Challenges of Cross Border Power Trade with Neighboring Countries and Interest of Bangladesh

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Table of Contents

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Executive Summary

The Bangladesh government has outlined the vision of making Bangladesh a middle income country by 2021 and a developed country by 2041. To implement that vision, massive development projects have been undertaken to strengthen the economy of the country. But economic development and electricity demand are proportionally related to each other. As a result, huge multi-dimensional activities have been undertaken in order to develop the power sector of Bangladesh and a master plan known as Power System Master Plan (PSMP) has been prepared. According to the Power System Master Plan (PSMP), the government has a target of generating 24000 MW by 2021, 40000 MW by 2030 and 60000 MW by 2041.

To diversify the sources of electricity generation, the primary fuel mix proposition has been revised where fuel mix should be: Gas/LNG 22.13%, Nuclear 10%, Domestic Coal 28.13%, Imported Coal 21% and Regional Grid 11.25%. As a result, importance has been imposed on the cross border trade of electricity. Cross border trade of electricity can assist in reducing energy prices, mitigating the power shortage, facilitating decarbonization and providing opportunity in extension and integration of the energy market. Moreover, as our country has limited land resources, using cross border power trade using transmission lines is very beneficial for our country. At present, Bangladesh imports 1160 MW power through cross border power trade and has a target of importing 4500 MW by 2030 and 9000 MW by 2041.

But there are many challenges in implementing an active and robust network that would amplify the current scenario of the cross-border electricity trading. Due to lack of political willingness and consensus among the neighboring countries, cross border power trade of Bangladesh is very poor and all of the power trades currently occurring are bilateral in nature and hardly provides any opportunity for multilateral cooperation. Without proper support of India, we cannot trade electricity with Nepal and Bhutan. Also, as a big power in south Asia, it can play a vital role in our electricity trading with BIMSTEC countries like Myanmar and Thailand etc. by convincing or demotivating them. Although there have been agreements among the nations to establish a multilateral collaboration like SAARC framework agreement and BIMSTEC agreement on power trade, absence of sophisticated international standard grid infrastructure within the nations have restricted the countries to form a unified synchronous grid structure within the nations that would help establishing multilateral power trade in this region.

Currently, there are few grid interconnections between nations but those interconnections are very insufficient to facilitate cross border power trade by creating synchronous grid structure covering a vast area of this region. Although there is ample amount of energy reserves in South-Asian region, the energy reserves are not properly explored and utilized. Moreover, countries of this region cannot share the energy reserve due to lack of legal framework and regulation of neighboring countries restricting universal usage of the energy resources.

For successful implementation of cross border power trade, multilateral regional cooperation among neighboring countries ensuring a level playing field is first and foremost a non-technical move. Although volatile and selfish attitude of regional big power makes it difficult to agree upon some effective decisions, Bangladesh must take a lead to start dialogue through different platforms: SAARC and BIMSTEC for its own interest. For the formation of a common synchronous grid, countries in this region need to increase their investment to strengthen their grid infrastructure based on consensus investment policy, prioritized supporting projects, incentive-based maintenance policy. Besides, new grid interconnections need to be established by promoting joint venture investment.

Moreover, countries need to review their transmission grid usage policy for promoting trilateral or multilateral power trade. Governments of the respective countries should be motivated to revise their fuel mix policy, energy exchange policy for promoting cross border power trade in this region. Besides, for proper utilization and exploration of the energy resources, countries of these regions need to form a uniform legal framework and regulation. For the formation of a uniform legal framework and regulation, European and African framework and regulations can be used. Thus, with the participation and cooperation of the regional countries this trade can be extended up to Thailand that has impact on economic development, de-carbonization, optimum energy production-usage, strong alliance and after all regional prosperity which obviously includes Bangladesh’s fair-share.

Chapter 1
Introduction

1.1 Background of the Study

The government has adopted Vision 2041 and seeks to eliminate extreme poverty and reach Middle-Income Country status by 2021, and Developed Country status by 2041. To achieve that goal, the country needs to achieve continuous economic growth through a robust communication system, industrial diversification and abundant energy availability. Energy is pivotal socio-economic development input and foundation stone of the modern industrial economy. Bangladesh and its neighboring countries like Bhutan, India, the Maldives, Myanmar, Nepal, Pakistan, Sri Lanka and Thailand etc. are currently experiencing a rapid growth in energy demand, along with economic growth and industrialization [1]. To maintain the continuous economic growth rate, the primary energy demand especially in the industrial sector is expected to increase sharply. To meet the rapidly increasing demand, Bangladesh needs to explore various alternative energy sources within and outside the country. As there is lack of energy sources within the country, Bangladesh can explore the energy sources of its neighboring countries and import energy from these countries through cross border power trade to meet up the growing demand of the energy and ultimately achieve its vision of becoming advanced country by 2041.

To find out the answer of the question why we want to go for cross border power trade with neighboring countries, First of all we need to consider international environmental agreement like the Paris Agreement, which was signed in 2016 by 195 nations; main aim is to keep a global temperature rise this century well below 2 degrees Celsius [2]. So, we need to find out more renewable energy to limit the use of fossil fuel and to decrease the emission of greenhouse gases like COx, NOx, SOx etc. Secondly, the possibility of our renewable source like hydro is limited in Bangladesh, the possibility of solar power is challenging due to lack of land and other renewable sources have less potential to generate a large amount of energy. On the other side, some of our neighboring countries have huge hydro potential which are superfluous to their demand. Economically feasible hydropower potential of India, Bhutan and Nepal are respectively 148,701 MW, 26,760 MW and 43,000 MW. [3][4] This gap between some countries having renewable energy deficiency and some countries having abundant economically feasible

renewable energy supply ability of this resign can be balanced by utilizing the available energy resources efficiently, creating a level playing field, assuring returns to investors, and providing affordable electricity to consumers. Cross Border Power Trade could make uses of the resources, provide affordable electricity to all, and promote environment-friendly socio-economic robust development by sharing energy resources and energy infrastructure. So, this Cross Boarder Power Trade will ensure secure and sustainable energy supply in the region and make the region socio-economically well-developed [1].

Bangladesh's total installed electricity generation capacity (including captive and renewable power) was 23,436 megawatts (MW) as of June 2020. [5] The generation of Bangladesh largely depends upon gas based generating plants and almost 60% of the total gas stored in the discovered gas mines of the country is already depleted. So, while introducing PSMP-2016, the government of Bangladesh has considered diversifying our generation to reduce the pressure on our gas reserve. Also, there was a huge crisis in our generation not very long ago. So to mitigate the power crisis and to supply the fast-expanding demand, the Bangladesh Government has been importing electricity from India since 2013 and 1,160 MW electricity is being imported daily [6]. Where 1000 MW electricity is being imported from India through 400kV Baharampur (India) - Bheramara double circuit transmission line, which may be considered as asynchronous connection as Indian Grid's frequency or any interruption cannot affect Bangladesh Grid. 160 MW electricity is being imported from India through Tripura (India) to Cumilla, which may be considered as a synchronous connection as Cumilla is disconnected from Bangladesh Grid and acts as a part of Indian Grid. Beside those Bangladesh Government is working to Import 500 MW electricity from Nepal's Karnali hydropower project through GMR Group [7].

For cross border power trade of Bangladesh with neighboring countries, basic legal tools must be defined first. The basic framework for Bangladesh is the ***Power Sector Master Plan 2016(PSMP-2016)***. In the *section 6.4* (Year-wise Fuel Mix in Total Net Power Generation Capacity), it is stated that, "the total amount of imported power in connection to the cross-border trade shall not exceed 15% of total generation capacity". In the projection of fuel mix the total cross border import will be 5% in 2021, 7% in 2025 and 10% in 2030 respectively [8]. PSMP 2016 is our fundamental legal tool for cross border power trade. For cross border power trade in south-Asia, ***"SAARC Framework Agreement for Energy Cooperation (Electricity)"*** is

considered as the fundamental framework. This agreement was signed by all Member States of SAARC(South Asian Association for Regional Cooperation) including Bangladesh on 27 November 2014 in 18th SAARC Summit held in Nepal on 26th-27th November, 2014. Under the Agreement, SAARC member states will provide non-discriminatory access to the regional transmission grids in their respective countries. Negotiations—through bilateral, trilateral, or regional agreements—will be conducted among member states in installing cross-border transmission lines and cross-border interconnections for cross-border electricity trade. The Memorandum of Understanding (MoU) for Establishment of the BIMSTEC(Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) Grid Interconnection was signed on 31 August 2018 at the Fourth BIMSTEC Summit held in Kathmandu, Nepal. [9] The MoU has entered into force on 07 April 2019. The BIMSTEC members are Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand. This MoU provides a broad framework for the Parties to cooperate towards the implementation of grid interconnections for the trade in electricity with a view to promoting rational and optimal power transmission in the BIMSTEC region.

1.2 Problem Statement

As demand for electricity is growing day by day, cross border power trade has become a necessity for the south and southeast Asian region, especially in Bangladesh. The countries of this region can be benefited greatly in technical, operational, economic, financial and environmental aspects from it. Optimal resources, transmission network, fuel import, energy security & reliability are the examples of technical and operational benefits. Through proper investment in the regional power market, cost-effective, improved and competitive service can be ensured with less exposure to volatile international energy prices that leads to high exporting scope for sustainable economic growth. Environment pollution is to be reduced to a great extent by leveraging renewable energy & distributed less impactful regional policy with the improvement in social indicators.

Although cross border power trade can provide significant economic and environmental benefits, it has some undeniable challenges. It needs to deal with multiple energy sector regulatory frameworks, such differences in the mandates of regulators across the region can create coordination issues, lack of adequate transmission line and infrastructure, institutional capacity,

financing policy, political consensus, multilateral, regional bodies and other energy related institution should extend technical and financial cooperation, it is difficult to bring the nations to the negotiating table. Also, volatile political relations among the neighboring countries are hampering the progress of various proposals on cross border power trade. In this study, different challenges regarding cross border power trade are thoroughly identified with a view to overcoming the obstacles to open new doorways of cross border power trade in South Asia, especially for the benefits of Bangladesh.

1.3 Objectives

1. To identify the challenges for establishing a common power grid among the South Asian countries and a power market in the continent.
2. To specify the legal policies needed to facilitate cross border power trade.
3. To analyze the way of introducing multilateral cooperation in the South Asia region among the nations in this region.
4. To determine the role of SAARC and BIMSTEC in establishing a common power grid in South Asian countries.
5. To analyze the way of benefiting Bangladesh from cross border power trade.

1.4 Research Questions

1. What are the challenges for establishing a common power grid among the South Asian countries and a power market in the continent?
2. What legal policies are to be made from the participating countries to facilitate cross border power trade?
3. How can we bring the south Asian nation in a common table to introduce multilateral cooperation in the South Asia region among the nations in this region?
4. What could be the role of SAARC and BIMSTEC in establishing a common power grid in South Asian countries?
5. How Bangladesh can be benefited from cross border power trade?

1.5 Methodologies

The study is both descriptive and exploratory in nature. For the purpose of the study, data have been collected from both the secondary and primary sources. As primary sources our planned sample size was to interview 10 experts on the given topic. But, because of the sudden outbreak of COVID-19, we only could manage to interview only one personnel. As a result, our primary data are not healthy. We only could focus on the secondary data sources. As secondary data sources multiple websites, journals, research papers, magazines, articles etc. have been analyzed. Power Sector Master Plan 2016(PSMP-2016), SAARC Framework Agreement for Energy Cooperation (Electricity) etc. were thoroughly studied to prepare this report.

1.6 Significance of This Study

To reduce energy deficit, dependency, import, dominance of single fuel and increase the use of renewable energy using limited, minimal energy infrastructure cooperation among the neighboring countries is a must. By identifying inter-regional energy trade opportunities several multilateral intra-regional energy trades can be fruitful. After assessing the interests of all concerned stakeholders & options, **SRETS** [10] has identified four multilateral trade and cooperation options that are practically implementable & will eventually include all countries of the region. Currently several electricity, petroleum, LNG(liquefied natural gas) trade are ongoing between India, Bhutan, Bangladesh, Nepal, Srilanka which prepare the ground for futuristic, large scale sustainable multilateral trading with the capability of fulfilling upcoming demand.

In recent times the region is expanding interconnections and increasing cross-border power flows. However, progress is slow. An assessment of the experiences provided by several electricity cooperation initiatives, in developing and developed countries, provides a number of conclusions relevant to electricity cooperation in South Asia.

The following key points [11] have to be focused in this regard:

- Regional Power Market.
- Regional Power Plant.
- Nonconventional Renewable Energy.

- Regional Refinery
- Regional Liquefied Natural Gas Terminal
- Scope for Private Sector Participation.

In policy level irrespective of time to time political tension & conflict long, mid & short term policy adoption in terms of jointly agreed framework will also help to create technically sound workforce. However cross border power trade can ensure the fuel mix, stable energy availability, justified costing that speed up overall economic growth, optimum environment friendly renewable energy use, regional solidarity & collaboration.

1.7 Limitations

The main limitation of this report is that it has been prepared within a short period of time. Because of time constraints, this study only tried to focus only the challenges of the cross-border power trade. Also, when this report is being prepared, the world has been affected by COVID-19 pandemic. As a result, it was not possible to reach many key informant personnel to collect primary data. So, this paper is mostly based on the secondary data.

1.8 Delimitations

Though this paper is prepared with a very limited scope, it creates some doors of opportunities. This study tries to focus on the challenges of the cross-border power trade in South Asia. It tries to identify the economical, technical and policy-related challenges associated with the cross-border power trade. If the challenges are identified properly, it directs the pathway of overcoming the obstacles and thus imposing a better cross-border power trade policy, especially for the betterment of Bangladesh in future.

Chapter 2

Literature Review

2.1 Legal Tools for Cross Border Power Trade

For cross border power trade with neighboring countries, our deals will be bilateral, trilateral or multilateral agreement. The agreements will be made based on the legal frameworks of respective countries. BREC is the regulatory authority of Bangladesh. PSMP 2016 is considered as the basic legal tool of Bangladesh.

For cross border power trade in south-Asia, "SAARC Framework Agreement for Energy Cooperation (Electricity)" is considered as the fundamental framework. This agreement was signed by all Member States of SAARC including Bangladesh in 18th SAARC Summit held in Nepal on 26th-27th November, 2014. Under the Agreement, SAARC member states will provide non-discriminatory access to the regional transmission grids in their respective countries [12].

The Memorandum of Understanding (MoU) for Establishment of the BIMSTEC Grid Interconnection was signed on 31 August 2018 at the Fourth BIMSTEC Summit held in Kathmandu, Nepal. The MoU has entered into force on 07 April 2019. The BIMSTEC members are Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand. This MoU provides a broad framework for the Parties to cooperate towards the implementation of grid interconnections for the trade in electricity with a view to promoting rational and optimal power transmission in the BIMSTEC region [13].

Central Electricity Regulatory Commission (CERC) is the regulatory authority of India's power sector. India followed the "Guidelines on Cross Border Trade of Electricity 2016" issued by their ministry of power for the power trade with Bangladesh, Nepal, Bhutan etc. After receiving inputs from various stakeholders, they felt a need to revise the guideline. As the supersession of that guideline on 18 December 2018, they issued the new **"Guidelines for Import/Export (Cross Border) of Electricity-2018" [14]**.

2.2 PSMP – 2016

Bangladesh is currently importing 1160 MW from India. Bangladesh also wants to import power from neighboring countries such as India, Bhutan and Nepal. Bangladesh is in a good position to

get the benefit of regional hydropower potential and import it through the cross-border transmission network. JICA (Japan International Cooperation Agency) Survey shows that the cross-border hydropower potential available to Bangladesh is 3,500-8,500MW in 2030, mainly from Nepal and north-west India. Bangladesh has a target for Cross-border Energy Imports: 3,500~8,500MW (by 2031), 9,000MW (by 2041).

"We expect that Bangladesh will be able to get electricity out of such hydropower generation through power interconnections with such neighboring countries for stable base load supply, energy fuel diversification, and climate change mitigation." [15]

2.3 Cross Border Power Trade in Europe

Cooperation in the field of electricity supply has a long tradition in Europe which inaugurated in 1921 and gradually become more organized by the formation of European Network of Transmission System Operators for Electricity (ENTSO-E) in 2009 with 43 transmission system operators from 36 European countries under the mandate of European Union (EU) [16]. There are five permanent regional groups for system operations based on synchronous areas, namely Continental Europe, Nordic, Baltic, Great Britain, and Ireland Northern Ireland. In the EU electricity market, electricity is traded Over-The-Counter (OTC) and on power exchanges [17]. OTC trading occurs outside of exchanges based on a contractual agreement with terms as agreed between two parties. Trading partners agree on the price and amount between themselves. Again, trading on European wholesale electricity markets is divided into two auction-based submarkets, the day-ahead market and the intraday market [18]. On the day-ahead market, market players trade in electricity for the following day. Bids and offers specifying the amount and supply time must be submitted by midday. On the intraday market, electricity can be continuously traded until 60 minutes before delivery time on cross-border connections.

2.4 Cross Border Power Trading in African Continent

Currently cross border power trade in the African continent in the guise of power pooling developed in the different regions of the continent. There are four power pools formed in the north, south, east and west regions of Africa comprising the regional countries. The four power pools are illustrated here in brief:

South African Power Pool (SAPP):

The SAPP is an entity consisting of the national electrical companies in southern Africa under the auspices of South African Development Community (SADC) [19]. The power grid and power market are common in this region among the member countries of SAPP. SAPP comprises 17 nations from the southern Africa regions and the secretariat is located in Harare, Zimbabwe. It was the first power pool formed in Africa founded in 1995 [20].

Eastern Africa Power Pool (EAPP):

The EAPP is the collaborative effort by the eleven countries of the eastern region of Africa for the purpose of a common interconnection among the participating countries for better utilization of resources. The secretariat is located in Addis Ababa, Ethiopia. It was founded in 2005 [21].

West African Power Pool (WAPP):

WAPP was formed in 1999 under the auspices of Economic Community of West African States (ECOWAS), a collaboration of 14 countries of West Africa. The participating members are currently working to establish a common power grid and a power market and to do so several projects have been already implemented. The headquarters of WAPP is located in Cotonou, capital of Benin [22].

North African Power Pool (NAPP):

Five northern African countries belonging to the Arab-Maghreb Union formed the NAPP to interconnect the transmission grids of each country in order to facilitate cross border power trading among the members [23].

Chapter 3

Analysis

As of June 2020, Bangladesh imports 1160 MW of electricity from India, which makes up 5.65 per cent of the total installed capacity of power plants from public and private sectors of Bangladesh as shown in the table below -

Table 1: Installed capacity of Bangladesh

Fuel type	Capacity (MW)	Total (%)
Coal	**524**	**2.55**
Gas	**11307**	**55.12**
HFO	**5403**	**26.34**
HSD	**1855**	**9.04**
Hydro	**230**	**1.12**
Imported	**1160**	**5.65**
Solar	**35**	**0.17**
Total	**20514**	**100**

The first cross-boundary electricity import initiative began in 2013 when 500 MW electricity was imported from Baharampur, India to an existing High Voltage Direct Current (HVDC) substation in Bheramara, Bangladesh. A 400 KV double circuit line connects the two substations in the two countries. Although the initial power transfer through this connecting unit is 500 MW there is scope for transferring more power through this portal and at present Bangladesh imports 1000 MW power through this connecting unit. [24]

PM Sheikh Hasina inaugurates the additional power import through Baharampur-Bheramara transmission link at a video conference with PM Narendra Modi from Ganabhaban

PM Narendra Modi dedicates the second cross border transmission interconnection system between India and Bangladesh, through video conferencing, in New Delhi.

The second initiative is through the 47 km double circuit transmission line linking the power grid at Suryamaninagar in Tripura to the Comilla power grid in eastern Bangladesh. Initially 100 MW electricity was imported by Bangladesh in March 2016, but the country intended to trade a further 100 MW through this line. However, at present, Bangladesh does not have the infrastructure capacity that is needed to take an additional 100 MW power from Tripura; so an additional 60 MW was added to the existing 100 MW after developing the necessary transferring facilities resulting in power import of 160 MW through this transmission link [25].

The present cross border power trade is limited to power import from India only. There are ample opportunities of power import from other neighboring countries: Nepal and Bhutan. But for that unified regulatory framework and Indian regulation for cross border trade of electricity (CBTE) needs to accommodate tri-lateral/ multilateral power trade provisions along with bi lateral power trade. Besides, more grid connection needs to be fairly developed and more conduction of feasibility study is required for promoting cross border power trade. Finally, political consensus needs to be developed based on trust, mutual confidence and mental set up for facilitating cross border power trade.

For importing electricity, the price must be reasonable. So, the distance has to be under consideration. Bangladesh has a 2400 km land border, 92% of which is with India and 8% is with Myanmar. These two countries are our closest neighbors. According to a study by SARI [26], Bangladesh has a prospect to import power from India, Bhutan and Nepal. Currently, we import powers by back to back HVDC connection from India. We also have the potential to import hydro or solar power from them. Bhutan and Nepal have hydro potentials. Bangladesh has an opportunity for power trade with these two countries. They can also have dry season support from Bangladesh. As we don't share common land borders with Nepal and Bhutan, our agreements will be trilateral instead of bilateral involving another country India. So, for these trades, we must keep the legal tools in consideration.

Table 2: Key Prospects for Cross Border Electricity Trade in the SA Region. Taken from: https://sari-energy.org/program-activities/cross-border-electricity-trade/cbet-opportunities-in-sa/

Importing Countries	Exporting Countries				
	India	Bhutan	Nepal	Bangladesh	Sri Lanka
India		Significant quantity of hydro power(H)	Significant hydro power export possible	Significant amount of gas or power possible; resource	Some peak power support possible

				uncertain	
Bhutan	Dry Season Support		Unlikely Similarity of resources and seasonal shortage	Small amount of thermal power and gas; connection via India (L)	No Scope
Nepal	Thermal power support. Dry season support.	Unlikely. Similarity of resources and seasonal shortages		Small amount of thermal power and gas; connection via India (L)	No Scope
Bangla-desh	HVDC back-to-back link. Sharing reserves; electricity swap Some hydro power; connection via India (L)	Some hydro power; connection via India (L)	Some hydropower; connection via India (L)		No Scope
Sri Lanka	Dry season and thermal power support	Unlikely (far off)	Unlikely (far off)	Unlikely (far off)	

All these countries hold memberships of regional corporations like SAARC, BIMSTEC, etc. These organizations have developed some frameworks, which have made the opportunity more feasible. For our research, we keep the tools by SAARC and BIMSTEC in our consideration.

3.1 SAARC

The South Asian Association for Regional Cooperation (**SAARC**) is the regional intergovernmental organization and geopolitical union of states in South Asia. Its member states are Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan and Sri Lanka. For cross border power trade in the SAARC area, ***"SAARC Framework Agreement for Energy Cooperation (Electricity)"*** [27] is considered as the fundamental framework. This agreement was signed by all Member States of SAARC including Bangladesh on 27 November 2014 in the 18th SAARC Summit held in Nepal on 26th-27th November 2014. Under the Agreement, SAARC member states will provide non-discriminatory access to the regional transmission grids in their respective countries. Negotiations—through bilateral, trilateral, or regional agreements—will be conducted among member states in installing cross-border transmission lines and cross-border interconnections for cross-border electricity trade. The then honorable minister to foreign affairs of Bangladesh, Mr. Abul Hasan Mahmood Ali signed the agreement.

This agreement allows,

- Authorized entities of SAARC member states, including private or public power producers, power utilities, trading companies, transmission utilities, distribution companies or other institutions established under the law, to buy and sell electricity within the region;
- Buying and selling entities to negotiate the terms and conditions, payment security mechanism and tenure of the electricity trade, subject to regulation by the laws of the concerned member states; and
- Member states to consider exempting export and import duties, and other fees for cross-border trade and exchange of electricity between buying and selling entities.

This framework has added a new dimension for the power trade policy in South-Asia.

3.2 BIMSTEC

Another organization in this region is the Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC); Seven Member States of BIMSTEC lying in the littoral and adjacent areas of the Bay of Bengal constituting a contiguous regional unity.

BIMSTEC Energy Sector works to enhance energy cooperation among the BIMSTEC Member States through the establishment of the BIMSTEC Grid Interconnection program. The **Memorandum of Understanding (MoU) for the Establishment of the BIMSTEC Grid Interconnection** [28] was signed on 31 August 2018 at the Fourth BIMSTEC Summit held in Kathmandu, Nepal. The MoU has entered into force on 07 April 2019. The BIMSTEC members are Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand. This MoU provides a broad framework for the Parties to cooperate towards the implementation of grid interconnections for the electricity trade with a view to promoting rational and optimal power transmission in the BIMSTEC region. Mr. Abul Hasan Mahmood Ali, the then honorable foreign minister of Bangladesh had signed the contract for the country.

Figure: Memorandum of Understanding (MoU) Signing for the Establishment of the BIMSTEC Grid Interconnection [https://www.flickr.com/photos/meaindia/43663593854]

The First Meeting of the BIMSTEC Expert Group on Energy [29] (1st Expert Group Meeting on Energy(EGME)) was held in Nay Pyi Taw, Myanmar on 28-29 March 2019. The output of the meeting was to finalize the draft Terms of References of the BIMSTEC Grid Interconnection Coordination Committee (BGICC) which is stated in the previous MoU.

Figure: **The First Meeting of the BIMSTEC Expert Group on Energy [**Source: https://bimstec.org/?event=the-first-meeting-of-the-bimstec-expert-group-on-energy]

On 25-26 February 2020, **"Conference on Enhancing Energy Cooperation in the BIMSTEC Region"** [30] was organized jointly by SARI/EI and BIMSTEC at BIMSTEC Secretariat, Dhaka, Bangladesh. The conference provided practical ideas and thoughts for developing the future work plan of the BIMSTEC Energy Cooperation.

Figure: Conference on Enhancing Energy Cooperation in the BIMSTEC Region [Source: https://sari-energy.org/event/bimstec-and-sari-ei-to-jointly-organise-workshop-on-enhancing-energy-cooperation-in-the-bimstec-region-on-25-26-february/]

Not only the framework developed by the regional corporations but also the national policy of the involved country must be in consideration. Currently, we have a power purchase agreement with India. This is based on bilateral policy. But in the case of Nepal or Bhutan, the scenario is not the same. These purchases will involve the land and transmission line of India. So, the legal tools of India are most important to us.

Central Electricity Regulatory Commission (CERC) is the regulatory authority of India's power sector. India followed the **"Guidelines on Cross Border Trade of Electricity 2016"** issued by their ministry of power for the power trade with Bangladesh, Nepal, Bhutan etc. There were some limitations in the guideline for cross border power trade between another two neighboring countries through India. So, after receiving inputs from various stakeholders, they felt a need to revise the guideline.

As the supersession of that guideline on 18 December 2018, they issued the new "**Guidelines for Import/Export (Cross Border) of Electricity-2018"** [31]. Based on the guideline, later on 8th

March 2019, CERC issued the "**Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019**" [32]. This revised version has eased the opportunity of tripartite agreements.

Currently, a joint working group comprising members from Bangladesh, Bhutan, India and Nepal are holding meetings twice a year to arrange a discussion on this platform.

3.3 PSMP 2016

There are some problems trading electricity. If we want to trade electricity by ac current, our quality of electricity needs to be compared with the neighboring or counterpart countries. The quality of our electricity must be equivalent or better than that of counterpart countries. If our electricity quality does not comply with the criteria, then it will be a problem. Second problem is that we want to import a very high amount of power from one connecting point because it increases efficiency. But, importing a high amount of power from a single point increases the risk of massive blackout. We all know that, in 2014, Bangladesh was hit by a nationwide blackout and India was responsible for that. The transmission line bringing electricity from India failed causing a blackout in Bangladesh. So, there is a risk of blackout. Thirdly, when two countries use a common transmission line, there is a risk of mutual interference. Mutual interference occurs due to grid accidents. The fourth problem is with the construction of interconnection lines. Without interconnection lines, no power trading is possible let alone trading with Nepal and Bhutan. So, for commercial operation, construction of case 2-HVDC(±800kV) (High Voltage Direct Current) and case 3-HVAC(765kV) (High Voltage Alternating Current) line is needed. These interconnection lines will be constructed by India if India feels that these lines will be helpful for them. India understands the necessity of case 2 line but India perhaps finds no reason to construct case 3 line. But, case 3 line is more effective and beneficial for Bangladesh because using this line, power can be imported from various regions. Another problem is that there can be interruption in power supply due to adverse relations between countries. One country may suddenly stop supplying power, putting the other country into great trouble for some other incident between the countries. Also, securing the transmission system is needed. In these long transmission systems, how can the safety be given? Who will take the responsibility for reconstruction and the failure of power supply for that time period if there is any problem? Bhutan and Nepal also want to export power to Bangladesh. But, to import power from these countries, India's support is needed as the power must be transmitted through

India. If some issue rises between India and Nepal or Bhutan, India may hamper taking electricity from them.

If our electricity quality does not comply with the criteria that the quality must be at least equivalent to that of counterpart countries, then we need to take steps for quality improvement. To avoid the incident of massive blackout, the amount of imported power from a single point must not exceed 10% of the demand. The problem of mutual interference can be minimized by connecting dc lines. For the construction of case 3 line, we need to convince India and if India does not get any benefit constructing this line then it should be given benefit through another way. To avoid the interruption in power supply due to adverse relation, a contract between the electricity sharing countries must be made where a penalty process will be defined. Also, imported power should be within the generating reserve margin and that should be within 10% of all supply capacity to avoid supply interruption. There should also be a deal between the countries on how the security to the transmission systems will be given so that India may not hamper the transmission line that will supply electricity from Nepal and Bhutan.

3.4 European Cross Border Power Trade

In Europe member countries demonstrated great political will and commitment in establishing their regional power market. This commitment translated into each state implementing economic reforms in their domestic power sector. At various stages, governments came together through several platforms to dialogue and exchange information. It is commendable that governments have come together to allow the common good to override their national interests, that is, to achieve an integrated region. However, in South Asia regional blocks have not been able to make such progress in their power market integration process due to lack of consensus among the regions.

The creation of strong institutions such as Agency for cooperation of energy regulators (ACER) [33] and European Network of Transmission system operators (ENTSO-E) [34] at various stages of cooperation have helped the development of the harmonized European power market. European electricity market is governed by eight network codes. They are: (i) Requirement for generator codes [35] covering the requirements for generators (synchronously and as-synchronously connected) to be connected and fostering the robustness of the European electricity network, (ii) demand connection code [36] covering the requirements for demand

facilities or distribution systems to be connected intending to establish a level-playing field in terms of connection requirements for load, (iii) high voltage direct current connection code [37] fostering the robustness of the European electricity network to establish a level-playing field in terms of connection requirements for HVDC connections, (iv) forward capacity allocation code [38] covering set up strategy of a pan-European platform for the allocation of long-term transmission rights and the types of long-term transmission, (v) capacity calculation and congestion management code [39] fostering an efficient integration of the European power markets at the day-ahead and intraday time frame, (vi) electricity balancing code [40] aiming at harmonizing and integrating the European balancing energy markets, (vii) system operation code [41] for setting minimum system security, operational planning and frequency management standards to ensure safe and coordinated system operation across Europe and (viii) restoration and emergency code [42] covering the rules for system restoration in case of interruption. These network codes have been carefully designed with the sole purpose of promoting energy security, efficiency and sustainability through a competitive market system for trading electricity. The well-functioning power-exchange system is supported by clear rules, an independent market surveillance unit to maintain transparency, and effective mechanisms for reducing transmission congestion. Such development of institutional and legal framework is a challenge for the cross-border power trade in Bangladesh.

In the EU, the power sector reform in the mid-1990s regulated third-party access to national transmission infrastructure, and as the states adopted the EU electricity directives in 2003 and 2009, they agreed to non-discriminatory third-party access to transmission infrastructure. The power market has moved beyond the basic requirement of non-discriminatory third-party access to national transmission infrastructure to a more sophisticated transmission and grid management system: The elimination of transmission border fees between countries has ensured that electricity buyers and sellers pay tariffs only at the point of connection. Moreover, these transmission prices are independent of distance between the traders. Such provisions and rules on transmission grid usage have played an important role in expanding electricity trade in the region [43]. Bangladesh is land locked by India and Myanmar. As a result, the trilateral power pool is greatly dependent on grid usage of India and Myanmar. So, imposing rules and provision on transmission grid usage of India and Myanmar is one of the major challenges for Bangladesh.

In EU countries, initiative to implement market liberalization in their domestic power sectors was crucial in helping the EU power market transition from the first phase of cooperation to the second phase: that of creating a competitive electricity market. Wholesale power trading in Europe is handled in exchanges and OTC. While OTCs are the main power of power trading, liquid auction based day-ahead and forward markets, together with open intra-day and balancing markets are instrumental to integrating markets [44]. Such creation of a competitive energy market in the south Asian region is a challenge in facilitating cross border power trade in that region.

3.5 African power trade

In the African Continent, cross border electricity trade is very prominent. The talk of cross border power trading arose in the beginning of the 80's and under the prescription of different world entities, several countries opened up to discussion about cross border electricity trading. In the vast African continent, there have been several power pools formed to ensure safe, reliable, cleaner use of energy. These countries can be a very good example for the south Asian nations to build a robust, safe and resilient power network across the region. In the African region, four power pool networks are exemplary. As most of the cross border trade of electricity in the South Asian region is bilateral in nature, the regional entities can benefit much from the working mechanism of these African power pools. In this paper, these African power pools are illustrated here.

Southern Africa Power Pool (SAPP):

In this region of Africa, there were several interconnections between countries. These connections are mentioned below:

- Zimbabwe and Zambia
- Congo and Zambia
- South Africa and Botswana, Lesotho, Namibia and Swaziland.
- Zambia, Zimbabwe and Botswana etc.

These interconnections between several countries lead to build a single and robust infrastructure in the region. The regional cooperation named as Southern African Development Community (SADC) played a very vital role in establishing the power pool. Eskom, a public utility of South Africa was assigned for planning in the power pool. Bilateral power trading already present in

the region assisted the agreements that were the founding stone of SAPP. The intergovernmental memorandum of understanding (MOU) comprised the framework of each interconnection among the member countries and it authorized and guaranteed inter-utility contractual obligations. Accordingly SAPP established policies and regulations through intergovernmental and inter-utility MoUs that allowed collaborations and guidelines for the cross border power trade among the member utilities.

As illustrated in above, there were several bilateral cross border power trading present in the south African region. But these bilateral agreements couldn't be feasible for a bulk amount of electricity trade, and disputes often rose between the countries while forming an agreement for power trade. Due to these reasons, SADC prescribed a general solution, thus a common power pool was formed in this region. Now twelve countries under SADC are participants of SAPP. SAPP is now responsible for ensuring a commendable power structure that enables a reliable, easily accessible, green and safe utilization of energy. There are some crucial factors that are crucial for the successful operation of SAPP. These are noted below with bullet points:

- There is a legal and regulatory framework present in SAPP. This framework provides integration and collaboration of the regional utilities of the power market.
- There is a harmony existing in the legal and operational framework.
- SAPP ensured an increase of power generation capacity.
- Different bilateral and multilateral agencies have been working towards a common power grid in the southern region of Africa.
- There has been a power market proposed to ensure proper utilization of resources.

Power trading between two countries within the African countries region was present for a very long time. In southern Africa, since the 1950s there have been discussions for electricity trading between DRC and Zambia. And eventually power trading between two countries led to formation of a power pool in the region that is now operating at a highly successful rate of electrification in the region. Every year each member contributes to the pool a predetermined amount as per the document that set up the pool. However, the World Bank and the Development of Southern Africa are the largest donors of the pool [45].

Chapter 4
Findings

1. Strong political will and consensus is the prerequisite for promoting cross border power trade in South-Asian region. There is a lack of harmony among the countries especially big powers like India, China and Myanmar in this region. So, formation of political consensus regarding power trade among the countries is a big challenge for cross border power trade.
2. There are ample reserves of energy potential in neighboring countries of Bangladesh: India, Nepal and Bhutan. Bangladesh can explore those resources in those countries and conduct feasibility studies in economic exploration of those resources. At present, only two grid connections are available: Baharampur – Bheramara and Suryamaninagar-Cumilla. So, for the cross border power trade strengthening of the existing grid structure and making more grid interconnectivity maintaining international standards is a challenge.
3. Bangladesh is landlocked by India and Myanmar. As a result, power import from neighboring countries other than India and Myanmar greatly depends on the co- operation and grid usage of India and Myanmar. The unified regulatory framework and Indian regulations for Cross border trade of electricity (CBTE) needs to be more generous in facilitating trilateral or multilateral power trade along with bilateral power trade. Moreover, promising change in the regulatory framework of electricity trading of Myanmar is also required for facilitating cross border power trade.
4. Bangladesh has the provision of importing energy from Laos, China and Thailand using the grid of Myanmar. But due to the Rohingya crisis, the present political relation between Myanmar and Bangladesh is not favorable enough to import energy from Laos, China or Thailand using the Myanmar grid.
5. Greater political will and consensus among the European countries have resulted in creation of five regional groups of system operators based on synchronous area which has made power trade in Europe easy. European countries in those groups can easily perform cross border power trade in those regions. But such type of political will and consensus is absent in South-Asian region. Besides, Institutional and regional framework in European

countries have played a vital role in promoting cross border power trade in Europe. Such types of institutional and regional framework have not been implemented in this region for promoting cross border power trade. Again, the European power market is governed by eight network codes which have been working as the backbone of European cross border power trade. Creation of such unified network codes for the facilitation of cross border power trade is to be accomplished. Liberalization of the power market in Europe has resulted in a competitive power market in Europe. Apart from bilateral contracts, energy is being traded in auction based day ahead and intraday market which has resulted in a competitive market place omitting monopoly nature. Lately, only contract based bilateral power trade is prevalent in the South-Asian region. So, formation of a competitive power market similar to Europe is a challenge for cross border power trade in this region.

6. In African region, some bilateral agreements and relations were present. The political leaders and rulers of the nations felt the need of formation of a common entity for interconnection of electricity within the region. The regional agencies paved the way for the national leaders to form a mutual agreement that would open up discussions about power trade. The regional agencies took the responsibility to form a power pool and manage them. The international donors and the regional donors were very much involved in establishing a common network for interconnection of electricity. A proper grid code was introduced to economically and effectively operate the electricity network. Such a common power grid can be beneficial for South-Asian countries and especially Bangladesh. But, the challenges persist regarding what would be the policy, where the grid would be established, how funds would be managed etc. So implementing all these in south Asia would be very challenging. Political willfulness among Bangladesh and its neighboring countries are very low. The regional institutions like SAARC and BIMSTEC are not sufficiently functional in the region. As a result the ruling parties of these south Asian countries are not coming together to a consensus for establishing a suitable power market. Last but not the least, lack of investment for infrastructure development to support cross border power trade is also downgrading the process for multinational collaboration.

Chapter 5

Recommendation and Conclusion

The size of economy of Bangladesh is growing very fast. In 2018, the GDP growth of Bangladesh was 7.9% which was the 6th highest in the world. Bangladesh is going to be a middle-income country by 2021 and the country has already fulfilled the prerequisites for being so. Many large industries are growing in this country. Efficient, easy, accessible, cheap and quality electricity will encourage the investors of our country to build small and large industries and also attract foreign investors. Besides, the economy of other countries in South Asia is also growing. As a result, adequate energy supply is a prerequisite to ensure sustainable growth in Bangladesh and other neighboring countries. With increasing demand of energy, it's a challenge to ensure necessary energy in a cost-effective manner amidst increasing oil prices & minimizing environmental pollution with increasing demand. To flatten the curve, boost economic growth, ensure sustainability and minimal environment pollution, there is no alternative other than the regional power trade. These Southeast Asian countries have various sources of renewable energy i.e. hydro, solar & natural resources i.e. gas, oil, coal that can ensure sufficient power supply at every corner. Through consensus of political parties, effective collaboration & resource utilization, Bangladesh can use the most benefit of regional power trade. As the energy demand curve of Bangladesh fluctuates a lot round the year, we can be benefitted by importing power at peak time & exporting in the winter season. Currently, Bangladesh has some form of power trade that exists bilaterally and is limited to power import only from India. Also other countries of South Asia presently have cross border electricity trading with India only in bilateral formation, hereby regional cooperation provides better opportunities for addressing the challenges. But it is undoubtedly clear that national rulers and political sentiment would be very vital for establishing a power pool in this region. The regional agencies especially SAARC and BIMSTEC are playing a significant role to make sure that the rulers and leaders of the member nations open up to discussions about building a common infrastructure & policy for power trading. But a volatile and malicious attitude towards other neighbours, big brother attitude has been failing the nations to create a common power market.

To avail the opportunities, it is necessary to

- Immediately develop & finalize a SAARC Regional Energy Trade and Cooperation Agreement. Discussion must be top priority for our own interest.
- Finalize market driven regulatory, investment, security, legal framework including trading policy, stakeholder's accountability, liability, proportionate investment, timeliness etc.
- Create opportunity for financing & private sector participation to speed up grid structure development and formation of synchronous grid covering the region. This must focus on energy transit, dispute resolution mechanism and free trading in energy-related materials, products & equipment as per WTO (World Trade Organization) rules.
- Prepare individual countries power sector development and reshape plan and policy i.e. quality improvement of electricity, provision for trilateral or multilateral power trade, build common transmission line, ensuring transmission line security.
- Implement some supporting projects i.e. LNG (liquefied natural gas) terminal, cross country gas pipeline setup, joint venture power plant standard.
- In depth and thorough case study of Southern Africa Power Pool (SAPP) and other African power pools work mechanism to mitigate future challenges.
- Engage & improve our local human resource to be capable of handling sophisticated exchanging mechanism with professionalism abiding by law and order.
- Carry out further detailed studies aiming comprehensive development & government's vision.

So, it can be concluded that a market-driven process for cross-border power trading together with a regulatory framework across the region that enforces a strong economic discipline would maximize the benefits from the development of interconnection projects among South Asian countries considered in an orderly manner.

References:

[1] Amin, S., 2017. Cross Border Trade On Electricity (CBTE): A pathway for achieving economic development and energy security. rising Asia, (8).

[2] "500MW to be bought from Nepal", thedailystar.net, 22 November, 2019. [Online]. Available:https://www.thedailystar.net/business/news/500mw-be-bought-nepal-1830388 [Accessed on 15 June, 2020]

[3] Kaoru Ogino, Mikiyasu Nakayama and Daisuke Sasaki, Domestic Socioeconomic Barriers to Hydropower Trading: Evidence from Bhutan and Nepal. MDPI journals, Sustainability 2019, 11(7), 2062; 7 April, 2019.

[4] "Hydro Electric Potential Development-Region wise", cea.nic.in, 2020. [Online]. Available: http://www.cea.nic.in/monthlyhepr.html [Accessed on 15 June, 2020]

[5] "Bangladesh power sector at a glance", Powerdivision.gov.bd, 2020 [Online]. Available: https://powerdivision.gov.bd/site/page/6cd25d49-3150-482a 8bd0701d18136af7/%E0%A6%8F%E0%A6%95%E0%A6%A8%E0%A6%9C%E0%A6%B0%E0%A7%87 [Accessed on 15 June, 2020]

[6] "500MW electricity from India starting June 2018", Dhakatribune.com, 17th May, 2018. [Online].Available:https://www.dhakatribune.com/bangladesh/powerenergy/2018/05/17/500mw-to-be-imported-from-india-in-june [Accessed on 15 June, 2020]

[7] "Historic Paris Agreement on Climate Change", Web.archive.org, 12 December, 2015. [Online].Available: https://web.archive.org/web/20160117141004/http://newsroom.unfccc.int/unfccc-newsroom/finale-cop21/ [Accessed on 15 June, 2020]

[8] "Power System Master Plan-2016", Powerdivision.gov.bd, 2020. [Online]. Available: https://powerdivision.gov.bd/site/page/f68eb32d-cc0b-483e-b047 13eb81da6820/ Power-System-Master-Plan-2016 [Accessed on 15 June, 2020]

[9] "Salient Facts on BIMSTEC Energy Cooperation", Bimstec.org, 2020. [Online]. Available: https://bimstec.org/?page_id=2538 [Accessed on 15 June, 2020]

[10] "SAARC Regional Energy Trade Study" [online] Available: https://www.sasec.asia/uploads/publications/srets_a.pdf/ [Accessed 8 June 2020].

[11] **"**ENERGY TRADE IN SOUTH ASIA:OPPORTUNITIES AND CHALLENGES". [online] Available: https://www.adb.org/sites/default/files/publication/29703/energy-trade-south-asia.pdf/ [Accessed 8 June 2020].

[12] G. Ministry of Power, *Powermin.nic.in*, 2020. [Online]. Available: https://powermin.nic.in/sites/default/files/uploads/SAARC_framework_agreement_for_energy_cooperation_electricity.pdf. [Accessed: 17- Jun- 2020].

[13] B. Secretariat, "28 Mar 19 - The First Meeting of the BIMSTEC Expert Group on Energy", *WFTR*, 2020. [Online]. Available: https://bimstec.org/?event=the-first-meeting-of-the-bimstec-expert-group-on-energy. [Accessed: 17- Jun- 2020].

[14] CERC, *Cercind.gov.in*, 2020. [Online]. Available: http://www.cercind.gov.in/2019/regulation/CBTE-Regulations2019.pdf. [Accessed: 17- Jun- 2020]

[15]*Power System Master Plan 2016 Summary*. Power Division Ministry of Power, Energy and Mineral Resources Government of the People's Republic of Bangladesh, 2016, pp. 21,63.

[16] "Inside ENTSO-E", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/about/. [Accessed: 15- Jun- 2020].

[17] D. Steinbacher, H. Schult, D. Fichter, K. Staschus, J. Schröder and A. Lenkowsk, *Cross-border cooperation for interconnections and electricity trade*. Navigant Energy Germany, A Guidehouse Company, 2019.

[18] "Single Day-ahead Coupling (SDAC)", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/ network_codes/cacm/implementation/sadc/. [Accessed: 15- Jun- 2020].

[19]"Energy integration overpowers SADC | Africa Investor", Africainvestor.com, 2020. [Online]. Available: http://www.africainvestor.com/energy-integration-overpowers-sadc/. [Accessed: 17- Jun- 2020].

[20]"Southern African power pool interview with Omar Vajeth", ESI-Africa.com, 2020. [Online]. Available: https://www.esi-africa.com/industry-sectors/transmission-and-distribution/power-pool-interview-with-omar-vajeth/. [Accessed: 17- Jun- 2020].

[21]"About EAPP - Eastern Africa Power Pool", Eastern Africa Power Pool, 2020. [Online]. Available: http://eappool.org/about-eapp/. [Accessed: 17- Jun- 2020].

[22]"Creation of the WAPP", ECOWAPP, 2020. [Online]. Available: http://www.ecowapp.org/en/content/creation-wapp. [Accessed: 17- Jun- 2020].

[23]"View Programme", Virtual PIDA Information Centre, 2020. [Online]. Available: https://www.au-pida.org/view-programme/9/.[Accessed: 17- Jun- 2020].

[24] "The financial express", 2020. [Online]. Availablehttps://thefinancialexpress.com.bd/trade/bangladesh-mulls-electricity-export-to-india-1566877917 [Accessed: 20- Jun- 2020].

[25] "Tripura to supply additional 100 MW power to Bangladesh", *Business-standard.com*, 2020. [Online]. Available: https://www.business-standard.com/article/news-ians/tripura-to-supply-additional-100-mw-power-to-bangladesh-116042300388_1.html. [Accessed: 20- Jun- 2020].

[26] USAID SARI/Energy Integration. 2020. *CBET Opportunities In SA | USAID SARI/Energy Integration*. [online] Available at: https://sari-energy.org/program-activities/cross-border-electricity-trade/cbet-opportunities-in-sa/ Accessed 17 June 2020].

[27] G. Ministry of Power, *Powermin.nic.in*, 2020. [Online]. Available: https://powermin.nic.in/sites/default/files/uploads/SAARC_framework_agreement_for_energy_cooperation_electricity.pdf.[Accessed: 17- Jun- 2020].

[28] G. Ministry of Power, *Powermin.nic.in*, 2020. [Online]. Available: https://powermin.nic.in/sites/default/files/uploads/BIMSTEC_MoU.pdf. [Accessed: 17- Jun- 2020].

[29] B. Secretariat, "28 Mar 19 - The First Meeting of the BIMSTEC Expert Group on Energy", *WFTR*, 2020. [Online]. Available: https://bimstec.org/?event=the-first-meeting-of-the-bimstec-expert-group-on-energy. [Accessed: 17- Jun- 2020].

[30] BIMSTEC and SARI/EI jointly organise "Workshop on Enhancing Energy Cooperation in the BIMSTEC Region on 25-26 February | USAID SARI/Energy Integration", *USAID SARI/Energy Integration*, 2020. [Online]. Available: https://sari-energy.org/event/bimstec-and-sari-ei-to-jointly-organise-workshop-on-enhancing-energy-cooperation-in-the-bimstec-region-on-25-26-february/.[Accessed: 17- Jun- 2020].

[31] G. Ministry of Power, *Powermin.nic.in*, 2020. [Online]. Available: https://powermin.nic.in/sites/default/files/uploads/Guidelines_for_ImportExport_Cross%20Border_of_Electricity_2018.pdf.[Accessed: 17- Jun- 2020].

[32] CERC, *Cercind.gov.in*, 2020. [Online]. Available: http://www.cercind.gov.in/2019/regulation/CBTE-Regulations2019.pdf. [Accessed: 17- Jun- 2020]

[33] "Home", *ACER*, 2020. [Online]. Available: https://www.acer.europa.eu/en. [Accessed: 20- June 2020].

[34] "Home", *ENTOS-E*, 2020. [Online]. Available: https://www.entsoe.eu/. [Accessed: 20- Jun- 2020].

[35] "Requirement for generators", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/rfg/.[Accessed: 20- Jun- 2020].

[36] "Demand connection code", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/dcc/.[Accessed: 20- Jun- 2020].

[37] "High voltage direct connection code", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/hvdc/. [Accessed: 20- Jun- 2020].

[38] "Forward capacity allocation code", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/fca/. [Accessed: 20- Jun- 2020].

[39] "Capacity calculation and congestion management code", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/cacm/.[Accessed: 20- Jun- 2020].

[40] "Electricity balancing", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/eb/. [Accessed: 20- Jun- 2020].

[41] "System operations", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/sys-ops/. [Accessed: 20- Jun- 2020].

[42] "Emergency and restoration", *Entsoe.eu*, 2020. [Online]. Available: https://www.entsoe.eu/network_codes/er/. [Accessed: 20- Jun- 2020].

[43] M. Luis, D. Carl and H. David, "*The integrated NORDIC power market and the deployment of renewable energy technologies: Key lessons and potential implications for the future ASEAN integrated power market*." Energy market integration in East Asia: Renewable energy and its deployment into the power system, 2013, pp. 2012--26.

[44] M. Karan and H. Kazdağli, "*The Development of Energy Markets in Europe*", *Financial Aspects in Energy*, pp. 11-32, 2011. Available: 10.1007/978-3-642-19709-3_2 [Accessed 16 June 2020].

[45]"The Potential of Regional Power Sector Integration: Southern African Power Pool (SAPP): Transmission & Trading Case Study", Economic Consulting Associates, 2009.

APPENDICES

ACER: Agency for cooperation of energy regulators.

BBIN: The Bangladesh, Bhutan, India, Nepal (BBIN) Initiative is a sub-regional architecture of countries in Eastern South Asia, a sub region of South Asia.

BERC: Bangladesh Energy Regulatory Commission.

BGICC: BIMSTEC Grid Interconnection Coordination Committee.

BIMSTEC: Bay of Bengal Initiative for Multi-Sectorial Technical and Economic Cooperation.

BPDB: Bangladesh Power Development Board.

BRI: Belt and Road Initiative.

CBTE: Cross Border Trade of Electricity.

CERC: Central Electricity Regulatory Commission (CERC), a key regulator of the power sector in India.

COMESA: Common Market for Eastern and Southern Africa (COMESA).

COMESA REC: Regional Economic Communities (REC) Common Market for Eastern and Southern Africa (COMESA).

COVID-19: It is a new virus linked to the same family of viruses as Severe Acute Respiratory Syndrome (SARS).

DRC: Democratic Republic of the Congo.

EAPP: Eastern Africa Power Pool.

ECOWAS: Economic Community of West African States.

EGME: Expert Group Meeting on Energy

ENTSO-E: European Network of Transmission System Operators for Electricity.

EU: European Union.

GMR Group: It is an infrastructural company headquartered in New Delhi.

HVAC: High Voltage Alternating Current.

HVDC: High Voltage Direct Current.

JICA: Japan International Cooperation Agency (JICA) is a governmental agency that coordinates Official Development Assistance (ODA) for the government of Japan.

LNG: liquefied natural gas**.**

MoU: Memorandum of Understanding.

NAPP: North African Power Pool.

OTC: Over the Counter.

PSMP: Power System Master Plan.

SAARC: South Asian Association for Regional Cooperation.

SADC: South African Development Community.

SAPP: South African Power Pool.

SARI/EI: South Asia Regional Initiative for Energy Integration.

SRETS**:** SAARC Regional Energy Trade Study

UMIC: Upper Middle-Income Country.

WAPP: West African Power Pool.

WTO: World Trade Organization.