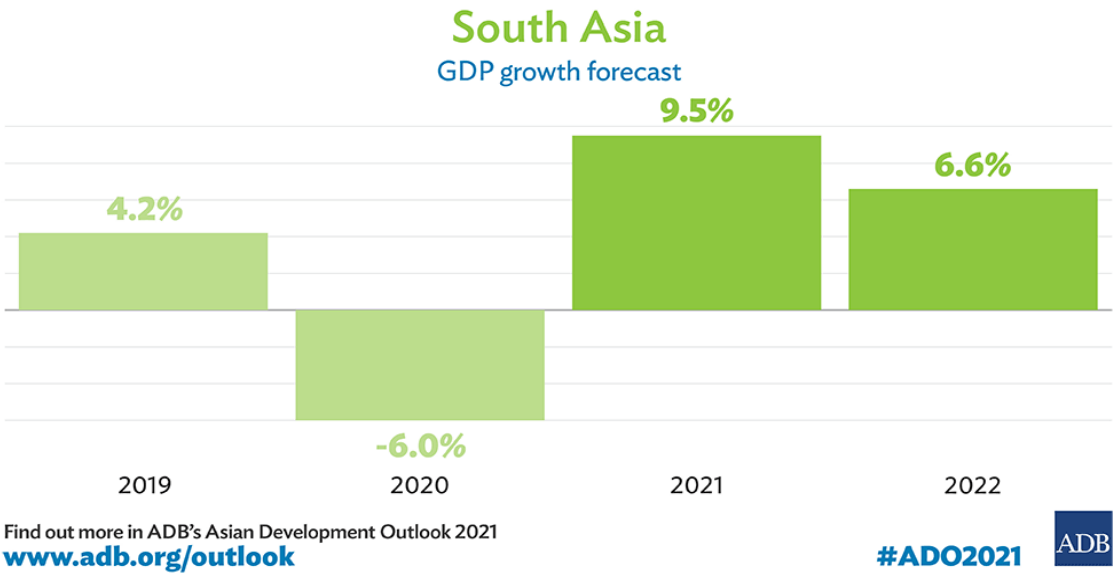


Figure 1: South Asia - GDP Growth Forecast[2]

The COVID-19 pandemic has impacted populations across the world both directly and indirectly and created challenges for economies and livelihoods that are unprecedented. According to the estimates, due to the impact of COVID 19, global economy may suffer losses to the extent of USD 8.8 trillion, equivalent to 9.7 % of global gross domestic product (GDP) (Sustainable Energy for All, 2020). However, according to the Asian Development Bank Outlook, April 2021 - Economic Forecasts (ADB, Economic Forecast, 2021), the region is expected to bounce back in the near future.

Rapid economic growth combined with rapid industrialisation, modernisation, and urbanisation led to the rising energy demand across all the countries of the SA region. According to World Bank report (World Bank Group, 2015) , "total regional generation would increase by 3.5 folds from 1,486 TWh in 2013 to 5,247 TWh in 2040". Projected electricity demand to grow annually at an average rate of 4.6% in Afghanistan, 6.6% in Bangladesh, 1.7% in Bhutan, 5% in India, 6.2% in Nepal, 6.1%in Pakistan and 4.5% in Sri-Lanka respectively during the period 2013-2040. For the region as a whole, total electricity demand will grow at an average rate of 5.2% annually during the period 2013-2040.

Further, the region is blessed with abundant diverse energy resources viz. coal, hydro, renewables etc. and offers potential large opportunities for Cross Border Electricity Trade (CBET), which can underpin and fulfil the vision of adequate supply of energy/electricity to all and enhance economic growth of the region. Energy resources available in SA Region are tabulated below:

[2] www.adb.org/outlook

Table 2: Energy Resource Potential in South Asia

Resources Potential	Coal (Million Tonnes)	Oil (Million Barrels)	Natural Gas (Trillion Cubic Feet)	Biomass (Million Tonnes)	Hydropower (GW)	Solar (GW)	Wind (GW)
Afghanistan	440	-	15	18-27	25	67	220
Bangladesh	884	12	8	0.08	0.33	3	-1
Bhutan	2	-	-	27	30	12	1
India	90,085	5,700	39	139	150	750	695
Maldives	-	-	-	-	-	-	-
Nepal	-	-	-	27	83	2	3
Pakistan	17,550	324	33	-	59	100	346
Sri-Lanka	-	150	-	12	2	6	24
Region Total	**1,08,961**	**5,906**	**95**	**223**	**349**	**940**	**1290**

Source: ADB[3] and compiled by author from various sources – SARI/EI data source, CEA – India, DHPS – Bhutan, Ministry of Energy, NEA – Nepal, CEB, Ministry of Energy – Sri-Lanka, NTDC, NEPRA-Pakistan, DABS-Afghanistan (number are rounded-off)[4]

From the above table, it may be seen that India and Pakistan have diverse energy resources e.g., coal, hydro, oil, natural gas etc., whereas Afghanistan, Nepal, Bhutan, Bangladesh, Sri-Lanka and The Maldives have limited energy resources available with them. Both Nepal and Bhutan have significant hydropower potential in excess of their demand. Bangladesh is reliant on natural gas reserves which are fast depleting. Bangladesh also has coal reserves but is yet to fully exploit them. Energy supply in Sri-Lanka is primarily based on biomass, petroleum, and hydroelectricity. The Maldives is dependent heavily on diesel for its domestic needs, which is largely imported as its own domestic resources comprise primarily of biomass. As such, the dominance of certain fuel types – coal in India, gas in Bangladesh, petroleum in Pakistan, hydro power in Bhutan and Nepal leads to over-dependence on these resources at a country level and leaves them vulnerable to supply side risks. Region is also blessed with large solar power potential around ~939 GW and out of which hardly ~3.8% has been developed so far. Similarly, region has wind potential of around ~1289 GW and out of which ~3.05 % has been developed so far (Panda, One Sun One World One Grid : Energy Integration in South Asia, 2021). It is important to have diversity in the energy supply mix as well as improve the energy access for large populations of the SA region, which are deprived of the benefits of electricity. Further, there is a need to balance the conventional sources

[3] Asian Development Bank 2012, https://www.adb.org/sites/default/files/publication/29703/energy-trade-south-asia.pdf
[4] http://sari-energy.org/wp-content/uploads/2021/03/presentation-09march.pdf

with the renewable energy resources for managing the climate change effects on the global basis. The optimization of energy resources through interconnected power systems across the region can address these challenges. Such a scenario in a region where some countries have diverse energy resources, and some have limited energy resources sets the best example for an ideal platform for energy cooperation to achieve sustainable growth through sharing of available natural resources in the region to enhance access to energy/electricity and to achieve economic growth of the region. With the declining cost of renewable energy, sustainable development of large-scale renewable resource within the region offers significant cost-saving. This will also help in facilitating clean energy transition, enhanced energy affordability at competitive price and energy security for the region. This also gives rise the potential for trade of renewable energy across SMS in an economical manner.

b) South Asia Power System Profile:

SMS in the past faced significant electricity shortages and access to electricity was also very poor. In the year 2000, access to electricity in the region was around 57% of the population. Further, in the year 2000, the per capita power consumption of SA region was around 356 kWh per capita whereas the world average was around 2386 kWh per capita in the same year, almost six times higher than SA Region (World Bank, 2014). Since then, the governments of SMS prioritised power sector development and worked on increasing access to electricity. As of 2019, around 94.4 % of population has access to electricity (World Bank, 2019). The electric power consumption of South Asia has also increased to 1,015 kWh per capita (Panda, 2021), it is still much less than the global average of 2,674 kWh per capita.

The installed electricity capacity of the SA Region has increased substantially over the years and currently it is around 456 GW. India, Pakistan and Bangladesh are large power systems

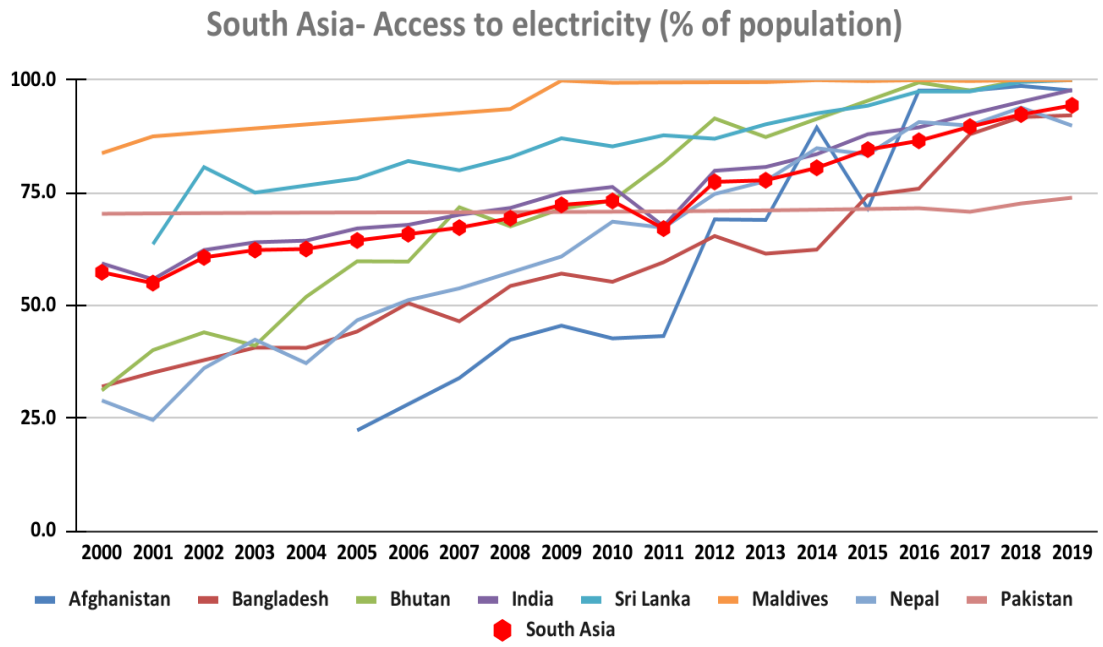


Figure 2: South Asia - Access to Electricity (% of Population)

whereas Afghanistan, Bhutan, Nepal, Sri-Lanka and The Maldives are small power systems. India is the largest country in the SA Region and has installed capacity of around 383 GW. Pakistan is the next largest power system with installed capacity of 37 GW. Installed electricity capacity of each member state and major fuel source for electricity generation is given in in Table 3 below:

Table 3: Installed Generation Capacity & Major Fuel Source for Electricity Generation

Country	Installed Generation Capacity (MW)	Major Fuel Type
Afghanistan	1,341	❖ Hydro and Oil Dominated ❖ High Electricity Imports
Bangladesh	25,171	❖ Gas & furnace oil dominated
Bhutan	2,326	❖ Hydro Dominated
India	383,373	❖ Coal Dominated ❖ Rapidly increasing Renewable energy -133 GW
Nepal	1,280	❖ Hydro Dominated
Pakistan	38,719	❖ Gas, Oil and Hydro dominated
Sri-Lanka	4,086	❖ Hydro and oil dominated
The Maldives	366	❖ Oil, Diesel dominated
Total Electricity Installed Capacity of SMS	**4,56,662**	❖ Overall dominated by Fossil fuel
Source: Compiled from various sources, India-As on May 2021 , Bangladesh-Power Cell, Bhutan-As on May,2021 BPSO , Pakistan-NEPRA-State of Industry Report 2020, Maldives, Nepal,		

The power generation in Afghanistan is dominated by hydro and oil with significant level of power imports from neighbouring Central Asian countries. Nearly 60% of electricity is imported from countries like Tajikistan, Uzbekistan and Iran. Bangladesh is dependent on gas (53.86%) and furnace oil (27.18%) for electricity generation (Bangladesh Power Development Board). The natural gas reserves are also fast depleting in Bangladesh. In Nepal and Bhutan, power generation is dominated by hydro. Coal contributes the major share of electricity production capacity (54.59%) in India, though recently renewable (24.95%) is increasing. Pakistan is predominantly dependent on thermal power plants (61%) followed by hydro (29%), RE and nuclear (NTDC, 2019). Electricity installed capacity in Sri-Lanka is primarily based on hydro, coal and petroleum. Maldives is dependent heavily on diesel for its domestic needs, which is largely imported as its own domestic resources comprise primarily of biomass. Further, in the Maldives, about 96% of generation is through oil and rest through RE. The diversity of energy resources and consumption presents many exciting opportunities for integrating national power grids and promoting CBET. As renewable and fossil energy sources are unevenly distributed in the region, CBET in many cases can offer more viable, affordable and rapid solutions compared to developing domestic generation capacity

(UNESCAP, 2018).

c) Current Status of Trade of Electricity & Interconnectivity:

SA region has a long history of power trade and grid interconnections between countries particularly in the eastern part of SA. As India is located at the centre of the region and shares its boundary with other four South Asian countries geographically, SA power grid interconnections offer many opportunities for trade of electricity to import, export or transit electricity (UNESCAP, 2018). The eastern part of SA region namely. Bangladesh, Bhutan, India and Nepal (BBIN) have developed a series of high voltage and low voltage interconnections for trade of electricity. Presently, CBET in the SA Region is bilateral in nature. CBET in the BBIN sub-region has been increasing over the years. Currently around 3,700 MW is being traded among BBIN countries and as per estimates it will grow to 12,200 MW in 2030 (India, 2021). As of 2021, around 17,497 GWh of electricity is being traded between BBIN countries which was ~7,705 GWh in the year 2014, i.e., an increase of 127 %. The proposed interconnection between India and Sri-Lanka is still at the feasibility study stage.

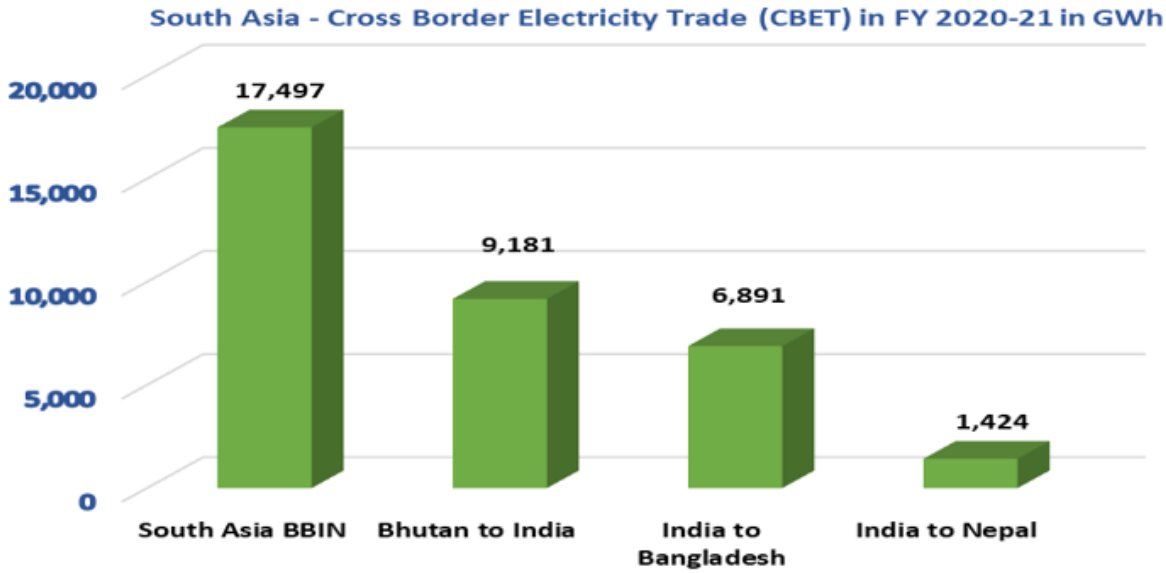


Figure 3: South Asia - Cross Border Electricity Trade in GWh in FY 2020-21[5]

On the western side, there is no grid interconnection and therefore no CBET taking place though the countries such as Pakistan and Afghanistan are connected outside the SA region. Pakistan is connected to Islamic Republic of Iran and Afghanistan is connected to Central Asian countries viz. Uzbekistan, Tajikistan, and the Islamic Republic of Iran. Further, under CASA-I (Central Asia South Asia), Pakistan is set to be connected to Central Asian Countries in the future. Feasibility study was conducted long ago to interconnect two large economies of the region viz. India and Pakistan, however no progress has been made so far. Figure 4 below shows the grid interconnections: i) existing, ii) under construction and iii) proposed transmission lines:

[5] https://posoco.in/download/monthly_report_february_2021/?wpdmdl

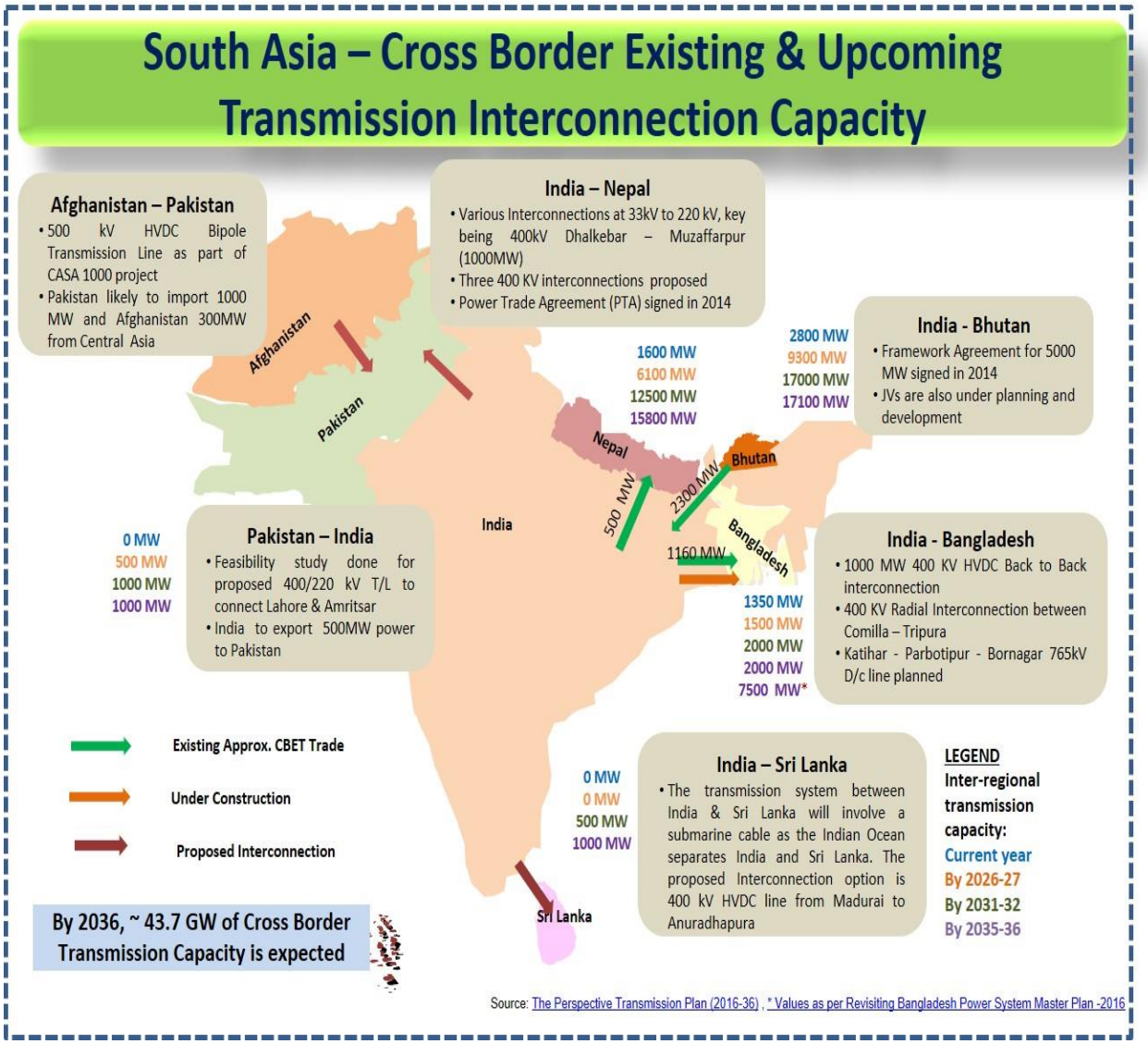


Figure 4: South Asia - Cross Border Existing & Upcoming Transmission Interconnection Capacity

Status of inter-connectivity and trade of electricity in SA region is tabulated in the Table 4 below:

Table 4: Status of Inter-Connectivity and Trade of Electricity in South Asia

Interconnection	Key Features
Bhutan – India	❖ Presently, Bhutan exports around 2,100 MW from Tala, Chukha, Kurichhu, Dagachu and Mangdechhu Hydro-electric Power Plants ❖ Transmission and associated infrastructure for Punatsangchhu I & II (2,220 MW) Hydro-electric Power HEPs under construction ❖ Capacity of 10,000 MW for export to India to be developed in Bhutan under the Umbrella Agreement signed between two countries
Bangladesh –India	❖ 1000 MW power is being supplied from India via 400 kV Berhampur-Bheramara line with HVDC station at Bheramara ❖ Through Tripura – Comilla transmission line, India exports around 100-160 MW power to Bangladesh.
Nepal – India	❖ Presently, India exports to Nepal in the range of 400-500 MW capacity ❖ Multiple interconnections at 11 kV to 132 kV with capacity of around 150 MW ❖ 400 kV Muzaffarpur- Dhalkebar line will ultimately have capacity of around 1000 MW

The connectivity status of Pakistan and Afghanistan with the Islamic Republic of Iran and Central Asian countries is summarized in Table 5 below.

Table 5: Status of Inter-Connectivity & Trade of Electricity of South Asia with Central Asia

Interconnection	Key Features
Pakistan- Iran	❖ Pakistan imports about 150 MW from Iran ❖ Pakistan in future will be connected for import of 1000 MW hydro power from Central Asia viz. CASA 1000. The Transmission line is under construction
Afghanistan-Iran - Uzbekistan, Tajikistan, the Islamic Republic of Iran, Turkmenistan	❖ Afghanistan is importing around 900 MW from Central Asian Countries and from Republic of Iran

In the medium and long term, this scenario is going to change as several new transmission interconnections are being proposed on the eastern side and southern side (with Sri-Lanka), which will enable greater integration of power systems that entail multilateral power trade in the SA region. In future, wherein two countries having no common border could also trade electricity through a third country acting as a transit route. India has taken lead in this regard and has come up with forward looking guidelines and procedures such as "Import/Export (Cross Border) of Electricity-2018" (Ministry of Power G. o., Guidelines for Import/Export (Cross Border) of Electricity 2018, 2018), "Procedure for approval and facilitating Import/Export (Cross Border) of electricity) by the Designated Authority", which allows transaction of electricity through Indian Grid under tripartite agreement (CEA, Procedure for Approval and Facilitating Import/Export (Cross Border of Electricity) by the Designated Authority, 2021). These guidelines/policies will be described in detail in Chapter 2.

d) Power Procurement Policy of Distribution Companies (DISCOM):

Power procurement policy of DISCOMs is largely influenced and governed by the overall power sector reform and institutional governance in each country. The electricity being a socio-economic good in the SA region, the generation, transmission and distribution of power is governed by policy and regulatory framework in all SMS and accordingly power procurement policy was evolved. Some SMS have undertaken measures to introduce reforms in the sector to improve its viability, attract private investments and fair pricing policy so as to facilitate the development of the sector and improve the access to electricity, quality and reliability of power supply. In many countries in the region, this process has led to enactment

of national policy/act and establishment of regulatory authorities for developing and implementing the regulatory framework of the sector. Except in India and Pakistan, where electricity utilities are unbundled into generation, transmission and distribution functions, in other SA nations, the electricity utilities are either vertically integrated or partially unbundled as summarised in Table 6 below:

Table 6: Different Models of Electricity Utilities in South Asia

Vertically Integrated	Partially Unbundled	Unbundled	Market Structure (Single Buyer)	Competitive market Structure- (Multi-Buyer/Seller)	Power Pricing Policy for CBET
Afghanistan, Nepal, The Maldives & Sri-Lanka	**Bangladesh** (Separate transmission Utility) **Bhutan** (Separate Generation Utility)	**India & Pakistan** (Separate Generation, Transmission & Distribution)	**Afghanistan Bangladesh Bhutan Nepal The Maldives Pakistan Sri-Lanka**	**India**	**India** has issued cross border trade guidelines which define pricing framework for CBET

Most of the countries in the region are vertically integrated where generation, transmission and distribution are bundled together and single buyer, govt. owned utility procures bulk electricity from various govt. & independent power producers. Further, in many cases, power procurement in these countries from independent power producers is generally based on negotiations. Therefore, SMS (except India) mostly lack commercial market, competitive & transparent power pricing framework, open access framework, competitive tariff-based bidding framework, structural reform, transmission pricing framework and are governed by single buyer model etc. Only India has a Multi-Buyer/Multi-Seller framework. In India, as per the Electricity Act 2003, the bulk consumers/DISCOM need to follow policies/regulations/guidelines for power procurement. DISCOMs/bulk consumers can buy/sell electricity on (i) Long-Term (more than 7 years), (ii) Medium-Term (1-5 years) and (iii) Short-term (less than 1 year) basis respectively. DISCOMs, based on the power supply-demand consumption/projections, make power procurement under the above three categories with the approval of the Regulatory Commission. Further, to bring transparency, competitiveness of prices, since 2011, bulk consumers/DISCOMs have been made to procure electricity on competitive tariff-based bidding either on long-term or medium-term basis (except hydropower). For short-term power procurement, DISCOMs can procure electricity through (i) bilateral/e-bidding, (ii) power exchanges and (iii) real time balancing. Further, details on India's power procurement policies/ guidelines etc. are explained in Chapter 2 of this report.

CBET in SA is predominantly bilateral and the trade is undertaken mostly under medium term

and long-term power purchase agreements. Currently, SMS are having different in-house power pricing and power procurement strategies depending upon the power market size and complexity, fuel dominance and market maturity (Jain & Ray, 2017). The domestic power pricing mechanism to some extent gets reflected in the existing power pricing framework for CBET, which is based on a mix of mechanisms such as government to government negotiation, through open tender/ bidding and through power exchanges. However, India and Pakistan both have issued guidelines and regulations for cross border electricity trade to facilitate smooth trade of cross border electricity.

A fair, transparent, and competitive pricing framework is essential for growth and to attract investment in the power sector. Excerpts of discussion paper on Market Based Economic Dispatch (MBED) (Ministry of Power, 2021)published by Central Electricity Regulatory Commission (CERC), India is reproduced below:

"Even in India, there is an absence of uniform price for procurement of power across the country, despite having unified and integrated grid. DISCOMs currently schedule generation on a day-ahead basis from amongst their portfolio of contracted generators. This practice is referred to as self-scheduling and is a sub-optimal outcome for the power system. A DISCOM goes by only its contracted portfolio without visibility of possible lower cost generation in other states being still under-utilized/available. All India analysis shows that the country very often ends up committing and utilizing costlier generation plants while cheaper generation plants are not fully scheduled/utilized. Instances of states violating the merit order even within their own contracted portfolio of generators is commonly noticed. India is working on to move towards a "One Nation, One Grid, One Frequency, One Price" framework by adoption of a market based economic dispatch, which will lead to discovery of uniform clearing prices in the day-ahead market. It is a desirable next step in India's transition to an integrated national framework for electricity and will help individual states and retail consumers to benefit from integrated operations and sharing of each other's resources".

e) Rationale of Uniform Power Pricing Mechanism for CBET:

One of the important ingredients for enhancing CBET in the region is to establish a competitive power market where buyers and sellers can buy and sell electricity in a most transparent & competitive way. Currently, SMS are having different power pricing and power procurement strategies depending upon the power market size and complexity, fuel dominance and market maturity. A uniform cost reflective power pricing mechanism for generation and transmission, on long/medium/short term, transit fee concept etc. will facilitate promotion of CBET as well investment in the region.

To have transparent & uniform power procurement framework across the member states, the key factors that need to be addressed are: i) review & analysis of power procurement policy/guidelines/tariff determination methodology prevailing in each member country; ii) review & analysis of existing CBET transactions and power procurement framework; iii)

review & analysis of generation and transmission tariff applicable to CBET transactions iv) transit transmission tariff mechanism; v) international experience & learnings on power pricing framework; vi) recommendations & implementation plan for SA Region etc. Favourable and coherent provisions will help to provide certainty to CBET transactions and promote investments in the region. Further, SAARC Inter-Governmental Framework Agreement (IGFA) for Energy Cooperation (Electricity), signed on November 27, 2014, by Foreign Ministers of the eight member states, also provides a strong basis for ensuring consistency in approach across the member states covering above parameters.

Decision makers of SMS Viz. Regulators/Country Governments need to develop and adopt enabling policies/regulations for creating transparent power pricing/tariff determination framework covering long/medium/short term for generation and transmission as a step towards competitive power market. At the same time, development of vibrant competitive short term power markets is necessary to complement the long-term Power market to meet the seasonal, peak power demand etc. This will provide reasonable certainty to the investors/ developers/traders involved in CBET transactions. Through competitive power pricing framework, SAARC Countries can optimize their power purchase portfolio to reduce overall cost of purchase.

f) Role of SAARC:

The SAARC, an Intergovernmental regional organization, was established in Dhaka on 8 December 1985 with the objective to promote the welfare of the people of South Asia and to promote active collaboration and mutual assistance among the SAARC Member States in economic, social, cultural, technical, and scientific fields etc. Under SAARC, the process of regional cooperation in the energy sector began in January 2000 with the establishment of a Technical Committee on Energy and later by the creation of a specialized Working Group on Energy in January 2004. The concept of an Energy Ring was prompted in the 12th SAARC summit in 2004 and a road map for developing the SAARC power market for electricity (SAME) was also developed. For the need to have a common agreement on energy cooperation and trade, finally the SAARC framework agreement for Energy Cooperation (Electricity) was signed at the Eighteenth SAARC Summit (Kathmandu, 26-27 November 2014) which has paved the way for regional electricity trade in the region. SAARC since then have been working towards promoting the development of an integrated regional power market in South Asia to facilitate power trade amongst the SAARC countries.

SAARC Energy Centre is playing an important role to enhance energy cooperation & integration to achieve overall economic growth of the South Asia Region. Cross Border Trade of Energy/Electricity will also help in addressing climate change in achieving Sustainable Development Goals (SDG) SDG7 of the United Nations.

1.2 Scope of Work:

a) Rationale and Objectives of the Study

The objective of the study is to develop and establish a uniform power pricing mechanism for CBET in South Asia consistent with the dynamics of the domestic power sector as well as regional requirements to promote grid connectivity, investment, and trade of electricity in the South Asia region. This will provide reasonable certainty to the Investors/ Developers/Traders involved in cross-border trade transactions. The study's recommendations covering uniform power pricing framework for CBET including power procurement mechanism, competitive bidding and tariff framework will help decision makers such as National Regulators/Empowered Entities/Ministries of SMS in reforming their tariff framework/power pricing rationale and strategy in the domestic market as well as in the CBET transactions to evolve towards transparent, competitive, and cost reflective power pricing mechanism. This will also ensure consistency in the CBET transactions and will remove the constraints/barriers that have often plagued or delayed such transactions because of lack of consistency and clarity.

b) Scope of the Study

The study will cover following:

a) Review and analysis of power pricing framework/strategy including long/medium/short term trade of electricity prevailing in each SMS.

b) Review and analysis of tariff determination principles/policies/guidelines/ structure for generation and transmission prevailing in each SMS.

c) Review & analysis of current power procurement framework/practices being followed for CBET in SMS.

d) Comparison of tariff framework/power pricing framework prevailing in SMS and gaps, if any.

e) Study of various stakeholders and their roles & responsibilities/ institutional structure prevailing in each SMS.

f) Study, review and analysis of transit fee framework for SMS based on international power pools experiences/learnings.

g) Identify various challenges/barriers in implementation.

h) Recommendations for uniform power pricing for CBET, power procurement framework for generation, transmission and transit fee including case studies for SMS for all forms of power trade.

i) Time bound implementation/action plan covering strategies for the decision makers

c) Approach and Methodology

As shown in Figure 5, a three-phase methodology/approach was adopted to conduct this study.

Figure 5: Research Methodology & Approach

The details of each phase are as follows:

Phase 1: Collection of all the primary data required to carry out this assignment to be done in this phase. The data to be collected from the available public resources or through SAARC Energy Centre (SEC) Portal. This phase also includes study of each country's commercial aspects of the electricity market viz. rational/policies/guidelines prevailing on Power Procurement framework/tariff determination principles, long/medium/short term trade framework, transmission charges allocation, payment mechanism etc. Further, kick off meetings held with SEC key officials to get their perspective/views on the power pricing mechanism which enabled to develop a quality and useful report for the benefits of key decision makers of SMS stakeholders.

Phase 2: Based on the data collected and study of each country's Power Procurement & Power Pricing framework to carry out an analysis **and comparison of each country's policies/guidelines/power procurement framework covering Tariff Principles, structure of Short/Long/Medium term power trade, various methods to calculate transmission charges allocation, Open Access charges, payment security mechanism, sharing of T&D losses etc. Study** to analyse the existing Power Procurement/Pricing framework of Power Trade in the South Asia Region. International experience /learnings on Transit fee concept to be analysed for SMS. **For Transit fee concept, analysis/learnings of different Power Pools in the globe to be carried out for South Asia Region.** Study to also identify the **various**

challenges/barriers for its implementation.

Phase 3: Based on the detailed analysis and feedback from SEC, study to cover recommendations covering uniform Power Pricing & Procurement Strategy/Framework for CBET to promote Cross Border Electricity Trade in the region. **Recommendation to cover tariff determination framework, transmission/wheeling charges for CBET transactions, Open Access framework, Long/Medium/Short term trade of electricity framework, payment mechanism, competitive tariff-based bidding framework, transit fee framework etc.** A detailed **implementation plan/road map for the decision makers of SA Region** for its implementation to be prepared. Summary of this report covering analysis, recommendations to be presented to SEC officials for their feedback and comments.

d) Limitations and Assumptions

All the data/information required for completing this assignment to be collected from public domain/SEC's data portal etc.

Chapter 2

Existing Electricity Pricing Mechanism of CBET in SAARC

2. Current Power Pricing Mechanism of CBET in SAARC

Each Country is sovereign in nature and has its own domestic power procurement & pricing framework, based on the prevailing power system regulations and reforms undertaken towards establishing competitive electricity market structure. From Cross Border Trade of Electricity and investors perspective, it is important to have suitable power pricing framework/mechanism for enhancing smooth trade of electricity. This chapter will cover the following.

a) Country wise critical review and analysis of relevant existing policies and regulations prevailing in each country relating to electricity procurement & pricing framework,
b) Reforms undertaken, Institutional structure,
c) Existing models of cross border electricity power pricing framework,
d) Shortcomings, barriers, and prevailing challenges with respect to CBET from the point of view of all stakeholders for devising electricity pricing framework for the South Asia Region.

2.1 Afghanistan

2.1.1 Sector Insights:

Afghanistan's power system size is 2,000 MW with installed capacity of domestic power generation of around 600 MW (50% thermal, 41% hydro and 9% from other renewable energy sources) (SEC, 2019). The off-grid network in the country has small diesel units, micro-hydro and renewable energy resources that are operated in the rural areas. Energy access remains a challenge in the country with only 40% population having access to electricity as of 2018. It is envisaged to increase this to 85% by 2024. The per capita electricity consumption is around 195 kWh/ person/year whereas global average is 3,100 kWh/year/person. Afghanistan fulfils its electricity requirements mainly by importing electricity from its neighbouring countries (SEC, 2019).. It imports 1,400 MW electricity from neighbouring Central Asian countries, which accounts for 3/4th of total energy consumption and costs 300 million USD per year (SEC, 2019). As of today, no cross-border power trade and interconnection exist with SMS. Afghanistan needs 5,000-6,000 MW of capacity to provide electricity to the entire country (SEC, 2019). Government plans to add domestic generation capacity of 2,300 MW (650 MW thermal, 1,150 MW hydro and 500 MW from renewable energy) (SEC, 2019).

According to the Renewable Energy Policy (Ministry Of Energy and Water, 2015), Afghanistan has set a target for deploying 4,500–5,000 MW of renewable capacity by 2032, which is equivalent to 95% of the total energy mix of 5,000–6,000 MW according to the targets of Power System Master Plan (PSMP). According to the Renewable Energy Policy (Ministry Of Energy and Water, 2015), country is endowed with good renewable energy resources viz. 222 GW of solar potential, 67 GW of wind and 23 GW of hydro potential in addition to biomass and geo-thermal resources.

Excerpts of the Article 2 “Objective” on page 5 in Chapter 1 of Power Services Regulation Act (Ministry of Energy and Water, 2016) of Afghanistan is reproduced below:

1- “To supply electrical energy from natural resources of the country and imported energy.
2- To improve the quantity and quality of energy services, and its development and promotion.
3- Economic growth and development as well as public welfare.
4- Public access to the electricity energy services in exchange to a fair price.
5- **Non-discriminatory access of the electricity energy service providers to the market.**
6- **Regulation of electricity related affairs throughout the country**. “

Power Services Regulation Act (Ministry of Energy and Water, 2016), establishes the Energy Regulation Authority and relevant section of the act is reproduced below:

“Article 5: In order to achieve the objectives stated in this law and for effective and better electricity service delivery, the Energy Services Regulation Department shall function within the Ministry of Energy and Water.”

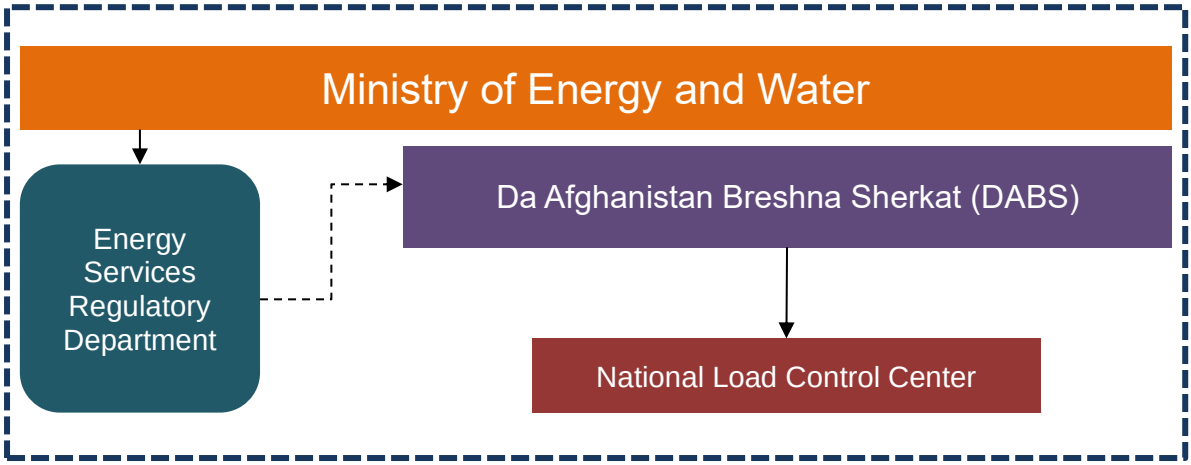


Figure 6: Institutional Framework of Afghanistan

Ministry of Energy and Water looks after policy and planning of energy sector. Da Afghanistan Breshna Sherkat (DABS), state-owned vertically integrated utility, manages electricity generation, transmission and distribution and import in Afghanistan. It also oversees the

planning and investment in system infrastructure. The National Load Control Centre (NLCC) handles system operation and control.

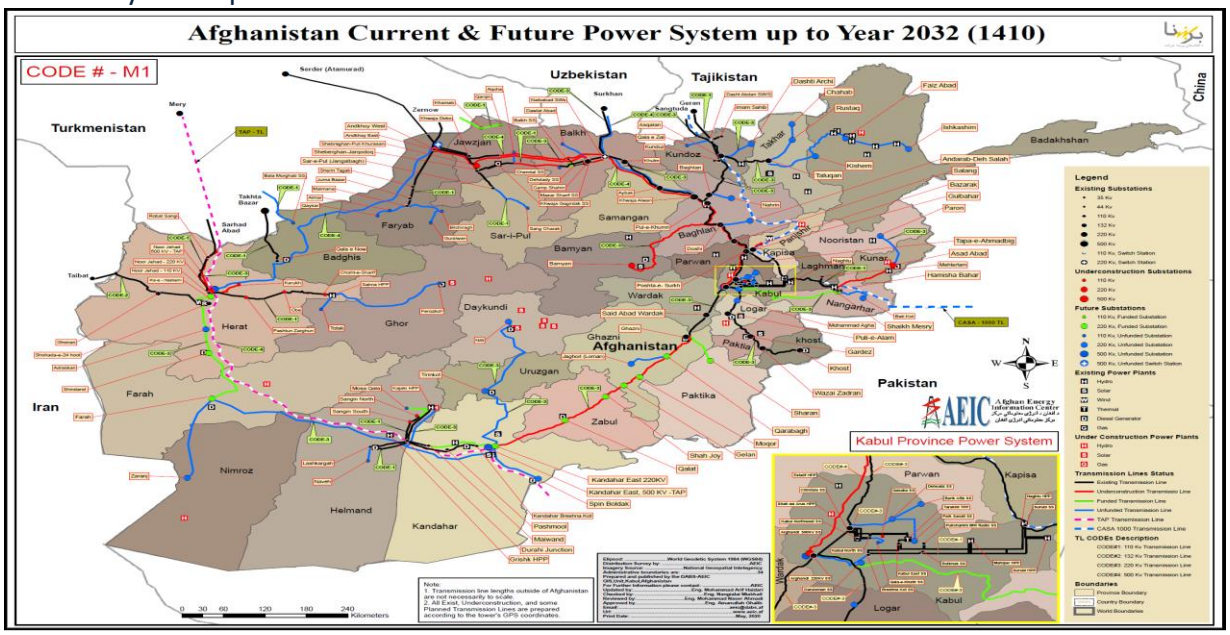


Figure 7: Afghanistan Current & Future Power System up to Year 2032 (1410)

2.1.2 Relevant Act, Policies and Regulations

Afghanistan's renewable energy policy came into existence in 2015 (Ministry Of Energy and Water, 2015). Some of the clauses of tariff related to grid-connected projects, Renewable (REN)-diesel hybrid projects and off-grid stand-alone projects are reproduced below:

"Section 5.3 Tariffs in accordance with the regulatory guidelines, procedures and processes, following methodology would be adopted for tariff setting for REN projects

1. For grid-connected projects, tariffs for grid connected projects will be set on the 'cost-plus' basis. A firm PPA will be signed between MEW, DABS and Private utility and the project developer mentioning the tariff, including the escalations.
2. For projects having distributed generation and local grid for distributed generation projects supplying electricity to third party, tariffs will be decided on mutually negotiated basis between MEW/ utility, the project developer and the consumer. Guiding principle for tariff determination could be 'cost- plus basis'. 'Avoided cost of generation' would be the basis in those regions where conventional generation would probably be significantly more expensive than REN source generation, as fuels have to be transported. A firm PPA will be signed between the project developer and MEW/utility.
3. For REN-diesel hybrid projects, tariffs will be based on replacement cost of diesel and/or prevailing tariffs whichever is less.
4. For off-grid stand-alone project, tariffs will be on mutually negotiated basis with an oversight provided by the Zonal Renewable Energy Centres (ZREC) to ensure that vulnerable communities are not burdened with high and unaffordable tariffs for basic and

essential electricity services."

From the above, it is observed that tariff/price in Afghanistan is determined on 'cost-plus' basis.

2.1.3 Existing Power Procurement Models in CBET

As mentioned earlier, there is no cross-border power trade and interconnection with SMS as of today. However, CASA-1000 will foster cross border power interconnection between Pakistan and Afghanistan. As Afghanistan is suffering huge power shortages, they heavily import electricity from its neighbouring Central Asian countries. The details of the import of electricity from the Islamic Republic of Iran, Tajikistan, Uzbekistan, and Turkmenistan are given in Table 7 below.

Table 7: Afghanistan - Electricity Imports from Central Asian Countries

Afghanistan: Electricity Imports (GWh) from Central Asian Countries					
Sr. No.	**Country**	**Unit**	**2018**	**2019**	**2020**
1	Total	GWh	4,986	4,932	5,156
1.1	Islamic Republic of Iran	GWh	743	758	817
1.2	Tajikistan	GWh	914.29	1,462	928
1.3	Uzbekistan	GWh	2,592	2,023	2,674
1.4	Turkmenistan	GWh	737	688	733
Source: DABS					

Price of Cross Border Trade of Electricity contracts are based on government-to-government negotiations through their respective nodal agencies/utilities.

2.1.4 Challenges/Barriers

As brought out in the foregoing para, Afghanistan does not have grid interconnection and trade of electricity with the South Asian Countries. Based on the existing import of electricity from Central Asian countries, price of Cross Border Trade of Electricity is based on government-to-government negotiations through their respective nodal agencies/utilities. While cross border electricity trade has benefited Afghanistan immensely, efforts should be made to move towards more market-based pricing in CBET in future and to have portfolio of both negotiated and market form of pricing. This will move towards a system of competitive price discovery and optimisation of cost. It is worthwhile to mention that India has recently published policy guidelines, regulations and business rules for cross border electricity trade

as India is importing and exporting electricity with Nepal, Bhutan and Bangladesh. As Afghanistan is also importing large quantum of electricity from Central Asian countries, it is preferable for Afghanistan also to publish guidelines/policies/regulations on cross border trade of electricity to have a long-term clarity and vision on CBET. Though Afghanistan has created an Energy Regulation Authority under the Ministry of Energy and Water, it is important to establish independent Regulatory Commission/Authority to have transparent regulated market as a first step. Further, efforts should be made to gradually move away from single buyer model to competitive buyer-seller model and establishment of power market platform to dispatch available electricity at the most competitive price in the interest of the consumers.

2.2 Bangladesh

2.2.1 Sector Insights:

Bangladesh power system has seen rapid enhancement in terms of generation capacity and transmission system in the previous decade. The power generation capacity has increased significantly from 4,942 MW (Power Cell, 2021) in the year 2009 to 25,227 MW in the year 2021 (Power Cell, 2021), an increase of 410% since 2009 and added 20,285 MW capacity between 2009-2021. Similarly, transmission lines have seen a significant growth from 8,000 km to 12,744 km by 2021, a 59.3% increase.

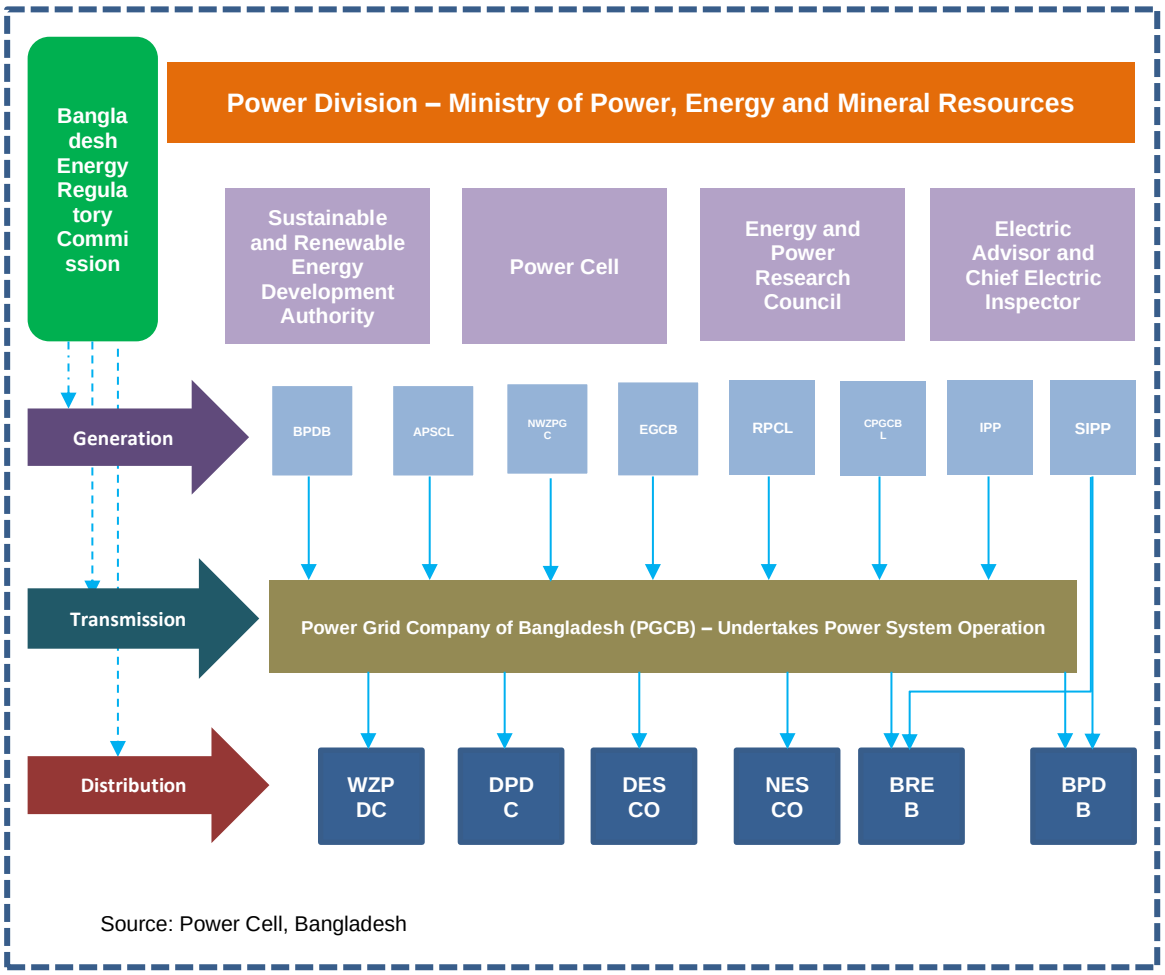


Figure 8: Institutional Framework of Bangladesh

While it is significant development, however as mentioned in the previous chapter, Bangladesh's power procurement system is centralised and is a single buyer model. All the electricity is being procured by the single buyer i.e., Bangladesh Power Development Board (BPDB). BPDB purchases power from public & private generation companies including rentals and sell electricity to distribution utilities. BPDB also is in the business of power generation (though there are independent power producers) and distribution of electricity. Power Grid Company of Bangladesh (PGCB), a subsidiary of BPDB, is a transmission company which owns & operates transmission network in Bangladesh. PGCB recovers its cost from distribution utilities through wheeling charges. It also functions as system operator in Bangladesh.

Bangladesh Electricity Regulatory Commission (BERC) is an apex regulatory authority of the country that regulates electricity tariff, handles dispute settlements, and involves in licensing of electricity generation, transmission & distribution. Bangladesh has five distribution companies operating in different regions and one rural electrification board to extend electrification in rural areas of the country. The power division of Ministry of Power, Energy & Mineral Resources (MPEMR) is the apex policy making body of power sector and administers all the electricity sector in Bangladesh. The institutional structure/framework prevailing in Bangladesh is depicted in Figure 8. The dominance of single buyer model is also a reflection of the level of power sector reform in the country. Over the years many steps have been taken, however country is yet to fully embark on the journey of competitive power market. It is important to highlight the various reforms that have been put in place including instruments, mechanism, and institution structure, which will eventually help to move towards competitive power market structure in future in Bangladesh. The brief synopsis of the sector reform is given in the Table 8.

Table 8: Bangladesh Power Sector Reform

- *Bangladesh Water and Power Development Authority was bifurcated, a statutory body viz. Bangladesh Power Development Board (BPDB) was created on May 1, 1972. BPDB operates under the control of the Power Division of the Ministry of Power, Energy and Mineral Resources, Government of Bangladesh. As part of the reform and restructuring process in 1996, transmission functions were vertically separated as a subsidiary of BPDB viz. Power Grid Company (PGCB) and distribution functions were also separated to create new distribution entities/utilities.*
- *For the management & electrification of the capital city of Bangladesh viz. Dhaka and its adjoining areas, Dhaka Electric Supply Authority (DESA) was created in 1990. Subsequently, DESCO was created in 1996 as a part of a reform process, who took over part of the distribution network of DESA. In July 2008, DESA was again restructured and renamed as Dhaka Power Distribution Company (DPDC).*
- *Govt. of Bangladesh as a part of continuous reform process, created following number of generation and urban distribution companies in different years as subsidiaries of BPDB such as a) Ashuganj Power Station Company Ltd. (APSCL): formed in 1996 b) Electricity Generation Company of Bangladesh Ltd. (EGCB): formed in 2004 c) Northwest Power Generation Company Ltd. (NWPGCL): formed in 2008 d) West Zone Power Distribution Company Ltd. (WZPDCL): formed in 2002.*
- *In addition to above, the Government of Bangladesh took various initiatives to reform the power sector such as i) to promote electrification in rural areas created Rural Electrification Board (REB) in October 1977; ii) created an independent Regulator in the country viz. Bangladesh Energy Regulatory Commission in 2003; iii) for the development of Renewable Energy created Sustainable Renewable Energy Development Authority in 2012 and iv) to promote private participation, enacted Policy Guidelines for Enhancement of Private Participation in 2008 etc.*
- *Further as part of a new reform initiative, as per the Annual Report 2019-20 of BPDB" BPDB is in the process of identifying Strategic Business Unit (SBU) for its generation and distribution sectors as a new reform initiative. Functional and financial performance of the SBUs will be operated like components of a corporate body and will be evaluated separately under the legal framework of existing BPDB structure.*
- *Taking reform further, as per the electricity act 2018, Bangladesh intended to develop of independent system operator. "5. Establishment of independent system operator. --{I) The Government shall, by notification in the Official Gazette. establish an independent system operator in accordance with the existing laws and regulations for operation of the power sector in a coordinated manner. (2) The independent system operator shall, in such manner as may be prescribed, monitor the flow of power transmission, make schedule and, on equity basis, allocate load in accordance with the merit order dispatch and on demand of the distribution agency or company. "*

2.2.2 Relevant Act, Policies & Regulations

While there is no comprehensive power pricing policy, the key acts, policies, and regulations which have some bearing/related to power pricing in Bangladesh are given below.

A. Bangladesh Energy Regulatory Commission Act, 2003 (BERC B. , 2003)
B. Private Sector Power Generation Policy of Bangladesh, October 1996 (revised November 2004 (Division, PRIVATE SECTOR POWER GENERATION POLICY, 2004))
C. Power Pricing Framework-2004 (Division, Power Pricing Framework, 2004)
D. Policy Guidelines for Power Purchase from Captive Power Plant- February 2007
E. Policy Guidelines for Enhancement of Private Participation in the Power Sector, 2008[6]
F. Power & Energy Fast Supply (special) act, 2010 (Power Cell, 2010), amended in 2015

6 Policy Guidelines for Enhancement Of Private Participation In The Power Sector, 2008

(Power Cell, 2015) & 2018 (Power Cell, 2018).

The Policies/Acts as mentioned above are discussed below in brief:

A. Section 34 (1) and (2) "Tariff" as covered in the Bangladesh Energy Regulatory Commission Act, 2003, (BERC Act, 2003) is reproduced below:

"34. Tariff— (1) Notwithstanding anything contained in any other law for the time being in force, the price of power generation in wholesale, bulk and retail, and the supply of energy at the level of end-user, shall be determined in accordance with the policy and methodology made by the Commission in consultation with the Government: Provided that this shall not be applicable in those cases, the tariff of which were determined by the agreement executed between the private company and the Government or by any of its agency before this Act comes into force.

(2) At the time of making the policy, the Commission shall take into consideration the following matters, such as: (a) Electricity Act, Presidential Order, Rural Electrification Act and DESA Act; (b) to harmonize the tariff with the cost of production, transmission, marketing, distribution, supply and storage of energy; (c) efficiency, least cost, excellent service, excellent investment; (d) consumers' interest; (e) power generation, and transmission, distribution and supply of energy on commercial basis; (f) development of national energy systems planning ; and (g) other matters considered necessary by the Commission for the fulfilment of the objectives of this Act. "

B. Private sector power generation policy of Bangladesh, October 1996 and revised in November 2004, stipulates that the power produced by the Independent Power Producers' (IPP) projects shall be purchased (according to Power Purchase Agreement) by BPDB/DESA/REB or any other transmission or distribution company which may be established in future, or any large consumer. It also states that IPP projects will be implemented on Build-Own-Operate (BOO) basis. International solicitation for specific projects will be processed by the Power Cell. On tariff aspects, it suggests a two-part tariff structure which would consist of (a) Capacity Payment and (b) Energy Payment.

C. The Power Pricing Framework, which was approved by the Government in January 2004, lays down the principles for codifying the process of tariff adjustment and to phase out prevailing distortions in tariff structure (Power Division, Power Pricing Framework, 2004). Among many other principles, this policy introduced the principle as reproduced below:

"Differentiated rates will be maintained for peak and off-peak consumption, and a two-part tariff introduced for BPDB's generation plants, with one part covering fixed (capacity) costs and the second part covering variable (energy) costs."

D. Tariff for Power Purchase from Captive Power Plant, according to the Policy guidelines for power purchase from captive power plant (February-2007) (Power Division, 2007) is reproduced below:

"5.1 The power purchase tariff shall have a structure that reflects the components of underlying costs to the extent reasonable and can also vary by peak and off- peak period.

5.2 The power purchase tariff shall be expressed in Taka/kWh.
5.3 Notwithstanding the methodology described in 5.1 and 5.2 above, the tariff for purchasing power from a Captive Power Plant by the Utility shall not exceed the published tariff (effective from 1st March 2007) by which BPDB sells power at 132 kV (Category G1) excluding wheeling charges; Provided that for increase of price of fuel, the fuel component of the tariff for purchase of power from the CPP may be adjusted.

5.4 The tariff proposal by the CPP shall contain break up of all components including fuel cost component. The Tariff shall be approved by the BERC. "

E. Policy Guidelines for Enhancement of Private Participation in the Power Sector 2008, for commercial plants stipulates "(g) Private Investors will: (iii) sell electricity, as shown in Annexure II, at price regulated by BERC to Public Sector Power Utilities "

F. As Bangladesh was facing power shortages in the early years of previous decade, government of Bangladesh had brought in specific fast track laws such as rapid increase in supply of electricity and fuel (special provisions) Act, 2010, to address power sector shortages. Section 3 & 4 of the Act is reproduced below:

"3. Notwithstanding anything contained in the Public Procurement Act, 2006 (Act No. 24 of 2006) or any other law for the time being in force, the provisions of this Act shall prevail."

This law has helped in bringing rapid capacity addition, though on flip side, it has led to situation of surplus production capacity, which remains unutilized because of having lower demand and has led to aggravated the cost burden of government. While installed capacity is around 25 GW, but maximum generation is 13.7 GW.

According to the Amended Electricity & Energy Supply Act by Harunur Rashid Shams (August 2020) (Shams, 2020), during the last fiscal year (2018-19), the BPDB paid almost Tk 9,000 crores ($ 1047.49 Million)[7] to 74 private companies as capacity payments.

4. The Government and all government-owned or controlled entities, under this Act, undertake any plan relating to rapid production, transmission, transportation and marketing of electricity or fuel or any plan relating to the import and transmission, transportation and

[7] considering a conversion factor of 1 dollar = 85.92 Taka as on 18th Nov. 2021

marketing of electricity or fuel from abroad. Can accept any proposal for speedy implementation (Laws of Bangaldesh, 2019) ".

This act was also first amended in 2015 (Power Cell, 2015) and then in 2018 (Power Cell, 2018) which extended its validity until October 2021[8]

From the above, it can be noted that currently Power purchase pricing in Bangladesh can be divided in-to three main categories/types viz. (i) negotiated, (ii) regulated and (iii) competitive (through tendering/bidding).

Further, in Bangladesh, three types of tariffs are primarily in operation viz. (i) Bulk or wholesale tariff-the rate at which BPDB purchases power from the generating entities at the tariff rate given in PPAs; (ii) wheeling charges paid to PGCB; and (iii) Retail Tariff-the rate at which the distribution companies sell to consumers.

Bulk Tariff: This is the rate at which BPDB procures power from the various power producers in accordance with the rates given in the respective Power Purchase Agreement (PPA).

Existing Tariff prevailing in Bangladesh according to BPDB's Annual Plan Report: In 2019-20, BPDB's average (pooled) bulk electricity supply cost was Tk 5.91 per kWh (6.9 cent/kWh)[9] .According to BPDB Annual Report 2017-18, the generation cost from various sources was viz. i) BPDB's own power plants: Tk 6.44/kWh (7.5 cent/kWh)[10]; ii) IPPs: Tk 5.72/kWh (6.7 cent/kWh)[11] ; iii) Rentals: Tk 8.77/kWh (10 cent/kWh)[12] ; iv) Public Plants: Tk 4.52/kWh (5.3 cent/kWh)[13] and v) Imports from India Tk 5.87/kWh (6.8 cent/kWh)[14]. Further, average cost of supply was Tk 6.33 /kWh (7.4 cent/kWh)[15]. Wheeling Charge: PGCB is being paid wheeling charges by the distribution companies at Tk 0.2291per kWh (0.27 cent/kWh)[16].

Bangladesh has ambitious power sector vision 2041, which is given in the Figure 9 below. It aims to increase its per capita generation from 464 kWh to 2100 kWh. The generation capacity is expected to reach to 79,500 MW by 2041. Renewable energy capacity to reach around 7,900 MW. With such ambitious targets it is important to look at the pricing mechanism in a holistic manner for better form of price discovery preferably through market instruments and mechanisms. According to the Bangladesh Power Sector vision 2041, Bangladesh is estimated to reach import of electricity to 12,000 MW by 2041, whereas presently trade of electricity is 1,160 MW.

8 Amend Electricity & Energy Supply Act by Harunur Rashid Shams , August 2020

9 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

10 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

11 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

12 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

13 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

14 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

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16 conversion rate of 1$ = 85.89 Tk as on 18th November 2021

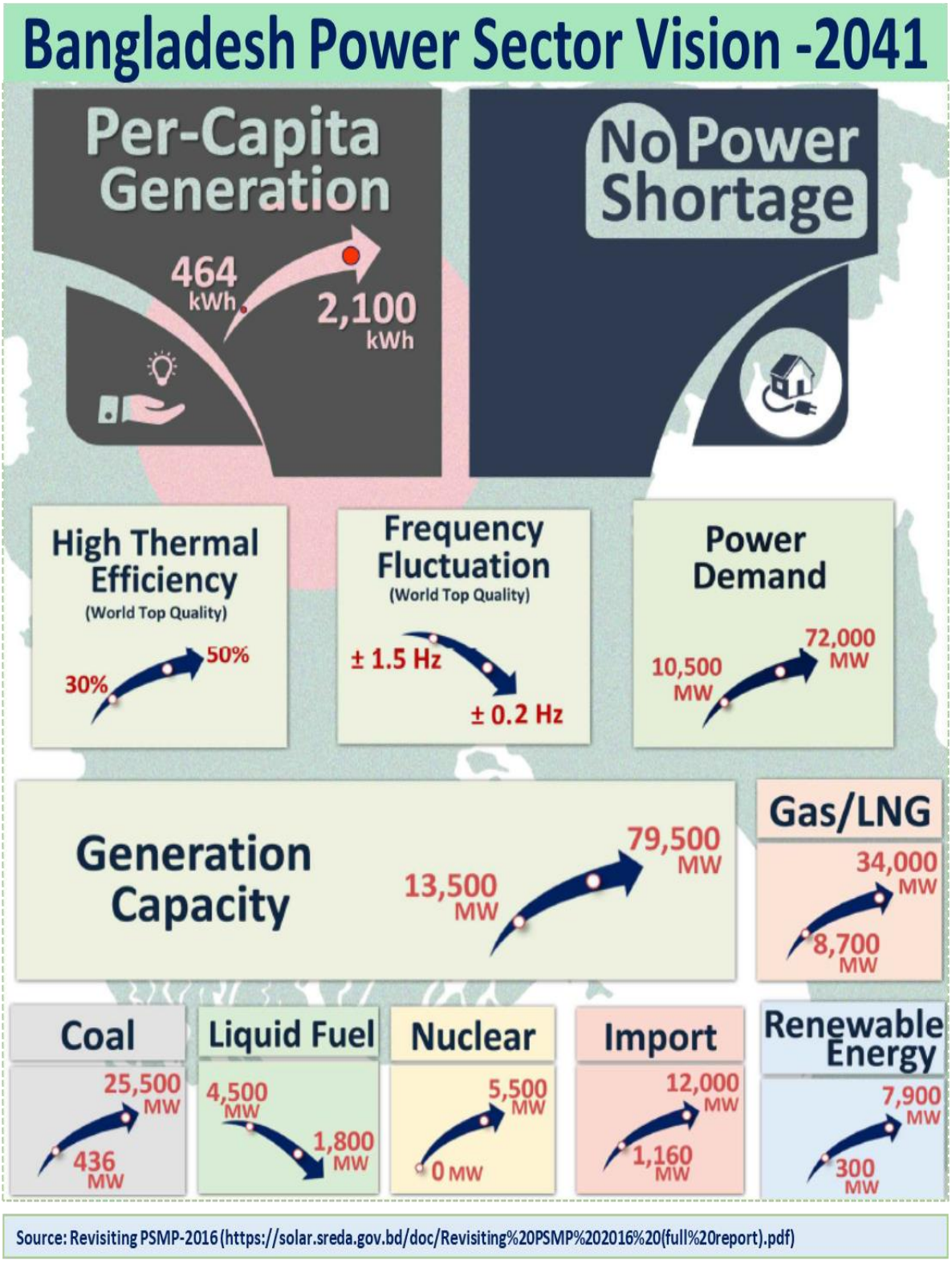


Figure 9: Bangladesh's Power Sector Master Plan-2016[17]

[17] https://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/4f81bf4d_1180_4c53_b27c_8fa0eb11e2c1/Revisiting%20PSMP2016%20%28full%20report%29_signed.pdf

2.2.3 Existing Power Procurement Models in CBET

Currently Bangladesh imports around 1,160 MW of electricity from India. India and Bangladesh transmission link of 400 KV having capacity of 500 MW was made operational in Dec '2013 and India commenced exporting electricity to Bangladesh. Out of this 500 MW total capacity, 250 MW was supplied by Government of India through NVVNL. For the balance capacity of 250 MW, BPDB invited competitive bids for supply of power for a period of 5 years and Power Trading Corporation of India (PTC) was the successful bidder. In 2016, another link viz. Tripura (India)- Comilla (Bangladesh) 400kV transmission interconnection link was commissioned & India started exporting 100-160 MW power to Bangladesh on a negotiated route/cost plus basis. Subsequently another 500 MW HVDC Transmission Link was established and has been in operation since September 11, 2018. Out of this 500 MW, the 250 MW electricity is being exported by NVVNL, trading company which is a subsidiary of National Thermal Power Corporation (NTPC) and 250 MW by Sembcorp Energy India Limited. So, broadly, price of electricity through CBET is a mix of G to G, Negotiated and bidding. India, through its recent cross border guidelines & regulations for trade of electricity, has allowed trade of electricity including trade on Indian power exchanges. Nepal is the first country in the region who has already started importing short term trade of electricity through Indian power exchanges. Whereas Bangladesh is yet to take initiative to start trading on Indian Power Exchanges for import/export of short-term trade of electricity.

Table 9: India-Bangladesh Cross Border Electricity Trade

Company	MW	Contract Type	Contract Period	Type
Current				
NVVN/NTPC to BPDB	250	Long Term	25 Years	G to G (negotiated)
Sembcorp	250	Short Term	03 Years	Commercial through bidding
NVVN Ltd, India	300	Short Term	03 Years	Commercial (negotiated)
PTC India Ltd	200	Short Term	03 Years	Commercial through bidding
NVVN/ Tripura to BPDB	160			G to G (negotiated)
Future Perspective				

"Bangladesh will import electricity from Indian firm GMR at a tariff rate of7.7172 US cents (equivalent to Tk6.4284) per kilowatt hour (each unit) for over a period of 25 years. For the import, the government will have to pay a total amount of Tk38,160.75 crore to GMR through NVVN. State-owned Bangladesh Power Development Board (BPDB) and NVVNL signed a non-bonding memorandum of understanding (MoU). "

Source: https://www.dhakatribune.com/bangladesh/government-affairs/2019/12/18/electricity-import-from-indian-firm-s-nepal-plant-cleared

2.2.4 Challenges/Barriers

All the existing Policies/guidelines in Bangladesh relating to power pricing viz. regulated, negotiated or Competitive bidding by the Government or Regulators have been intended to promote domestic power market. In the existing market structure, BPDB a government owned power utility is solely responsible for buying and selling of electricity. Present trade of electricity & Power Pricing framework between India and Bangladesh is bilateral and mix of G to G, Competitive bidding etc. The SAARC intergovernmental framework signed by all the member states in 2014, also promotes multilateral power trade, however, same is yet to be materialized by the countries. Recently, on case-to-case basis, process has been initiated to buy and sell electricity between Bangladesh & Nepal and Bangladesh & Bhutan. Cabinet Committee on Public Purchase of Bangladesh also provides its approval for such import. For example, Cabinet Committee on Public Purchase of Bangladesh has given the nod to import power at a rate of 7.71 US cents per kWh for a period of 25 years for the import of power from Upper Karnali Hydropower Project in Nepal (Rijal, 2019).

While CBET has benefited Bangladesh and created a win-win situation for both India and Bangladesh in the current pricing, efforts should be made to move towards more market-based pricing in CBET in future and to have portfolio of both negotiated and market form of pricing. This will move towards a system of competitive price discovery and optimisation of cost. While India has allowed the trade on its power exchange and Nepal is importing power through India's power exchange, such trade between India and Bangladesh is yet to happen. More efforts should also be made also to gradually move away from single buyer model to competitive buyer-seller model and establishment of power market platform in Bangladesh. It is also important for Bangladesh to develop short-term power market including Power Exchange for better utilization of resources for discovery of transparent power pricing in the interest of the consumers.

It will be worthwhile to mention that while a country like India has come up with clear-cut

policy guidelines, regulations, and business rules for cross border electricity trade, similar policy guidelines, regulations, and business rule as appropriate in the context of Bangladesh also needs to be promulgated to have a long-term clarity and outlook on cross border electricity trade.

2.3 Bhutan

2.3.1 Sector Insights

Bhutan power system has seen rapid enhancement in terms of generation capacity and transmission system in the recent past. In the year 2014, electricity generating capacity was ~ 1,606 MW (DRE, 2016) from major hydropower plants, 8.2 MW from other small hydro and 10,352 kVA from diesel generators owned by Bhutan Power Corporation (BPC). Currently, total hydro power installed capacity in the country is around 2,335 MW.

Bhutan sector reform started in the early 2000 with the promulgation of electricity act of Bhutan in the year 2001 (Bhutan, 2001). The Electricity Act 2001, helped to create Regulatory body vie "Bhutan Electricity Authority", separate business of transmission/distribution functions viz. "Bhutan Power Corporation Limited" (BPC) and separate generation company viz. "Druk Green Power Corporation Limited" (DGPC) were formed.

Prior to restructuring of the sector, the Department of Power under the Ministry of Trade and Industry was mandated to look after all aspects of power sector. Today, it continues to provide planning and policy guidelines as the Department of Hydropower & Power Systems under the Ministry of Economic Affairs (MOEA). The MOEA of Bhutan plays a key role in overall development of energy sector policies. The three planning & coordination departments that comes under the ministry are a) Department of Renewable Energy (DRE) b) Department of Hydropower & Power Systems (DHPS) c) Department of Hydro-MET

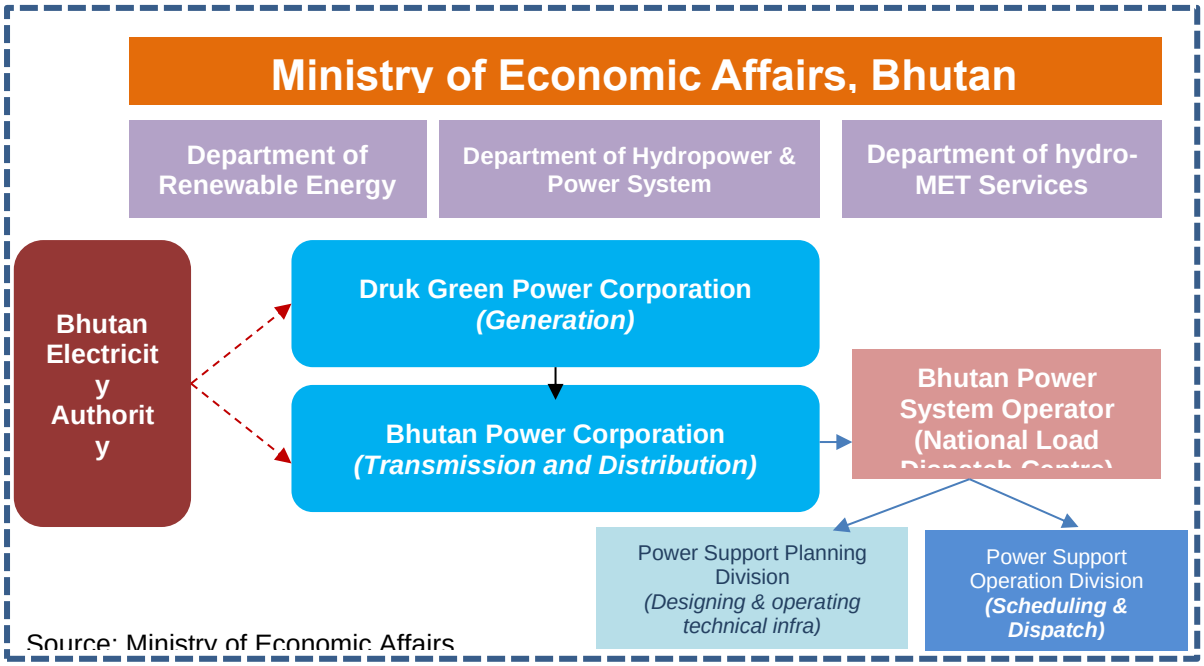


Figure 10 Institutional Framework of Bhutan

services. DRE is responsible for expansion of renewable energy power generation (Ministry of Economic Affairs R. G., 2016). It is also accountable for development of feed-in-tariff framework/policy.

According to the BPC website, BPC was formed as an offshoot of the erstwhile Department of Power, the then Ministry of Trade and Industry and was launched as Transmission & Distribution Public Utility Company on 1st July 2002 with an objective that the corporatization of the utility functions would lead to greater efficiency and better delivery of electricity supply services in the power sector". It is the responsibility of the BPC to cater to domestic demand and to provide transmission access for export of surplus power to India (DGPC, Corporate Profile). It is also the system operator of Bhutan (BEA, 2014). Bhutan Power System Operator (BPSO) is responsible for scheduling & dispatch of electricity and oversees the design & operational aspects of technical infrastructure.

On the generation front, "Druk Green Power Corporation Limited (DGPC)" was established in January 2008 through the merger of the three hydropower corporations of Basochhu, Chhukha and Kurichhu (Annual Report 2019). It is an electricity utility company that operates and maintains hydropower assets of Bhutan. Tala was merged with DGPC in 2009 and has grown significantly since then. In accordance with domestic electricity tariff policy of the Kingdom of Bhutan 2016 (Domestic Electricity Tariff Policy , 2016)& sustainable hydropower development policy (SHDP) (Bhutan Sustainable Hydropower Development Policy, 2021), DGPC is responsible for ensuring domestic electricity supply security as well as for provision of royalty energy obligations.

Bhutan has evolved over the years in terms of regulatory decision-making by creating an independent regulatory authority. After the establishment of regulator Bhutan Electricity Authority (BEA) in accordance with the Electricity Act of Bhutan 2001, BEA was granted full autonomy (Annual Report 2017-2018) from 1st January 2010 (Annual Report 2017-2018). Since then, all the divisions have carried out respective operational plans every fiscal year in line with the provisions of the Electricity Act, 2001 (Annual Report 2019-2020).

According to the BEA website (BEA, 2021), the functions of the authority are, "

i) to develop regulations, standards, codes, principles and procedures, which include, but are not limited to the following;

- performance standards, including minimum technical and safety requirements for construction, operation and maintenance of generation, transmission and distribution facilities;
- tariff-setting, including tariffs for generation not regulated by power purchase agreement, transmission, distribution, and retail sale. These regulations should also comprise terms and conditions for connection fees and investment contribution from customers, and for provision of access to the transmission grid and distribution networks;
- subsidies to entities carrying out non-economic viable electricity supply based on the policies and planning executed by the 14 Minister;
- requirements for Licensees' reporting, accounting and issuance of information to the Authority;

- system operation, including dispatch of generation; and
- levies, charges or royalties to be paid by Licensees.

ii) to process applications and issue, modify and revoke licences for generation, transmission, system operation, export, import, distribution and sale of electricity;

iii) to monitor the performance of Licensees and their compliance with provision of this Act, regulations, standards, codes, licences and contracts approved by the Authority and concession agreements entered into between the Minister and Licensees;

iv) to determine, or approve tariffs proposed by the Licensees, and review existing tariffs;

v) to prescribe and collect fees, charges or royalties from Licensees;

vi) to impose any fines, sanctions or penalties for any breach of provisions of this Act, regulations, standards, codes, licences or contracts to be approved by the Authority, and concession agreements entered into between Licensees and 15 the Government;

vii) to establish a dispute resolution process and settle disputes between Licensees and between Licensees and customers relating to the enforcement of this Act, regulations, codes, standards, and licences issued under this Act, contracts approved by the Authority and concession agreements entered into between the Minister and Licensees, or otherwise any other arrangement for settlement of disputes which are not determined by the mentioned legal instruments; and

viii) any other duties or responsibilities delegated by the Minister. “

Bhutan is power export - oriented country as it is exporting all surplus power to its immediate buyer India. According to the Annual Report-2019 (Annual Report 2019) of Druk Green Power Corporation Limited, “With about 70% of the energy generated being exported to India, hydropower revenues constitute about 25% of revenues to the exchequer and offset much of the balance of payments with India and contributes to about 7.5% of the country’s gross domestic product.”

There is a long history of close cooperation between India and Bhutan in the field of power sector cooperation. India-Bhutan relations brief (Ministry of External Affairs, 2018) of Ministry of external affairs of India states, “The ongoing cooperation between India and Bhutan in the Hydropower sector is covered under the 2006 Agreement on Cooperation in Hydropower and the Protocol to the 2006 agreement signed in March 2009. Under this Protocol, Government of India has agreed to assist Royal Government of Bhutan in developing a minimum of 10,000 MW of hydropower and import the surplus electricity from this to India by the year 2020 “

That India-Bhutan relations brief further states “in April 2014, an Inter-Governmental Agreement was also signed between India and Bhutan for development of four more HEP’s of capacity 2120 MW (600 MW Kholongchhu, 180 MW Bunakha, 570 MW Wangchhu and 770 MW Chamkharchhu) under the Joint Venture Model.” These projects are expected to have both the JV partners owning 50:50 shareholdings each in the JV company with debt-equity ratio of 70:30, and equity shared equally between JV partners. MEA is providing Druk Green Power Corporation’s (Bhutanese) share of equity as grant. For example, Kholongchhu HEP is being implemented jointly by Satluj Jal Vidyut Nigam (SJVN) and DGPC. The shareholder’s agreement between DGPC and SJVN was signed on 30.09.2014. Joint Venture company registered as "Kholongchhu Hydro Energy Ltd (50:50 JV of SJVN & DGPC) in Bhutan on 12.06.2015 (SJVN, 2021).

2.3.2 Relevant Act, Policies & Regulations

There are two types of electricity tariff in Bhutan i.e. domestic electricity tariff and tariff for cross border exports of electricity and accordingly power pricing is set. For tariff determination purpose, the Ministry of Economic Affairs prepares general policies & guidelines, while BEA formulates regulations for electricity tariff retail sale, generation and transmission business respectively.

Tariff for cross border exports is a combination of negotiated electricity export price (in case of intergovernmental projects between India and Bhutan according to the intergovernmental agreements) and negotiated commercial tariff (in case of public-private hydropower partnership projects such as Dagachu[18] according to the PPAs signed) respectively.

For domestic tariff, the tariff is set according to the domestic electricity tariff policy of the Kingdom of Bhutan, 2016 (Ministry of Economic Affairs R. G., 2016) and as per the Tariff Determination Regulation 2016 of Bhutan Electricity Authority (BEA, Tariff Determination Regulation 2016). Domestic electricity tariff policy of the Kingdom of Bhutan provides guidelines for tariff determination; however, the industrial customers may opt to have separate arrangement through a Power Purchase Agreement (PPA) with the service provider to ensure long term predictability upon approval by Bhutan Electric Authority (BEA). According to the policy “In case of the injection of electricity from non- conventional renewable energy sources into the grid, the price of such electricity shall be governed by a separate feed-in tariff regulation mentioned in the Alternate Renewable Energy Policy.”

Some of the key provision of domestic electricity tariff policy of the Kingdom of Bhutan-2016 (Ministry of Economic Affairs R. G., 2016) are reproduced with sections as below:

“ 6.2. Bhutan Electricity Authority (BEA)

[18] Dagachhu Hydroelectric Project (DHP) is Bhutan’s first public-private hydropower partnership, with Druk Green Power Corporation holding 59% equity, India's Tata Power Company Ltd. with 26%, and the National Pension and Provident Fund owning the remaining 15%.

The BEA is an autonomous regulator for the electricity sector. BEA shall develop regulations for formulating domestic tariff including subsidies in accordance with the provisions in the EA Act 2001 and this Policy. **BEA shall determine and approve the Cost of Supply and submit the tariff proposal including subsidy allocations to the Minister through DHPS for consideration.** There shall be one representative from private sector as Commissioner in the BEA. "

" 7 **Guiding Principles for Tariff formulation**

In general, the tariff for generation, transmission and distribution shall be **computed on a cost-plus model**. The cost shall comprise of O&M, depreciation, return of Assets & working capital, regulatory fees & levies, losses and the power purchase. While the domestic electricity demand for the next tariff cycle shall be based on the forecasts, the mean annual energy generation for the past three years with 98% water utilization factor to the extent of generation capacity less royalty energy shall be used for computation of the generation tariff. Other relevant models of tariff determination shall be explored for application.

To achieve the policy objectives, it is necessary to come out with the true, fair and competitive costs of supplies to the various customer categories without any inherent subsidy beyond forms of economic regulation provided by this policy in formulating the costs of supplies. Based on such cost of supplies, the end customer tariffs shall be computed by providing subsidies to targeted customers in a transparent manner to ensure that the tariff is fair, equitable and affordable. Therefore, to rationalize the cost of supplies, the following guidelines for tariff parameters shall be adopted:

7.1 …….7.13

7.14 **Tariff Structure**

The generation tariff structure shall comprise of a single weighted average energy charge from selected generating plants.

The tariff structure for general LV customers shall comprise of only energy charges with progressive blocks and tariff starting with a lifeline block to ensure that the energy is provided at minimal rate for meeting the basic energy requirements. The tariff structure for other LV customers such as commercial, industrial, institutions, street lightings, temporary connections etc. shall consist of single tier energy charge.

The tariff structure for MV and HV customers shall consist of fixed and variable charges. The fixed charge shall be to recover the network cost and the variable charge shall be the generation cost. BEA shall work towards the recovery of the generation cost as the energy charge and fixed cost through the demand charge.

The wheeling charge shall consist of common single charge levied per kWh of energy

wheeled through the network including export. In order to optimize the transmission infrastructure, common corridors are being constructed for exporting of electricity from several generating stations. BEA shall work towards wheeling charge structure that addresses congestion, scheduling, capacity / access issues, losses, and fixed cost recovery etc.

In the long run, the tariff structure should be in such a way to encourage efficient use and conservation of electricity."

Some of the key provisions of Bhutan's Tariff Determination Regulations 2016 with sections are reproduced below:

"Chapter 1 on page 3
"Objective
4. The objective of this Regulation is to provide for the determination of electricity prices in accordance with the Electricity Act of Bhutan, 2001 and the Domestic Electricity Tariff Policy 2016. "

"CHAPTER V Cost of Supply Methodology on page 8

Section 32 :
The Authority shall determine the costs of supply for the forthcoming Tariff Period for the Licensee."
Chapter VIII Determination of End user Prices: Principles of determination of tariff on page 21**.** "Principles for determining Tariff Schedules
Section 89 In preparation of the Tariff Schedules, the Licensees shall be guided by the Clause 7.14 of the Domestic Electricity Tariff Policy 2016. "

From the above it has been observed that pricing for domestic electric follows a dominant cost-plus approach and price is determined through regulation. Market form of pricing is yet to evolve in Bhutan.

2.3.3 Existing Power Procurement Models in CBET

As elaborated in the previous section, tariff for cross border exports is a combination of negotiated electricity export price (in case of intergovernmental projects between India and Bhutan according to the intergovernmental agreements) and commercial tariff (in case of public-private hydropower partnership projects such as Dagachu according to the PPAs signed).

According to the India -Bhutan relations brief-2021 (Ministry of External Affairs) "Till date under intergovernmental model has constructed four major hydro-electric projects (HEPs) in Bhutan totalling 2,136 MW, including 336 MW Chukha HEP, 60 MW Kuricchu HEP, 1,020 MW Tala HEP and 720 MW Mangdechhu HEP. Currently, there are two Intergovernmental (IG) model HEPs under construction viz. 1,200 MW Punatsangchhu–I HEP and 1,020 MW

Punatsangchhu–II HEP. The Concession Agreement for the Kholongchu project in East Bhutan was signed in June 2020 and the project is expected to be completed in 2026“. Power generated from intergovernmental projects such as Chukha, Kuricchu, Tala and Mangdechhu is exported to India through the Indian power trader i.e., Power Trading Corporation of India.

In case of 126 Megawatt (MW) Dagachhu Hydroelectric Project, the first public-private hydropower partnership (DGPC-59% equity, India’s Tata Power Company- 26 % and National Pension and Provident Fund (NPPF) 15 %), the power is sold in India through a 25-year sales agreement with Tata Power Trading Company (TPTC).

According to the financial analysis report of ADB (ADB, FINANCIAL ANALYSIS), the tariffs for the sale of the plant’s energy have been agreed with the Tata Power Trading Company (TPTC) of India, and a power purchase agreement (PPA) was signed in 2008 with TPTC. The PPA was revised in July 2013 due to the increase in costs of Dagachu. As a result, the base-year tariff has been agreed at Indian rupees 2.90 per kilowatt hour (kWh), with 2% annual escalations over the 25-year PPA.

2.3.4 Challenges/Barriers

Bhutan has been the champion of cross border electricity trade in the South Asia region with exporting around 2,000 MW. Present trade of electricity & Power Pricing framework between India and Bhutan is based on bilateral mechanism predominantly through negotiation for the intergovernmental projects and commercial tariff for public-private hydropower partnership project such as Dagachhu.

According to the National Transmission Grid Master Plan -2018, Bhutan has an ambitious target to increase installed capacity to 23,833 MW, with domestic demand projected to be around 1,150 MW, and around 22,683 MW of capacity will be available to export electricity by 2040.

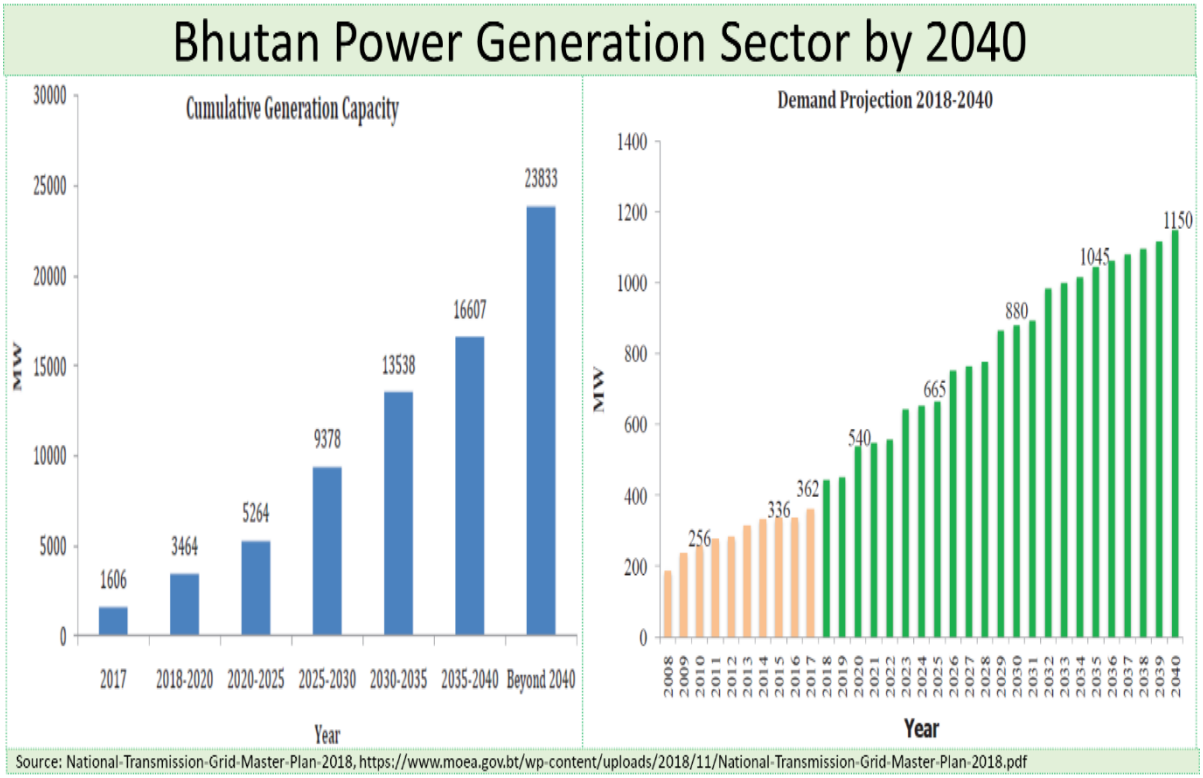


Figure 11: National Transmission Grid Master Plan

While electricity trade has created a win-win situation for both India and Bhutan in the current pricing, efforts should be made to move towards more market form of pricing in CBET and to have portfolio of negotiated and market form of pricing and participating in India's power market to begin with and in other SMS power markets subsequently.

India has revised its policies to allow the trade on its power exchange and Nepal is participating in India's power exchange. Such trade between India - Bhutan is yet to happen. As most of power export from Bhutan is hydro dominated, that can also provide balancing source of power. An effort may be made to tap imported power to balancing market/ancillary service market, which is evolving in India.

More efforts should also be made to gradually move away from single buyer model to competitive buyer-seller model and to establish power market platform in Bhutan.

2.4 India

2.4.1 Sector Insights

India power system is the largest power system in South Asia with an installed capacity of 384 GW (CEA, 2021) as of 30.06.2021 which was around 199 GW (CEA, 2020) as on 31.03.12 and 105 GW as on 31.03.02

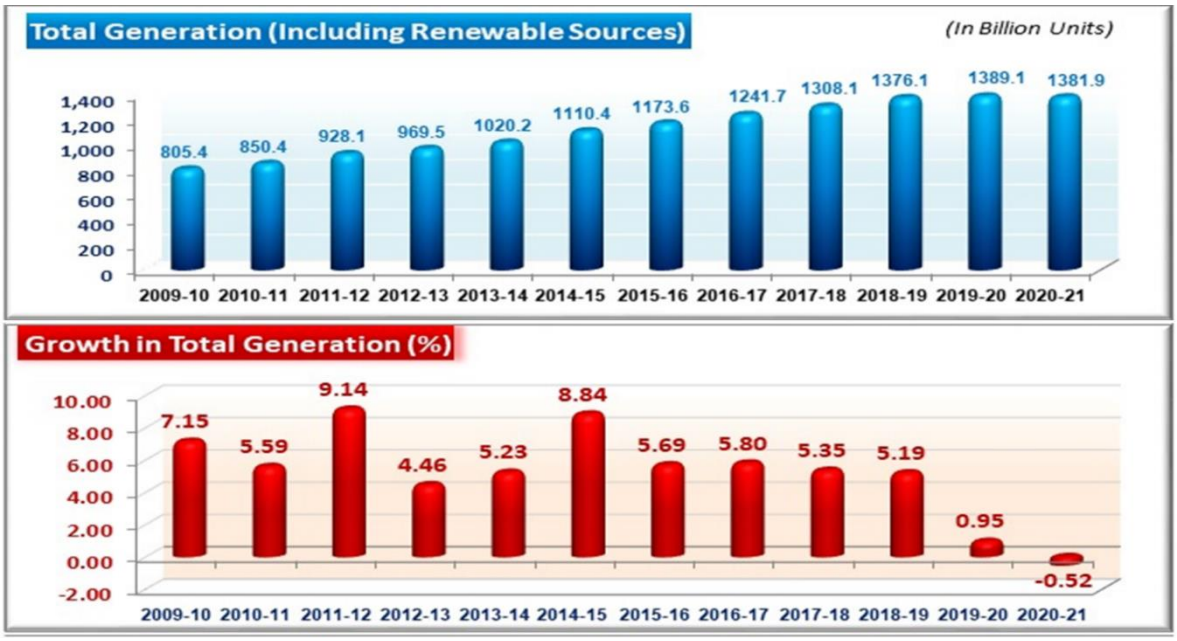


Figure 12 India Power Generation in BUs 2009-10 to 2020-21

(CEA, 2020). As can be observed from the above, installed capacity has grown exponentially over the years. The power generation has increased from 805.4 TWh in the year 2009-10 to 1,381.9 TWh by 2020-2021[19], a 71.57% increase. Out of the total installed capacity, share of thermal (Coal, Lignite, Gas, Diesel) contributes 60%, RES (Renewable Energy Sources) 24 % and Hydro contributes 12.20% of the fuel mix. Installed Capacity fuel mix.

Fuel	Capacity (MW)	% Of Total
Total Thermal	2,34,728	61.30%
Coal	2,02,675	53.00%
Lignite	6,620	1.7%
Gas	24,924	6.50%
Diesel	510	0.10%
Hydro (Renewable)	46,209	12.20%
Nuclear	6,780	1.80%
RES* (MNRE)	95,013	24.80%
Total	**3,82,730**	

* Installed capacity in respect of RES (MNRE) as on 30.04.2021. RES (Renewable Energy Sources) includes Small Hydro Project, Biomass Gasifier, Biomass Power, Urban & Industrial Waste Power, Solar and Wind Energy.[20]

[19] https://powermin.gov.in/en/content/power-sector-glance-all-india, Accessed on 14-07-2021 at 18.00 hrs.
[20] https://powermin.gov.in/en/content/power-sector-glance-all-india, Accessed on 14-07-2021 at 18.00 hrs.

In the pre-independence (1910-1947), Electricity Act, 1910 provided the basic framework and was regulated accordingly. Post-independence, electricity was made a concurrent subject i.e., law can be made both by the Union and the state governments. The power sector was primarily developed through State Electricity Boards (SEBs) created under the Electricity Act, 1948.

During the 1975-89, central sector generation companies i.e., NTPC (1975), NHPC (1975), NEEPCO (1976), NPCIL (1987) and transmission companies such as PGCIL (1989) was created to supplement the work of SEBs.

During the period 1991-96, opening of generation sector initiated and independent power producers were encouraged to address the substantial power shortages. Electricity Supply Act Amended (1991) to promote private power developers, Mega Power Policy (1995) and process of unbundling of vertically integrated State Electricity Boards started in some states such as unbundling & privatisation of Orissa SEB (1995) followed by Haryana & Andhra Pradesh. In 1998, Electricity Regulatory Commission Act was promulgated which led to the formation of Independent Regulatory Commission at central and state levels.

In the year 2003, landmark Electricity Act-2003 was passed which led to the introduction of many innovative concepts in Indian electricity industry such as competition in the industry, De-licensing of Generation, Open Access, Trading as Distinctive Activity and Power Market, setting up of Appellate Tribunal, Independent Power System Operator etc. In 2008, another landmark that happened was Power Exchanges (PXs) were established and started their operations with different products such as Day Ahead etc. The legal framework mandated under EA 2003, facilitated development of competitive power market and power trader in India.

Key features of Electricity Act -2003 are:

1. Creating competition in the industry.
2. Non-discriminatory open access in transmission.
3. Delicensing of generation.
4. Dispensing single buyer model.
5. Ensuring supply of electricity to provide for open access in distribution to be implemented in phases.
6. Electricity trading recognized as a distinct licensed activity.
7. Development of market (including trading) in electricity made the responsibility of the Regulatory Commission.
8. Encouraging autonomous regulation with the separation of policy regulation and operational aspects.
9. Setting up of Appellate Tribunal for dispute resolution

Over the years, the coordination and harmonization among legal, technical, and regulatory bodies have led to the integration of the regional grids which have played the crucial role for development of India's national power market.

The Ministry of Power (MoP) and Ministry of New and Renewable Energy (MNRE) are apex bodies for formulating policy and dealing with matters relating to development schemes, programmes, decentralized and distributed generation schemes etc. in Indian Power Sector. Electricity being a concurrent subject in India, both centre and state have the powers to frame the policies. The Central Electricity Authority (CEA) is the planning & technical arm of MoP that advises Indian government on policy matters and develops plans for the advancement of power system of the country.

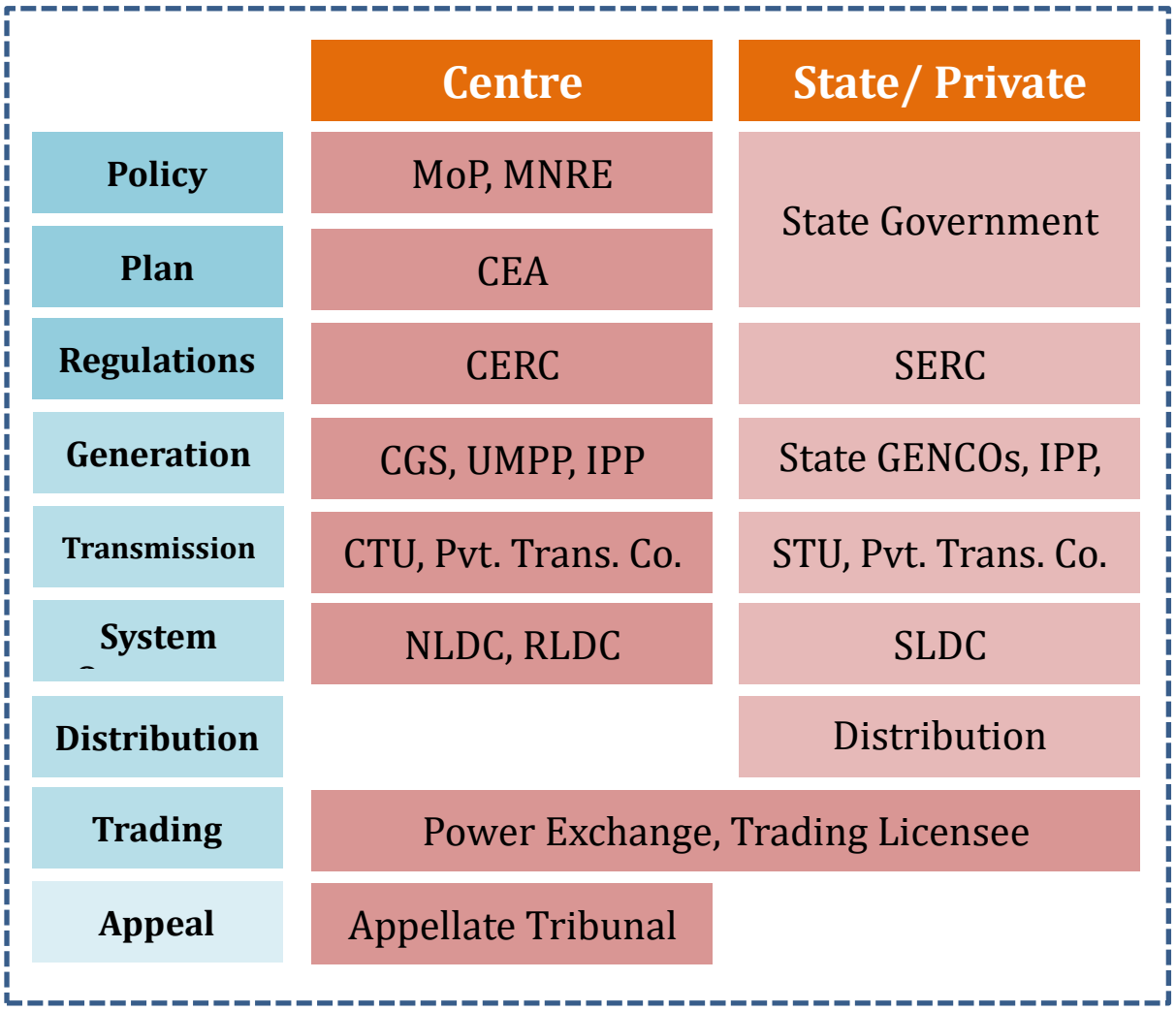


Figure 13: Institutional Framework of Indian Power Sector

Central Electricity Regulatory Commission (CERC) is responsible for regulating inter-state generation, transmission, and trading of electricity whereas State Electricity Regulatory Commission (SERC) is responsible for regulating intra-state concerns in generation, transmission, distribution, and trading of electricity. One of the major roles of state electricity regulatory commissions is to approve tariff for retail sale of electricity. The transmission sector is managed by both centre & state companies in India. For inter-state transmission,

Power Grid Corporation of India (PGCIL) handles the planning, implementation and operation & maintenance. It is also known as Central Transmission Utility (CTU). Similarly, State Transmission Utility undertakes the operation of Intra-state transmission system.

The National Load Dispatch Centre (NLDC) is the system operator that handles the scheduling & dispatch of electricity over inter-regional links. NLDC acts a nodal agency that gives transmission access to power exchanges. At regional level, Regional Load Dispatch Centre (RLDC) monitors grid operation. Similarly, State Load Dispatch Centre (SLDC) monitors grid operation at state level.

The distribution segment in India is undertaken by both state-owned DISCOMs and private players where majority of electricity distribution operations in states are handled by state-owned DISCOMs. Normally, DISCOMs buy power from GENCOs through Power Purchase Agreements (PPAs) and through power markets for providing supply to its consumers. PPAs generally are of three types. i.e., Long-Term, Medium-Term, and Short-term.

Indian Power market has evolved from single buyer/seller model to spot trading on exchange model. There are two power exchanges in India and several trading licensees are operating that allows competition, transparency, and liquidity in the market. Appellate Tribunal is the body that hear appeals against the orders of the adjudicating officer or the Central and State Electricity Regulatory Commissions in India. It resolves complex issues and over the years it has facilitated the development of Indian Power Sector.

2.4.2 Relevant Act, Policies & Regulations

Power pricing/tariff framework in India has undergone substantial changes viz. initially it was cost plus basis, negotiated tariff, upfront, feed in tariff for renewables and competitive tariff-based bidding etc. According to the Electricity Act 2003, the Central Electricity Regulatory Commission (CERC) holds the responsibility to regulate the electricity tariff, develops tariff methodology by formulating regulations & guidelines to be followed by each State Electricity Regulatory Commissions (SERC). Further, Electricity Act 2003 stipulates about tariff regulation, tariff determination and determination of tariff by bidding process. Considering transparency on buying and selling, since 2011, it is mandatory for DISCOs to procure electricity on competitive tariff-based bidding, except for hydro power. There are two types of Competitive tariff-based bidding, (i) Case-I: where developers have to arrange themselves land, fuel, technology etc. and (ii) Case-II: where government arranges land, fuel, technology and invites bids for bidders to quote tariff only. Competitive bidding has been successful as cost of tariff has come down substantially.

DISCOMs can procure hydro power on cost plus basis, subject to demand & supply with approval of Regulatory Commission. Guidelines for long term, medium term, short term buy/sell and process of obtaining Open Access are well in place. Cost plus tariff was based on the principle of two-part tariff i.e. (i) Capacity component and (ii) Variable Component. There are traders, who trade electricity on behalf of buyers and sellers. There are two power

exchanges platforms in India where buyer/seller/traders can bid and arrange electricity on day ahead basis, term ahead basis etc. based on their capacity and requirements.

The Tariff under cost plus basis is determined and approved by Regulator under section 62 of Electricity Act, whereas for tariff discovered under competitive tariff-based bidding, Regulator has to adopt discovered tariff (no determination of tariff) according to Section 63 of Electricity Act.

Various acts/regulations relating to tariff/power pricing framework are discussed below in detail:

As brought out in the foregoing para, prior to 1991, the power sector in India was guided by the Indian Electricity Act, 1910 and The Electricity (Supply) Act, 1948.

(i) Indian Electricity Act 1910 (CERC, 1910): Objective of the Act was to put in place structural framework for supply of electricity in India to attract private capital. In brief, the highlights of EA 1910 were as follows:

(b) Structural Framework for electric supply
(c) Growth of electricity industry through private licensees.
(d) Licenses granted by State Governments for supply in a specified area.
(e) Legal framework for laying down wires and other works
(f) Ensure fair relationship between licensees and consumers

(ii) Indian Electricity Act 1948 (CERC, 1948) mandated establishment of State Electricity Board (SEB) besides creation of Central Power Utilities etc. as follows:

(a) To foster growth and development, electric supply across country
(b) Creation of Central Electricity Authority (CEA) at Centre for planning at National level
(c) State Electricity Board (SEB) integrated utility with presence in generation transmission and distribution.
(d) National Thermal Power Corporation (NTPC) and National Hydro Power corporation (NHPC) set up in 1975.
(e) Transmission Utility at centre viz. Power Grid was set up in 1992.

(iii) In 1998, India came out with Regulatory Commission Act' 1998 (CERC, 1998) to establish independent Regulatory commission at the Centre and State level in India. Chapter III, Section 13: "POWERS AND FUNCTIONS OF THE CENTRAL COMMISSION" according to the Act is reproduced below:

"Section 13: The Central Commission shall discharge all or any of the following functions, namely: -

(a) To regulate the tariff of Generating Companies owned or controlled by the Central Government;
(b) To regulate the tariff of Generating Companies, other than those owned or controlled by the Central Government specified in Cl. (a), if such Generating Companies enter into or otherwise have a composite scheme for generation and sale of electricity in more than one State-,
(c) To regulate the inter-State transmission of energy including tariff of the transmission utilities;
(d) To promote competition, efficiency and economy in the activities of the electricity industry;
(e) To aid and advise the Central Government in the formulation of tariff policy which shall be, -

(i) Fair to the consumers; and
(ii) Facilitate mobilisation of adequate resources for the power sector;

(f) To associate with the environmental regulatory agencies to develop appropriate policies and procedures for environmental regulation of the power sector;
(g) To frame guidelines in matters relating to electricity tariff,
(h) To arbitrate or adjudicate upon disputes involving Generating Companies or transmission utilities in regard to matters connected with Cls. (a) to (c) above;
(i) To aid and advise the Central Government on any other matter referred to the Central Commission by that Government."

(iv) In 2003, Government of India came out with Indian Electricity Act 2003 which consolidated the earlier laws viz. Indian Electricity Act, 1910, the Electricity (Supply) Act, 1948 and the Electricity Regulatory Commissions Act, 1998.

Section 61 (Tariff Regulations), Section 62 (determination of tariff) and 63 (determination of tariff by bidding process) relating to tariff as contained in the EA'2003 are reproduced below:

"Section 61: Tariff Regulations: The Appropriate Commission shall, subject to the provisions of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely: -
(a) the principles and methodologies specified by the Central Commission for determination of the tariff applicable to generating companies and transmission licensees;
(b) the generation, transmission, distribution and supply of electricity are conducted on commercial principles;
(c) the factors which would encourage competition, efficiency, economical use of the resources, good performance and optimum investments;
(d) safeguarding of consumers 'interest and at the same time, recovery of the cost of electricity in a reasonable manner; (e) the principles rewarding efficiency in performance;
(f) multiyear tariff principles;
(g) that the tariff progressively reflects the cost of supply of electricity and also, reduces and

eliminates cross-subsidies within the period to be specified by the Appropriate Commission; (h) the promotion of co-generation and generation of electricity from renewable sources of energy;

(i) the National Electricity Policy and tariff policy"

According to the above provisions, the principles of the tariff are based on (a) the factors which would encourage competition, efficiency, economical use of the resources, good performance and optimum investments; (b) safeguarding of consumers' interest and at the same time, recovery of the cost of electricity in a reasonable manner; (c) rewarding efficiency in performance; (d) the tariff progressively reflects the cost of supply of electricity and also, reduces and eliminates cross-subsidies; (e) the promotion of co-generation and generation of electricity from renewable sources of energy etc.

Section 62: Determination of tariff as contained in the act is reproduced below:

"(1) The Appropriate Commission shall determine the tariff in accordance with provisions of this Act for –

(a) supply of electricity by a generating company to a distribution licensee:

Provided that the Appropriate Commission may, in case of shortage of supply of electricity, fix the minimum and maximum ceiling of tariff for sale or purchase of electricity in pursuance of an agreement, entered into between a generating company and a licensee or between licensees, for a period not exceeding one year to ensure reasonable prices of electricity;

(b) transmission of electricity;

(c) wheeling of electricity;

(d) retail sale of electricity.

Provided that in case of distribution of electricity in the same area by two or more distribution licensees, the Appropriate Commission may, for promoting competition among distribution licensees, fix only maximum ceiling of tariff for retail sale of electricity.

(2) The Appropriate Commission may require a licensee or a generating company to furnish separate details, as may be specified in respect of generation, transmission and distribution for determination of tariff.

(3) The Appropriate Commission shall not, while determining the tariff under this Act, show undue preference to any consumer of electricity but may differentiate according to the consumer's load factor, power factor, voltage, total consumption of electricity during any specified period or the time at which the supply is required or the geographical position of any area, the nature of supply and the purpose for which the supply is required.

(4)No tariff or part of any tariff may ordinarily be amended more frequently than once in any

financial year, except in respect of any changes expressly permitted under the terms of any fuel surcharge formula as may be specified.
(5)The Commission may require a licensee or a generating company to comply with such procedures as may be specified for calculating the expected revenues from the tariff and charges which he or it is permitted to recover.
(6)If any licensee or a generating company recovers a price or charge exceeding the tariff determined under this section, the excess amount shall be recoverable by the person who has paid such price or charge along with interest equivalent to the bank rate without prejudice to any other liability incurred by the licensee.

Section 63: Determination of tariff by bidding process: the provision as contained in the act are reproduced below:
"Notwithstanding anything contained in section 62, the Appropriate Commission shall **adopt** the tariff if such tariff has been determined through transparent process of bidding in accordance with the guidelines issued by the Central Government."

According to above provisions, it is clear that Commission will adopt tariff (not determine tariff) if it is discovered through transparent bidding mechanism.

Govt. of India in the year 2005 issued "Guidelines for Determination of Tariff by Bidding Process for Procurement of Power by Distribution Licensees"[21]. These guidelines detail out process of RfP, RfQ, model PPA to be part of bidding document, Procedures for invitation of bids, tariff structure etc.

"Section 4: Tariff structure" as contained in these guidelines is reproduced below:

"4.1 For procurement of electricity under these guidelines, tariff shall be paid and settled for each payment period (not exceeding one month). A multi-part tariff structure featuring separate capacity and energy components of tariff shall ordinarily form the basis for bidding. Procurement under case-2 where procurer offers a captive fuel source (such as captive coal mine) for concurrent development and use for power production covered under the procurement query would also have a multi-part tariff structure featuring separate capacity and energy components of tariff.

4.2. In case of long-term procurement with specific fuel allocation (Case 2), the procurer shall invite bids on the basis of capacity charge and net quoted heat rate. The net heat rate shall be ex-bus taking into account internal power consumption of the power station. The energy charges shall be payable according to the following formula:

Energy Charges =Net quoted heat rate X Scheduled Generation X Monthly Weighted Average price of Fuel/Monthly weighted average Gross Calorific Value of Fuel

[21] https://powermin.gov.in/sites/default/files/uploads/Guideline_for_determination_of_tariff_and_SBD_for_case_1.pdf

If the price of the fuel has not been determined by the Government of India, government approved mechanism or the Fuel Regulator, the same shall have to be approved by the appropriate Regulatory Commission. In case of coal / lignite fuel, the cost of secondary fuel oil shall be factored in the capacity charges.

4.3. Tariffs shall be designated in Indian Rupees only. Foreign exchange risks, if any, shall be borne by the supplier. Transmission charges in all cases shall be borne by the procurer. Provided that the foreign exchange rate variation would be permitted in the payment of energy charges [in the manner stipulated in para 4.11(iii)] if the procurer mandates use of imported fuel for coastal power station in case-2. Provided further that the foreign exchange rate variation would also be permitted in the payment of energy charges [stipulated in para 4.11 (iii)] if the bidder chooses to supply power using domestic gas or RLNG or both or imported coal for long term procurement under Case-1.

Capacity charges

4.4 Capacity charge shall be paid based on actual availability, according to charges quoted in Rs/kWh and shall be limited to the normative availability. The normative availability for Case 1 and thermal stations under Case 2 shall be a maximum of 85%. For hydroelectric stations under case-2, the normative availability shall be at the level of normative annual plant availability factor as specified in the tariff regulations of the Central Electricity Regulatory Commission (CERC) prevailing at the time of the bid process. The capacity component of tariffs may feature separate non-escalable (fixed) and escalable (indexed) components. The indices to be adopted for escalation of the escalable component shall only be Wholesale Price Index (WPI), Consumer Price Index (CPI) or a combination of both WPI and CPI and the Base year shall be specified in the bid document.

4.5 Capacity charges for availability beyond the normative availability shall be a prespecified percentage of the non-escalable component of the capacity charges. The percentage applicable shall be specified in the RFP and shall be limited to a 40% of the non-escalable component of the capacity charges. The procurer shall have first right of refusal on energy generated beyond normative availability. In case actual availability is less than the normative availability, capacity charges shall not be payable for the shortfall compared to the normative availability. In case availability is lower than a predetermined level (which is identified in the RFP and may be about 5% below normative availability), penalty at the rate of 20% of the capacity charge shall also be applicable to the extent of the shortfall in availability below such predetermined level."

Government of India in 2016 came out with National Tariff Policy, 2016 with the objective to streamline and to promote competition in the sector. The general approach to tariff of the national tariff policy, 2016 is reproduced below:

"5.1 Introducing competition in different segments of the electricity industry is one of the key features of the Electricity Act, 2003. Competition will lead to significant benefits to consumers through reduction in capital costs and also efficiency of operations. It will also facilitate the price to be determined competitively. The Central Government has already issued detailed guidelines for tariff-based bidding process for procurement of electricity by distribution licensees.

5.2 All future requirement of power should continue to be procured competitively by distribution licensees except in cases of expansion of existing projects or where there is a company owned or controlled by the State Government as an identified developer and where regulators will need to resort to tariff determination based on norms provided that expansion of generating capacity by private developers for this purpose would be restricted to one time addition of not more than 100% of the existing capacity.

5.3 The tariff of all new generation and transmission projects of company owned or controlled by the Central Government shall continue to be determined on the basis of competitive bidding according to the Tariff Policy notified on 6th January 2006 unless otherwise specified by the Central Government on case-to-case basis.

5.4 The Central Electricity Regulatory Commission in consultation with Central Electricity Authority and other stakeholders shall frame within six months, regulations for determination of tariff for generation of electricity from projects using coal washery rejects. These regulations shall also be followed by State Electricity Regulatory Commissions.

5.5 The developer of a hydroelectric project, including Pumped Storage Plant (PSP), would have the option of getting the tariff determined by the Appropriate Commission for the power to be sold through long term Power Purchase Agreements (PPAs) on the basis of performance-based cost of service regulations

5.6 Notwithstanding anything contained in Para 5.5 above, the developers of hydroelectric projects of more than 100 MW design capacity for which sites have been awarded earlier by following a transparent process and on the basis of pre-determined set of criteria would have the option of getting the tariff determined by the Appropriate Commission for the power to be sold through long term PPA on the basis of cost plus under Section 62 of the Act.

5.11 Tariff policy lays down the following framework for performance-based cost of service regulation in respect of aspects common to generation, transmission as well as distribution.

- Return on Investment
- Equity Norms

- Depreciation
- Cost of Debt
- Operating Norms
- Renovation & Modernization
- Multi-Year Tariff
- Benefits under CDM
- Composite Scheme

The tariff determination process includes activities such as tariff –filing, tariff hearings etc. which is followed by issuance of a tariff order that is made once in a year (sometimes once in three years)."

Central Electricity Regulatory Commission (Sharing of inter-State Transmission Charges and Losses) Regulations. These regulations issued by CERC come into force from the date that is separately notified by the commission. The principles of sharing Transmission Charges are reproduced below:

"(1) The transmission charges shall be shared amongst the DICs (Designated Inter-State Customers) on monthly basis based on the Yearly Transmission Charges such that: -

(a) The Yearly Transmission Charges are fully recovered; and

(b) Any adjustment on account of revision of the Yearly Transmission Charges are recovered.

(2) Yearly Transmission Charges for transmission system shall be shared on monthly basis by DICs in accordance with Regulations 5 to 8 of these regulations subject to the exceptions provided in Clauses (3), (6), (9) and (12) of Regulation 13 of these regulations.

(3) Long Term Access or Medium-Term Open Access for projects covered under Clause (1) of Regulation 13 shall not be considered for apportionment of Yearly Transmission Charges under Regulations 5 to 8 of these regulations.

(4) Sharing of transmission charges for DICs shall be based on the technical and commercial information provided by the DICs, inter-State transmission licensees, NLDC, RLDCs, SLDCs and CTU to the Implementing Agency. "

According to the revised guidelines for Procurement of Electricity for Medium Term from Power Stations set up on Finance, Own and Operate (FOO) basis (Ministry of Power G. o., 2019), relevant section is reproduced below: -

"

1. The terms and conditions specified in the Model Bidding Documents referred to herein above shall, by reference, form part of these Guidelines and shall be treated as such.

2. The application of these Guidelines shall be restricted t projects from which power is procured in accordance with an Agreement for Procurement of Power for a period between one and five years, with a provision for extension of this period upto 25% of

the initial contract period or one year whichever is lower, with mutual consent.

3. The tariff determined through the DEEP e-Bidding process using e-reverse Auction based on these Guidelines comprising the Model Bidding Documents shall be adopted by the Appropriate Commission in pursuance of the provisions of section 63 of the Act.

4. Any deviation from the Model Bidding Documents shall be made by the Distribution Licensees only with the prior approval of the Appropriate Commission. Provided, however, that any project specific modifications expressly permitted in the Model Bidding Documents shall not be construed as deviations from the Model Bidding Documents.

5. The amendments made in the Guidelines for Procurement of Electricity from Thermal Power Stations set up on Design, Build, Finance, Own and Operate (DBFOO) basis vide Ministry of Power Resolution No. 23/9/2015-R&R dated 16th April 2015 in view of new coal block auction policy issued by Ministry of Coal, shall also apply, mutatis mutandis, for procurement of electricity for Medium Term from Power Stations set up on Finance, Own and Operate (FOO) basis. “

According to the Guidelines for short-term (i.e., for a period of more than one day to one year) Procurement of Power by Distribution Licensees through Tariff based bidding process (Ministry of Power, 2016).

“The Central Government vide resolution dated 16th May 2012, notified the “Guidelines for short term (i.e., for a period less than or equal to one year) Procurement of Power by Distribution Licensees through Tariff based bidding process”, under the provisions of section 63 of the Act (Ministry of Power, 2016). The Para 2 of the Guidelines of 2012 provided that "As and when considered appropriate (not later than 5 years from the issue of these guidelines), the Central Government would examine and introduce a system of 'Reverse Auction' through an e-platform (Ministry of Power, 2016).”

Accordingly Central Government notified the revised Guidelines for short term (i.e., for a period of more than one day to one year) Procurement of Power by Distribution Licensees through Tariff based bidding process inter alia introducing system of 'Reverse Auction' through an e-Bidding Portal w.e.f. 1st April 2016 (Ministry of Power, 2016). The relevant section related to tariff of the Guidelines for short-term (i.e., for a period of more than one day to one year) Procurement of Power by Distribution Licensees through Tariff based bidding process (Ministry of Power, 2016) is reproduced below: -

“ 5. Tariff Structure

5.1. The Procurer based on its requirement may invite the bids on round the clock (RTC) basis

or for different time slots. Procurer may also provide flexibility to the Bidder(s) to bid for a part of the tendered quantity, subject to a given minimum quantity. Bid capacity offered by the Bidder shall have to be constant for the entire contract period.

5.2. The Bidder shall quote the single tariff at the Delivery Point upto three (3) decimals which shall include capacity charge, energy charge, trading margin (in case of Bidder being a Trader), applicable Point of Connection (POC) charges upto Delivery Point and all taxes, duties, cess etc. imposed by Central Govt. / State Govt. / Local bodies. Tariffs shall be designated in Indian Rupees only.

5.3. For inter-State transmission of power, state/regional periphery of the Procurer to be taken as Delivery Point. For intra-state transmission of power, inter-connection point of seller with STU/ CTU to be taken as Delivery Point.

5.4. For avoidance of doubt, Intra-state open access charges, transmission charges and losses along with POC injection charges and loss up to the POC interface are on Seller's account and POC drawl charges and losses along with intra-state open access, transmission charges and losses are on Procurer's account.

5.5. The tariff should be constant and there shall be no escalation during the contractual period. If Bids are invited for different time slots, then tariff may be different for each time slot.

5.6. If the power is being supplied through alternate source, additional charges and losses if any, due to cancellation of existing corridor and booking of new corridor etc., shall be to the account of Bidders. "

India is further making significant advancement in moving towards market form of pricing. According to the Discussion Paper on Market Based Economic Dispatch-MBED (Ministry of Power, 2021) issued by Ministry of Power, Government of India "India has attained the status of 'One Nation, One Grid, One Frequency' and there are hardly any constraints today in the inter-regional transfer of electricity. The true benefit of physical integration is realisable only when India transits to a national merit-order and a country-wide balancing area instead of the siloed self-scheduling and balancing mechanisms currently followed."

Discussion Paper on Market Based Economic Dispatch-MBED (Ministry of Power, 2021) paper argues that "It is also possible to move towards a "One Nation, One Grid, One Frequency, One Price" framework by adoption of a market based economic dispatch, which will lead to discovery of uniform clearing prices in the day-ahead market. "

Average Cost of Supply and Average Revenue of State Power Utilities from the year 2008-09 to 2018-19 (CERC) is given below in table

Table 10: Average Cost of Supply and Average Revenue of State Power Utilities from the year 2008-09 to 2018-19

Year	Average Cost of supply (INR/kWh)	Average revenue (without subsidy) (INR/kWh)	Revenue Gap (INR /kWh)	Revenue as % of cost
2008-09	3.40	2.63	0.77	77
2009-10	3.55	2.68	0.87	75
2010-11	3.98	3.03	0.95	76
2011-12	4.55	3.30	1.25	73
2012-13	5.03	3.76	1.27	75
2013-14	5.19	4.00	1.19	77
2014-15	5.21	4.15	1.06	80
2015-16	5.43	4.23	1.20	78
2016-17	5.48	4.36	1.12	80
2017-18	5.60	4.51	1.09	81
2018-19	6.09	4.74	1.35	78
Source: CERC[22]				

From the above table, it may be noted that All India average cost of supply viz. INR 3.40/KWh and average revenue (without subsidy) INR 2.63/kWh in the year 2008-09 has increased to INR 6.09/kWh and INR 4.74/kWh, respectively in the year 2018-19. The revenue as percentage of cost of supply was varying between 78% to 81% in the last 5 years, means, the average revenue was about 20% lower than the average cost of supply. As such this gap is financed through budgetary support as subsidy by the Government.

Tariff of Central Public Sector power generating companies (Source CERC report on Short Term Power market): On an average, during the year 2019-20 (CERC) the distribution companies paid between INR 2.01 and `5.75 per kWh for procuring power from coal-based stations, between INR 3.68 and INR 6.37 per kWh from gas-based power stations, and between INR 1.16 per kWh and `8.46 per kWh from hydro power stations.

[22] https://cercind.gov.in/2020/market_monitoring/Annual%20Report%202019-20.pdf

Table 11 Size & Prices of Short-term Power Market (Bilateral and Power Exchange)

Year	Electricity Transacted through trading Licensees (TWh)	Price of Electricity Transacted through Trading licensees (`/kWh)	Size of bilateral trader Market in ` Crore	Electricity Transacted through Power Exchanges (TWh)	Price of Electricity Transacted through Power Exchanges (INR/kWh)	Size of Power Exchange Market in ` Crore	Total Size of the bilateral trader + Power Exchange Market (INR Crore)
2009-10	26.72	5.26	14055	7.19	4.96	3563	17617
2010-11	27.70	4.79	13268	13.52	3.47	5389	18657
2011-12	35.84	4.18	14979	15.54	3.57	5553	20532
2012-13	36.12	4.33	15624	23.54	3.67	8648	24272
2013-14	35.11	4.29	15061	30.67	2.90	8891	23952
2014-15	34.56	4.28	14801	29.40	3.50	10288	25089
2015-16	35.43	4.11	14557	35.01	2.72	9539	24096
2016-17	33.51	3.53	11844	41.12	2.50	10280	22124
2017-18	38.94	3.59	13970	47.70	3.45	16457	30427
2018-19	47.32	4.28	20255	53.52	4.26	22809	43064
2019-20	29.95	4.51	13516	56.45	3.24	18303	31820

From the above table it may be noted that the size of the bilateral and power exchange market increased from Rs. 17,617 Crore in 2009-10 to Rs. 31,820 Crore in 2019-20 at an average annual growth rate of 6%. The volume of electricity transacted through bilateral and power exchange during 2009-10 to 2019-20, registered a positive growth of 1% and 23% respectively. While the price of electricity transacted through both bilateral and power exchange registered a negative growth of -2% and -4% respectively. The monetary value of the short-term market covering both bilateral and Power Exchange is as high as Rs. 43,000 crores in a year. Power Price is the reflection of demand and supply. If demand is more and supply is less, prices are high and vice versa.

From the above it can be concluded that Post Electricity Act 2003, India has initiated major reforms such as delicensing of Generation, Guidelines for Competitive tariff-based bidding, Concept of Traders, Concept of Open Access, DISCOMs to mandatorily procure power through Competitive tariff bidding except hydro, establishing Power Exchanges, various incentive schemes to improve performance of Discos, Unbundling of Electricity Boards etc. Presently, India has well established policies/regulations for power market where multiple buyers/sellers/Traders trade electricity on long/medium/short term basis and prices are discovered by the market forces and the govt. has no role in particular relating to price fixing.

2.4.3 Existing Power Procurement Models in CBET

India is a leader in cross border trade in the region with multiple cross border connections with Nepal, Bhutan and Bangladesh and trade has been increasing over the years.

Table 12: Growth of Cross Border Trade of Electricity, 2013-14 to 2019-20 (TWh)[23]

Year	Bhutan (+) (TWh)	Nepal (-) (TWh)	Bangladesh (-) (TWh)	Myanmar (-) (TWh)	Net Export/Import by India (TWh)
2013-14	5.56	0.84	1.45	0.00	3.27
2014-15	5.11	1.00	3.27	0.00	0.84
2015-16	5.56	1.47	3.65	0.00	0.43
2016-17	5.86	2.02	4.42	0.00	-0.58
2017-18	5.61	2.39	4.81	0.01	-1.59
2018-19	4.66	2.80	5.69	0.01	-3.84
2019-20	6.31	2.37	6.99	0.01	-3.06
(+) Import; (-) Export Source: POSOCO					

The growth of cross border trade of electricity between India and its neighbouring countries during the period from 2013-14 to 2019-20 is presented in the table-12[24]. India has been importing electricity from Bhutan and exporting electricity to Nepal, Bangladesh in SA region and also to Myanmar, which is beyond South Asian Region. As it can be seen in table-12, India was net importer of electricity during the period from 2013-14 to 2015-16 and net exporter of electricity during the period from 2016-17 to 2019-20 and as a net exporter of electricity is on increasing trend. Under the CERC (Cross Border Trade of Electricity) Regulations 2019 (CERC, 2019), sale and purchase of electricity between India and the neighbouring countries is allowed through:

- Mutual agreements between the local entities and the entities of the neighbouring countries.
- Through bilateral agreements between two countries.
- Bidding route or through mutual agreements between entities.

Any Indian trader, after obtaining approval from a designated authority, can also trade in Indian Power Exchanges on behalf of any entity of neighbouring country complying with these regulations.

Pricing of cross border power trade at present is through a mix of mutual agreements, bilateral agreements between the two countries, and bidding.

[23] https://cercind.gov.in/2020/market_monitoring/Annual%20Report%202019-20.pdf
[24] https://cercind.gov.in/2020/market_monitoring/Annual%20Report%202019-20.pdf

For example, in case of India-Bhutan, Tariff for cross border exports is a combination of negotiated electricity export price (in case of intergovernmental projects between India and Bhutan according to the intergovernmental agreements) and commercial tariff (in case of public-private hydropower partnership projects such as DAGACHU according to the PPAs signed). Similar is the case with Nepal and Bangladesh.

Indian Energy Exchange (IEX) in its bulletin of 19th April'2021 (IEX, 2021), highlighted that for the first time, cross border power trade on Power Exchange has taken place and Nepal was the first country to trade in IEX platform for Day Ahead market.

2.4.4 Challenges/Barriers

With the promulgation of a) Guidelines for Import/Export (Cross Border) of electricity- 2018 (Ministry of Power G. o., 2018) on 18th December 2018 b) Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019 (CERC, 2019) on 8th March 2019 and c) procedure for approval and facilitating import/export (cross border) of electricity by the designated authority on February,2021 (CEA, 2021), there is absolute clarity and transparency across policy, regulation and procedural level for cross border trade of electricity. In view of above guidelines, first time Nepal has started cross border trade of electricity on Indian power exchange platform.

Existing trend of CBET has shown that Countries have benefited by trade of electricity such as Bangladesh was able to reduce its energy shortages to meet the huge deficit, Bhutan was able to grow its revenues and GDP by selling surplus power and Nepal was also able to meet its deficit and meet auxiliary power required for construction of new hydro power projects. In future, the trade of energy/electricity is likely to enhance substantially. It is therefore important that steps are taken by the SMS to move towards competitive power market structure including multilateral/trilateral trade to bring transparency in power pricing mechanism for the benefits of consumers.

2.5 The Maldives

2.5.1 Sector Insights

The Maldives is a country having many islands. Geographically, it lies southwest of Sri-Lanka and India, about 700 kilometres (430 mi) from the Asian continent's mainland. Its territory spans roughly 298 square kilometres (115 sq. mi.). Maldives is one of the most geographically dispersed sovereign states in the world with around 557,426 inhabitants (Wikipedia, 2021).

The Maldives' power sector had grown exponentially over the last several decades, with dominance of diesel-based power generation and slowly increasing renewable energy. Due to diesel-based energy system, it has a high dependency on imported fossil fuels as primary sources of energy. According to the Island Electricity Data book 2019 (Maldives Energy Auhtority, 2019), Energy imports to Maldives totals to 643,900 Tonnes and consisted of aviation gas, diesel, petrol and cooking gas. Diesel fuel contributes to the highest percentage of the total, accounting to 81% of total fuel imports.

According to the Island Electricity Data book 2019 (Maldives Energy Auhtority, 2019), installed diesel generation capacity in Inhabited islands is 319 MW, and in resorts it is estimated to be 210 MW, so in total the installed capacity is ~ 530 MW. As on 2018, The Maldives has renewable energy system of 16.5 MW and since 2016 the annual growth rate of solar PV installation is 45%-55%. Further, for power generation, a total of 213,612,457 litres of diesel was consumed to produce 750.6 GWh of electricity in (year). The greater Malé region (Malé, Villingili and Hulhumalé) accounts for 58% of the total electricity generation in all the inhabited islands, highest annual electricity production of about 440 GWh, with an installed capacity of 162 MW (Maldives Energy Auhtority, 2019). According to the project document of the Asian Infrastructure Investment Bank-Sovereign-Backed Financings, more than half of electricity consumption is concentrated in the capital city of Malé, and while Malé has the largest power system with an installed capacity of 81MW, there are only four other islands that have generation capacity larger than 1 MW.

Maldives has gone through various changes in terms of institutional governance. Currently, Energy Department under the Ministry of Environment, Climate Change and Technology is in charge of formulating policies related to the energy sector in line with the legislative framework of the Republic of Maldives.

Department of Energy under the Ministry of Environment, Climate Change and Technology is responsible for formulating policies for the energy sector and for strengthening international cooperation to bring investment in the sector (Ministry of Environment, 2016). There are two Sections under Energy Department viz. a) Policy and Sector Development, and b) Energy Technology Development.

On regulation front, as regulatory institution has gone some changes. The President of The

Maldives ratified the new Utility Regulatory Authority Act on 13th December'2020 which was passed by Parliament on 23rd November 2020 (The President's Office, 2020). The Utility Regulatory Act establishes an authority to regulate and oversee the management of public utility services in the country, in line with Regulatory Utility general guidelines, plans and procedures according to the provision of utility services. Further, after ratification, the Utility Regulatory Authority Act has been published in the Government Gazette on 07 February 2021 .

Further, "It may be highlighted that with the establishment of Utility Regulatory Authority, the Maldives Energy Authority, which was functioning under the Ministry of Environment, has been dissolved according to the President's order[25].

There are two State Owned Power Utilities in The Maldives which are responsible for both Generation and services are (i) State Electric Company Limited (STELCO) and (ii) FENAKA Corporation Limited (FENAKA).

According to the STELCO website (STELCO, 2021), In 1949, the company was formed as government owned company with an installed capacity of only 14 kW and they were responsible initially to provide electricity to the Male residences viz. about 50 in numbers only. '. Over the past five decades the Company operated as a Government Department such as "Department of Electricity" and "Maldives Electricity Board" respectively. In 1997, "State Electric Company" STELCO, was formed. Presently, the total number of customers in Male' are about 37,660 and in different islands the number of consumers as on 2016 are 14,462. About 7.5 % of Maldives' energy needs are met by solar'. Further, STELCO now provides electricity to 35 islands with a total capacity of 180 megawatts (Aiham, 2020).

FENAKA (FENAKA, Articles, 2019) is the largest state-owned utility which has operation in 150 islands and provides them electricity, water, and sewerage. Further, FENAKA has 149 powerhouses providing electricity to 153 inhabited islands. On an average, growth of electricity consumption is 10% annually (FENAKA, 2021). FENEKA aims to transform 70% of power generation through renewable energy sources (FENAKA, 2019).

According to the Project Document of the Asian Infrastructure Investment Bank-Sovereign-Backed Financings (AIIB, 2021), The national Strategic Action Plan of 2019-2023 covers a specific goal achieving "Clean Energy" by developing renewable energy and setting its targets viz.: (i)to increase the share of renewable energy in the energy mix by 20% compared to 2018 levels, (ii) to reduce fossil fuel usage for electricity generation by 40 million litres and (iii) to increase renewable energy storage capacity to 30 MWh. By 2023, Maldives plans to have 75 MW of solar capacity installed.

25 https://www.ura.gov.mv/v1/news/president-establishes-utility-regulatory-authority/

2.5.2 Relevant Act, Policies & Regulations

According to the latest Utility Regulatory Authority Act published by the Government Gazette (URA U. R., 2021) (available in local language not in English) on 07 February 2021 which has now been replaced with the earlier Maldives Energy Authority working under Ministry of Environment, it could be presumed that it regulates the electricity prices in the Maldives as it was being done by erstwhile Maldives energy authority. For example, according to the information related to the Tariff revision 2019 published on dated 08 December 2019 (prior to establishing Utility Regulatory Authority) available in the website (URA, 2019) , "Maldives Energy Authority has reduced the electricity tariff and introduced a new fuel discount of 12 Laari per kWh KWhon all Islands except for Male', Hulhumale' and Vilimale'. The revised tariffs are as given below (URA, 2019).

Domestic Category

MALDIVES ENERGY AUTHORITY

Region	All Islands excluding Male', Hulhumale', Vilimale'					Category	Domestic			
Band	Old Tariff	Tariff Reduction	Fuel Discount	Current Tariff *without* Fuel Discount	Current Tariff *with* Fuel Discount	Charges *before* change	Charges *after* change	Difference	Difference	% of Customers
kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR	MVR	MVR	%	%
0 - 100	1.50	0.00	-0.12	1.50	1.38	150	138	-12	-8%	24
101 - 200	1.70	0.00	-0.12	1.70	1.58	320	296	-24	-8%	18
201 - 300	2.15	0.00	-0.12	2.15	2.03	535	499	-36	-7%	19
301 - 400	2.50	0.00	-0.12	2.50	2.38	785	737	-48	-6%	14
401 - 500	4.00	-1.05	-0.12	2.95	2.83	1185	1020	-165	-14%	10
501 - 600	4.50	-0.95	-0.12	3.55	3.43	1635	1363	-272	-17%	6
601 +	5.50	-1.25	-0.12	4.25	4.13	>1635	>1363			9

MALDIVES ENERGY AUTHORITY

Region	Male', Hulhumale', Vilimale'					Category	Domestic			
Band	Old Tariff	Tariff Reduction	Fuel Discount	Current Tariff *without* Fuel Discount	Current Tariff *with* Fuel Discount	Charges *before* change	Charges *after* change	Difference	Difference	% of Customers
kWh	MVR / kWh	MVR / kWh	MVR / kWh	MVR / kWh	MVR / kWh	MVR	MVR	MVR	%	%
0 - 100	1.50	0.00	-0.12	1.50	1.38	150	138	-12	-8%	9
101 - 200	1.70	0.00	-0.12	1.70	1.58	320	296	-24	-8%	10
201 - 300	2.15	0.00	-0.12	2.15	2.03	535	499	-36	-7%	15
301 - 400	2.50	0.00	-0.12	2.50	2.38	785	737	-48	-6%	15
401 - 500	2.95	0.00	-0.12	2.95	2.83	1080	1020	-60	-6%	13
501 - 600	3.55	0.00	-0.12	3.55	3.43	1435	1363	-72	-5%	10
601 +	4.25	0.00	-0.12	4.25	4.13	>1435	>1363			27

Figure 14: Domestic Category Tariff-Maldives

Business Category

MALDIVES ENERGY AUTHORITY

Region	Male', Hulhumale', Vilimale'					Category	Business			
Band	Old Tariff	Tariff Reduction	Fuel Discount	Current Tariff *without* Fuel Discount	Current Tariff *with* Fuel Discount	Charges *before* change	Charges *after* change	Difference	Difference	% of Customers
kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR	MVR	MVR	%	%
0 - 100	3.50	0.00	-0.12	3.50	3.38	350	338	-12	-3%	19
101 - 300	3.25	0.00	-0.12	3.25	3.13	1000	964	-36	-4%	18
301 - 500	3.65	0.00	-0.12	3.65	3.53	1730	1670	-60	-3%	15
501 - 600	4.00	0.00	-0.12	4.00	3.88	2130	2058	-72	-3%	6
601 - 3000	4.35	0.00	-0.12	4.35	4.23	12570	12210	-360	-3%	37
3001 - 10000	5.75	0.00	-0.12	5.75	5.63	52820	51620	-1200	-2%	5
10000 +	6.65	0.00	-0.12	6.65	6.53	>52820	>1363			1

MALDIVES ENERGY AUTHORITY

Region	Addu, Fuvahmulah					Category	Business			
Band	Old Tariff	Tariff Reduction	Fuel Discount	Current Tariff *without* Fuel Discount	Current Tariff *with* Fuel Discount	Charges *before* change	Charges *after* change	Difference	Difference	% of Customers
kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR	MVR	MVR	%	%
0 - 100	3.25	0.00	-0.12	3.25	3.13	325	313	-12	-4%	44
101 - 200	3.75	0.00	-0.12	3.75	3.63	700	676	-24	-3%	11
201 - 300	4.75	0.00	-0.12	4.75	4.63	1175	1139	-36	-3%	7
301 - 400	6.00	0.00	-0.12	6.00	5.88	1775	1727	-48	-3%	6
401 +	6.00	0.00	-0.12	6.00	5.88	>1775	>1727			32

MALDIVES ENERGY AUTHORITY

Region	All Islands excluding Male', Hulhumale', Vilimale', Addu & Fuvahmulah					Category	Business			
Band	Old Tariff	Tariff Reduction	Fuel Discount	Current Tariff *without* Fuel Discount	Current Tariff *with* Fuel Discount	Charges *before* change	Charges *after* change	Difference	Difference	% of Customers
kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR/ kWh	MVR	MVR	MVR	%	%
0 - 100	4.50	-1.25	-0.12	3.25	3.13	450	313	-137	-30%	49
101 - 200	5.75	-2.00	-0.12	3.75	3.63	1025	676	-349	-34%	12
201 - 300	6.50	-1.75	-0.12	4.75	4.63	1675	1139	-536	-32%	9
301 - 400	7.50	-1.50	-0.12	6.00	5.88	2425	1727	-698	-29%	7
401 +	7.50	-1.50	-0.12	6.00	5.88	>1775	>1727			24

Figure 15: Business Category Tariff-Maldives

Earlier also, Maldives Energy Authority (MEA) fixed the tariff. Maldives Energy Authority (MEA) has approved new electricity tariffs to provide electricity to domestic customers in all inhabited islands. [26]

The Maldives has also successfully experimented the solar PV deployment through bidding processes. Maldives had invited tenders for installation solar PV system and is responsible for the design, build, finance, own, operate and transfer of all facets of the project in Feb 6th, 2020. According to the World Bank's Project Information Document (PID)-Accelerating Renewable Energy Integration and Sustainable Energy (P172788) (WorldBank, 2019), IPP bids in the Greater Male area with STELCO as an offtake, supported by the Bank-funded Accelerating Sustainable Private Investment in Renewable Energy (ASPIRE) project, have demonstrated that electricity from solar PV independent power producers (IPPs) can be purchased as low as at 10.9 US cents per kWh, dramatic tariff reduction seen between Phase

26 https://www.ura.gov.mv/v1/news/mea-approves-new-electricity-tariff-for-domestic-customers/

1 and Phase 2 bidding; falling from 21 US cents per kWh in Phase 1 to 10.9 US cents per kWh in Phase 2.
According to the Project Document of the Asian Infrastructure Investment Bank-Sovereign-Backed Financings (AIIB, 2021), country has limited track record for utilities to engage in power purchase agreements (PPAs) with independent power producers (IPPs). According to the above report, STELCO signed three PPAs with IPPs according to the details given below:

i) PPA was signed in 2011 up to around 650 kW under its own initiative, at a tariff of 25 US cents/kWh for 20 years: ii) PPA for 1.5 MW solar PV, with a tariff of 21 US cents/kWh for 20 years and iii) PPA for an additional 5 MW, with a tariff of 10.9 US cents/kWh for 15 years. The second and the third PPAs were tendered under the Accelerating Sustainable Private Investments in Renewable Energy (ASPIRE) project.

At the moment, FENAKA has also no experience on procuring power from IPPs, but the model is expected to be replicated in outer islands where sufficient scale can be achieved.

2.5.3 Existing Power Procurement Models in CBET

The Maldives does not have any cross-border power trading with any neighbouring countries. It is unlikely that there will be any cross-border power trading in future because of geographical limitations and overall feasibility.

2.5.4 Challenges/Barriers

As mentioned earlier, the Maldives does not have any cross-border power trading with any neighbouring countries. It is unlikely that there will be any feasible cross-border power trading in future because of geographical limitations. Therefore, it may not be appropriate to lay down shortcomings, barriers and prevailing challenges with respect to CBET from the point of view of all stakeholders, essential for devising electricity pricing framework.

2.6 Nepal

2.6.1 Sector Insights

Nepal power sector has grown steadily over the years. Currently, total installed capacity of Nepal is 1,332 MW (NEA, 2020) , which was around 697 MW (NEA, 2010)[27] in the year 2010. IPPs contribute to about 52% of total capacity viz. 696 MW out of 1,332 MW of installed capacity in the year 2020. Peak demand has increased from 546 MW in the year 2011 to 1408 MW in 2020. Country has seen a steady rise in electricity purchase from India, from 694 GWh in the year 2011 to 2,813 GWh in the year 2019. According to the annual report of NEA for the fiscal year 2019/2020, "The total power purchased from Independent Power Producers (IPPs) in Nepal has increased substantially during the last 10 years viz from 1039 GWh in the year 2011 to 2,991 GWh in the year 2020, i.e., an increase an increase of 187% approx. Similarly, the total energy imported from India has also increased substantially from 694 GWh in 2011 to 1,729 GWh in 2020, i.e., an increase of 149% approx."

Table 13 Nepal Power Sector-Key Facts

Particulars	2011	2012	2013	014	2015	2016	2017	2018	2019	2020*
Availability (GWh)										
NEA Own Generation	2,125	2,359	2,292	2,298	2,368	2,133	2,305	2,308	2,548	3,021
Power Purchase from IPPs	1,039	1,074	1,176	1,070	1,269	1,166	1,778	2,168	2,190	2,991
Power Purchase from India	694	746	790	1,319	1,370	1,778	2,175	2,582	2,813	1,729
Total Availability (GWh)	3,858	4,179	4,258	4,687	5,007	5,077	6,258	7,058	7,551	7,741
Peak Demand (MW)	946	1,027	1,095	1,201	1,291	1,385	1,444	1,508	1,320	1,408

* Provisional Figures (Subject to audit), Source-NEA Annual Report 2020, https://www.nea.org.np/annual_report?page=1

Ministry of Energy, Water Resources and Irrigation is governing body of energy sector in Nepal. It oversees formulation of electricity sector policies and strategic plans for system expansion. Nepal Electricity Authority (NEA) is vertically integrated utility that is responsible for generation, transmission and distribution of electricity in Nepal and has separate directorates for the operation & management of each. It is also the single buyer of electricity in Nepal. The transmission directorate handles several functions such as scheduling & dispatch, grid development and grid operation. As a part of the reform initiative, Electricity Regulatory Commission has been established according to the Electricity Regulation Commission Act, 2017 (ERC N. , 2017). Electricity Regulatory Commission (ERC) (ERC, 2021)

[27] https://www.nea.org.np/annual_report?page=2

is the apex regulator that regulates sales & purchase of electricity, determines tariff, formulates the grid code & distribution code, maintains competition and work towards safeguarding of consumer's interest. Prior to formation of ERC, the tariff setting was as performed by Electricity Tariff Fixation Commission.

a) Government of Nepal has taken initiatives to reform the power sector and created (i) a transmission Company viz. "Rastriya Prasaran Grid Co Ltd (RPGCL) on 12 July 2015 to transmit and evacuate the power for the development and operation of the hydropower sector (RPGCL, 2021) and (ii) established a generation Company viz. Vidhyut Utpadan Company Limited (VUCL) on 20 November 2016. VUCL has a plan to become a leading electricity generation company across the country (VUCL, 2021). Further, Alternative Energy Promotion Centre (AEPC) is state-owned body that is responsible for promoting & developing large-scale use of renewable energy technologies and promotes rural electrification. Institutional Structure prevailing in Nepal is depicted in Figure 16 below.

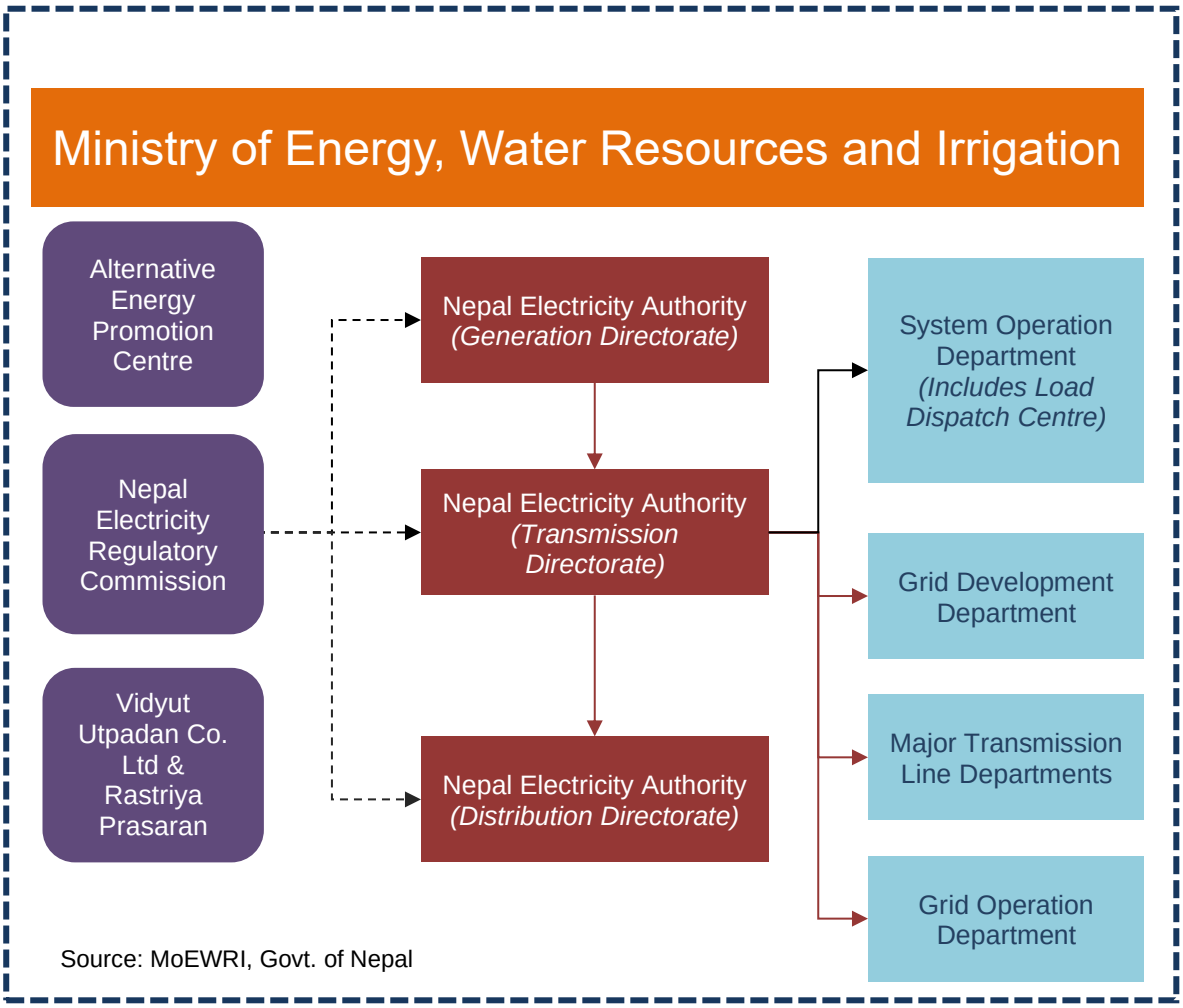


Figure 16: Institutional Framework of Nepal

According to the annual report of NEA for the fiscal year 2019/2020 (NEA, Annual Reports, 2020), "Power Trade Department (PTD) is responsible for trading of electric power in both domestic and cross border market. It is the single window interface of NEA with Independent

Power Producers (IPPs) for processing their application for Power Purchase Agreement (PPA). Functions of Power Trade Department may be broadly classified into three categories:

i. PPA processing and signing: It covers PPA processing activities up to and including its signing.
ii. PPA implementation and monitoring: It includes PPA administration after its execution till commercial operation.
iii. Operational administration and monitoring of PPAs: It includes PPA administration after commercial operation.

2.6.2 Relevant Act, Policies and Regulations

Electricity Regulatory Commission established according to the Electricity Regulation Commission Act, 2017 is the apex regulator that regulates sales & purchase of electricity and determines tariff. "Section 13 of the Electricity Regulation Commission Act, 2017 (ERC, 2017), relating to "Determination of Tariff and Regulation of Electricity Purchase and Sale" is reproduced below: -

"13. Determination of Tariff and Regulation of Electricity Purchase and Sale:
(1) The commission may work as follows for the determination of tariff and regulation of electricity purchase and sale:

A. In consideration of the operation cost, depreciation calculation rate, payment of principle and interest, repair and maintenance expenses, electricity structure construction, reconstruction, restoration and share investment related annual dividend and condition and basis of electricity tariff rate determination, prescribe the tariff payable by the consumers.
B. Until the wholesale market is established for the purchase and sell of the electricity prescribe the purchase/sale rate and process thereof to be carried out among the licensed persons for distribution and licensed person for generation or licensed person business or the corporate body established by Nepal Government.
C. To grant consent to the licensed persons for the purchase and sale of the generated electricity.
D. To identify and implement the essential resolution so as to minimize the electricity tariff.
E. To prescribe transmission and distribution charge (Wheeling charge).
F. To prescribe surcharge for the particular period of time over the related matter of electricity services in the special circumstance.

Electricity Regulatory Commission Rules, 2018, further provides details on the Tariff and Charges (Chapter 4) (ERC, 2018). "Section 9: Criteria for Fixation of Electricity Tariff", of the Electricity Regulatory Commission Rules, 2018 is reproduced below.

"9. Criteria for Fixation of Electricity Tariff:

(1) While fixing the electricity tariff to be paid by the consumers pursuant to Rule 8, the

Commission shall fix on the following basis:

(a) Operation cost of electricity system or production mechanism,
(b) Depreciation rate,
(c) Repayment of principle and interest,
(d) Maintenance cost,
(e) Mode of construction and operation of electricity structures,
(f) Reconstruction and rehabilitation and returns to be received on an annual basis in consideration of share investment,
(g) Power Purchase Agreement,
(h) Changes in consumers' price index,
(i) Revenue rate and changes therein,
(j) Policy adopted by the Government of Nepal in relation to electricity development,
(k) Other criteria deemed appropriate by the Commission.

(2) The Commission shall, also take the marginal cost of the electricity generation, the exchange rate of convertible foreign currency, cost of the fuel to be used for the production of electricity and the financial agreement entered between the licensee and the financial institution providing loan or investing capital in the concerned electricity project as the base while fixing electricity tariff pursuant to this Rule.

Provided, however, that while fixing the tariff and other fees/charges of electricity to be consumed by the Government of Nepal itself or a corporate body with more than fifty percent of share capital of the Government of Nepal, the Commission shall fix the tariff and other fees/charges in such a way as to abide by the agreement entered into by the Government of Nepal or by that corporate body with the financial institutions in relation to the concerned electricity project.

(3) The Commission may develop and implement necessary standards in relation to the fixation of electricity tariff. "

The commission can also fix the Power Purchase/Sales Rate as detailed in the Electricity Regulatory Commission Rules 2018. "Section 10: Fixation of Power Purchase/Sale rate" Of the Electricity Regulatory Commission Rules, 2018 is reproduced below.

"10. Fixation of Power Purchase/Sales Rate:

(1) The Commission may, pursuant to Clause (b) of Sub-Section (1) of Section 12 of the Act, develop and implement necessary standards for the purpose of fixation of power purchase/sales rate between the persons obtaining distribution license and the persons obtaining generation license or persons obtaining trade license or a corporate body

established by the Government of Nepal under the prevailing law.

(2) The Commission may, while fixing power purchase/sales rate, also bring into use **the two-part tariff system** – Capacity Charge incorporating loan investment made in the project and Energy Charge incorporating equity, returns, tax, royalty, operation and maintenance cost. "

According to the section 11 of the Electricity Regulatory Commission Rules, 2018, rate can also be fixed on Mutual Understanding and the section 11 is reproduced below:

"

(1) In a case where an agreement has been entered into between the generation licensee and electricity consuming industry or institution as to purchase/sell electricity, the generation licensee and such an industry or institution may specify power purchase/sales rate on a mutual understanding by obtaining consent of the Commission.
(2) While specifying power purchase/sales rate pursuant to Sub-Rule (1), it shall be done as to be maintained uniformity with the power purchase/sales rate agreed with other industries or institutions of similar types.
(3) While specifying power purchase/sales rate pursuant to Sub-Rule (1), it shall not be done in collusion with each other in a manner to have adverse impacts on the consumers. "

NEA enters into power purchase agreements with various power generation companies (IPPs of Nepal). Broadly, pricing is based on cost plus, negotiation, pre-defined maximum price and competitive bidding. According to the annual report of NEA for the fiscal year 2019/2020 (NEA, 2020), "NEA has fixed posted rates for energy purchase from three categories of projects; viz Run of River (ROR), Peaking Run of River (PROR) and Storage type projects."

Excerpts of NEA's board decisions on the power purchase rates and associated rules for PPA of ROR/PROR/storage projects effective from 2074/01/14 (April 27, 2017)[28] are reproduced below: -

"1. Rated capacity of hydropower projects to be eligible for local currency PPA =any capacity
2. Rated capacity of hydropower projects to be eligible for foreign currency PPA = above 100 MW

Maximum power purchase rate for energy = NEA's rate decided for ROR/PROR/Storage projects ROR (Posted rate with 3% simple escalations for 8 years for the capacity up to 100 MW and the base rate to be lowered for projects above 100 MW with ROE higher than 17 %)

[28] https://www.nea.org.np/admin/assets/uploads/PPA_Rates.pdf

Table 14: ROR Posted rate

Option	Season[29]	Rate NR/kWh (upto 100 MW project)	Min. Dry season Energy required
1 (Dry and wet season 6 months each)	Wet (Jestha 16 - Mangsir 15)	4.80	30 %
	Dry (Mangsir 16- Jestha 15)	8.40	
2 (Dry and wet season months 4 and 8 respectively)	Wet (Baisakh- Mangsir)	4.80	15 %
	Dry (Poush- Chaitra)	8.40	
Nepali Calender: Jestha: May-June; Asar: June-July; Shrawan: July-August; Bhadau: August-September; Aswin: September-October; Kartik: October-November; Mansir: November-December; Poush: December-January; Magh: January-February; Falgun: February-March; Chaitra: March-April; Baisakh- April-May			

PROR (Posted rate with 3% simple escalations for 8 years for the capacity up to 100 MW and the base rate to be lowered for projects above 100 MW with ROE higher than 17 %)

Table 15: PROR Posted rate

Season	Time of Day	Daily hours required to generate at rated capacity	Rate NR/kWh	Min. Dry season Energy required
Dry (Mangsir 16- Jestha 15)	Peak hours	1 hr to less than 2 hrs	8.50	30 %
		2 hrs to less than 3 hrs	8.80	
		3 hrs to less than 4 hrs	9.40	
		4 hrs to 6 hrs	10.55	
	Non-peak hours		8.40	
Wet (Jestha 16- Mangsir 15)	All hours		4.80	

[29] https://nepali-unicode.com/blog/nepali-months-english.html

Nepali Calender:- Jestha: May-June; Asar: June-July; Shrawan: July-August; Bhadau: August-September; Aswin: September-October; Kartik: October-November; Mansir: November-December; Poush: December-January; Magh: January-February; Falgun: February-March; Chaitra: March-April; Baisakh- April-May

i.e., for PRoR projects, dry season tariff is NRs. 8.5, NRs. 8.8, NRs. 9.4, NRs. 10.55 for peaking hour of 1 to less than 2 hours, 2 to less than 3 hours, 3 to less than 4 hours and 4 to 6 hours respectively and for wet season, tariff is NRs. 4.8.

STORAGE (3% simple escalations for 8 years and base rate to be lowered for projects of any rated capacity with ROE higher than 17 %)

Table 16: Storage Posted rate

Season	Rate NR/kWh	Min. Dry season Energy required
Dry (Mangsir 16- Jestha 15)	12.40	35 %
Wet (Jestha 16- Mangsir 15)	7.10 (If wet season energy is more than 50%, this rate shall be decreased by the excess %)	
Nepali Calender:- Jestha: May-June; Asar: June-July; Shrawan: July-August; Bhadau: August-September; Aswin: September-October; Kartik: October-November; Mansir: November-December; Poush: December-January; Magh: January-February; Falgun: February-March; Chaitra: March-April; Baisakh- April-May		

"

According to the annual report of NEA for the fiscal year 2019/2020 (NEA, 2020), "The total number of PPAs signed with the various IPPs is 341 and the combined installed capacity of this is 5,978.13 MW as of FY 2019/20." During the FY 2019/20, a total of 2 new PPAs were signed with a combined installed capacity of 9 MW with solar power projects based on tariff-based competitive bidding and Viability Gap Funding (VGF). For the large hydro power projects which gets processed through Investment Board of Nepal (IBN), NEA also enters in to such PPAs for the domestic electricity. For cross border electricity export, such project entities/developers can also enter into negotiations/power purchase agreements with buyers beyond Nepal subject to relevant rules and regulations of importing/transit country (as the case may be) as well as of exporting country, if applicable. Price of such power is decided through negotiations or through established processes as applicable, subject to relevant rules and regulations of importing/transit country (as the case may be). For example, according to the CERC (Cross Border Trade of Electricity Regulations), 2019 of India (CERC, Cross Border Trade of Electricity Regulations, 2019) "Provided that in case of import of electricity from the hydro generation projects located in any of the neighbouring countries, the tariff thereof shall be determined by the commission according to the parameters

specified in the tariff regulations notified from time to time, only if the hydro generator approaches the Commission through the Government of the neighbouring country and is agreed to by the buying Indian entity(ies). “

2.6.3 Existing Power Procurement Models in CBET

Nepal - India trade electricity through various transmission lines operating at various voltage levels from 11kV to 220kV. Presently Nepal is importing power from Bihar and Uttar Pradesh power grid of India. List of cross Border transmission lines are a) Gandak - Ramnagar – 132kV b) Dhalkebar - Muzaffarpur- 400kV (Presently charged at 132kV) c) Kusaha-Kataiya. - 132kV d) Mahendranagar – Tanakpur -132kV e) Siraha – Jaynagar - 33kV f) Birpur – Kataiya - 33kV g) Jaleswar - Sursand - 33kV h) Birgunj – Raxaul -33kV i) Bhairahwa – Nautanawa– 33kV j) Koilabas – Lamhi – 33kV k) Nepalgunj – Nanpara– 33kV l) Dhangadhi – Paliya – 33kV m) Mahendranagar – Lohiahed – 33kV and n) Chandragadhi – Thakurgunj – 33kV.
NEA imports/exports electricity with India through various mechanisms and primarily the price of such electricity is determined through negotiations (except the power which is imported from Indian power exchange). According to the annual report of NEA for the fiscal year 2019/2020 (NEA, 2020), “A total of 1,729 GWh of electricity was imported through various transmission links including Dhalkebar-Mujaffarpur line in FY 2019/20, whereas Nepal has also been able to export 107 GWh of electricity to India, an increase of 18.6% through power exchange mechanism.”

The Power Pricing of Cross Border Electricity trade between India and Nepal is based on G to G, commercial Contracts negotiated through Indian traders viz. PTC and NVVNL and also trading Day Ahead through Indian Power Exchange Platform.

According to the annual report of NEA for the fiscal year 2019/2020 (NEA, 2020), “Government of Nepal has given prior approval to NEA for all types of cross border power trading including Day Ahead Market (DAM), Term Ahead Market (TAM) and long term, medium term and short-term power trading. This enabled NEA to operationalize the agreement signed with NVVN earlier for power trading through the power exchange markets of India after the Conduct of Business Rules (CBR/Procedure) is approved by the concerned ministry of Government of India which was finalised on 26th February 2021 (CEA, 2021). In addition to power exchanges, NEA has also commenced the commercial preparations by signing a composite agreement with NVVN for transactions involving both purchase and sale of electrical energy. According to the agreement, NEA is required to sign separate agreements for each transaction with NVVN in future for selling Nepal’s surplus energy. This will herald a new era of cross border power trading between Nepal and India with a myriad of implications on profit earning, transmission capacity utilization, technology transfer and system stability along with other mutually shared benefits “. On Monday, 19 April 2021, Nepal started the import of electricity through India’s power exchange platform i.e. The Indian Energy Exchange, India’s premiere energy marketplace (IEX, 2021).

2.6.4 Challenges/Barriers

Nepal has become the leader in transition to the market form of cross border electricity trade in South Asia with the initiation of the import of electricity through India's power exchange platform i.e. The Indian Energy Exchange. Present trade of electricity & power pricing framework between Nepal and India (other than power exchange) is bilateral tariff determination is based government-to-government negotiation by the power exchange committee and other are through commercial negotiation with power trader of India such as Power Trading Corporation of India (PTC) and NTPC Vidyut Vyapar Nigam ltd (NVVN).

Nepal has ambitious plans to tap into Indian power market as exporter of electricity. According to the transmission system development plan of Nepal, six 400 kV Cross Border Transmission lines are planned viz a) Attariya-Bareily b) Dododhara–Bareily c) Phulbari–Lucknow d) New Butwal–Gorakhpur e) Dhalkebar – Muzzafarpur and f) Inaurwa – Purnea Cross Border Transmission Line (RPGCL, 2018).

Through CBET, Nepal was able to meet its power deficit and also meet auxiliary power requirement for construction of new hydro power projects. Various hydro power projects in Nepal are under construction and in future the trade of energy/electricity is likely to enhance substantially. Further, Nepal needs to move from Single buyer model to Competitive buyer/seller model.

As most of the power export from Nepal is hydro dominated, it is useful for providing balancing power/ancillary services for load balancing to counter intermittency of solar and wind power, which are being deployed in massive scale in particularly in India (450 GW by 2030).

2.7 Pakistan

2.7.1 Sector Insights

Pakistan's installed capacity at the time of creation in 1947 was just 60 MW which had grown to 21,593 MW (NEPRA, 2010) in 2010 and now in 2020 it is 38,719 MW (both Non-renewable & renewable) (NEPRA, 2020). In the period from 2010 to 2020, Pakistan added substantial generation capacity of 17,126 MW. Out of total installed capacity of 38,719 MW, thermal accounts for 64%, followed by hydro about 25%, and the balance is solar, wind, nuclear, bagasse and captive etc. NTDC transmission system has also grown substantially in the last decade. In 2010, NTDC's total transmission lines (both 500 kV and 220 kV) was 12,445 circuit kilometre (ckm) which has grown to 18,519 circuit kilometre (ckm) i.e., increase of about 48**%.**

At the time of its creation in 1947, Pakistan's,electrical utility was a vertically integrated company known as Karachi (Karachi Electric Supply company – KESC) which was serving 15% of national demand at that time (Bacon, 2019).Currently, two power purchasing agencies

exist viz. Karachi (KE) responsible for Karachi and nearby areas and Central Power Purchasing Agency-Guarantee (CPPA-G) responsible for rest of Pakistan. Similarly, the transmission system of Pakistan is also divided into two entities viz. KE network which is responsible for Karachi and nearby areas whereas for the rest of the country, NTDC is responsible. The distribution of electricity in Pakistan is performed/operated by the region-wise DISCO's licensed by the regulator viz. NEPRA. In Karachi, KE is the sole organization which handles distribution also.

For the development of hydro projects and water sector projects, the vertically integrated Water and Power Development Authority (WAPDA) was created in 1958 as an autonomous body under the federal government. Till 1991, KESC was a bundled utility and was responsible for generation, transmission and distribution in Karachi and nearby areas whereas WAPDA was responsible for Generation, Transmission and Distribution in other areas.

Pakistan has taken various initiatives to reform the power sector such as establishing independent regulator, separating business of buying and selling of electricity from NTDC to independent organization viz. Central Power Purchasing Agency etc. As Pakistan was suffering from power shortages, the reform process was initiated in 1992 to attract private investments to the sector. WAPDA was restructured and only hydro generation remained with them. Thermal generation was given to PEPCO and 14 other corporate entities were established as follows:

(i) Four (4) thermal Generation Companies were formed (GENCOs)
(ii) One (1) National Transmission & Power Despatch Company (NTDC)
(iii) Ten (10) Distribution Companies (DISCOs) and K-Electric for Karachi

The power division in Ministry of Energy, Pakistan is responsible for making the policies, strategic plans and looks after general monitoring activities in generation, transmission and distribution and coordination among different federal agencies in the country. The Institutional structure prevailing in Pakistan is depicted below:

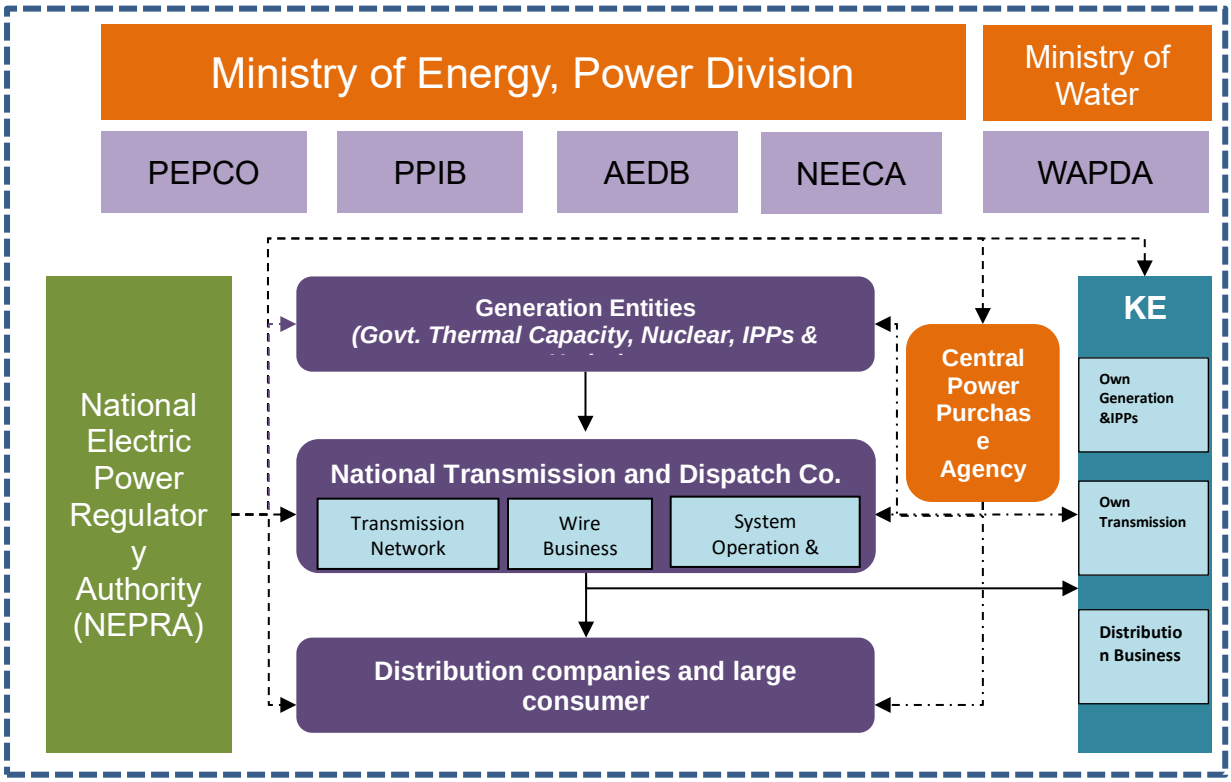


Figure 17: Institutional Framework of Pakistan

Till 2015, it was a single buyer model, NTDC was responsible for buying of electricity from all the generators including private and selling electricity to distribution companies. Even the Power Purchase Agreements were signed between NTDC and generators on behalf of Discos. In 2015, the Economic Coordination Committee (ECC) of the Pakistan Cabinet decided to transform the electricity market from single-buyer model to Competitive Trading Bilateral Contracts Market (CTBCM). As such, the Central Power Purchasing Agency (CPPA-G) drafted the Market Rules & comprehensive plan for transition of the power market to a CTBCM. The concept of CTBCM is that existing PPAs signed between IPPs and NTDC/CPPA-G signed on behalf of DISCOMS will be converted into bilateral contracts between each IPPs and DISCOMS.

2.7.2 Relevant Act, Policies & Regulations

Prior to 1998, it can be named as pre regulated regime where tariff was set for two companies by the Government of Pakistan viz. for KE and WAPDA on the formula mainly driven by the two covenants viz. 40% self-financing equal to average of three years' investment program and 1.5 times Debt Service Coverage Ratio. It means that keeping in view of economic and social objectives, historical tariff setting was mainly to recover cash costs of whole supply chain. After the formation of independent regulator NEPRA, tariff setting is being done by NEPRA, therefore can be named as post regulated regime. The price/tariff for generation, transmission and distribution segments and setting of consumer end tariff is designed by regulator keeping in view the Tariff Standards & Procedure Rules, 1998 as well as the policy direction of the GOP. The tariff of Generation sector works on principle of two-part tariff structure. i.e., Capacity Charge & Energy Charge. The variable charge consists of fuel

component and variable operation & maintenance component. The tariff of transmission sector includes use of system charges (fixed cost) and pool generation cost (fixed plus variable cost), transfer pricing mechanism. For distribution sector, the tariff component includes Distribution Margin (Fixed Cost) and Power Purchase Price. The central power purchasing agency procures power on behalf of DISCOMs at the price predetermined by the regulator (Lodhi).

National Electric Power Regulatory Authority (NEPRA) in 1998 came out with Tariff Standards & Procedures Rules '1998 (NEPRA, 1998). Subsequently in 2018, NEPRA through amendment, came out with "Guidelines for Tariff Determination" under NEPRA (Amendment) Act, 2018 (NEPRA, 2020).

The following general guidelines as applicable in the determination, modification or revision of rates, charges, and terms and conditions for provision of electric power services are reproduced below (source: NEPRA Industry Report 2020):

"7.8.1 (a) Tariffs should allow licensees the recovery of any and all costs prudently incurred to meet the demonstrated needs of their customers, provided that assessments of licensees' prudence may not be required where tariffs are set on other than cost-of-service basis, such as formula-based tariffs that are designed to be in place for more than one year;
(b) Tariffs should generally be calculated by including a depreciation charge and a rate of return on the capital investment of each licensee commensurate to the earned by other investments of comparable risk;
(c) Tariffs should allow licensees a rate of return which promotes continued reasonable investment in equipment and facilities for improved and efficient service;
(d) Tariffs should include a mechanism to allow licensees a benefit from, and penalties for failure to achieve, the efficiencies in the cost of providing the service and the quality of service;
(e) Tariffs should reflect marginal cost principles to the extent feasible, keeping in view the financial stability of the sector;
(f) The Authority shall have a preference for competition rather than regulation and shall adopt policies and establish tariffs towards that end;
(g) Tariffs may be set below the level of cost of providing the service to consumer's categories consuming electric power below such consumption as may be prescribed, as long as such tariffs are financially sustainable;
(h) Tariffs should, to the extent feasible, reflect the full cost of service to consumer categories with similar service requirements;
(i) Tariff should seek to provide stability and predictability for consumers; and
(j) Tariffs should be comprehensible, free of misinterpretation and shall state explicitly each component"

NEPRA in 2011 came out with Upfront tariff regulations (NEPRA, 2011), Part IV: GUIDELINES

& STANDARDS as contained is reproduced below:

"5. The upfront tariff shall be technology specific, fuel specific, site/region specific with different financing options (local, foreign or mixed) etc.
6. While approving the upfront tariff, due regard will be given to: —
a. The tariffs already determined or approved for similar site/region, technology or fuel etc;
b. Type of technology such as Wind Turbines, Combined Cycle Gas Turbine, Steam Turbine or Reciprocating engine etc.
c. Number of units and size (MW)
d. Installed capacity, auxiliary consumption, net capacity etc.
7 The upfront tariff determined/approved by the Authority shall remain applicable for such period as may be determined/specified by the Authority.
8. The upfront tariff shall be given for the brand-new machinery only.
9. The upfront tariff shall commence on the COD and shall remain effective for the tariff control period as specified by the Authority.
10. The terms and conditions of upfront tariff determined/approved by the Authority shall form part of upfront tariff and once accepted shall not be subject to modification or adjustments except for the adjustments/indexations allowed at the time of approval of the application."

In 2014, NEPRA issued procedures, guidelines, and regulations for tariff approval for prices discovered under Competitive bidding and subsequently in 2017 (NEPRA, 2017) came out with approval procedures of competitive bidding. Some of the Key highlights of Competitive Bidding Guidelines are:

(i) The bids should be site and technology specific.
(ii) Before initiating the bidding process, RFP to be approved by NEPRA
(iii) The levelized tariff approved by the NEPRA for similar technology shall be taken as benchmark and reverse bidding from the benchmarked levelized tariff figure should be done.
(iv) After invitation, no changes can be made in the RFP without the approval of NEPRA.
(v) Bid evaluation report along-with complete records to be submitted to NEPRA for approval.

NEPRA in 2017 also came out with regulations for import of electricity viz. "National Electric Power Regulatory Authority (Import of Power) Regulations, 2017" (NEPRA, 2017). According to these regulations, the Buyer needs to submit all the necessary details in the prescribed format containing details such as sources, quantum of energy to be procured, tariff details, cost estimates, feasibility study, cost of interconnectivity etc. to the Regulator viz. NEPRA. NEPRA to approve the rate, terms & conditions of the power to be imported and also need to intimate the federal government for notification in the gazette. Buyer will be required to sign the PPA in line with the rate and terms & conditions approved by Regulator.

To promote private investment in the Generation and to standardize the conditions for investment for IPPs, Government of Pakistan in 1994 (Bacon, 2019) issued "Policy Framework and Package of Incentives for Private Power Generation Projects". This policy was a major milestone in the Pakistan Power sector by attracting $5 billion in investment and adding almost 4,500 MW of generation capacity at the cost-plus tariff methodology. The policy allowed the IPPs to place the currency risk and fuel supply risk with the government. As fuel cost was pass-through in the tariff, the policy favoured developers who were willing to build plants that could be brought online fast. Most of the plants brought online were oil-based. The policy guaranteed a fixed return over the life of the project regardless of the efficiency and performance of the plants. Abstracts of this policy (1994) are highlighted below:

(i) The standardization of contracts
(ii) Remuneration for all electricity at US 5.7 cents
(iii) Power-grid connection and supply guarantee for the required primary energy sources.
(iv)Exemption from numerous forms of taxation (capital-gains tax, income tax, turnover tax) and duties.
(v) Guaranteed acceptance of supplied power and delivery of required primary energy sources.
Government of Pakistan also created a new state-owned institution, the Private Power and Infrastructure Board (PPIB), whose main function was to provide guidance for the implementation of power plant projects.
For the sustainable growth of economy, Government of Pakistan has recently come out with National Electricity Policy 2021 with the objectives to make the Power Sector more efficient, reliable, secure, Competitive, transparent and to make available supply of electricity to all at affordable prices. The policy identified action plans need to be taken in different areas of the power sector viz. (a) Generation; (b) Transmission; (c) Distribution & Supply; (d) System Operations;(e) Market development;(f) Cost of services, tariff and subsidies; (g) Energy efficiency & Conservation; (h) Integrated Planning and (i) Governance to achieve the sustainable growth of power sector vis-a-vis economy of the country. The above Policy will help to create environment for establishing competitive power market in the country. Some of the important Points of the Actions Plan of this policy are discussed below in brief:

a. Generation: Any capacity expansion shall be only on a competitive and least cost basis, except for Strategic Projects. For Strategic Projects (a) the qualification and methodology shall be given in the National Electricity Plan, and (b) the Federal Government to approve such projects on a case-to-case basis. Procurement of power from such projects which do not qualify strategic projects, beyond least cost principle shall be subject to the provisioning of subsidy by Government/Provincial Government (to the extent of incremental cost of such projects beyond least cost). Policy also encourages construction of multipurpose water reservoirs, hydro power, increasing share of renewable energy according to the IGCEP based on least-cost principle.

b. Transmission: All expansion of the transmission network under the PPP model will be carried out on a competitive basis, giving equal opportunity to all the interested parties.

c. Distribution & Supply: Keeping in view that existing operations of DISCOMs have led to accumulation of circular debt which has threatened the financial viability of the distribution sector and Power sector as a whole, policy therefore emphasizes for efficient tariff structures to create sufficient liquidity in the power market. Keeping in view of current market liabilities, regulator to review/revisit the target set for T&D losses and revenue collections.

From the above Pakistan National Electricity Policy'2021, it can be concluded that Government of Pakistan is moving towards transparent, Competitive Power Market viz. availability of electricity at most competitive prices, which is in the interest of consumers.

2.7.3 Existing Power Procurement Models in CBET

On the western side of Pakistan, there is no grid interconnection and therefore no CBET taking place in South Asia Region, though Pakistan is connected outside the South Asian region. In 2002, Iran and Pakistan signed the first agreement for the import of 34 MW[30]. According to NEPRA's State of Industry report 2020, Pakistan imported about 513.74[31] GWh from Iran during 2019-20. According to NEPRA's Amendment No. 5 issued on 14th Jan'2020[32], tariff effective from 1st January 2017 to 31st December 2019 between NTDC/CPPA-G and TAVANIR, Iran for Supply of 100 MW is according to following formula:

R= 2.5 + 0.07 * P

Where:

- R: Electricity Energy payable in US$ Cents per each kWh
- 2.5: US Cents per kWh for the fixed portion of the delivered electricity cost
- 51.5 US$ < P < 100 US$

Wherein "P" is monthly average crude oil price ranging from US$ 51.5 to US$ 100 per barrel. By applying this formula, the tariff will remain in the range of US Cents 6.10/kWh to US Cents 9.50/kWh depending upon the variation in oil prices. It may also be mentioned here that the tariff of US cents 6.10/kWh to US cents 9.50/kWh was applicable during the period between January 2016 to 31st December 2016. NEPRA, as brought out in the foregoing paras above, have come out regulations for import of electricity. Further, under CASA-I, Pakistan is set to be connected to Central Asian Countries in the future. Feasibility study has been conducted to interconnect two large economies of the region viz. India and Pakistan, however no progress has been made so far.

[30] https://en.irna.ir/news/84092407/Pakistan-hoping-to-extend-electricity-imports-from-Iran

[31] https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202020.pdf

[32] https://nepra.org.pk/tariff/Tariff/CPPAG/2020/PAR-137%20Amendment%2014-01-2020%201062-64.PDF

2.7.4 Challenges/Barriers

All the existing Policies/guidelines in Pakistan relating to power pricing viz. regulated, upfront, Negotiated or Competitive by the Government or Regulator have been intended to promote domestic power market. As per NEPRA state industry report 2020 (State of Industry Report, 2020), for Renewable energy, AEDB has initiated the process for development of such projects on Competitive bidding. In the present market structure, CPPA-G established as market operator (government owned power utility) and is also responsible for making transition from single buyer model to Competitive Power market in the country. Under the new concept of Competitive Trading Bilateral Contracts Market (CTBCM), existing PPAs signed between IPPs and NTDC/CPPA-G on behalf of Discos need to be converted into bilateral contracts between each IPPs and DISCOMs (Business Profile, 2021). Further, CPPA-G needs to develop short term power market including setting up of Power exchanges to optimize resources to the full extent. Power Exchanges provide an excellent platform for the buyer/sellers to transact in a most transparent, competitive, and efficient way. After adopting concept of Competitive tariff-based bidding in India, cost of tariff has declined substantially as compared to cost plus basis. For example, adopting concept of Competitive tariff-based bidding for renewable energy in India, tariff discovered was about Rs 2.44 per kWh (based on latest bidding by SECI). In the long run, it is important for CPPA-G to develop Competitive tariff-based bidding concept along-with setting up of short-term power market including energy exchanges to have competitive tariff for the benefits of consumers.

Cross Border Trade of Electricity in the eastern region has helped the countries to optimize their energy resources, availability of electricity at competitive prices, to meet their energy demand etc. However, as CBET in South Asia region is bilateral, it is important for the countries to move to multilateral Power trade. The move towards market form of pricing in CBET will help in making transition towards a system of competitive price discovery and optimisation of cost. Though SAARC intergovernmental framework signed by all the member states in 2014, also promotes multilateral power trade, same is yet to be materialized.

It is also important for the two big economies of the south Asia region viz. India and Pakistan to promote grid connectivity vis-à-vis growth of economy. Looking at the existing trend of Cross Border Electricity Trade in SAARC, the power pricing may be based on government-to-government negotiation, Competitive bidding framework etc. However, efforts should be made to have a market form of pricing in CBET both for import and export and to have portfolio of negotiated and market form of pricing. The move towards market form of pricing in CBET will help in making transition towards a system of competitive price discovery and optimisation of cost.

2.8 Sri-Lanka

2.8.1 Sector Insights

Sri-Lanka power sector has grown steadily over the years. Currently, total installed capacity

of Sri-Lanka is 4,217 MW (CEB, 2019), which was around 2,819 MW (CEB, 2010) in the year 2010. As of 2019, the Ceylon Electricity Board (CEB), the vertically integrated monopoly and the single buyer contributes around 2,953 MW (71%) of installed capacity whereas IPPs contributes around 1,264 MW (29%).

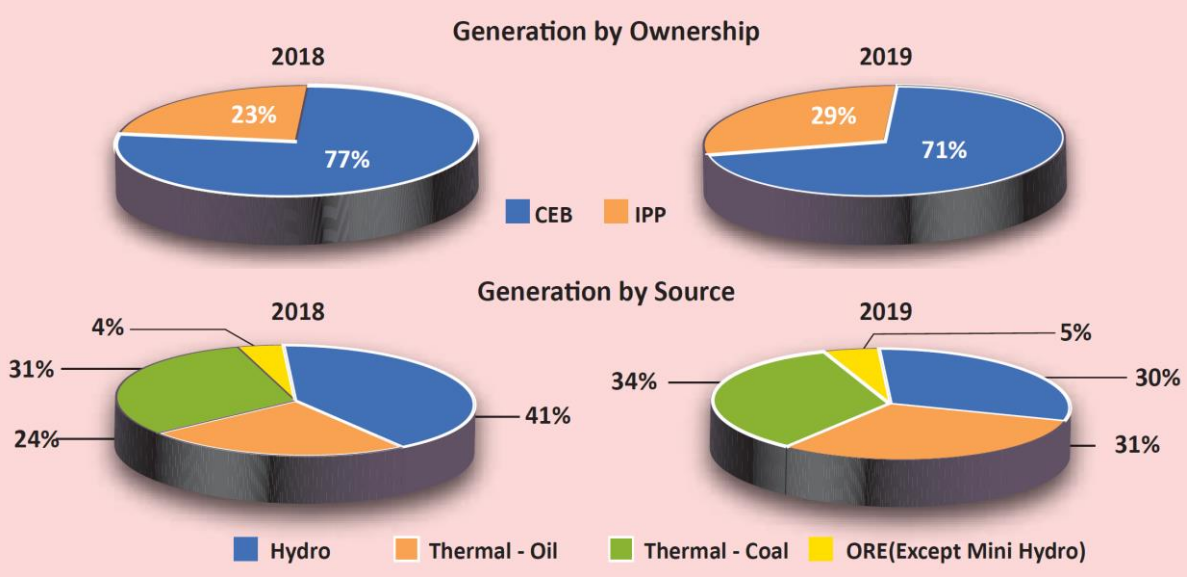


Figure 18: Electricity Generation in Sri-Lanka by Ownership & Source

Power generation is dominated by Coal (34%) followed by oil (31%) and hydro (30%). Maximum demand in the year 2019 was 2,668.7 MW.

Electricity Reform Act, No. 28 of 2002, introduced the concept of creating a separate independent regulator i.e. the Public Utilities Commission of Sri-Lanka (PUCSL), the concept of various licenses (generation, transmission, and distribution), re-organisation of electricity industry etc. Ceylon Electricity Board (CEB), the government-owned, vertically integrated utility of Sri-Lanka is responsible for carrying out all major functions of Generation, Transmission and Distribution. It owns major share in Hydro & Thermal power plants. On 01st November 1969, CEB was established under Parliament Act No. 17 of 1969 (Knowledge Hub, 2021). The energy sector in Sri-Lanka is governed by Ministry of Power. The Public Utilities Commission of Sri-Lanka (PUCSL) provides regulatory oversight on country's power sector. It plays a role in approving Bulk Supply, Distribution and Retail Supply Tariffs. The distribution sector in Sri-Lanka is managed both by CEB & Lanka Electricity Company Ltd. (LECO) with CEB having operations in four divisions whereas LECO operating only in one division. The Institutional Structure prevailing in Sri-Lanka power sector is depicted below Figure 19:

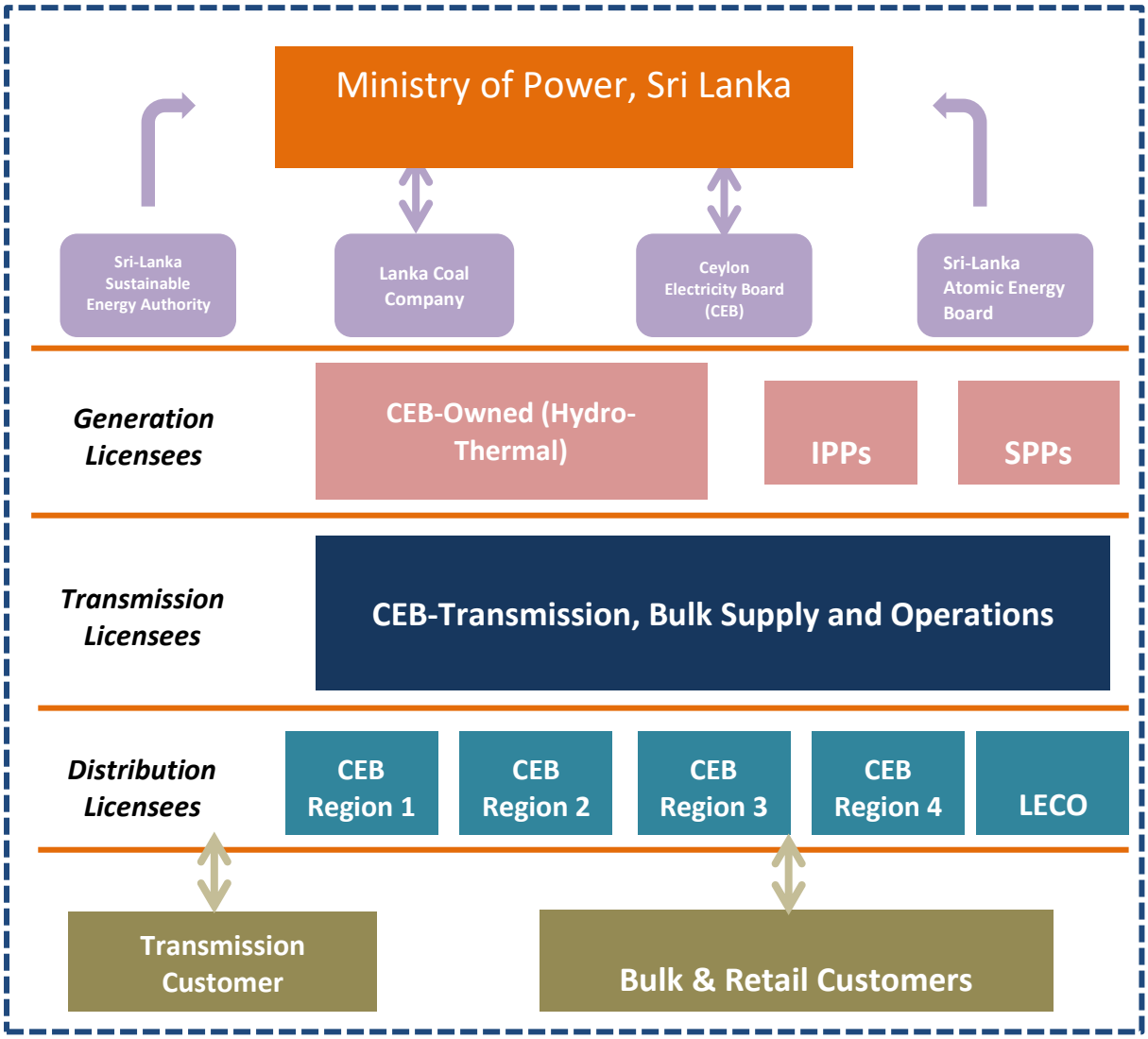


Figure 19 Institutional Framework of Sri Lanka

2.8.2 Relevant Act, Policies & Regulations

Section 4.3 and 4.7 of The National Energy Policy and Strategies of Sri-Lanka (Ministry of Power, National Energy Policy and Strategies of Sri Lanka, 2019) relating to development of transparent pricing methodology, subsidy and enhancing share of renewable energy through competitive bidding is reproduced below:

Description	Responsibility
"4.3 Providing Energy Supply Services at the Optimum Cost to the National Economy	
To ensure that energy services are provided at the optimum long-term cost to lower the burden on the national economy, the following targets and milestones will have to be met by the institutions to which responsibilities are assigned;	
3a A transparent pricing methodology for electricity and fossil fuel products will be developed and implemented by mid-2020 by the CEB, the CPC and other sector players through a regulatory mechanism	CEB/CPC/ PUCSL

established by the PUCSL.	
3b the life-line electricity tariff will be limited only to low-user household customers using less than 30kWh per month. A study will be conducted by MoPE in 2020 to decide other target groups of energy users that deserve special consideration, the subsidy amount and the source of funds."	MoPE
"3.8 Strengthening Good Governance in the Energy Sector	
3.8.2 Procurement of plant, equipment, crude oil and other fuels, as well as power purchase agreements and similar concessions, will be made through a streamlined competitive bidding scheme ensuring transparency, accountability and avoiding long term delays.	
4.7 Enhancing the Share of Renewable Energy	
7c A fully-fledged competitive bidding scheme for renewable energy investments will be implemented through a resource development programme to realise a pipeline of 'ready to invest' projects by mid-2020 by the SEA, realising 20% of generation with a cumulative renewable energy generation capacity of 1,600 MW by 2023.	SEA/CEB
7d Applications received by the SEA when feed-in tariffs were on offer, but held up due to the termination to feed in tariffs, which are at various stages of the approval process will be channelled to a competitive bidding model by using suitable interim approaches such as offering project proponents preferential treatments when they were opened up for competition considering the maturity of a project, investments made, etc. A list of such alternate options will be jointly developed by the CEB and the SEA by mid 2020for different technologies, considering their inherent attributes so that all such projects in abeyance could be expeditiously developed within a competitive bidding framework by end 2023. "	SEA/CEB

From the above it is clear that a transparent power pricing methodology is to be developed. The power purchase agreements to be streamlined and also development of competitive bidding framework. In the case of Renewable Energy, competitive bidding is to be adopted.

PUCSL is to regulates the tariffs and other charges levied by licensees. The relevant section of the Sri-Lanka Electricity Act, No. 20 of 2009 is reproduced below:

"CHAPTER II FUNCTIONS OF THE COMMISSION

3. (d) to regulate tariffs and other charges levied by licensees and other electricity undertakings, in order to ensure that the most economical and efficient service possible is provided to consumers; "

"Tariffs 30. (1) This section shall apply to-

(a) tariffs or charges levied by the transmission licensee[33] for the transmission and bulk sale of electricity (hereinafter referred to as "transmission and bulk sale tariffs"); and
(b) tariffs or charges levied by the distribution licensee for the distribution and supply of electricity (herein after referred to as "distribution and supply tariffs").

(2) Transmission and bulk sale tariffs and distribution and supply tariffs, as the case may be, shall, in accordance with conditions specified in the relevant licence -

(a) be set by the relevant licensee in accordance with **a cost reflective methodology approved by the Commission**;
(b) permit the relevant licensee to recover all reasonable costs incurred in the carrying out of the activities authorized by its licence on an efficient basis,
(c) be **approved by the Commission in accordance with the policy guidelines approved by the Cabinet of Ministers** under section 5; and (d) be published in such manner as may be required by the Commission, in order to ensure public knowledge. "

"Section 17: Functions of the Commission", according to the Public Utilities Commission of Sri-Lanka act, No. 35 of 2002 (PUCSL, 2002), section 17 "Functions of the Commission is reproduced below

" 17. Subject to the provisions of this Act, the Commission shall, among other things, —

(h) regulate tariffs and other charges levied by regulated entities where required by any industry Act; "

Public Utilities Commission of Sri-Lanka have come up with various tariff methodologies such as the follows.

- Electricity Tariff Methodology (2015)
- Cost Reflective Methodology for Tariffs & Charges (2016)
- Tariff Methodology for Transmission Customers
- Methodology for Tariffs for Persons Exempted from the Requirement to Obtain a License to Distribute and Supply Electricity Download User Guide for Electricity Pricing And Tariff Determination Model For Exempted Persons EP Tariff Model
- Non-Conventional Renewable Energy (NCRE) Tariffs Methodology

The Electricity Tariff Methodology (2015), issued by Public Utilities Commission of Sri-Lanka on November 2015 (PUCSL, 2015) , provides the details of a) The Bulk Supply Tariffs, that include the component of the tariff relating to the use of the Transmission System and component of the tariff related to electricity generation b) The Distribution Tariff, that includes the component of the tariff relating to the use of the licensee's Distribution System

[33] CEB is the only transmission license as per the section 9 (2) of the Sri Lanka Electricity Act, No. 20 of 2009 " 9. (2) No person other than the Ceylon Electricity Board, established by the Ceylon Electricity Board Act, No. 17 of 1969 shall be eligible to apply for the issue of a transmission licence."

and c) The Retail Supply Tariff, that includes the component of the tariff relating to supply of electricity.

"Section 2.2: Generation Cost" according to the Electricity Tariff Methodology (2015), issued by Public Utilities Commission of Sri-Lanka (PUCSL) on November 2015 (PUCSL, 2015) is reproduced below:

" 2.2 GENERATION COSTS

2.2.1 STRUCTURE

Electricity production is a responsibility of the Generation Licensees (hereinafter the Generators"), licensed by the Commission. The energy and capacity produced by the Generators, shall be purchased by the Single Buyer.

Prices for Capacity and Energy sold by the Generators and purchased by the Single Buyer are defined in the Power Purchase Agreements (PPAs), establishing commercial conditions for such sales and purchases.

Based on the prices established in the PPAs and the quantities generated by each Generator arising from the economic dispatch performed by the System Operator, the Single Buyer shall determine the generation costs that shall be used to calculate the Bulk Supply Tariffs.

The economic dispatch performed by the System Operator shall be subject to the Merit Order Dispatch Methodology established by the Commission. "

The Electricity Tariff Methodology (2015), issued by Public Utilities Commission of Sri-Lanka iIt n November 2015 (PUCSL, 2015) on Filing and Approval of CEB Generation PPAs, mentions the following.

" 2.2.2.2.4 Filing and Approval of CEB Generation PPAs Capacity and energy prices for each CEB Generation PPA, shall be prepared by the CEB Generation Licensee, and submitted to the Commission by the Transmission Licensee for approval according to the filing procedure established by the Commission. ……."

According to the Electricity (Procurement) Rules No. 02 of 2016[34], which lays down the rules for procurement of electricity by Transmission Licensee is reproduced below:

"2. Prior to commencing the process for procuring new electricity generation capacity through a new electricity generation plant or by the expansion of the generation capacity of an existing plant (hereinafter referred to as the "Project"), the licensee shall in terms of Section 43(2) of the Act, submit to the Commission a proposal setting out all relevant

[34] https://ceb.lk/front_img/img_reports/1532498998Electricity_Procurement_Rules.pdf

information.

4. If satisfied, the Commission shall approve the proposal together with the draft request for proposal which shall form a part of the notice published by the licensee calling for tenders to procure new generation capacity.

5. The Commission shall, after approving the proposal, inform the Licensee to publish the notice regarding Request for Proposal Document in one Sinhala, Tamil and English in daily newspaper and post it on the website of the transmission licensee.

6. The Licensee shall publish the notice of the approval Request for Proposal Document in the Gazette

11. After the licensee has evaluated the Project Proposal, such licensee shall recommend the most suitable Project Proponent to the Commission for its approval in terms of Section 43(5) of the Act.

12. The licensee shall obtain the approval of the Commission of the draft Power Purchase Agreement that may be attached to the specifications and to any modification thereof pursuant to negotiations with a prospective supplier of new generation capacity."

According to the Non-Conventional Renewable Energy (NCRE) Tariffs Methodology (PUCSL, 2011) issued by Public Utilities Commission of Sri-Lanka on October 04, 2011, there are two options of calculating tariff, relevant section is reproduced below. (It may be mentioned that this tariff methodology was applicable to capacities less than 10MW only. Further, it is learnt that this is not applicable any more as procurement of RE is currently restricted to competitive bidding.)

"The NCRE based electricity purchase tariffs (Tariffs) will be calculated based on projected cash flow of a generic 1 MW plant over 20 years, including the Return on Equity (ROE) for 15 years. There will be two options; (1) tiered (three tier tariff) and (2) flat tariff, options.

3.1. Tiered option

a) Tier 1 (first 8 years): Cash outflow will include loan repayment for 6 years, annual O &M cost, Return on Equity and Fuel cost
b) Tier 2 (next 7 years): Cash outflow will include, annual O &M cost, Return on Equity and Fuel cost
c) Tier 3 (next 5 years): Cash outflow will include, annual O &M cost, Fuel cost and an Incentive Payment
In all three tiers, escalations will be applicable for O & M cost, Fuel cost and the Incentive payment.

3.2. Flat option

This option is a constant tariff over 20 years, where the same cash outflows are taken with the year 1 estimated escalation applied to total SPPA period, and a single all-inclusive tariff is determined for each technology. “

From the above it can be concluded that, pricing electricity is heavily regulated in Sri-Lanka. In Sri-Lanka, CEB is the single buyer of electricity that purchases electricity from generation licensee (PUCSL, 2015). There is no competitive power market platform in Sri-Lanka.

2.8.3 Existing Power Procurement Models in CBET

Presently, Sri-Lanka does not have any cross-border power trading/grid connectivity with any neighbouring countries. The cable connection beneath/under the sea between India and Sri-Lanka, which has been under discussion for more than a decade a now, is yet to be materialized.

2.8.4 Challenges/Barriers

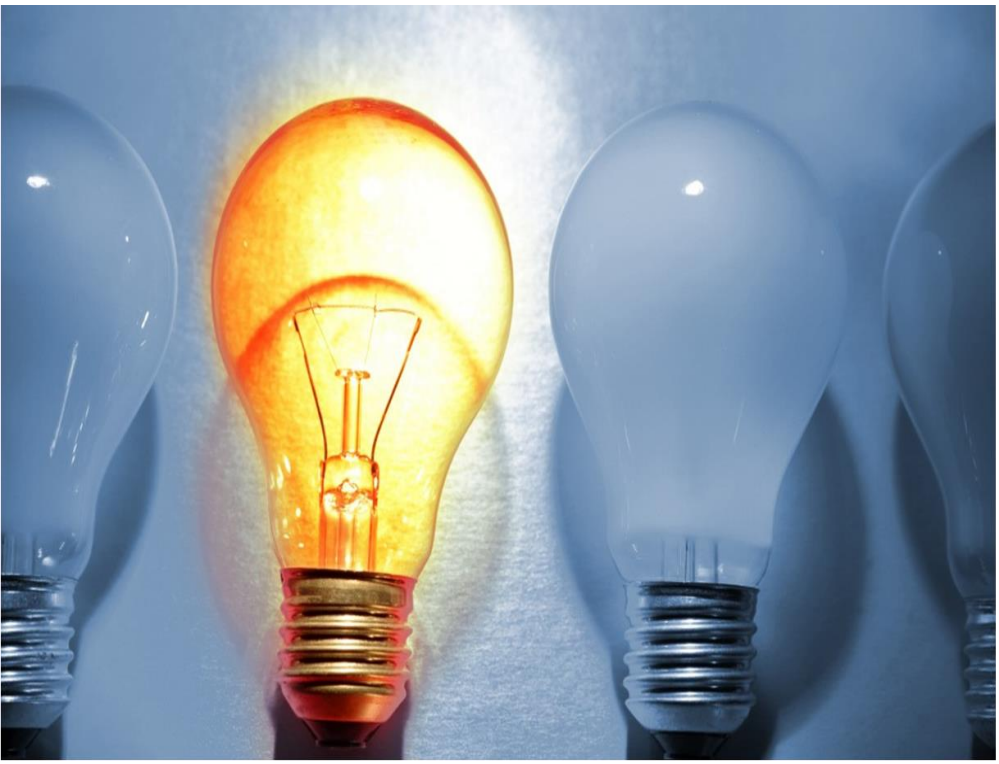
As mentioned, Sri-Lanka does not have any cross-border power trading with any neighbouring countries, therefore it may not be appropriate to lay down shortcomings, barriers, and prevailing challenges with respect to CBET from the point of view of all stakeholders, essential for devising electricity pricing framework. However, the following may be taken into consideration while devising CBET pricing in future.

1. Looking at the existing trend of Cross Border Electricity Trade in SAR, it can be expected that framework between Sri-Lanka and India (other than power exchange) may be based government-to-government negotiation. However, efforts should be made to have a market form of pricing in CBET both for import and export and to have portfolio of negotiated and market form of pricing and participating in India’s power market to begin with and in other SA countries power market.

2. Though SAARC intergovernmental framework signed by all the member states in 2014, also promotes multilateral power trade, same is yet to be materialized by the countries. The move towards market form of pricing in CBET will help in making transition towards a system of competitive price discovery and optimisation of cost.

3. More efforts should also be made in Sri-Lanka also to gradually move away from single buyer model to competitive buyer-seller model and establishment of power market platform in Sri-Lanka.

Chapter 3



Suggested Power Pricing framework for CBET

3. Suggested Power Pricing framework for CBET

Preamble: During the last few years, power reforms in SAR have led a transition from a vertically integrated monopoly market structure to a competitive & transparent Power market structure viz. moving towards competitive tariff-based bidding and power exchange's structure, though in some countries vertically integrated monopoly is in existence. The sole purpose of these reforms is to promote competition among market players and to make the electricity market more efficient, liquid, and competitive in prices. Countries with significant power reforms such as India have helped to increase the number of buyers and sellers including private players, created a dynamic market structure and changed the electricity pricing pattern. Transparent, efficient and a cost reflective power pricing mechanism is critical for creating sustainable cross border electricity trade in the South Asia region. Keeping in view of the above, this chapter will cover Recommended/Suggested Power Pricing Mechanism for the South Asia region.

3.1 Principle and Philosophy

As brought out in Chapter 2, each Country has its own policies/regulations/laws for domestic power pricing framework viz. cost-plus basis, regulated tariff, negotiated tariff, Competitive tariff-based bidding etc. and are regulated by the Regulators of that country. Further, countries have framed their own power procurement & pricing policies/laws/regulations, which reflect upon the size of power system, level of power sector reform, demand-supply position etc. In respect of Cross Border trade of electricity (CBET), except India and Pakistan, no other countries have framed their CBET specific guidelines/policies/regulations so far. The regulation of India spells out clearly the power pricing mechanism for cross border trade of electricity.

Presently, out of the SMSs, Bangladesh, Bhutan, India, and Nepal are interconnected and there is ongoing trend of electricity trade for import and export of electricity. These four countries are trading electricity on bilateral basis where India is the main hub for import and export of electricity to Bangladesh, Bhutan, and Nepal. As Bangladesh, Nepal and Bhutan do not share geographical boundaries together, they need access from India for interconnection and trade of electricity.

As discussed in previous chapters, power pricing framework in Bangladesh, which is importing electricity from India, is a mix of G2G, negotiated power pricing and competitive bidding framework respectively. In case of Bhutan, Govt. of India is providing mix of grant and soft loans to Govt. of Bhutan for developing various hydro power projects. As the Govt. of India is providing necessary financial assistance for development of hydro power projects, the power pricing framework for such hydro projects is based on G2G, negotiated power pricing framework. Besides G2G based hydro power projects in Bhutan, some hydro projects are being developed by private developers and through joint ventures where Govt. of Bhutan

and private entities are developing jointly. In case of such projects which are being developed by private entities and through Joint ventures, the power pricing mechanism is based on commercial rate. In the case of India-Nepal power trade, Nepal is importing electricity at present on negotiated tariff basis to meet its power shortages as well as for construction power required for building new hydro power plants. Recently, Nepal has started procuring electricity also from the Indian Power Exchanges. In the long run, Nepal is expected to become a net exporter of electricity.

Ideally, the power pricing needs to be framed to provide reliable, affordable, and sustainable electricity for all. In principle, power pricing for cross border electricity trade should be cost reflective and needs to be designed in such a way that infrastructure remains viable and sustainable across entire electricity value chain. While deciding the price for CBET, following principle should be taken into consideration:

(a) Encourage competition, economical use of the resources, good performance
(b) Balancing the interest of Generators on one hand & beneficiaries on the other side
(c) Encourage efficiency and economy that ensure financial viability of the project
(d) Encourage Investments for building strong infrastructure for reliable power supply
(e)Ensure transparency, consistency, and predictability in pricing approach across jurisdictions which minimize the perceptions of pricing risk
(f) System of incentive and disincentive for performance
For robust development of power sector, it is important that across all utilities in value chain viz. generation, transmission, distribution should be able to recover the cost of their capital investment, cost of operation, supplies and maintenance of equipment, cost of metering equipment, billing, collection and miscellaneous services, and satisfactory return on the total capital investment.

3.2 International Experience/Learnings

3.2.1 South African Power Pool (SAPP)

South Africa Development Community (SADC) in 1995 signed Intergovernmental Agreement to create South African Power Pool (SAPP). SAPP comprises 12-member countries; namely Angola, Botswana, the DRC, Lesotho, Madagascar, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe (SAPP, 2019). The SAAP concept was introduced due to the uneven and complementary resources availability for power generation across the region. In SAAP, Northern network/part is predominantly dominated by hydro power whereas Southern network/part is predominately having thermal power (Musaba, 2009). Mix of thermal and hydro power is a good combination that helps in load balancing, peaking power etc.

Both type of bilateral contracts i.e., firm, and non-firm basis is applicable in SAAP. However, bulk of cross border electricity trade (about 90-95%) in the SAAP is based on fixed/firm co-

operative bilateral contracts normally for a duration of 1-5 five years (Musaba, 2009) non-firm contracts are subject to interruptible with notice, provided prior notice is given and no penalties are applicable in such cases. Whereas Firm contracts provide premium for reliability and penalties for non-delivery. The bilateral contracts provide assured supply of electricity and does not allow to accommodate varying demand profiles and prices. The pricing of electricity depends on the type of consumption viz. peak, off-peak, standard etc. Negotiated power pricing mechanism also prevails where both buyer and seller agree to promote and develop new power projects. (ECA, 2009) Normally, bilateral negotiated contracts are in the Price range of 0.85 – 3.00+ US Cents/kWh (Musaba, 2009). Further, in bilateral contracts, if both buyer and seller agree can adopt Capacity and Energy Charges power pricing mechanism also. Further, Transmission/ Wheeler service providers are a party to such agreements. In 2003, SAPP initiated development of competitive Power Market in the form of Day-ahead Market (DAM). Subsequently, SAPP developed an Ancillary Services market and a Balancing mechanism (Market Overview, 2021). According to the latest Annual Report of SAPP (2019), bilateral power market constitutes about 68%, whereas Competitive Power market comprises of 32% of the total cross border power trade and nine members participated during the period. Out of total share of Competitive Power market, 85% was traded on Day Ahead market. In 2019, Average yearly Day Ahead Market (DAM) clearing price was 4.94 US Cents/kWh and average minimum monthly clearing price was 3.25 US Cents/ kWh and maximum monthly clearing price was 6.45 US Cents/kWh (SAPP, 2019).

In summary, the principle and philosophy of cross border power pricing mechanism in SAPP since its conception has been mix of bilateral firm, non-firm-based contracts, negotiated contracts, short-term Competitive Power market viz. Day Ahead Market, Ancillary and balancing contracts etc.

3.2.2 European Electricity Market

Europe's power market evolved during 1990s and they decided to open markets gradually to promote competition when most of the national electricity companies had monopoly in the market. They came out with various liberalization directives/energy packages right from the year 1996. EU in its latest 4th Energy Package published in 2019 (EUR-Lex home, 2016) introduced new electricity market rules to attract investment to enhance renewable energy capacity addition. The new market rules so introduced also provides incentives for consumers and for eligible power plants developers to receive subsidies. The 4th Energy package consisting of one directive (Electricity Directive (2019/944/EU) (EUR-Lex home, 2016) and three regulations: (i) Electricity Regulation (2019/943/EU) (EUR-Lex home, 2019), (ii) Risk-Preparedness Regulation (2019/941/EU) (EUR-Lex home, 2019) and (iii) Agency for the Cooperation of Energy Regulators (ACER) Regulation (2019/942/EU) (EUR-Lex home, 2019). The package also included requirement for the Member States to prepare contingency plans for potential electricity crises and increases the ACER's competences in cross-border regulatory cooperation when there is risk of national and regional fragmentation. In brief, it can be summarized that EU since 1996, have been taking initiatives through various directives

to harmonize the internal energy market, to harmonize regulations, to address market access, to bring transparency, to protect consumer, to support interconnection, and to enhance adequate supply of Energy with a view to build a more competitive market-based supply price. The new electricity market design rules adopted in 2019, have paved the way to better cope with the new realities of energy markets, dominated by renewable energy production.

In Europe, to facilitate cross-border electricity trading and to provide non-discriminatory open access, separate markets for transfer capacity have been developed which link the wholesale electricity markets of different countries with each other. Europe had long-term contracts with neighbouring utilities having transmission rights. The participation in Power exchanges is voluntary and this process is referred as coupling of electricity markets. The market coupling is usually facilitated by exchanges with the day-ahead auction market. As the day-ahead market closes at the day-ahead stage, intra-day and real time markets are not accessible by the market player across the border. APX (Netherlands), Belpex (Belgium), and Power next (France) are the first exchanges to jointly allocate the day-ahead capacities on their internal borders. The market is divided into different zones when the network gets congested. The internal network constraints are not taken into account in wholesale pricing and zonal pricing approach is used to clear the market. Therefore, pricing of electricity in Europe are market based and long-term contacts were gradually discouraged over the years. Contracts, which are pre-dated the market integration process, had not yet expired, and were kept in place and in a way prevented the entry of new market players and overall market integration. The European Court of Justice (ECJ) had now decided that such long-term contracts undermined potential access to the market by new players and protected the position of the incumbent (Meeus, 2020).

Excerpts of the EU's directive (COUNCIL, 2018) of 11 December 2018 on the promotion of the use of energy from renewable sources, also covers concerns on long term power purchase agreements is reproduced below: "Member States shall assess the regulatory and administrative barriers to long-term renewables power purchase agreements, and shall remove unjustified barriers to, and facilitate the uptake of, such agreements. The Member States shall ensure that those agreements are not subject to disproportionate or discriminatory procedures or charges." Excerpts of the Council of European Energy Regulators report (CEER, 2021) states, "This is an important step in helping to increase the market share of renewables in the energy mix whilst maintaining longer-term investment certainty". Therefore, it can be concluded from the learnings of European power market that it is important to have mix of short term and long-term contracts for overall efficiency, affordability, and healthy investment environment in the power sector.

3.2.3 Nord Pool Power Pool

Nordic market is one of the most developed markets in the Europe and the first international power exchange to offer multinational contracts. It was initiated in 1993 led by Norway's

liberalization and the new energy act of 1991. It is jointly operated by two transmission system operators (TSO) - Statnett in Norway and Svenska Kraftnat in Sweden. Nord pool also operates a spot market called Nord Pool Spot. The day-ahead spot market in Nord Pool offers contracts for the next day delivery. Apart from offering physical electricity delivery contracts, Nord pool also offers varied products for the financial market. Nord Pool ASA is a financial market which provides contracts for price hedging and risk management. Nord Pool offers contracts of up to six years' duration, with contracts for days, weeks, months, quarters, and years. The Nord Pool also assumes liability for covering the future clearing of financial contracts in order to reduce the risk of the contracts for buyers and sellers. Nord Pool Clearing also provides clearing for financial, standardised electricity contracts traded on and off the exchange. It has evolved over the years and currently it is a highly advanced market with trade with Baltic States and the UK. In 2019 Nord Pool had a total turnover of 494 TWh traded power, this includes more than 90 % of total power consumption in the Nordic and Baltic market (Union, 2020).

This clearly denotes that overwhelming amount of trade is through power exchanges. However, Nordic PPAs - Oxford Institute for Energy Studies (Akinci & Ciszuk, 2021) states, "the PPA contracts are today the single most important driving factor behind the rapid expansion of wind power in Sweden and have begun to spread across Europe as an accelerator for the transition to renewable electricity production". In the Nordic market, long- or medium-term offtake agreements have been signed between large electricity users (as well as electricity traders) and hydropower producers for decades. However, the latest trend of power procurement and signing of agreements are the solar and wind power respectively.

Therefore, even in highly advanced market like Nord Pool, power procurement structure is mix of short and long-term contracts. However, it is important to note that 90% of Power Procurement in Nord Pool is short-term and on Power Exchanges.

3.2.4 Greater Mekong Power Market

The Greater Mekong Sub-region (GMS) comprises of Cambodia, the People's Republic of China (specifically Yunnan Province and Guangxi Zhuang Autonomous Region), Lao People's Democratic Republic, Myanmar, Thailand, and Viet Nam. In 1992, with assistance from the Asian Development Bank (ADB), these six countries entered into a program of sub-regional economic cooperation, designed to enhance economic relations. The Regional Power Trade Coordination Committee (RPTCC) manages regional power trade in the sub-region. Cross Border Power Trade in GMS is bilateral and through Specific Power Purchase Agreements signed between the parties (ADB, 2020). Excerpts of the report of GMS Power Market Development (Thorncraft, 2019) is reproduced "Presently, within the GMS, most instances of cross-border trade relate to the direct connection of power stations in one country that are largely dedicated to exporting power to a neighbouring jurisdiction. The importing system retains isolation from the exporting power system and the associated transmission lines do not permit third party access as a result of restrictions in the project's power purchase

agreements (PPAs). Such restrictions are viewed to be a significant barrier in the quest for higher levels of power system integration in the GMS". GMS countries are also planning for dedicated transmission links for cross-border power trade and for transition to regulatory frameworks with multiple sellers and buyers which is required for developing competitive power market. According to the IEA report on establishing multilateral power trade in ASEAN, (IEA, 2019) the GMS roadmap has following four stages:

- **Stage 1**: Bilateral power transactions where the PPAs of bilateral trading between neighbouring countries without synchronization.
- **Stage 2:** Partial regional transmission network and trade among any pair of GMS countries based on available capacity of lines linked to PPAs. The power trading possible between any pair of GMS countries by third-party access (TPA) with surplus capacity.
- **Stage 3**: Third parties other than utilities are allowed to trade.
- **Stage 4**: Establishment of a fully competitive regional competitive market within the GMS

Though GMS has drawn road map to achieve competitive power market, the implementation of stages is slow. In GMS, the power trade is primarily bilateral, and contracts are often negotiated between the countries through relevant institutions.

3.3 Detailed Recommendations/Suggestions on Power Pricing Mechanism for import/export of Electricity in SAR (Supported with examples including global best practices/learnings)

All countries in South Asia being sovereign countries have framed its own power pricing procurement policies/laws, depending upon size of power system, power sector reform, demand-supply position, it is therefore, important to have, standard practices for power procurement & pricing framework for cross border trade of electricity to encourage investment and grid connectivity in the region. It is also important that while framing such suggested pricing framework, care has to be taken that the existing framework for power procurement & pricing within each nation should not get unduly affected. Further, the suggested power procurement & pricing framework for cross border trade of electricity should be able to address concerns such as mode of procurement, period for which power is contracted, suitable mechanism for pricing, transmission/wheeling pricing framework etc. Further, for transparent power pricing mechanism, there should be clear cut roles and responsibilities to be defined for various stake holders viz. Government, Regulators, Power Utilities etc. Though presently, Afghanistan, Pakistan, Maldives and Sri-Lanka are not interconnected with other South Asian countries, however, keeping in view of future prospective, suggested power pricing framework for these countries shall also prevail.

Keeping in view of existing cross border power pricing framework in South Asia Region and as well as learnings of international experiences, the detailed suggested power pricing

mechanism for CBET for South Asia Region is shared below.

3.3.1 Government to Government (G2G) Negotiated based Pricing Mechanism (Long/Medium Term Power Procurement)

Suggested Framework: Keeping in view of existing trend of import/export of electricity on G2G Negotiated Power Pricing mechanism in South Asia region and to support countries good will gesture for each other, it is suggested that "**G2G Negotiated based mutually agreed Power Pricing Contracts including any review of prices during the tenure of the contracts be continued covering all types of generation resources viz. thermal, hydro or renewables on two part or single part tariff as the case may be. Further, Power Procurement on Long term be considered as more than 5 years and Medium-term be considered as 1 to 5 years. However, in future, region may take steps to phase out G to G framework and move towards Competitive Power market structure to encourage discovery of transparent power pricing mechanism for trade of electricity."**

Explanation Memorandum: In BBIN sub-region of South Asia, country governments have signed intergovernmental bilateral agreements to promote development of Power Projects and or trade of electricity on G-to-G basis, as a good will gesture. For example, Govt. of India is providing mix of grant and soft loans to Govt. of Bhutan for developing/developed various Hydro Power Projects such as Mangdechhu (720 MW), Punastsangchhu-I (1200MW) and Punasangchhu-II (1020 MW) as a part of good relationships. As the Govt. of India is providing necessary financial assistance for development of hydro power projects, the power pricing framework for such hydro projects is based on G2G negotiated Power Pricing framework. According to the power purchase agreements, Bhutan is to supply its surplus power to India at the negotiated power pricing basis. These PPAs are on long term basis viz. for the useful life of the plant.

Similarly, to promote relationships with Bangladesh and to strengthen cooperation between two countries, Govt. of India in 2013 (PPA Signed in 2012) started providing 250 MW thermal power at competitive G2G negotiated price from its NTPC, Central Power Utility for a period of 25 years (Media, 2013) viz. on Long-term basis to meet huge power deficit of Bangladesh facing at that time. Another 250 MW was procured by BPDB, Govt. of Bangladesh on Competitive tariff-based bidding route from PTC India on medium-term for a period of 3 years (Amarnani, 2013).
In South Asia, India has notified/classified **long-term Power** Procurement as more than **7 years, medium-term** Power Procurement as **1 to 5 years** and **short-term** power procurement **less than 1 year.**

On global experience, CASA-I is also an example where Afghanistan and Pakistan have signed PPAs for purchase of 1,300 megawatts of surplus Hydro Power from Central Asia viz. Tajikistan and Kyrgyzstan on G2G Negotiated based Power Pricing Mechanism. Till the competitive power market is fully developed in the SAR, Cross Border trade of electricity on

G2G negotiated based power pricing mechanism may be continued as a process of Country's good will gesture and towards strengthening relationships.

3.3.2 Cost Plus/Negotiated based Power Pricing Mechanism (Long term/Medium term Power Procurement)

Suggested Framework: Looking at existing power pricing mechanism of import/export of electricity in South Asia Region/ international experience and considering following facts, it is suggested that **"Power Procurement & Pricing mechanism for Hydro Power be on Cost plus/Negotiated, Long term basis and Single part tariff. However, going in future, to move towards establishing competitive power market, countries may take steps to award hydro power projects on Competitive tariff-based bidding for discovery of transparent power pricing for the benefits of consumers.**

Explanation Memorandum: Hydro Power projects are capital intensive, have long gestation period, associated with large risks such as geological and hydrological risks etc., therefore it makes uncertain for the private developers to invest in this sector. As hydro projects are highly capital intensive, the tariff of the hydro power particularly in the initial years is not competitive as compared to other power projects such as thermal, solar, wind projects respectively. Normally, Developer is required to payback debt and other dues to the lenders in a period of about 10 years from the date of commissioning of the plant. Therefore, after 10 years or so viz. after clearing debt and dues, the tariff of hydro power is much competitive and comparable with any other source of projects. It is therefore being suggested that Hydro Power be procured on long term basis to take advantage of cheaper power. Due to flexibility in operation and good ramping capability, hydro power is also very useful for meeting peaking demand and also for balancing of intermittent supply of Solar and Wind supply.

In case of hydro power, tariff consist of fixed cost element only and no variable cost, as fuel viz. water is considered as free. Fixed cost includes interest on loans, return on equity, Depreciation, O&M Expenses, Interest on Working Capital. The experience of present trade of electricity in South Asia region also suggests single part tariff. For example, both the Daggachu and Tala hydro power stations in Bhutan, which are selling electricity to India, are based on single part tariff.

The global experience of South African Power Pool shows that they initiated the process of cross border trade of electricity through bilateral, cost plus, Negotiated Contracts on Firm/Non-firm basis. In Nord pool, for Example, DB Engineering & Consulting (German based Company) who is in the business of implementing mobility Projects viz. Railways/Metro has signed PPA for cross border power purchase of 190 GWh of Hydro Power from Mågeli hydroelectric power plant in southern Norway through Nordlink North Sea cable for a period of 10 years (Tsanova, 2021). Further, Norsk Hydro ASA's fully owned subsidiary of Hydro Energi AS has signed a new long-term power contract (News, 2020) with Hafslund E-CO Vannkraft AS which is in the business of Norweign Aluminum for an aggregated supply of 0.9

TWh for the period from 2021 to 2027 (about 6 years period). As both the above companies viz. Hydro and Hafslund E-CO Vannkraft has good relationship and cooperation had signed contract for an aggregated supply of 1.18 TWh in June'2021 and since 2014, Hydro has signed 16 long-term power purchase agreements (PPAs), all of which are based on hydropower or wind power. Together with Hydro's 10 TWh captive hydropower production in Norway, the long-term PPAs will be used in Hydro's aluminium production in Norway in the coming decades (News, 2020).

In GMS, a new trend is observed where trade is moving in other areas of energy sources such as wind energy for cross border power trade. Recently, Vietnam Electricity and Impact Energy Asia Development (IEAD) Limited signed the 25-year Power Purchase Agreement (PPA) for the Monsoon Wind Project on 12 July 2021 (GMS, 2021). According to the information available ion the greatermekong.org (GMS, 2021) website "The 600MW wind energy project will be the largest wind farm in Southeast Asia and the first cross-border wind energy project. It will be located in Sekong and Attapeu provinces in Southern Lao PDR, and export green energy to Central Vietnam through a 500-kilovolt transmission line. Construction is expected to begin in 2022, with commercial operation aimed for 2025."

3.3.3 Discovery of Power Pricing through Competitive tariff-based bidding (Long & Medium-Term Power Procurement)

Suggested framework: With the existing trend of buy and sale of electricity in SAR, it suggested that "**Except Hydro Power, all the other cross border power procurements and trade such as thermal, renewables etc. be on Competitive tariff-based bidding basis either on two part or single part tariff for long OR Medium term as the case may be for the benefit of consumers."**

Explanation Memorandum: Govt. of India on 19th January'2005 through gazette notification issued the Resolution on "Guidelines for "Determination of Tariff by Bidding Process for Procurement of Power by Distribution Licensees." (Office Memorandum, 2010) According to the notification, the guidelines for tariff-based bidding to apply for power procurement of base-load, peak-load and seasonal power through competitive bidding mechanisms as follows:

(i) Case 1: Such Projects where the location, technology, or fuel is not specified by the procurer;
(ii) Case 2: Location based specific Projects with fuel allocation such as captive mine or hydro-power projects, load centre projects, which the procurer intends to set up under tariff-based bidding process.

However, the process of award of hydro power projects on Competitive tariff-based bidding route keeps on extended by Govt. of India.
Under the above notification of Govt. of India for Competitive tariff-based mechanism, during

the year 2006, concept of Ultra Mega Power Projects (UMPP) under case II setting up of Coal based Power Project of capacity more than 4000 MW at specific location was initiated. Initially two UMPP under Case 2 were identified for award under Competitive tariff-based bidding route viz. Sasan UMPP along with allotment of fuel viz captive coal mine block and another Mundra UMPP Coastal based (imported coal based) respectively. For both the above UMPP project under case 2, Government of India created shell company, acquired the land, obtained various clearances for the project, and then invited the bids for the developers to quote on Competitive tariff-based bidding. As the land acquisition and clearances takes substantial time, case 2was necessary to avoid delay in completion of the projects. The result of the Competitive tariff-based bidding was very encouraging. For Sasan UMPP (Madhya Pradesh), where captive coal mine block was also allotted, the levelized tariff of the lowest bidder discovered was INR. 1.19 per kWh whereas for cost plus thermal generation projects prevailing at that time was in the range of INR 4 to 4.50 per kWh. Similarly, for Mundra UMPP which was coastal based (imported coal based) tariff discovered was just INR 2. 26per kWh as compared to other imported coal-based tariff of around INR 5 per kWh prevailing at that time. Subsequently, States viz. Punjab, Haryana, UP, Jharkhand, Chhattisgarh also followed award of coal-based Power Projects on Competitive tariff-based bidding in different year. For Example, Punjab invited bids for Talwandi Sabo coal-based Power project for the capacity of 1,980 MW in the year 2008 and the levelized tariff of lowest bidder was INR 2.86 per kWh and for Rajpura Coal based Power project of capacity 1,320 MW in the year 2010 was INR 2.88 per kWh under Competitive tariff-based bidding case2.

In the projects under competitive tariff-based bidding (Case 1), developers have to identify and acquire land and have to obtain various clearances for the project themselves (Government is not responsible). A few coal-based Power Projects under case 1 competitive tariff-based bidding are given below in table (table name/number):

Table 17: Discovery of Prices under Case 1 Competitive tariff-based bidding route

State	Utility	Year	Levelized tariff (per KWh)
Haryana	HPGC	2008	2.86
Madhya Pradesh	MPPCL	2008	2.7
Gujarat	GUVNL	2009	3.25
Rajasthan	RVPNL	2009	3.21
UP	UPPCL	2011	3.24

The above table shows that the prices discovered were much cheaper/competitive as compared to cost plus negotiated basis contracts prevailing at that year.

Further, in India all the DISCOs/Bulk Consumers are procuring renewable energy viz. Solar and Wind etc. through Competitive tariff-based bidding route and the results of such bidding is also very encouraging. There are many examples, however in the recent competitive tariff-based bidding for 330 MW (total bid invited for 500 MW) solar plants to be built at the Neemuch in Madhya Pradesh, price discovered was INR 2.14 per kWh[35].

From the above examples/learnings, it is clear that Power procurement through competitive tariff-based bidding mechanism is transparent and price discovery is much competitive/cheaper than procured from other mechanisms viz. cost-plus basis, negotiated basis etc. In future, South Asia Region may adopt Cross Border Power Procurement through Competitive tariff-based bidding mechanism on Long/Medium term procurement from all the resources except hydro power for the benefits of consumers.

3.3.4 Discovery of Power Pricing through Power Exchanges, e-bidding platform, and Ancillary Service Market.

Suggested Framework: Looking at recent experience of electricity trading between India and Nepal on Power Exchanges and extensive international experience of trade on Power Exchanges in various power pools in the world, it is suggested **that "short Term Power Procurement be classified/notified as less than 1 year. Countries in South Asia Region are encourage to trade Day Ahead market/term ahead market on Power Exchanges[36] for discovery of transparent power pricing."**

"Further, Short term electricity trade of one month or more but less than 1-year, South Asia Region may create common E-portal for discovery of transparent & Competitive prices to encourage buyers and sellers for trade of electricity for the benefits of consumers. It is further recommended that for short term power trade (being less than 1 year), the tariff to be Single part with no escalation, due to shorter duration."

"Region to develop ancillary services market which can be traded on Power Exchanges or through competitive manner to support renewable energy penetration in the grid for sustainability and reliability of the grid"

Explanation Memorandum: Power trading on Power Exchanges is a well-established mechanism for discovery of transparent and Competitive Power Pricing mechanism in the World. For discovery of transparent power pricing mechanism for short term power trade, India also took initiative in the year 2008 and established Power Exchange in the country. Power Exchanges are platform where Generators, Bulk Consumers, Traders etc. bid for the various products available for bidding such as Day Ahead, Week Ahead basis and volume and prices are discovered through transparent mechanism. Presently, India has two Power Exchanges IEX and PXI where the buyers and sellers bid their requirement for Day

[35] https://www.financialexpress.com/industry/tata-power-arm-wins-330-mw-solar-project-in-madhya-pradesh-auctions/2309085/

[36] Initially through the exchange platform as available and going forward through the market coupling.

Ahead/Term Ahead basis. According to the details given in Chapter 2 for India, for example, the Prices discovered through Power Exchanges have always been found to be much cheaper/competitive as compared to bilateral short term power market. For example, for 2019-20, Prices discovered through Power Exchanges on Day Ahead market was INR 3.40 per kWh whereas price of short-term bilateral power market for the same year was INR 4.51 per kWh (Table 11 of Chapter 2) Hence, about INR 1.11 per kWh was cheaper in power exchange market than short term bilateral market.

The Regional Power Market/Power Pools in the globe such as European Power Market, Nord pool, South African Power Pool etc. trade large volume of their power-on-Power Exchange platforms, as the pricing system is very transparent. In 2019, total trade volume through Nord Pool power exchange was 494 TWh, which is more than 90 % of total power consumption in the Nordic and Baltic market (Union, 2020). In SAAP also, under competitive Power market the trade on Power Exchanges comprises of 32% of the total cross border power trade during the year 2019.

Considering that renewable energy penetration in the grid is taking place very aggressively in most of the SA countries, there will be need for ancillary service in the power system required to maintain reliability of the grid and to support the primary function of delivering energy to customers. Hydropower plant in particular pumped storage hydro power plant can be a credible source of ancillary services. In the above context, hydro resource rich countries such as Nepal, Bhutan, India through CBET can provide ancillary services to maintain grid reliability. However, such projects need appropriate power market & price signal for development of such projects. Therefore, it is important to develop a regional competitive ancillary service market which can be traded on power exchanges or on a competitive manner among the countries of the region.

Learnings of various power pools/ regional power market in the globe suggests that trading on power exchanges is most transparent and competitive price discovery is ensured through this mechanism.

The graphical representation of the above suggested power pricing framework including the existing scenario with respect to generation for CBET is given in the Figure 20 below

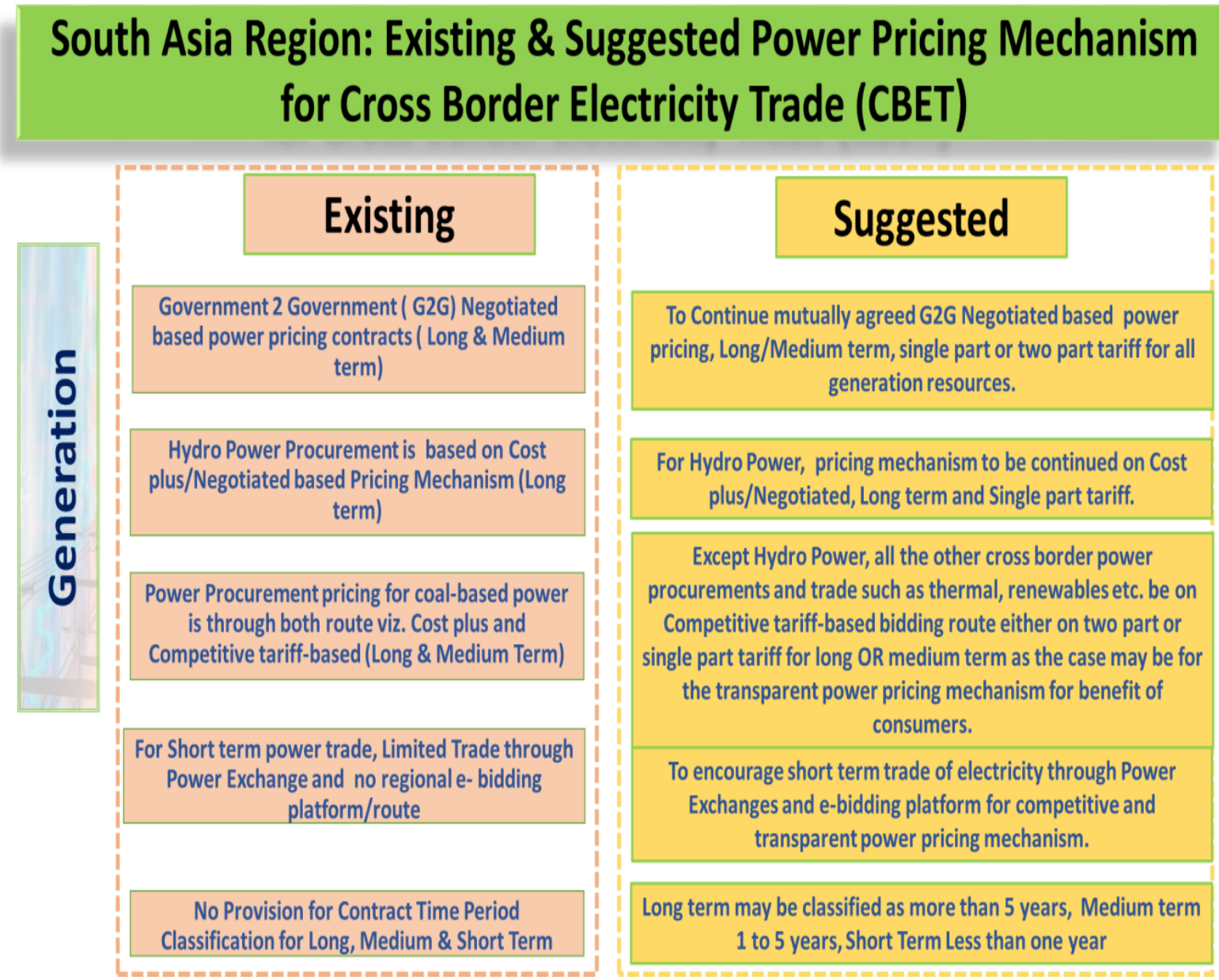


Figure 20: Suggested Power Pricing (Generation) Framework for CBET

3.3.5 Sharing of Transmission/Wheeling Pricing Mechanism

Suggested Framework: Based on industry structure, regulatory framework prevailing in each country, they have adopted different mechanism/methodology for working out transmission pricing viz. postage stamp, distance based, Contract based, Point of Connection based etc. For Cross Border Transmission pricing framework, each link in the overall transmission path passing through different countries needs to be separately determined, therefore a segmented approach without making much regulatory changes as of now needs to be adopted/continued. It is therefore suggested that **"For Cross Border Trade of Electricity, Transmission system within a Country/Countries, the transmission pricing framework/methodology of that country shall be applicable, and the national regulator of that country will be responsible for fixing and approving the transmission tariff including criteria and methodology for transmission power pricing mechanism".**

"Further, in case of bundled tariff (where the countries do not have separate methodology for working out transmission pricing), country/countries need to separate out transmission power pricing for the purpose of cross border electricity trade." "However, in the future, countries need to have common transmission pricing framework/guidelines issued by the Regional Regulator (whenever formed) acceptable to all the countries, and is sensitive to distance, direction and quantum of power flow for high efficiency."

Explanation Memorandum: For transmission pricing framework, it is essential to allocate transmission related costs to such entities which are utilizing the transmission system. Each Country has its own transmission pricing framework, and it differs among South Asian Countries. For Example, it is bundled with retail tariff in Afghanistan, Bhutan, and Nepal. In Bangladesh, Pakistan, and Sri-Lanka it is postage stamp, whereas in India it is Point of connection (POC) pricing framework. The mechanism for recovery of transmission tariff is based on per unit, per MW. It would be challenging for the Generators/Traders/Bulk Consumers connected to transmission system in each SMS to sell or buy power from other SMS, in the absence of separate transmission pricing framework. Presently, for Example, buyer in Bangladesh is paying transmission charges according to India's Pricing framework (POC charges) for utilizing Indian transmission system and Bangladesh transmission charges in line with Bangladesh pricing framework (Postage Stamp).

In Europe, different tariff schemes have evolved and co-exist across Europe (ENTSO-E, 2018). However, there are regional regulations and guidelines at European level to govern transmission tariff. According to the ACER's Practice report on transmission tariff methodologies in Europe (ACER, 2019) "In Pursuant to Article 59(1)(a) of the Electricity Directive (EU) 2019/944[37], each national regulatory authority (NRA) has the duty of fixing or approving, in accordance with transparent criteria, transmission tariffs or their methodologies, or both. Pursuant to Article 18(1) of the Electricity Regulation (EU)

[37] Directive (EU) 2019/944 of the European Parliament and of the Council of 5 June 2019 on common rules for the internal market for electricity and amending Directive 2012/27/EU. OJ L 158, 14.6.2019, p. 125.

2019/9432[38], tariffs for access to the transmission network shall, inter alia, be cost reflective, transparent, take into account the need for network security and flexibility, reflect the efficient actual costs incurred, be applied in a non-discriminatory manner, and be non-distance. In accordance with Article 18(9) of Regulation (EU) 2019/943, ACER shall provide and update, at least every two years, a best practice report on transmission tariff methodologies, while taking account of national specificities. Regulatory authorities shall duly take the best practice report into consideration when fixing or approving transmission tariffs or their methodologies."

From the above, it shows that national regulator of each country in European Power market is responsible for fixing and approving transmission power pricing framework taking into consideration transparent criteria and methodology, based on the guidelines issued by the regional regulator viz. ACER.

3.3.6 Transit Fee Pricing Mechanism

Suggested Framework: Primarily as of now, trade of electricity is on bilateral basis. However, recently, steps have been initiated between Govt. of Bangladesh & Nepal for trilateral trade of electricity. GMR, a private developer has signed MOU with Govt. of Nepal for building the 900 MW upper Karnali Hydro power in Nepal. For sale of 500 MW, GMR, through Indian Trading Company NVVNL, an arm of NTPC, is negotiating with Govt. of Bangladesh the commercial terms & conditions and tariff etc. In the latest development, the Bangladesh Cabinet Committee on Public Purchase has also given its approval to import power at a rate of 7.71 US cents per kWh for a period of 25 years. However, Letter of Intent and Power Purchase Agreement (PPA) are yet to be completed. This will be the first case where Nepal will be selling electricity directly to Bangladesh by using Indian transmission system. However, the modalities viz. wheeling charges, transit fee etc. for using Indian Power Transmission system is yet to be finalized. As of now, there is no example of transit fee mechanism existing in South Asia Region. There are some international examples of trade of electricity where Seller/Generator of one Country has signed PPA for sale of electricity with buyer of third Country and the transmission system is passing through intermediary Country/Countries such as CASA-I. Keeping in view of above, it is suggested **"that countries to adopt Zero Transit fee pricing mechanism for cross border trade of electricity in the interest of enhancing trade of electricity, as it is presently at nascent stage, However, in future, countries need to develop a suitable methodology for transit fee mechanism including having provision of suitable cap (to the extent as minimum as possible as the countries decide) with the principle that it is reasonable, affordable, transparent, reflective of the cost associated with security and sustainable over the project tenure so that it should not be burden on the consumers and barrier for enhancing trade of electricity."**

Explanation Memorandum: Transit means movement of goods produced at a particular

[38] Regulation (EU) 2019/943 of the European Parliament and of the Council of 5 June 2019 on the internal market for electricity. OJ L 158, 14.6.2019, p. 82.

location in one country to be consumed at another location in a third country by using territory of intermediary country/Countries. In brief, transit fee mechanism is entitled to be paid in accordance with agreements concluded between the Seller in one country and Buyer in third country and passing through the intermediary Utility of another Country for providing the necessary transit facility.

Transit fee in international trade in electricity has been very complex when there is no single integrated electricity market system. It may be noted that transit fee is in addition to be paid for transmission/wheeling prices/charges and other charges for usage of the transmission system of a country. In most of the cases, Transit fee is based on the negotiation between the country governments and to an extent arbitrarily, though some considerations are taken into account while deciding the transit fees such as providing security etc. Further, Transit fee models vary case-to-case basis.

Case study of CASA-1000 project for Transit fee

The CASA-1000 aims to export 1,300 MW of surplus hydro power from Tajikistan and Kyrgyzstan to Afghanistan and Pakistan. The estimated tariff including transit fee according to the feasibility study of CASA-1000 and also according to the negotiations are given below:
:

Table 18: Comparison of estimated tariff (according to feasibility report) & Negotiated tariff between the parties

Item	Estimate (US Cents/kWh) according to feasibility study	As negotiated (US Cents/kWh)
Energy Charge	1.5	5.10
Afghanistan Transit Charge	0.0	1.25
Transmission	2.98	2.98
Others	0.50	0.50
Total	4.98	9.83
Source: NEPRA[39]		

Transit fee of US cents 1.25/kWh being charged by Afghanistan is purely government-to-government negotiations. As understood, Afghanistan is charging this transit fee to provide the necessary security during and after the construction of the project.

From the above, it appears that there is no established criteria or methodology for transit fee

[39] https://nepra.org.pk/tariff/Tariff/NTDC/2016/PAR-117%20NTDCL-CASA%2021-06-2016%208892-94.PDF

mechanism, rather countries negotiate and fix transit fee towards services such as for providing security etc.

The graphical representation of the above suggested power pricing framework including the existing scenario with respect to transmission and transit mechanism for CBET is given in Figure 21 below

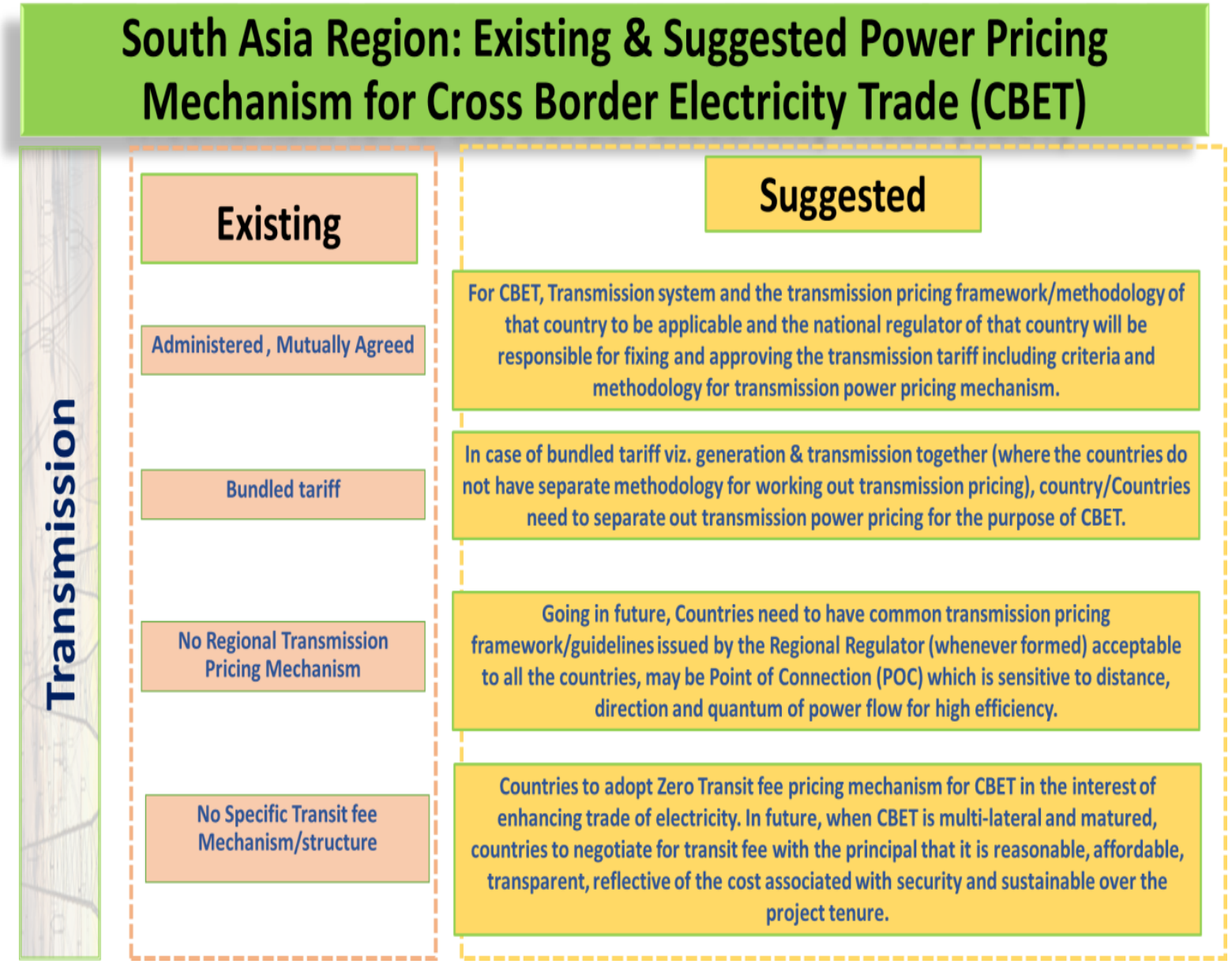


Figure 21: Existing & Suggested Power Pricing Mechanism (Transmission & Transit) for CBET

3.4 Conclusion

The existing trend of electricity trade in South Asia as well as in other regional power integration/power pools in the world has shown that there should be a win-win situation for the countries to promote cross border trade of electricity for the economic growth and development of their country/region. It is also referred that Competitive Power Pricing

mechanism discovered on a most transparent way will facilitate smooth trade of electricity and will help to attract investment for building cross border infrastructure for the sustainable development required for the whole electricity value chain. As brought out above, South Asia learnings on Power pricing mechanism shows that it is mix of different power pricing mechanism such as G2G, negotiated, cost-plus, Competitive tariff-based bidding, trading on Power Exchanges etc.

Global learnings also show that initially the countries in the regions such as South African Power pool, European Power market have commenced Cross border trade of electricity on bilateral, Long and Medium-term contracts, cost plus, negotiated based contracts, Firm Contracts, Non-Firm based Contracts etc. For example, in SAPP, about 90-95% cross border trade of electricity is on bilateral, cost plus negotiated basis for a duration of 1 to 5 years or longer. European Power Market has issued various directives right from year 1996 till date for developing cross border Competitive Power market in the region. Global learnings also show that they have moved for trade of electricity by adopting transparent power pricing mechanism such as competitive bidding, trading on Power Exchanges, ancillary services contracts, balancing market etc. From the lenders/financial Institution's perspective, long term contracts are preferred as the repayments are assured in such contracts.

Further, in SAR, presently, except for part of short-term trade of electricity between India-Nepal i.e. Day Ahead on Power Exchanges, all the other trade of Electricity is on Long (for the useful life of plants particularly hydro) and Medium-term (between 1 and 5 years) only. hydro power is preferred to be procured on Cost Plus and on long term basis to take its full benefits of Competitive price in the longer term after its debts and other dues are paid off. Based on current trend of electricity trade in South Asia and International experience it can be concluded that there should be mix of Power Pricing Mechanism viz. (i) Continue to Procure cross border Power on Long term (more than 5 years), medium term (1 to 5 years) PPAs on bilateral, G2G, Negotiated basis, two part or single part as the case may be ; (ii) Procurement of Hydro Power on Cost Plus, Negotiated, Single Part tariff and on Long term basis; (iii) In future, move towards procurement of Thermal, Renewables power etc. on Competitive tariff based bidding for procurement on Long term and Medium term basis; (iv) To promote new dedicated Joint Venture between the Country Governments/Joint Ventures between Power Utilities Government/Private Power Developers for cross border Power projects on long term, cost plus, negotiated based contracts ; (v) For optimum utilization of all power resources, short term (less than 1 year) trade of electricity on e-platform, Power Exchanges etc. needs to be implemented/preferred. The Regional Institution, viz. SAARC can play a vital role by developing an action plan to implement Power Pricing mechanism in the region. However, efforts should be to gradually move from Cost Plus basis to Competitive tariff based bidding and short-term trade of electricity on Power Exchanges/E-bidding platform. Further, for a transparent Power Pricing mechanism, there should be clear cut roles and responsibilities defined for various stake holders viz. Government, Regulators, Power Utilities etc.

Chapter 4

Implementation of the Recommended Electricity Pricing Mechanism

4. Implementation of the Recommended Electricity Pricing Mechanism

As brought out in Chapter 2 & 3 above, discovery of competitive, transparent power pricing framework for CBET is one of the important factors for creating confidence in investors, enhancing grid interconnectivity and for smooth trade of cross border electricity in the region. Global as well as Indian experience/learnings shows that discovery of prices on competitive tariff-based bidding framework except hydro viz. coal based, Renewable energy viz. solar & wind etc. on long/medium term has resulted in cheaper/competitive pricing as compared with cost-plus, negotiated based pricing mechanism. Further, short-term trade of electricity on Power Exchanges platform is likely to be structurally transparent and price competitive. This is due to the fact that prices discovered through the market forces results in the most transparent & competitive prices.

Global experience as well as existing trade in South Asia region, shows that, in particular, for enhancing cross border power trade, it is required to overcome challenges/barriers such as trust & relationship issues between countries, harmonization of policies/regulations, harmonization of grid codes, coordination of integrated transmission planning and operation systems, Institutionalization, reform & restructuring etc. Further, the role of various stakeholders viz. Country Govt., national Regulators and Regional Institution such as SAARC etc. are critical for establishing competitive power market vis-à-vis power pricing mechanism in the region. Therefore, for successful implementation of competitive power market vis-a-vis power pricing framework, interventions will be required at both country level and regional level. Therefore, activities/actions required at Country level and at regional level has been identified separately as both are equally important for developing Competitive Power market/Power pricing framework in the region. For actions required at regional level, the regional Institutions. SAARC can play a vital role to facilitate in implementation of the same.

Keeping in view of all above, as a holistic approach, a suggested implementation plan at country level and regional level for moving towards a competitive & transparent power pricing framework along with time frame for the CBET in the South Asia region is shared below in tabular form:

A. Country Wise Implementation Plan

Afghanistan		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Government to develop & publish Afghanistan National Electricity Policy (AFNEP). b) Govt. to establish independent Electricity Regulatory Commission for determination/adoption of tariff i.e., Afghanistan Electricity Regulatory Commission (AERC). c) Govt. to frame clear cut guidelines/policies for import/export of electricity by Generators/Bulk Consumers/Traders etc. either separately or as a part of the National Policy. d) Govt. to issue broad based vision document/guidelines/policies for cross border power Procurement methodology on long, medium and short-term basis. e) Govt. to publish Policies/Guidelines for Procurement of Power through Competitive tariff-based bidding route (except for hydro power Projects) f) Govt. to prepare and	a) National Regulator i.e., AERC to develop regulations for import & export of electricity based on Government's Policies/guidelines. b) Regulator i.e., AERC to frame regulations for procurement of Power through Competitive tariff-based bidding. c) Regulator i.e., AERC to develop necessary regulations for creating sustainable short term power market/ competitive Power Market in domestic market as well as for CBET.	a) Create fully functional competitive power market in the domestic market as well as for CBET covering Implementation & mandatory enforcement of policies/Guidelines & Regulation. b) In future, based on economic viability and enhanced volume of trade of electricity and grid interconnectivity between Eastern and western part of South Asia, can plan either to trade on establishing separate regional SAARC Power Exchange (SPX) platform or to trade on existing Indian Power Exchange as the case may be for trade of Day Ahead market for discovery of cheaper/competitive power pricing according to international

	develop broad policies/guidelines for development of Short-Term Power Trade market. g) Govt. to publish policy/guidelines for setting up of Traders for trade of electricity.		learnings.

Bangladesh		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Govt. to frame clear cut guidelines/policies for import/export of electricity by Generators/Bulk Consumers/Traders etc. b) Govt. to issue broad guidelines/policies for cross border power Procurement methodology on long, medium- and short-term basis c) Govt. to publish Policies/Guidelines for Procurement of Power through Competitive tariff-based bidding route (except for hydro power Projects) d) Govt. to develop broad policies/guidelines for development of Short-Term Power Trade market e) Initially, Like Nepal, Bangladesh may also use Indian Power Exchange Platform for buy & sell of Day Ahead market to take advantage of Cheaper/Competitive power. f) Govt. to publish policy/guidelines for setting up of Traders for trade of electricity. g) To develop strategy to Move towards competitive power market structure	a) Regulators to develop regulations for import & export of electricity based on Government's Policies/guidelines. b) Regulator to frame regulations for procurement of Power through Competitive tariff-based bidding route based on Government policies/guidelines. c) Regulator to develop necessary regulations for creating sustainable short term power market in domestic market as well as for CBET. d) Regulator to publish conduct of Market/Business Rules for trade of Day Ahead Market for trading on Power Exchanges. e) To develop E-Portal for discovery of prices for short trade of electricity for more than one month but less than 1 year.	a) Implementation of Power Procurement and Power Pricing framework for domestic as well as for CBET based on approved Government's policies/Guidelines

Bhutan		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Government to come out with Policy/Guidelines along with strategy, action & Implementation plan for Sustainable development of hydro power in the country. b) Govt. to frame clear cut guidelines/policies for import/export of electricity by Generators/Bulk Consumers/Traders etc. c) To begin with, use the existing Indian power exchanges Platform like Nepal for buy & sell of Day Ahead market to take advantage of Cheaper/Competitive power d) Govt. to develop guidelines for Procurement of Power on Competitive tariff-based bidding route. e) Govt. to develop strategy to move towards competitive power market structure such as Competitive tariff-based bidding and trading of Power on existing Indian Power Exchange platform, initially.	a) Regulators to develop regulations for import & export of electricity based on Government's Policies/guidelines. b) Govt. to Come out with strategy and action plan to establish Power Trading Company in Bhutan for trade of power c) Regulators to develop Power Trading regulation d) Regulator to frame regulations for procurement of Power through Competitive tariff-based bidding. e) Regulator to develop regulations for creating sustainable short term power market/ competitive Power Market in domestic market as well as for CBET according to the Government's broad-based vision document. f) To develop E-Portal for discovery of prices for short trade of electricity for more than one month but less than 1 year.	a) Implementation and enforcement of policies/Guidelines & Regulation for Competitive Power market in the domestic as well as for CBET. b) Implementation and operation of the Power Trading Company in Bhutan.

India		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Government to come up with a long-term vision and outlook document for cross border grid integration/ SAARC regional grid to be set up as a part of the overall policy of Govt. of India towards CBET. b) Government to Come up with Guidelines/Policies for deepening of power market reform and implementation of new designs such as Market Based Economic Dispatch (MBED) framework. c) To facilitate knowledge sharing with other SA countries in development of competitive power market structure such as Procurement of Power on Competitive tariff-based bidding route, concept of long, medium, and short term, market etc. d) To prepare broad based vision document for cross border power trade on Indian Power Exchanges for SAARC member states. e) To continue to expand the Indian Power Exchange Platform to buy & sell from the Day Ahead market for all other SA countries (Nepal is already trading)	a) Regulator to facilitate sharing of knowledge with other SA countries in development of Competitive power market structure in the region. b) Govt. to facilitate in development of Standard/Model Power Purchase Agreements on Competitive tariff-based bidding for CBET. c) Govt. to facilitate in development of Standard/Model bidding document for buy and sell of Hydro power for CBET on cost plus basis. d) Govt. to facilitate in development of Standard/Model bidding document for Transmission Service Agreement. e) Regulator to develop regulations for participating in the Market Based Economic Dispatch (MBED) framework.	a) Implementation and enforcement of policies/Guidelines & Regulation for Competitive Power market for the domestic market as well as for CBET.

Nepal		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Government to come out with Policies/Guidelines along with strategies, and action & implementation plan for sustainable development of hydro power in the country. b) Govt. to frame clear cut guidelines/policies for import/export of electricity by Generators/Bulk Consumers/Traders etc. c) Government to develop policies/guidelines for procurement of power through competitive tariff-based bidding route. d) Govt. to issue broad guidelines/policies for cross border power Procurement methodology on long, medium- and short-term basis. e) To develop business rules to continue to trade on Indian Power Exchange Platform with more market products to buy & sell electricity.	a) Regulators to develop regulations for import & export of electricity based on Government's Policies/guidelines. b) Regulator to frame regulations for procurement of Power through Competitive tariff-based bidding. c) Regulators to develop Power Trading regulation in Nepal. d) Depending upon volume of Power trade, govt. may carry out techno-economic viability for setting up Traders for trading of electricity in future. e) To develop E-Portal for discovery of prices for short trade of electricity for more than one month but less than 1 year.	a) Implementation and enforcement of policies/Guidelines & Regulation of competitive Power market in domestic market as well as for CBET.

Pakistan		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Continue to implement Competitive Trading Bilateral Contracts Market (CTBCM) within a given time frame. b) Govt. to develop guidelines for Procurement of Power through competitive tariff-based bidding route. c) Govt. to develop broad vision document/ guidelines for development of Short-Term Power Trade market in the domestic market as well as for CBET. d) Govt. to issue guidelines/policies for cross border power Procurement methodology on long, medium and short-term basis e) Develop competitive power market structure by creating multiple buyers and sellers (including traders) to buy & sell electricity in the domestic market as well as for CBET. f) To move towards establishing competitive Short Term Power market establishing Power Exchange for	a) Regulator to develop Regulations for procurement of cross border trade of electricity on a competitive tariff-based bidding route. b) Regulator to develop business rules for short term trade of electricity on Power Exchange Platform for optimum utilization of resources. c) To develop E-Portal for discovery of prices for short term trade of electricity for more than one month but less than 1 year.	a) Implementation and enforcement of policies/Guidelines & Regulations for establishing Competitive Power Market/Power Pricing mechanism for the domestic market as well as for CBET.

trade of Day Ahead Market & Term Ahead Market for discovery of transparent power pricing mechanism in line with international experience & learnings. g) Govt. to develop action plan for grid interconnectivity with neighbouring countries of SA for the economic growth & development. h) Govt. may take a step-by-step approach to move away from Upfront, Negotiated, Cost Plus regime to Competitive Power Market structure viz. tariff-based bidding route, E-portal for short term trade, establishing a Power Exchange etc.		

Sri-Lanka		
Short Term (1-3 years)	**Medium Term (3-6 years)**	**Long Term (more than 6 years)**
a) Government to come up with comprehensive/whitepaper covering cost benefit analysis on cross border grid interconnectivity as a part of CBET policy. b) Govt. to develop clear cut policies/guidelines for import and export of electricity. c) Government to develop policy guidelines for Procurement of Power through Competitive tariff-based bidding route. d) Government to develop broad vision document/guidelines for trade of short-term cross border power on Power Exchange Platform. e) Govt. to issue guidelines/policies for cross border power Procurement methodology on long, medium- and short-term basis. f) Govt. to Come out with strategies and an action plan to establish a Power Trading Company in Sri-Lanka	a) Regulator to develop regulations for import & export of electricity based on Government's Policies/guidelines. b) Regulator to frame regulations for procurement of Power through Competitive tariff-based bidding. c) Regulator to develop necessary regulations for creating sustainable short term power market/ competitive Power Market in domestic market as well as for CBET according to the Government guidelines/policies. d) To begin with use of existing power exchange platform viz. Indian Power Exchange for Day Ahead market to take advantage of Cheaper/Competitive power as and when Sri-Lanka is interconnected with other South Asian member states. e) Regulator to develop Power Trading regulations f) Regulator to frame power market regulations for conduct of Business Rules for Short Term Power trade on Power Exchanges for CBET	a) Implementation and enforcement of policies/Guidelines & Regulation for establishing Competitive Power Market/Power Pricing mechanism for domestic as well as for cross border trade of electricity. b) Implementation & fully functioning of Power Trading Company

B. Implementation Plan at Regional level

Short Term (1 to 3 years)	Medium Term (3-6 years)	Long Term (more than 6 years)
a) SAARC to play advocacy in the region for making operational SAARC Council of Energy Experts of Regulators created earlier by SAARC for harmonization of regulations, cross cutting of regulations, capacity building etc. To achieve the above objectives, SAARC may develop strategy/action plan covering role, responsibilities, funding pattern based on the international learnings/experience for making operational Council of Energy Experts of Regulators in the Region. b) SAARC to facilitate development of Comprehensive/White paper for establishing Regional Association /Forum of Power Utilities for Coordinated transmission planning and harmonization of grid codes and system operation of the South Asia grid such as SAARC Transmission Utilities Association (STUA), SAARC Power System Operators Association (SPSOA) etc. c) Design & frame a common set of model power market	a) Operationalization of SAARC Council of Experts of Energy Regulators (Electricity) b) SAARC to facilitate to establish Regional Association /Forum of Power Utilities for Coordinated transmission planning and harmonization of grid codes and grid interconnectivity such as SAARC Transmission Utilities Association (STUA), SAARC Power System Operators Association (SPSOA) under the SAARC council of Energy Experts of Regulators (electricity). c) To play advocacy with National Regulators of country Governments for implementation of model/standard set of Common regulations. d) To play advocacy for implementation of Competitive tariff-based bidding route on long/medium term basis (except hydro). e) To play advocacy for implementation and acceptance of model/Standard Power Purchase Agreement for procurement of Power on Competitive tariff-based bidding. f) To play advocacy for implementation and	a) To Continue to facilitate Implementation and operationalization of SAARC Council of Energy Experts of Regulators for harmonization of regulations. b) To continue to facilitate Implementation and Operationalization of SAARC Transmission Utilities Association (STUA), SAARC Power System Operators Association (SPSOA) under the SAARC council experts of energy (electricity) Regulators. c) To continue to facilitate implementation and monitoring of various activities required for developing Competitive Power Market in the region.

regulations for developing Competitive Power market for CBET in the south Asia Region. d) Develop a strategy to move towards competitive power market structure and facilitate in setting up SAARC Power Exchange (SPX) in the region. e) SAARC to facilitate and develop Standard/Model Power Purchase Agreement (PPA) on Competitive tariff-based bidding for CBET acceptable to all member states. f) To develop a Standard/Model Power Purchase Agreement (PPA) to buy and sell hydro power for CBET on cost plus basis. g) To develop model/standard Transmission Service Agreement (TSA) for CBET. h) SAARC to facilitate the development of sharing/common transmission pricing mechanism for CBET acceptable by all the member states in the region covering trilateral and multilateral trade.	acceptance of model/Standard Power Purchase Agreement for procurement of Power on Cost plus basis for hydro power. g) To play advocacy for implementation and acceptance of model/Standard Power Transmission Service Agreement. h) To facilitate in development of E-Portal for CBET for discovery of prices for short term trade of electricity for more than one month but less than 1 year in the South Asia Region covering trilateral and multilateral trade in future depending upon grid connectivity and volume of trade. i) SAARC to facilitate implementation of sharing/common transmission pricing mechanism for CBET in the region covering trilateral and multilateral trade.	d) To facilitate agreement and enforcement of the development of sharing/common transmission pricing mechanism for CBET in the region covering trilateral and multilateral trade.

Annexure I

Central Electricity Regulatory Commission's Regulations No. L-7/145(160)/2008-CERC dated 19th January'2009 for the determination of tariff for the 5 years' regulatory period viz. 2009-2014 along with example of Tariff Calculations

General Concepts & Definitions of Key Provisions of CERC Tariff Regulations[40]:

1. **Scope and extent of application**: These regulations shall apply in all cases where tariff for a generating station or a unit thereof (other than those based on non-conventional energy sources) and the transmission system is to be determined by the Commission under section 62 of the Act.

2. **Some Important Definitions:**

2.1 Auxiliary energy consumption: The quantum of energy consumed by auxiliary equipment of the generating station, and transformer losses within the generating station, expressed as a percentage of the sum of gross energy generated at the generator terminals of all the units of the generating station

2.2 **Beneficiary:** in relation to a generating station means the person purchasing electricity generated at such a generating station whose tariff is determined under these regulations

2.3 **Capital Cost**: means the capital cost as defined in regulation 7

2.4 **Declared Capacity' or 'DC'**: in relation to a generating station means, the capability to deliver ex-bus electricity in MW declared by such generating station duly taking into account the availability of fuel or water

2.5, **Date of commercial operation or COD:** the date declared by the generating company after demonstrating the maximum continuous rating (MCR) or the installed capacity (IC) through a successful trial run after notice to the beneficiaries, from 0000 hours of which scheduling process according to the Indian Electricity Grid Code (IEGC) is fully implemented, and in relation to the generating station as a whole, the date of commercial operation of the last unit or block of the generating station;

2.6 **Gross calorific value:** The heat produced in kcal by complete combustion of one kilogram of solid fuel or one litre of liquid fuel or one standard cubic meter of gaseous fuel, as the case may be.

2.7 **Gross Station Heat Rate**: The heat energy input in kcal required to generate one kWh of electrical energy at generator terminals of a thermal generating station.

2.8 **Infirm Power:** means electricity injected into the grid prior to the commercial operation of a unit or block of the generating station;

2.9 **Installed capacity**: The summation of the name plate capacities of all the units of the generating station or the capacity of the generating station (reckoned at the generator terminals) approved by the Commission from time to time

2.10 **Maximum Continuous Rating' or `MCR'**: in relation to a unit of the thermal generating station means the maximum continuous output at the generator terminals, guaranteed by the manufacturer at rated parameters, and in relation to a block of a combined cycle thermal generating station means the maximum continuous output at the generator terminals,

[40] https://cercind.gov.in/Regulations/Terms-and-Conditions-of-Tariff-Regulations_2009-2014.pdf

guaranteed by the manufacturer with water or steam injection (if applicable) and corrected to 50 Hz grid frequency and specified site conditions;

2.11 **Original Project Cost:** means the capital expenditure incurred by the generating company or the transmission licensee, as the case may be, within the original scope of the project up to the cut-off date as admitted by the Commission;

2.12 **Operation and maintenance expenses**: The expenditure incurred on operation and maintenance of the project, or part thereof, and includes the expenditure on manpower, repairs, spares, consumables, insurance and overheads.

2.13 **Plant Availability Factor (PAF)**: in relation to a generating station for any period means the average of the daily declared capacities (DCs) for all the days during that period expressed as a percentage of the installed capacity in MW reduced by the normative auxiliary energy consumption.

2.14 **Scheduled Energy**: means the quantum of energy scheduled by the concerned Load Dispatch Centre to be injected into the grid by a generating station over a day;

2.15 **Useful life**: in relation to a unit of a generating station and transmission system from the COD shall mean the following, namely: -

(a) Coal/Lignite based thermal 25 years generating station

(b) Gas/Liquid fuel based 25 years thermal generating station

(c) AC and DC sub-station 25 years

(d) Hydro generating station 35 years

(e) Transmission line 35 years

3.0 **Key Provisions covered under Chapter 2 of above CERC Regulations on Procedures for tariff determination and computation of Capital cost and Capital structure**

3.1 **Capital Cost of a project: shall include**

(a) the expenditure incurred or projected to be incurred, including interest during construction and financing charges, (i) being equal to 70% of the funds deployed, in the event of the actual equity in excess of 30% of the funds deployed, by treating the excess equity as normative loan, or (ii) being equal to the actual amount of loan in the event of the actual equity less than 30% of the funds deployed, (b) capitalized initial spares subject to the ceiling rates specified in regulation 8; and (c) additional capital expenditure determined under regulation 9

3.2 **Initial Spares**: shall be capitalized as a percentage of the original project cost, subject to following ceiling norms: (i) Coal-based/lignite-fired thermal generating stations - 2.5%; (ii) Gas Turbine/Combined Cycle thermal generating stations - 4.0%; (iii) Hydro generating stations - 1.5%; (iv) Transmission system (a) Transmission line - 0.75% and (b) Transmission Sub-station - 2.5%; (c) Series Compensation devices and HVDC Station - 3.5%

3.3 **Debt-Equity Ratio**: For a project declared under commercial operation on or after 1.4.2009, if the equity actually deployed is more than 30% of the capital cost, equity in excess of 30% shall be treated as normative loan.

4.0 **Example of Tariff Calculations/Computation of Tariff for a Thermal Project of capacity of 500 MW in line with CERC regulations:**

The tariff for supply of electricity from a thermal generating station shall comprise of two

parts, namely, capacity charge and energy charge.

A. Capacity Charge/Annual Fixed Cost: CERC norms for calculating the annual fixed cost (AFC) of a generating station or a transmission system shall consist of the following components:

Sl. No.	Components of Capacity charge/Annual Fixed Cost	FY 2009-14
(i)	Return on equity	15.5%
(ii)	Interest on loan capital loan	According to actuals
(iii)	Depreciation	5.28%
(iv)	Interest on working capital	Based on normative parameters
(v)	O&M expenses	Based on normative parameters
(vi)	Cost of secondary fuel oil (for coal based & lignite fired generating stations)	Based on normative parameters

Explanation:

(i) **Return on Equity (RoE):** CERC has specified a Pre-Tax RoE of 15.5% for the tariff period FY 2009-14. Further, it has allowed an additional RoE of 0.5% for projects commissioned after April 2009 within specific timelines. The additional RoE allowed by CERC is acting as an incentive for a project developer to achieve time-bound milestones.

(a) In case of the generating company paying Minimum Alternate Tax (MAT) @ 11.33% including surcharge and cess:

Rate of return on equity = 15.50/ (1-0.1133) = 17.481%

(b) In case of generating company paying normal corporate tax @ 33.99% including surcharge and cess:

Rate of return on equity = 15.50/ (1-0.3399) = 23.481%

(ii**) Interest on Capital Loan**: The interest on loan shall be calculated on the normative average loan of the year by applying the weighted average rate of interest. CERC has specified a debt-equity ratio of 70:30 as the funding mix for the capital cost of a project. The interest on debt funds is recoverable as part of the tariff.

(iii) **Depreciation:** The salvage value of the asset shall be considered as 10% and depreciation shall be allowed up to maximum of 90% of the capital cost of the asset. Depreciation shall be calculated annually based on Straight Line Method and at rates specified in Appendix-III to these regulations. CERC for the for the regulatory period FY 2009-14, the CERC has increased the depreciation rate to 5.28% for most components of the project.

(iv) Interest on Working Capital: CERC norms for the working capital for a thermal power station for the period FY 2009-2014 is given below in the table:

Sl. No.	Components	FY 2009-14
1.	Coal Stock	1½ Months for Pit head and 2 Months for Non-Pit Head

2.	Secondary Fuel Oil Stock	2 Months
3.	Maintenance Spares	20% of O&M Costs –Coal based 30% of O&M Costs– Gas Based
4.	Sales Receivables	2 months
5.	O&M expense	1 month

(v) **Operations & Maintenance (O&M) Costs**: CERC has specified O&M Costs for thermal power stations on the normative parameters (Rs. lakh/MW), depending on the class of the machine installed by the power station. The normative O&M expenses allowed are given in table below:

Rs Lakhs/MW	200/210/250 MW	300/330/350 MW	500MW	600 MW & above
2009-10	18.20	16.00	13.00	11.70
2010-11	19.24	16.92	13.75	12.37
2011-12	20.34	17.88	14.53	13.08
2012-13	21.51	18.91	15.36	13.82
2013-14	22.74	19.99	16.24	14.62

(vi) **Cost of Secondary Fuel Oil consumption**: According to Tariff regulations for the period FY 2009-14, the CERC has included the cost of SFO as part of AFC. Projects are able to recover the cost of SFO on the basis of normative consumption norms specified by the regulator and the plant availability factor during the year.

B. **Energy Charges (for recovery of Primary fuel costs):** CERC's Normative parameters for thermal power stations are given in the table below:

Sl. No.	Norms for operation	2009-14
1.	Plant Availability Factor	85%
2.	Gross Station Heat Rate: for existing stations For 200/210/250 MW For 500 MW and above	 2500 2425
3.	Secondary Fuel Oil Consumption For Coal Based	 1.0 ml/KWh
4.	Auxiliary Energy Consumption 200 MW Series 500 MW Series (Steam driven BFP) 500 MW Series (power driven BFP	 9.0%/8.5% 6.5%/6.0% 9.0%/8.5%

Nominal Tariff Calculations:

Assumptions:

Plant Capacity :500 MW; Cost/MW: Rs. 6 crores; Debt: Equity ratio: 70:30, Interest on loans: 10%, Interest on Working Capital: 10%, Plant availability factor: 85%

CERC Norms:

ROE: 15.5%; Depreciation: 5.28%; O&M: Rs 16.24 lakhs/MW for 660 MW, Auxiliary Consumption: 9%/8.5%; SHR: 2425; SFO: 1.0ml/KWh

A. Fixed Cost Component calculations:

(1) Return on Equity

Capital cost = 500MW x 6Cr./MW = INR 3000 Cr.

Debt/Equity ratio = 70:30

Equity = 3000x 0.30 = INR 900 Cr.

Hence Return on Equity (ROE) = 15.50x900/100= INR139.50Cr

(2) Interest on Loan: Debt = 3000 x 0.70 = INR 2100 Cr.

10% of debt. = 0.1x2100= INR 210 Cr

(3) Interest on working capital: 10% of WC = 0.1x300 (10% of total cost) = INR 30 Cr

(4) Depreciation: 5.28% of capital cost = 5.28x3000/100 = INR 158.40 Cr

(5) O&M cost: INR 16.24 lakhs per MW= 16.24x500/100 = Rs. 81.2Cr

Hence Total fixed cost = 1 + 2+ 3+ 4+ 5

= 139.50 + 210 + 30.0 +158.40 + 81.20 = Rs. 619.10 Cr

Conversion of MW into Million Units (MUs) 1 MW = 1MW x 365days x 24hours xPLFx1000/10,00,000

Total Power Generation: 500 x 365 x 24 x 0.85 x 1000/ 10,00,000 = 3723 MU

Hence fixed cost per unit = INR 619.10 Cr / 3723 MU = INR**. 1.66 per kWh**

B. **Variable Cost:**

Assumptions: Cost of Oil/liter = 35,000; Gross calorific value of oil = 10,000 Kcal/KWh; Cost of Coal =INR 2000 per ton; Gross calorific value of Coal= 3800 Kg/KWh

CERC Norm: Specific oil consumption = 1ml/KWh; Specific coal consumption= 0.64 kg; Station Heat Rate= 2425 Kcal/KWh

ii) Cost of oil consumption per KWh = Specific Oil consumption x Cost of Oil/liter

= 1ml/KWh x 35000/1000 = Rs. 0.035/ kWh

iii) Heat contribution of oil per KWh= Gross calorific value of Oil x Specific Oil consumption

= 10,000 x 1ml/kWh= 10 kcal/kWh

iv) Heat contribution of Coal = Station Heat Rate –Heat contribution of Oil

= 2425-10 = 2415 Kcal/kWh

5) Specific Coal consumption = Heat contribution of coal /Gross calorific value of coal = 2415/3800 = 0.63 Kg/KWh

(6) Cost of Specific Coal consumption per KWh= Specification Coal consumption x Cost of Coal = 0.63 kg/KWhx INR 2000 Rs /KWh /1000 = 0.63x2000/KWh/ 1000= INR 1.26 /KWh.

Hence, Total Variable Cost per KWh: Cost of Specific Oil consumption + Cost of

Specific Coal consumption = INR (0.035 + 1.26) / kWh = INR 1.295 /kWh

As 6.5 % of the power consumed is towards Auxiliary consumption, Power available at Ex bus

will be to subtract 6.5% of available power viz.
Variable cost per unit/1 − Auxiliary consumption % viz. =1.295 /(1− 0.065)= INR 1.385/kWh
Hence Variable cost at Ex bus bar = INR 1.385/KWh

Conclusion:

Nominal Tariff for 500 MW Power station with CERC guidelines of Jan'2009 and according to assumptions taken= (Total Fixed Cost / Unit) + (Total variable cost (Ex-bus)/Unit)
= Rs (1.66+1.385)/KWh = INR **3.045/KWh**

Bibliography

ACER. (2019). *Practice report on transmission tariff.* Ljubljana. Retrieved from https://extranet.acer.europa.eu/Official_documents/Acts_of_the_Agency/Publication/ACER%20Practice%20report%20on%20transmission%20tariff%20methodologies%20in%20Europe.pdf

ADB. (2020). *HARMONIZING POWER SYSTEMS IN THE GREATER MEKONG SUBREGION.* ADB. Retrieved from https://www.adb.org/sites/default/files/publication/615341/harmonizing-power-systems-gms-facilitate-trade.pdf

ADB. (2021, April). Economic Forecast. Retrieved from www.adb.org/outlook

ADB. (n.d.). *FINANCIAL ANALYSIS.* Retrieved from https://www.adb.org/sites/default/files/linked-documents/37399-043-bhu-fa.pdf

Aiham, A. (2020, March 4). *Renewable Energy*. Retrieved from The Edition: https://edition.mv/environment/15303

AIIB, A. I. (2021). *Project Document.* AIIB. Retrieved from https://www.aiib.org/en/projects/details/2021/_download/maldives/AIIB-20210226-P000377-Maldives-Solar-Power-Development-and-Energy-Storage-Published.pdf

Akinci, E., & Ciszuk, S. (2021). *Effects on renewable growth and implications for electricity markets.* The Oxford Institute of Energy Studies. Retrieved from https://www.oxfordenergy.org/wpcms/wp-content/uploads/2021/02/Insight-84-Nordic-PPAs-effects-on-renewable-growth-and-implications-for-electricity-markets.pdf

Ali, W. (2016, November 2). *The Future of South Asia and the Role of the United States*. Retrieved from The Asia Foundation: https://asiafoundation.org/2016/11/02/future-south-asia-role-united-states/

Amarnani, A. (2013, August 22). *NEWS UPDATES / TRANSMISSION/DISTRIBUTION*. Retrieved from Indian Power Sector: https://indianpowersector.com/2013/08/india-to-export-power-to-bangladesh-from-october/

Bacon, R. (2019). *Learning from Power Sector Reform.* World Bank. Retrieved from https://documents1.worldbank.org/curated/en/403611557151850485/pdf/Learning-from-Power-Sector-Reform-The-Case-of-Pakistan.pdf

Bangladesh Power Development Board. (n.d.). *Annual Report (2019-2020).* Bangladesh Power Development Board. Retrieved from https://www.bpdb.gov.bd/bpdb_new/resourcefile/annualreports/annualreport_1605772936_AnnualReport2019-20.pdf

BEA. (2014). *LICENCE FOR THE SYSTEM OPERATION OF POWER SYSTEM.* Retrieved from https://archive.internationalrivers.org/sites/default/files/attached-files/system-operator.pdf

BEA. (2021). *Functions*. Retrieved from Bhutan Electricity Authority: http://bea.gov.bt/bea-functions/

BEA. (n.d.). *Annual Report 2017-2018.* Thimphu: Bhutan Electricity Authority. Retrieved from http://www.bea.gov.bt/wp-content/uploads/2021/03/AnnualReport-1718.pdf

BEA. (n.d.). *Annual Report 2019-2020.* Thimphu. Retrieved from http://www.bea.gov.bt/wp-content/uploads/2021/03/AnnualReport1920.pdf

BEA. (n.d.). *Tariff Determination Regulation 2016.* Retrieved from http://www.bea.gov.bt/wp-content/uploads/2021/03/TariffDeterminationRegulation.pdf

BERC. (2003). BERC Act, 2003. Retrieved from http://www.berc.org.bd/site/view/law/-

BERC, B. (2003). Retrieved from http://www.berc.org.bd/sites/default/files/files/berc.portal.gov.bd/law/5a4ee42b_258c_496f_abc8_eeaea60bcc37/BERC%20Act%202003%20(English).pdf

Bhutan, N. A. (2001). *Electricity Act of Bhutan.* BEA. Retrieved from http://www.bea.gov.bt/wp-content/uploads/2021/03/ElectricityActBhutan2001.pdf

Business Profile. (2021). Retrieved from Central Power Purchasing Agency: http://cppa.gov.pk/Home/CompanyProfile

CEA. (2020). *Growth of Electricity Sector in India from 1947-2020.* New Delhi: CEA. Retrieved from

https://cea.nic.in/wp-content/uploads/pdm/2020/12/growth_2020.pdf
CEA. (2021). *ALL INDIA INSTALLED CAPACITY.* CEA. Retrieved from https://cea.nic.in/wp-content/uploads/installed/2021/06/installed_capacity.pdf
CEA. (2021). *Procedure for approval and facilitating Import/Export (Cross Border of Electricity) by the Designated Authority.* Retrieved from https://cea.nic.in/wp-content/uploads/2021/02/Final_DA_Procedure_26022021.pdf
CEA. (2021). *Procedure for Approval and Facilitating Import/Export (Cross Border of Electricity) by the Designated Authority.* New Delhi.
CEB. (2010). *Statistical Digest Report.* CEB. Retrieved from https://ceb.lk/front_img/img_reports/1531993961CEB_Statistical_Digest_Report_2010.pdf
CEB. (2019). *Statistical Digest.* CEB. Retrieved from https://ceb.lk/front_img/img_reports/1601877736Statistical_Digest_2019_Web_Version.pdf
CEER. (2021). *Long-Term Generation Investment Signals in a Market with High Shares of Renewables.* Belgium: Council of European Energy Regulators. Retrieved from https://www.ceer.eu/documents/104400/-/-/37c6d086-9305-4439-c038-a1590bff4f9c
CERC. (1910). *THE INDIAN ELECTRICITY ACT.* Retrieved from https://cercind.gov.in/IEA1910.pdf
CERC. (1948). *THE ELECTRICITY (SUPPLY) ACT.* Retrieved from https://cercind.gov.in/electsupplyact1948.pdf
CERC. (1998). *THE ELECTRICITY REGULATORY COMMISSIONS ACT.* Retrieved from http://indianpowersector.com/home/wp-content/uploads/2010/09/Electricity-Regulatory-Commission-Act-1998.pdf
CERC. (2019). *Cross Border Trade of Electricity Regulations.* CERC. Retrieved from https://cercind.gov.in/2019/regulation/CBTE-Regulations2019.pdf
CERC. (n.d.). *Report on Short-term Power Market in India: 2019-20.* Retrieved from https://cercind.gov.in/2020/market_monitoring/Annual%20Report%202019-20.pdf
COUNCIL, T. E. (2018). DIRECTIVES. *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32018L2001&from=fr
DGPC. (n.d.). *Annual Report 2019.* DGPC. Retrieved from https://www.drukgreen.bt/wp-content/uploads/2020/09/CAD_Publication_AnnualReport19_2019.pdf
DGPC. (n.d.). *Annual Report 2019.* Retrieved from https://www.drukgreen.bt/wp-content/uploads/2020/09/CAD_Publication_AnnualReport19_2019.pdf
DGPC. (n.d.). *Corporate Profile.* Retrieved from https://www.drukgreen.bt/wp-content/uploads/2020/06/Corporate-Profile-.pdf
Division, P. (2004). *Power Pricing Framework.*
Division, P. (2004). *PRIVATE SECTOR POWER GENERATION POLICY.* Dhaka.
DRE, M. o. (2016). *Bhutan Energy Data Directory 2015.* Thimphu: Department of Renewable Energy, Ministry of Economic Affairs. Retrieved from https://www.moea.gov.bt/wp-content/uploads/2018/07/Bhutan-Energy-Data-Directory-2015.pdf
ECA. (2009). *The Potential of Regional Power.* ESMAP. Retrieved from https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_South%20African%20Power%20Pool-Transmission%20&%20Trading.pdf
ENTSO-E. (2018). *Overview of Transmission Tariffs in Europe:.* ENTSO-E. Retrieved from https://eepublicdownloads.entsoe.eu/clean-documents/mc-documents/TTO_Synthesis_2018.pdf
ERC. (2017). *Electricity Regulation Commission Act, 2074.* Retrieved from https://erc.gov.np/storage/listies/April2020/erc-act-2017-english.pdf
ERC. (2018). *Electricity Regulatory Commission Rules.* Retrieved from https://erc.gov.np/storage/listies/April2020/erc-rules-2018.pdf
ERC. (2021). Retrieved from Electricity Regulatory Commission: https://erc-gov-np.translate.goog/?_x_tr_sl=ne&_x_tr_tl=en&_x_tr_hl=en&_x_tr_pto=nui,sc
ERC, N. (2017). *Electricity Regulation Commission Act, 2074.* Kathmandu: Nepal Government. Retrieved from https://erc.gov.np/storage/listies/April2020/erc-act-2017-english.pdf

EUR-Lex home. (2016). Retrieved from EUR-Lex: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2016:0864:FIN
EUR-Lex home. (2016). Retrieved from EUR-Lex: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=COM:2016:0864:FIN
EUR-Lex home. (2019). Retrieved from EUR-Lex home: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1581587333688&uri=CELEX:32019R0943
EUR-Lex home. (2019). Retrieved from EUR-Lex home: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32019R0941
EUR-Lex home. (2019). Retrieved from EUR-Lex home: https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1581587497849&uri=CELEX:32019R0942
FENAKA. (2019, November 3). *Articles*. Retrieved from Becoming the Benchmarked Utility Service Provider: https://fenaka.mv/articles/13
FENAKA. (2019, November 5). *Articles*. Retrieved from FENAKA: https://fenaka.mv/articles/7
FENAKA. (2021). *Electricity Services*. Retrieved from FENAKA: https://fenaka.mv/services/electricity
GMS. (2021, July 26). *Home*. Retrieved from Greater Mekong Subregion: https://greatermekong.org/viet-nam-electricity-signs-power%C2%A0purchase%C2%A0agreement%C2%A0-lao-pdr-wind-farm
IEA. (2019). *Establishing multilateral power trade in ASEAN*. Retrieved from IEA: https://www.iea.org/reports/establishing-multilateral-power-trade-in-asean
IEX. (2021, April 19). *Media Release.* Retrieved from IEXindia: https://www.iexindia.com/Uploads/PressRelease/19_04_2021Press%20Release%20-%20CBET%20Launch-19.4.21.pdf
India, M. o. (2021, March 10). *Media Center*. Retrieved from Ministry of External Affairs, Govt. of India: https://www.mea.gov.in/Speeches-Statements.htm?dtl/33611/Foreign+Secretarys+Remarks+at+the+Inauguration+of+the+South+Asia+Group+on+Energy+at+the+Research+and+Information+System+for+Developing+Countries
Jain, G., & Ray, S. (2017). *Roadmap for South Asian Regional Power Exchange (SARPEX).*
Knowledge Hub. (2021). Retrieved from CEB: https://ceb.lk/ceb-history/en
Lodhi, A. L. (n.d.). *Costing and Tariff Setting in Power Sector of Pakistan.* ICMA. Retrieved from https://www.icmap.com.pk/Downloads/Booklet_Power_Sector_in_Pakistan.pdf
Maldives Energy Auhtority. (2019). *Island Electricity Databook 2019.* Retrieved from https://www.environment.gov.mv/v2/wp-content/files/publications/20201123-pub-island-electricity-databook-2019.pdf
Market Overview. (2021). Retrieved from SAPP: http://www.sapp.co.zw/market-overview-0
Media. (2013, August 7). Retrieved from NTPC: https://www.ntpc.co.in/en/media/press-releases/details/supply-power-bangladesh-nvvn
Meeus, L. (2020). *The Evolution of Electricity Markets in Europe.* Edward Elgar. Retrieved from https://cadmus.eui.eu/bitstream/handle/1814/69266/9781789905465%20ebook.pdf?sequence=4&isAllowed=y
Ministry of Economic Affairs, B. (2021). *Bhutan Sustainable Hydropower Development Policy.* Retrieved from Ministry of Economic Affairs, Bhutan: https://www.moea.gov.bt/wp-content/uploads/2017/07/Sustainable-Hydropower-Development-Policy-2021.pdf
Ministry of Economic Affairs, R. G. (2016). *Domestic Electricity Tariff Policy .* Retrieved from https://www.moea.gov.bt/wp-content/uploads/2017/07/dhps2-1.pdf
Ministry Of Energy and Water, A. (2015). *RENEWABLE ENERGY POLICY.*
Ministry of Energy and Water, A. (2016). *Power Services Regulation Act.*
Ministry of Environment, C. C. (2016, July 14). *DEPARTMENTS*. Retrieved from Ministry of Environment, Climate Change and Technology: https://www.environment.gov.mv/v2/en/department/170
Ministry of External Affairs. (2018). *India-Bhutan relations.* Ministry of External Affairs, India. Retrieved from http://www.mea.gov.in/Portal/ForeignRelation/Bhutan_May_2018.pdf
Ministry of External Affairs. (2021, March 10). *Media Center*. Retrieved from Ministry of External

Affairs, Govt. of India: https://www.mea.gov.in/Speeches-Statements.htm?dtl/33611/Foreign+Secretarys+Remarks+at+the+Inauguration+of+the+South+Asia+Group+on+Energy+at+the+Research+and+Information+System+for+Developing+Countries

Ministry of External Affairs. (n.d.). *Embassy of India,Thimphu.* Retrieved from https://mea.gov.in/Portal/ForeignRelation/Bhutan_2021.pdf

Ministry of Law, J. a. (2019). Retrieved from Laws of Bangaldesh: http://bdlaws.minlaw.gov.bd/act-print-1059.html

Ministry of Power. (2016). *Procurement of Power for short term by distribution licensees through tariff based process using National e-bidding portal-reg.* New Delhi. Retrieved from https://www.mstcecommerce.com/auctionhome/RenderFileGeneralAuctions.jsp?file=PPA-Revised-Guidelines-Short-Term.pdf

Ministry of Power. (2019). *National Energy Policy and Strategies of Sri Lanka.* MINISTRY OF POWER, ENERGY AND BUSINESS DEVELOPMENT. Retrieved from http://powermin.gov.lk/english/wp-content/uploads/2019/11/2135-61_E.pdf

Ministry of Power. (2021). *Seeking Comments on Discussion Paper on Market Based Economic Dispatch (MBED).* New Delhi. Retrieved from https://powermin.gov.in/sites/default/files/webform/notices/Seeking_comments_on_Discussion_Paper_on_Market_Based_Economic_Dispatch_MBED.pdf

Ministry of Power, G. o. (2018). *Guidelines for Import/Export (Cross Border) of Electricity.* New Delhi. Retrieved from https://powermin.gov.in/sites/default/files/uploads/Guidelines_for_ImportExport_Cross%20Border_of_Electricity_2018.pdf

Ministry of Power, G. o. (2018). *Guidelines for Import/Export (Cross Border) of Electricity 2018.* New Delhi: Ministry of Power.

Ministry of Power, G. o. (2019). *Revised Guidelines for Procurement of Electricity for Medium Term from Power Stations set up on Finance, Own and Operate (FOO) basis.* New Delhi: Ministry of Power, Govt. of India. Retrieved from https://www.mstcecommerce.com/auctionhome/RenderFileGeneralAuctions.jsp?file=PPA-Revised_Guidelines_for_Procurement_of_Electricity_for_Medium_Term_from.pdf

Musaba, L. (2009). Energy Trading in the SAPP. Retrieved from https://pubs.naruc.org/pub.cfm?id=53725F31-2354-D714-516F-84BB2A4058E5

NEA. (2010). Retrieved from https://www.nea.org.np/annual_report?page=2

NEA. (2020). *Annual Report 2019/2020.* Retrieved from https://www.nea.org.np/annual_report?page=1,%20Electricity%20Generation%20Power%20Plants%20and%20Projects-%20page%20number-%20239

NEA. (2020). *Annual Reports*. Retrieved from Nepal Electricity Authority: https://www.nea.org.np/annual_report

NEA. (2020). *Annual Reports*. Retrieved from Nepal Electricity Authority: https://www.nea.org.np/annual_report

NEPRA. (1998). *Tariff Standards and Procedure Rules.* Islamabad. Retrieved from https://nepra.org.pk/Legislation/2-Rules/2.1%20NEPRA%20Tariff%20Standards%20and%20Procedure%20Rules,%201998/NEPRA%20(Tariff%20Standards%20and%20Procedure)%20Rules%201998%20along%20with%20all%20amendments.pdf

NEPRA. (2010). *State of Industry Repot .* Retrieved from https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202010.pdf

NEPRA. (2011). *Upfront Tariff (Approval & Procedure) Regulations.* Islamabad: NEPRA. Retrieved from https://nepra.org.pk/Legislation/Regulations/NEPRA%20Up-front%20Tariff%20(Approval%20%20Procedure)%20Regulations%202011%20along%20with%20all%20amendments.pdf

NEPRA. (2017). *IMPORT OF POWER REGULATIONS.* NEPRA. Retrieved from

https://nepra.org.pk/Legislation/Draft/NEPRA%20Import%20of%20Power%20Regulations%20December%202017%20Final.pdf
NEPRA. (2017). *NEPRA COMPETITIVE BIDDING TARIFF (APPROVALPROCEDURE) REGULATIONS.* NEPRA. Retrieved from https://nepra.org.pk/Legislation/3-Reg/3.7%20NEPRA%20Competitive%20Bidding%20Tariff%20(Approval%20Procedure)%20Regulations,%202008/NCBT-01%2003-05-2017%206072.pdf
NEPRA. (2020). *State of Industry Report.* Retrieved from https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202020.pdf
News. (2020, November 6). Retrieved from Hydro: https://www.hydro.com/en/media/news/2020/hydro-signs-additional-long-term-hydropower-contract-for-norwegian-aluminium-portfolio/
NTDC. (2019). *Indicative Generation Capacity Expansion Plan (2018-40).*
(2010). *Office Memorandum.* New Delhi: Ministry of Power, Govt. of India. Retrieved from https://powermin.gov.in/sites/default/files/uploads/Guideline_for_determination_of_tariff_and_SBD_for_case_1.pdf
Panda, R. R. (2021, March 4). One Sun One World One Grid : Energy Integration in South Asia.
Panda, R. R. (2021, March 15). Prospects for Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opportunities and Way Forward. Retrieved from https://safirasia.org/sites/default/files/highlights.pdf
Panda, R. R. (2021, March 15). Prospects for Sustainable Energy Infrastructure Development and Role of Cross Border Energy Trade in South Asia: Challenges, Opprtunities and Way Forward. Retrieved from https://safirasia.org/sites/default/files/highlights.pdf
Peiris, D. (2014, March 24). *South Asia Regional Brief*. Retrieved from World Bank.
Power Cell, B. (2010). Retrieved from http://www.powercell.gov.bd/site/view/law/-
Power Cell, B. (2015). Retrieved from http://www.powercell.gov.bd/sites/default/files/files/powercell.portal.gov.bd/law/7ad03d75_5f5d_44b6_acdb_fc4c54cc70e3/POWER%20&%20ENERGY%20FAST%20SUPPLY%20(AMENDMENT)%20ACT,%202015.pdf
Power Cell, B. (2015). Retrieved from http://www.powercell.gov.bd/sites/default/files/files/powercell.portal.gov.bd/law/49ce6e85_140c_4a94_9a7c_91d3b7c719b9/aeb5379d61949e7aba3e2ada421d8a6a.pdf
Power Cell, B. (2018). Retrieved from http://www.powercell.gov.bd/sites/default/files/files/powercell.portal.gov.bd/law/125aedc8_8ea0_4d58_b1e9_2d7cfb3fefaa/IMG.pdf
Power Cell, B. (2018). Retrieved from http://www.powercell.gov.bd/sites/default/files/files/powercell.portal.gov.bd/law/125aedc8_8ea0_4d58_b1e9_2d7cfb3fefaa/IMG.pdf
Power Cell, B. (2021). *Achievement at a Glance*. Retrieved from http://www.powercell.gov.bd/site/view/powerdiv_achievement_at_glance/-
Power Division, B. (2004). *Power Pricing Framework.* Retrieved from https://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/f6d0e100_e2d8_47e7_b7cd_e292ea6395d3/8.%20Power%20Pricing%20Framework.pdf
Power Division, B. (2007). *Policy Guidelines for Power Purchase from Captive Power Plant.* Retrieved from https://berc.portal.gov.bd/sites/default/files/files/berc.portal.gov.bd/policies/37a75205_8c94_434e_b8e8_0dd643b2a00d/Policy%20Guidelines%20for%20Power%20Purchase%20from%20Captive%20Power%20Plant,%202007.pdf
PUCSL. (2002). *PUBLIC UTILITIES COMMISSION OF SRI LANKA ACT.* PARLIAMENT OF THE DEMOCRATIC. Retrieved from http://powermin.gov.lk/english/wp-content/uploads/2020/09/2002-No.-35-Public-Utilities-Commission-of-Sri-Lanka-Act-E.pdf
PUCSL. (2011). *The Methodology for Feed-in-Tariff.* PUCSL. Retrieved from https://www.pucsl.gov.lk/wp-content/uploads/2017/10/ncre_tariffs-methodology.pdf

PUCSL. (2015). *Tariff Methodology.* Retrieved from https://www.pucsl.gov.lk/wp-content/uploads/2017/10/Electricity-Tariff-Methodology.pdf
Rijal, P. (2019, December 20). *Money*. Retrieved from The Kathmandu Post: https://kathmandupost.com/money/2019/12/20/bangladesh-agrees-to-pay-7-7-cents-per-unit-for-upper-karnali-power
RPGCL. (2018). *Transmission System Development Plan of Nepal.* Retrieved from https://www.rpgcl.com/storage/listies/January2021/tsmpn-rpgcl-gon.pdf
RPGCL. (2021). *About Us*. Retrieved from Rastriya Prasaran Grid Company Limited: https://www.rpgcl.com/pages/about-us
SAPP. (2019). *Annual Report.* Retrieved from http://www.sapp.co.zw/sites/default/files/SAPP%20ANNUAL%20REPORT%202019.pdf
SEC, S. E. (2019). Afghanistan Country Presentation on DABS Energy Sector InfoGraphics Final Version [Recorded by S. E. Centre]. Pakistan.
Shams, H. R. (2020). Retrieved from Research Gate: https://www.researchgate.net/publication/344070681_Amend_Electricity_Energy_Supply_Act
SJVN. (2021). *HYDRO POWER*. Retrieved from SJVN Limited: https://sjvn.nic.in/businessprojectdetails/28/5/16
STELCO. (2021). *Our Company*. Retrieved from STELCO: https://www.stelco.com.mv/our-company
Sustainable Energy for All. (2020). *The Recover Better with Sustainable Energy Guide for South Asian Countries.*
The President's Office, R. o. (2020, December 12). *Press Release*. Retrieved from The President's Office: https://presidency.gov.mv/Press/Article/24118
Thorncraft, S. (2019). *Greater Mekong Subregion Power Market.* World Bank. Retrieved from https://documents1.worldbank.org/curated/en/541551554971088114/pdf/Greater-Mekong-Subregion-Power-Market-Development-All-Business-Cases-including-the-Integrated-GMS-Case.pdf
Tsanova, T. (2021, August 5). *Other*. Retrieved from Renewables Now: https://renewablesnow.com/news/deutsche-bahn-signs-ppa-for-hydropower-from-norway-750017/
UNESCAP. (2018). *Integrating South Asia's Power Grid for a Sustainable and Low Carbon Future.* Retrieved from https://www.unescap.org/resources/integrating-south-asia-s-power-grid-sustainable-and-low-carbon-future
Union, E. (2020). *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020D1500&from=EN
Union, E. (2020). *Official Journal of the European Union*. Retrieved from https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020D1500&from=EN
URA. (2019). Tariff Revision. Retrieved from https://www.ura.gov.mv/v1/news/tariff-revision-2019/
URA, U. R. (2021). Retrieved from https://www.ura.gov.mv/downloads/utility-regulatory-authority-act/
VUCL. (2021). *About Us*. Retrieved from Vidhyut Utpadan Company Limited: https://vucl.org/pages/about-us
Wikipedia. (2021, October 24). *Maldives*. Retrieved from Wikipedia: https://en.wikipedia.org/w/index.php?title=Maldives&oldid=1051602896
Wikipedia. (2021). *South Asia*. Retrieved from Wikipedia: https://en.wikipedia.org/w/index.php?title=South_Asia&oldid=1051785558
World Bank. (2014). *Electric power consumption (kWh per capita) - South Asia, World*. Retrieved from The World Bank: https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC?locations=8S-1W
World Bank. (2019). *Access to electricity (% of population) - South Asia*. Retrieved from The World Bank: https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=8S
World Bank. (2019). *Access to electricity (% of population) - South Asia*. Retrieved from The World Bank: https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS?locations=8S

World Bank Group. (2015). *How Much Could South Asia Benefit from Regional Electricity Coopeartion and Trade.*

WorldBank. (2019). *Project Information Document (PID).* World Bank. Retrieved from https://pubdocs.worldbank.org/en/431721577135487791/12139-Project-Concept-Information-CTF-DPSP-3-Maldives-WB-ARISE.pdf