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Promoting cross-border electricity trade (CBET) through the Power Exchange in India, by all South Asian nations.

Building consensus among Bangladesh stakeholders to begin trading in the Indian power exchange

IRADe-SARI-49 (2022)

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We also acknowledge and express our appreciation for all those individuals, who offered their time and generous support throughout this exercise. We hope that this document will serve as a valuable resource for promoting Power Exchange based power trading in the South Asian Region.

Preface

We are pleased to present the Report on **Benefits of transacting on the power exchange for power trade among the South Asian countries: Case Studies of Nepal and Bangladesh**, developed under the South Asia Regional Initiative for Energy Integration (SARI/EI) project, supported by the USAID and implemented by Integrated Research and Action for Development (IRADe).

This Study focusses on the opportunities available for the South Asian nations for trading in the Indian power exchange, as has been allowed in the **Guidelines for Import / Export (Cross Border) of Electricity- 2018 issued by Government of India, Ministry of Power, December, 2018**. This opportunity has already been availed by Nepal and Bhutan, for obtaining benefits for the respective countries, in terms of reducing the average cost of purchase of electricity, while buying power from the power exchange, as well as earning revenue from selling power in the power exchange.

The power exchange provides the flexibility of purchasing or selling power on need basis, without having to deal with commitment on a longer term basis or to pay commitment charges by the buyer, even if the buyer does not need to purchase power at certain times, as is applicable in medium term and long term contracts. Also, the granularity in the power exchange allows a buyer or seller to transact in the power exchange for as little a time slot as 15 minutes.

Bangladesh is considering to participate in the power exchange, for reducing the average cost of supply to the consumers. It was therefore decided to have consultations with the Bangladesh stakeholders to explain the benefits of transacting in the power exchange, while at the same time answering all their questions. This was also presented to the highest echelons of the Government of Bangladesh. The bidding strategy for trading in the power exchange was also discussed with Nepal stakeholders to optimize purchase and sale of the same. Detailed calculations have been done in this Report, quantifying the benefits obtained by Nepal by trading in the power exchange, and potential benefits that would accrue to Bangladesh for the same. This could allay apprehensions, if any.

I sincerely thank Mr. S. K. Ray, Senior Consultant, SARI/EI, IRADe, for his invaluable contribution in drafting this report. I appreciate the research team at SARI/ EI Secretariat /IRADe, for their valuable inputs and guidance through sustained efforts, in ensuring the quality of the Report.

Jyoti Parikh

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Executive Summary

In the South Asian Region (SAR), Cross Border Trade in Electricity (CBTE) has largely been happening between four countries i.e. Bangladesh, Bhutan, India and Nepal (BBIN). The CBTE between these nations started mainly through Power Purchase Agreements (PPAs) which were Government to Government agreements. The SARI/EI (South Asia Regional Initiative in Energy Integration) Program of USAID has been actively promoting cross border trading in electricity, including creation of a regional energy market in South Asia. Power exchange based CBTE is a very important short term market, the most popular being the Day Ahead Market (DAM). The idea of South Asian Regional Power Exchange (SARPEX) was conceptualized and a roadmap prepared for the same in the Phase IV of the Program. A mock exercise was carried out in 2017 to ascertain the feasibility and desirability of the same with active participation of the various stakeholders of the SAR (South Asia Region). The key findings were approved and disseminated, as also a policy brief for the same.

The government of India (GoI) came up with revised Guidelines for Import / Export (Cross Border) of Electricity in December 2018, which also permitted the neighbouring South Asian countries to take part in the power exchange in India, The Central Electricity Regulatory Commission (CERC), the national electricity regulator of India, came out with follow-up Regulations for CBTE in March 2019 and the Central Electricity Authority (CEA) with Procedure for approval of CBTE by the Designated Authority in February 2021.

Subsequently, Nepal after obtaining the required approvals started to trade in the Exchanges. Nepal started buying power from the Indian power exchange in April 2021 and selling power in the power exchange in November 2021. In case of Bhutan also, it bought power from the power exchange from January to March 2022, to tide over the shortage created by outage of their largest power plant, the Tala Hydro Power Plant for HRT (Head Race Tunnel) repair works.

With this in mind, it was felt that a proper study needs to be conducted with the objective of to promote sustainable CBTE through the Power Exchange by all nations of SAR. Bangladesh who wasn't participating in the exchange was particularly in focus. Hence building consensus among Bangladesh stakeholders, to begin trading in the Indian power exchange, was the primary objective of the study.

The study, besides examining the Guidelines, Regulations and Procedures taken out by India as mentioned above, also examined the currently available Cross Border Transmission capacity and also the details of the additional capacity likely to be added in the next 5 years, particularly in the context of exchange based CBTE. From the available data, an attempt was made to roughly quantify the transmission capacity that may be available for exchange based CBTE.

The details of Nepal's trade in Indian power Exchange for the period April'2021 to July'2021 were analyzed in detail. This report enumerates how Nepal benefited from buying power from the Indian Exchange, both in terms of mitigating power shortage, and also in terms savings that occurred for Nepal, as compared to the other short term power purchase agreements available to them. The estimated saving to Nepal, for a period of less than four months was of the order of 25 Crs INR. Similar benefits were obtained by Bhutan, when they bought power judiciously from Indian Exchanges during January to March 2022.

Bangladesh's generation is heavily dependent on sources such as HFO, HSD and gas, a substantial quantum of which is imported. These account for close to 75% of their total generation capacity and are quite expensive.

The analysis of the Nepal's data was used to ascertain how Bangladesh may benefit from CBTE through exchanges. It was found that Bangladesh can buy cheaper power from the exchanges to substitute its costlier domestic power practically throughout the year. The Yearly Average RTC price in Day Ahead Market in Indian Energy Exchange for the year 2021 was INR 3.95 per unit. The landed cost of power in Bangladesh, counting the addition of transmission charges and losses and various fees, etc was assumed to be about INR 4.50 per unit. As detailed in the report, the variable cost of the costliest power in Bangladesh that can be replaced by this power will to be around INR 10 at present. Thus a saving of INR 5.5 per unit would accrue to Bangladesh per unit. As per the prevailing transmission capacity availability, the quantum of power that Bangladesh could have bought from exchange was about 190 MW and this is equivalent to 4.56 Mus per day. Thus the total savings that could have happened for Bangladesh in 8 months in 2021 would have been approximately INR 605 Crs. Based on certain assumptions, as detailed in the report, w.r.t. the exchange prices and fuel cost of Bangladesh's domestic consumption, the benefit to Bangladesh over next five years would be more than 3000 Crs Bangladeshi Taka.

Stakeholder consultations were held with various organizations in Bangladesh such as the Power Cell, Ministry of Power, Energy and Mineral Resources, BPDP (Bangladesh Power Development Board), PGCB (Power Grid Corporation of Bangladesh), BERC (Bangladesh Energy Regulatory Commission), etc. where these benefits were showcased. A capacity building program was also held covering the various aspects of exchange based CBTE. Subsequently, a high level meeting was held with the Secretary, Power Division, and Director General, Power Cell, Ministry of Power, Energy and Mineral Resources, to inform them of the benefits of Bangladesh taking part in the power exchange. They were generally in agreement with the benefits accruing from Bangladesh taking part in the power exchange. All queries raised by the stakeholders and the participants were addressed to the extent possible. A roadmap has also been prepared for Bangladesh to start trading in the Power Exchange in India. Steps required on immediate basis and on a long term basis to start trading in the Indian power exchange, including changes in policies and regulations required to facilitate the same, have been mentioned in the same. Similarly, stakeholder consultations were also held in Nepal with NEA (Nepal Electricity Authority), ERC (Electricity Regulatory Commission) of Nepal, and IPPAN (Independent Power Producers Association of Nepal), on the bidding strategy w.r.t, hydro power generators, and the opportunities for hydro power plants for the different types of markets in the power exchange. All the stakeholder acknowledged the benefit of exchange based CBTE and expressed confidence that such trades will increase in future.

Now that the benefit to Nepal based on actual trading in exchange has been quantified, this will further strengthen the view that was prevalent that exchange based CBTE is beneficial for all the concerned nations, as the same is now based on actual data. There is awareness of the benefits of CBTE in general and exchange based CBTE in particular. The stakeholders also accepted the establishment of SARPEX on a longer term basis, when there is significant volume on the exchange platform to justify the same.

CHAPTER – I

Introduction

CHAPTER – 1

In the South Asian Region (SAR), Cross Border Trade in Electricity (CBTE) has largely been happening between four countries i.e. Bangladesh, Bhutan, India and Nepal (BBIN). The CBTE between these nations started mainly through Power Purchase Agreements (PPAs) which were Government to Government agreements.

A number of MOUs were signed between India and the neighboring countries leading to bilateral contracts on electricity trades. As far as trade between India and Nepal is concerned, there are trade Agreements through three interconnections, through 132 kV line at Tanakpur, through the 400 kV Dhalkebar–Muzaffarpur transmission line and through other 132 and 33 kV transmission lines as detailed further in the report. For the other 132 and 33 kV transmission lines, there is a power trade mechanism between Nepal and India through Bihar and Uttar Pradesh states of India. Under this mechanism, the two countries can buy power from each other as and when needed. The price has been fixed at INR 6.18 per unit for trading (buying or selling) power through the 132kV transmission line and INR 6.65 for trading through the 33 kV transmission line. Under the 132 kV Tanakpur point, Nepal has been importing power ranging from 15 to 35 MW, under a short-term Power Purchase Agreement (PPA) with the Power Trading Corporation of India (PTC) Ltd. since 2008, in addition to getting 70 MUs of free electricity annually as per the Mahakali Treaty, from Tanakpur point. For power trade through the 400 kV Dhalkebar–Muzaffarpur transmission line, a long-term Power Sale Agreement (PSA) was signed with PTC for the import of 150 MW power for 25 years. In 2020, an agreement was signed by NVVN for supply of upto 350 MW from Muzaffarpur for one year at INR 4.18 per unit.

The cross-boundary electricity imports between Bangladesh and India began in 2013 through the Baharampur (India)-Bheramara (Bangladesh) 400 Kilovolt (KV) double circuit line and HVDC back-to-back link at Bheramara. It started with a single block of the HVDC link, through which about 500 MW of power could be imported by Bangladesh. The second block of the link was commissioned in the year 2018, which resulted in the power import by Bangladesh from India going up to 1000 MW. A second interconnection between Suryamaninagar sub-station in Tripura in India was made radially in 2016 through a 400 kV D/C line, presently charged at 132 KV, to Comilla sub-station in eastern Bangladesh, through which power of about 160 MW is being imported by Bangladesh. The Agreement has recently been renewed for a period of 5 Years, w.e.f. March 2021.

India is importing power from Bhutan from various power plants connected through various lines. They are mainly import of a total of about 2000 MW power from Tala Hydro Electric Plant (HEP) (1020MW), Chukha HEP (336MW), Kurichu HEP (60MW) and Mangdechu HEP (720 MW) power plants in Bhutan. Further, Punatsangchu-II (1020 MW) and Nikachhu (118 MW) HEPs in Bhutan, are expected to be commissioned by 2023, and Punatsangchu-I (1200 MW) and Kholongchhu (600 MW) HEPs by 2026, the power from which will also flow to India.

These trades have led to the different nations benefiting by either increasing the power availability in the nation or by earning from sale of power. However, these trades do not provide trades close to real time, like a power exchange does. The day-ahead market (DAM) in the power exchange, in particular, is very useful for trading power for the next day, when a more accurate prediction can be made of the power situation.

The SARI/E (South Asia Regional Program in Energy) program was started by USAID in the year 2000 for promoting energy security in South Asia, with Cross Border Trade in Energy being one of the methods of ensuring this. Subsequently phase -2, 3 and 4 were also launched. Currently, the extended fourth phase, named SARI/EI (South Asia Regional Initiative in Energy Integration) has been running from 2018 onwards. A Project Steering Committee (PSC) and three Task forces were constituted for effective implementation of the SARI/EI program. The three Task Forces focus on three distinct areas of Harmonization of Policies and Regulations, Advancing transmission interconnections and creation of an energy market in South Asia, and consists of senior Government representatives of the South Asian countries. The PSC is an oversight body for guiding the Task Forces and consists of the senior most officers of the Governments of South Asia. A key objective of Task Force-3 was creating an enabling environment for a sustainable market for energy trading in South Asia.

During the 4th phase of the (SAR/EI) program, in order to initiate exchange based trades in the South Asia Region (SAR), a South Asian Regional Power Exchange (SARPEX) was envisaged to be established. A mock exercise was carried out for a South Asian Regional Power Exchange, with realistic data of trading (volume and price bids) fed in by the various countries. This was done in order to assess the feasibility and desirability of SARPEX.

The SARPEX Mock exercise was led by the Task Force – 3. A trading platform was created where actual bidding was done in the existing power exchange in India by the BBN (Bangladesh, Bhutan, and Nepal) participants. Core teams were nominated by the authorized organizations in Bangladesh, Bhutan and Nepal. Since exchange operation was a new concept for these nations, two capacity building programs were also held in order to support the core teams. The core team's members from Bangladesh, Bhutan and Nepal submitted bids on the mock platform created, whereas the bids for India were taken from actual bidding carried out by the Indian bidders in the already running power exchange.

The mock exercise was carried out for the period April'2015 to March'2016 in the Day Ahead Market. A total of 71 days representing the entire period of one year was selected for conducting the exercise, Bidding was done for all 96 dispatch periods for the selected 71 days and the results were extrapolated for the entire year, Suitable assumptions were made of the inter-country transmission capacity and transmission losses and charges. The mock exercise yielded the results for a period of one year. The DAM was operated in two different modes of operation*. In the Unified mode, bids from all the nations were transacted together. In the Sequential mode, bids of India were transacted first and the un-cleared bids were then transacted along with the bids from the neighboring nations. The results clearly demonstrated that a power exchange for the South Asia Region (SAR) will be hugely beneficial to all the participating countries. The total surplus generated for the region (Total of consumer and producer surplus) was about INR 10 Billion in both the modes of operation.

A policy brief on SARPEX was prepared and submitted to various stakeholders in SAR and India in particular. The policy brief recommended the initiation of Exchange based trades for the South Asian Regional power, in particular the DAM. The Task Force also finalized the key findings of the SARPEX Mock Exercise, along with proposed Market Design and Rules.

The Government of India notified the Guidelines for Import/Export (Cross Border) of electricity in 2016, and revised the Guidelines in 2018. CERC subsequently brought out the (Cross Border Trade of Electricity) Regulations in 2019.

The CERC's regulations were followed by the Procedure for Approval and facilitating Import/Export (Cross Border) of Electricity by the Designated Authority (DA) in February 2021. The recommendations and the various activities of the SARI/EI work on SARPEX have probably contributed to these developments.

After notification of the Procedure for Cross Border Tarde in electricity, in April'2021, Nepal started trading in the Indian Energy Exchange w.e.f. 18th April 2021, after getting approval from the Designated Authority, in accordance with the Procedure. It thus became the first BBN nation to participate in any Exchange based CBTE in the SAR. As in October, 2021. Bhutan and Bangladesh had not started trading in the Indian power exchange. Subsequently, Bhutan became the second of the BBN nations to trade in the power exchange w.e.f. 1st January 2022, after getting approval from the Designated Authority. However, so far, Bangladesh has not started participating in the exchange.

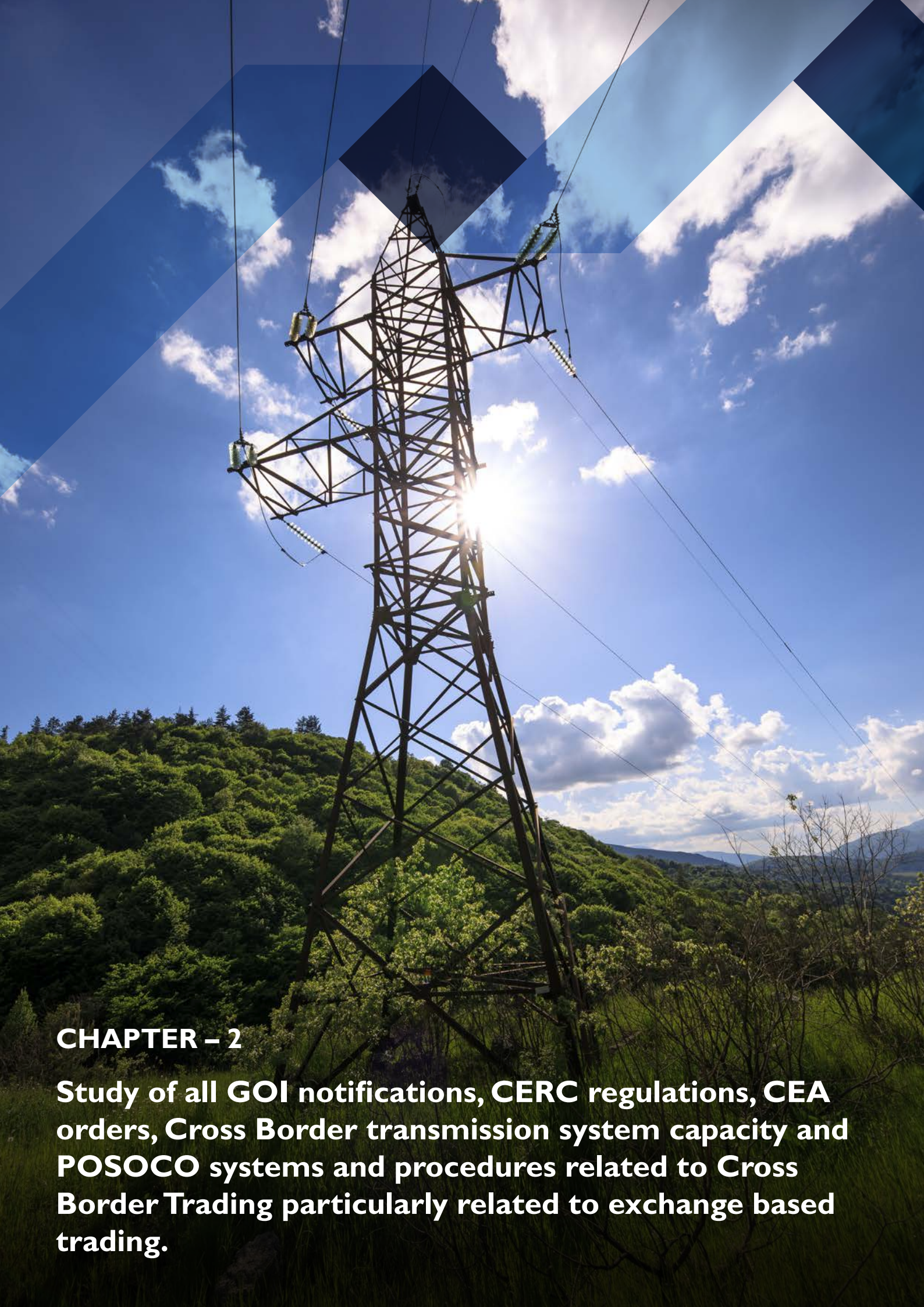
Thus a need was felt for a study to be conducted for "Promoting cross-border electricity trade (CBET) through the Power Exchange in India, by all South Asian nations and Building consensus among Bangladesh stakeholders to begin trading in the Indian power exchange" under the USAID funded SARI-EI Project. A brief of the Terms of Reference (TOR) of the contract is as given below:

A study of all GOI notifications, CERC regulations, CEA orders etc. related to Cross Border Trading, particularly related to exchange based trading was to be carried out. The transmission capacity available for CBTE was also to be ascertained. Nepal's experience of participating in the exchange and the benefits accrued would be computed by data analysis and consultation with stakeholders. This would then be shared with the Bangladesh and Bhutan stakeholders. Interaction with the Bhutan and Bangladesh stakeholders would also lead to a better understanding of the hurdles being faced by them

https://irade.org/Sarpex_Key%20Findings%20report.pdf

in participating in exchange based trading, if any. The ultimate objective of the activity was to expand the Exchange based trading to other neighboring countries, considering the mutual benefits for all the BBINS nations derived out of the same, and also to build the capacity of the Bangladesh stakeholders to participate in such trading.

The Study commenced on 1st August 2021 and was completed in phases on 31st August 2022, because of delay in being able to tour Nepal, on account of the pandemic and later crowding of international travel.



CHAPTER – 2

Study of all GOI notifications, CERC regulations, CEA orders, Cross Border transmission system capacity and POSOCO systems and procedures related to Cross Border Trading particularly related to exchange based trading.

CHAPTER – 2

2.1 Guidelines for Import / Export (Cross Border) of Electricity- 2018 issued by Government of India, Ministry of Power, December, 2018

These Guidelines were issued in Dec' 2018, repealing the earlier guidelines on Cross Border Trade of Electricity issued in 2016. The fresh guidelines have mainly four objectives.

2.1.1 The objectives of these Guidelines are to:

- Facilitate import/ export of electricity between India and neighboring countries;
- Evolve a dynamic and robust electricity infrastructure for import/ export of electricity;
- Promote transparency, consistency and predictability in regulatory mechanism pertaining to import/ export of electricity in the country;
- Reliable grid operation and transmission of electricity for import/ export.

2.1.2 The Agreement for trade

The import/ export of electricity between India and the neighbouring country(ies) was allowed through mutual agreements between Indian Entity(ies) and Entity(ies) of the neighbouring country(ies) under the overall framework of agreements signed between India and the neighbouring country(ies) consistent with the provisions of the prevailing laws in the respective country(ies).

In a significant development, tripartite agreements were also allowed, under the overall framework of bilateral agreements signed between Government of India and the Government of respective neighbouring country (ies) of the participating Entity (ies).

2.1.3 Institutional Framework

The import/ export of electricity by Indian entities shall be governed by the rules/ regulations and policies framed and notified by Government of India/ Central Electricity Authority (CEA)/ Central Electricity Regulatory Commission (CERC), and wherever applicable, the appropriate State Electricity Regulatory Commission(s). Ministry of Power, Government of India would appoint a Designated Authority for facilitating the process of approval and laying down the procedure for import/ export of electricity. The Designated Authority would also coordinate with the respective authority of the neighbouring country for planning, monitoring and commissioning of transmission lines for import/ export of electricity, the grid security, safety and operation and any other function as assigned by the Ministry of Power, Government of India. The notification led to the appointment of Member (Power System), Central Electricity Authority (CEA) as the Designated Authority (DA) for facilitating the process of approval and laying down the procedure for import/export of electricity vide Ministry of Power, Govt. of India OM dated 24th December, 2018. It also empowered the Indian regulators, both the Central Electricity Regulatory Commission (CERC) and, wherever applicable, the State Electricity Regulatory Commission(s) (SERC(s)) to regulate the import/ export of electricity by Indian entities. Similarly, Member (Power System), CEA as the designated authority, was granted the authority to allow any Indian entity to export/ import power from the neighboring nations.

2.1.4 Eligibility and other terms and conditions for participation

The guidelines also laid down the conditions for an entity to be eligible for import/export of power.

The Guidelines allowed any Indian power trader, after obtaining approval from the Designated Authority, to trade in Indian Power Exchanges, on behalf of any Entity of neighboring country, for specified quantum as provided in the Approval and complying with CERC Regulations.

2.1.6 Transmission System, Scheduling and Accounting

The cross border transmission lines may normally be constructed between the pooling stations of one country to the pooling stations of the other country for secure, safe and controlled operation of the

grid. The interconnection between these pooling stations of the countries shall be monitored by the system operator of the respective country. The transmission charges, scheduling, metering, accounting, deviation settlement, secure grid operations involving the Indian Grid and any other related operational mechanism would be governed in accordance with the applicable Regulations of the Government of India.

A Nodal Agency would be appointed for each neighbouring country, which shall be responsible for settlement of grid operation related charges as per CERC regulations. Subsequently, in November 2019, a single Settlement Nodal Agency (SNA) has been appointed by the Government of India, i.e. NTPC Vidyut Vyapar Nigam (NVVN), for settlement of grid operation related charges with neighbouring countries, namely, Bangladesh, Bhutan, Nepal and Myanmar.

Dispute Resolution

Disputes involving Entities of separate countries may be mutually agreed by the participating Entities or settled through the International Arbitration Centre as mutually acceptable.

2.2 Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019

These regulations were issued by CERC under provisions of Section 178 of the Electricity Act 2003 (36 of 2003) read with Section 66 thereof and the Guidelines on import and export of Electricity issued by Ministry of Power, Government of India.

2.2.1 There are certain significant terms used in this regulation, whose definitions has to be noted. Some of them are

1. 'Entity' means a company or authority or Board or autonomous body corporate or juridical person of India or any of the neighboring countries which proposes to participate in cross border trade of electricity. Thus an entity can be Indian entity or any entity from the neighboring nations.

2. 'Participating Entity' means an entity approved by the Designated Authority for the purpose of cross border trade of electricity between India and any of the neighboring countries or any entity as designated by Government of India for import or export of power through bilateral agreement between Government of India and Government of any of the neighboring countries;

   Thus any 'Entity' becomes a 'Participating entity' only after its approval by DA or that designated by the Government of India for import or export of power through bilateral agreement between Government of India and Government of any of the neighboring countries

3. 'Buying Entity' means the entity which has been granted long-term access or medium-term open access or short-term open access and is purchasing electricity in accordance with these regulations

4. 'Selling Entity' means the entity which has been granted long-term access or medium-term open access or short-term open access and is selling electricity in accordance with these regulations

5. 'Competent Authority' means the authority of the neighboring country vested with the power to accord approval(s) on matters related to cross border trade of electricity with India;

2.2.2 Applicability and scope

These regulations would be applicable to the Participating Entities in India and the neighboring countries which are engaged in cross border trade of electricity with India.

The regulations allow CBTE between India and the neighboring country (ies) through mutual agreement between Indian entity and the entity of the neighboring countries, under the overall framework of agreements signed between India and the neighbouring country (ies). The agreements signed should be consistent with Indian law and the law of the neighboring countries.

In case of tripartite agreements, the CBTE across India shall be allowed under the overall framework of bilateral agreements signed between Government of India and the Governments of the respective neighboring countries of the Participating Entities

2.2.3 Institutional Framework

The Designated Authority would be responsible for facilitating the process of approval and laying down the procedure for import and export of electricity. It will also be responsible for coordinating with the authorities in the neighboring country in this matter. The Transmission Planning Authority for India shall coordinate with the Transmission Planning Authorities of the neighboring countries for planning of transmission system for CBTE.

SNA shall be responsible for settling all charges pertaining to grid operations related to transactions with the neighboring countries and as such will be a member of the deviation pool, reactive energy pool and other regulatory pools.

Central Transmission Utility (CTU) shall be responsible for granting long-term and medium-term open access with respect to CBTE between India and the neighboring countries and for billing, collection and disbursement of the transmission charges. For Short Term open access, this role will be played by NLDC, who shall also be the system operator for CBTE.

2.2.5 Trade through Indian Power Exchanges

The regulation allows any electricity trading licensee of India to trade in the Indian Power Exchanges on behalf of any Participating Entity of neighboring country after obtaining necessary approval from the DA.

This is a welcome step, which enables CBTE through exchanges. But, it may be noted that only Indian trading Licensee is allowed to trade; trading licensees or participating entities of neighboring countries are not allowed to trade in the Indian Power Exchange, possibly because the Power Exchange is regulated by the Indian National Regulator, the Central Electricity Regulatory Commission, and the national regulator cannot have jurisdiction over the entity of a different country.

2.2.6 Transmission Planning, Connectivity and Access

The Cross Border Transmission Link between India and any neighboring country shall be planned jointly by Transmission Planning Agencies of the two countries with the approval of the respective Governments. The manner of implementation of Cross Border Transmission Link between the pooling station within India till the Indian border and the implementing agency shall be decided by Government of India. There is also a provision for a participating entity having a generating station located in a neighboring country to develop, operate and maintain the dedicated transmission system from the generating station to the pooling station within India at its own cost after obtaining all the necessary approvals from respective countries.

A Participating Entity located in a neighboring country shall apply to the CTU for grant of connectivity to the Indian Grid and/or long-term access or medium-term open access. The participating entity of the neighbouring country getting connected to the Indian grid through dedicated transmission systems for cross border trade of electricity only needs to apply for connectivity. A Participating Entity located in the neighboring country and getting connected to the Indian grid through Cross Border Transmission Link shall not be required to apply for Connectivity to the Indian grid. For Short term open access, application is to be made to NLDC. Application fees as detailed in the regulations has to be paid.

Interface Meters, Communication facilities and System Recording Instruments need to be installed on both sides of the border for import/export of power. Reactive Power compensation and/or other facilities shall be provided by Participating Entities connected to Indian grid as far as possible in the low voltage systems close to the load points thereby avoiding the need for exchange of Reactive Power to/ from Indian grid and to maintain voltage within the specified range. The Participating Entities already connected to the grid shall also provide additional reactive compensation as per the quantum and timeframe decided by respective Regional Power Committee(s) in consultation with NLDC.

2.2.7 System Operation

The regulations mention that all grid operation related provisions shall be applicable as per the prevailing regulations of the Commission. It has to be ensured that reliable, secure and stable operation of the interconnected grid takes place to ensure grid security at any point of time. The interconnection between India and the neighbouring country shall be monitored and controlled by the respective System Operators of the two countries, with proper coordination. Operational planning including outage plan shall be carried out by NLDC and its counterpart in the neighbouring country for secure and reliable operation of the CBTE.

Total Transfer Capability (TTC), Transmission Reliability Margins (TRM) and Available Transfer Capability (ATC) for the cross border trade of electricity shall be assessed in advance by System Operators in India and the concerned neighboring country, considering the network limitation on their respective side, and lower of the two values of ATC assessed by the two countries shall be considered for allowing cross border trade of electricity. The schedule would be revised, if any further constraints are reported by any of the two NLDCs.

Scheduling of electricity is to be carried out between the buying entity and selling entity, as per agreed quantum in the contracts. Scheduling will be for 15 minutes time block or any other notified interval. Transmission System losses shall be declared on weekly basis shall be borne in kind by the buying entity or the selling entity. The selling entity or the buying entity, as the case may be, shall inform their requisitions to the SNA who in turn shall co-ordinate with System Operators of respective neighboring countries for scheduling of cross border transactions and revisions during the day of operation.

The Energy Accounting for all the electricity imported and /or exported from/ to a neighboring country shall be carried out on a net basis for each country by the respective RPCs. All payments shall be settled by the parties through the Settlement Nodal Agency who shall be a member of the Regional Deviation Pool Account acting on behalf of the selling entity or buying entity of the neighboring country and pay or receive charges on account of deviation and also settle the same with the selling entity or buying entity of the neighboring country. SNA shall be similarly involved in the payment of the reactive energy charges. It may be noted that the charges for deviation from schedule at the inter-connection point shall be as per the DSM Regulations in India. The segregation of charges within the neighboring country shall be carried out by the agency designated by the concerned neighboring country. The procedure for curtailment of trade in CBTE is similar in nature to that application to trades within India.

The regulation also provides for six-monthly operational coordination meetings to be held by the System Operator of India (NLDC) and its counterpart in the neighboring country to discuss various aspects associated with the operation of the cross border interconnection(s) including any protection and commercial related issues.

2.2.8 Treatment of transmission losses and various charges.

For delivery of electricity at the pooling station within India, transmission charges in the form of Point-of-Connection (PoC) injection charges or PoC withdrawal charges for import/export of power shall be applicable as per provisions of Sharing Regulations in India.

In case of Transmission losses, withdrawal PoC losses and injection PoC losses of the respective regional grid (Regional Grid of India) as applicable shall be applied at the interface. Accordingly, Net schedule at Indian end of the Cross Border Transmission Link shall be arrived at after applying injection PoC loss for the concerned injection zone and withdrawal PoC loss for the concerned withdrawal zone.

SNA shall pay the Fees and Charges of the System Operator in India on behalf of the entities of the neighboring countries. SNA shall register itself as a user of concerned System Operator and shall pay the applicable registration charges. Any selling entity or buying entity in India proposing to sell or buy electricity from or to the neighboring country shall make payments to the SNA for fees & charges of System Operation in India.

For the payment security for Transmission Charges, an irrevocable, unconditional and revolving Letter of Credit (LC) of the requisite amount is to be established in favor of the CTU by the cross border customer, in case of long term and medium term access. Similarly, an LC of the requisite amount is to be established in favor of the SNA also for the grid related charges.

2.2.9 Dispute Settlement and Resolution mechanism

In case of any dispute, which is within Indian Territory, the same will be settled as per the Electricity Act 2003. In case the dispute is between entities of different countries, the same shall be settled mutually within 60 days. Otherwise the same shall be settled at the Government level and lastly through International Arbitration Centre acceptable to the parties of the dispute.

2.3 Procedure for approval and facilitating Import/Export (Cross Border) of Electricity) by the Designated Authority. (CEA) Dated 26.02.2021

Subsequent to the GoI guidelines and the CERC notification, CEA came up with this procedure in February 2021, for facilitating approval and other matters related to Import/Export (Cross Border) of Electricity between India and neighboring countries.

2.3.1 Objectives:

To facilitate coordination with nodal agencies/Authority of Neighbouring Countries (ANC) for transmission system planning, joint system studies, surveys, preparation of feasibility study reports, system development, construction, erection, monitoring, testing, commissioning, operation and maintenance of transmission system for Import/Export (Cross Border) of Electricity in transparent manner, etc.

To lay down procedure for safety, security and coordinated operation of the interconnected national grids.

To facilitate grant of approval to eligible entities to participate in Import/Export (Cross Border) of ElectricityCross Border Transmission Links

A. **Joint Technical Team –** Transmission (JTT-T) was set up for performing works related to development of cross-border links. Indian side of JTT-T is to assist the DA. The Indian side of JTT-T shall comprise Nodal Officer of DA (CE (PSPA- II) of CEA) as team leader and members from CTU and POSOCO. The representative from CTU shall be convener of the team from Indian side. The main functions of the JTT-T are:-

- To plan cross-border transmission system
- Coordinate commissioning / monitoring of planned transmission system,
- Prepare feasibility report of cross-border transmission links.
- Facilitate development of cross-border exchange of electricity, including preparation of master plans, etc.

Planning of Cross Border Links - Based on the decision in Joint Steering Committee (JSC)/ Joint Working Group (JWG) comprising of senior Government officials of the two countries, or proposals received by the Designated Authority seeking approval for import/export (cross border) of electricity or proposals received from CTU, the Designated Authority may request JTT-T to examine the requirement of new cross border links. The Authority of the Neighboring Country (ANC) may also approach the Designated Authority for the planning and development of a cross-border link.

After receiving the in principle approval of the Government, the Designated authority shall examine the proposal in consultation with the CTU, keeping in mind the various factors like quantum of power to be traded between countries and proposed timelines for commissioning of the transmission system for import/export (cross border) of electricity, details of the existing cross-border link and proposal for any additional feasible cross border links, transmission, generation and load data etc.

The matter will be referred to JTT-T for identifying system strengthening/augmentation of cross border link which will then give its findings. CEA and CTU shall also carry out system study to assess system strengthening requirement of the corresponding inter-state as well as intra-state transmission system in India.

Preparation of feasibility report (FR)- The same is to be prepared by JTT-T, as directed by JSC/JWG, after discussion on the cross-border transmission plan in JSC/JWG meetings.

Implementation, Monitoring & Coordination of Cross Border Transmission Link – Once the planning activities are over, the detailed system studies and cost implications will be placed before the Government for a decision on sanction of the linkage and the funding thereof. The construction shall be taken up only after Government approval. Designated Authority and Authority of the neighboring country (ANC) shall monitor the progress of Cross Border Transmission links in the respective countries. Broadly, the part of the Cross Border Transmission Line (CBTL) in the Indian territory will be constructed and monitored by the Indian agencies like CEA and CTU and for the part of the CBTL in the territory of the neighboring country will be constructed and monitored by the respective agencies of that country.

Thus a very clear and effective procedure was laid down for setting up of Cross Border Transmission Lines (CBTL). As the Joint Technical Team – Transmission (JTT-T) is a team comprising members from CEA, CTU, POSOCO from India side and the respective members from the neighboring country. The data and views of the neighboring countries shall also be an input for the decision making by the JTT-T.

Commissioning of Cross Border Transmission Link- After ensuring the safety aspects by the relevant authorities of both countries, CTU and the Implementing Agencies of the two countries shall carry out joint inspection and validate reports of pre-commissioning tests of each other's facilities and submit a joint report on the inspection to their respective national load dispatch centers (NLDC) that the link is ready for energization. The intra-country transmission lines forming part of the cross-border power transfer scheme shall be declared commissioned as per rules, regulations and contractual conditions of the respective country. CTU and NLDC shall inform about the DA about the completion of the commissioning process. Settlement Nodal Agency (SNA) shall be responsible for arrangement of power for testing of transmission line and associated equipment(s) for forward and/or reverse flow of power.

Grid security, safety and coordination between the cross-border grid operators

B. **Joint Operation Committee (JOC)**- Set up for discharging the function of coordination with neighboring country related to grid security, safety and operation; DA shall be assisted by Indian side of the Joint Operation Committee (JOC). The Indian side of the JOC shall comprise the Nodal Officer of DA as team leader and members from POSOCO and CTU. Representative from POSOCO shall be convener of the team from Indian side. Broad functions of JOC would inter-alia include:

- Setting up common operation philosophy, recovery procedure, information exchange between system operators. Protection coordination including planning and setting of System Protection Scheme (SPS), under frequency relays and df/dt, etc, as needed.
- Methodology and assumptions for calculation of TTC/ATC/TRM for cross border electricity exchange under STOA. It may be inferred that the transmission capacity thus determined will be available for exchange based transactions also.
- Annual maintenance outage plan
- Coordination of requirement for SCADA, data telemetry and communication system.

The procedure further enumerates the Operation Philosophy and the System Security Aspects, coordination for system protection and relay settings between the power system operators of the respective nations. For Operational Liaison, a well-defined protocol for information exchange between the System Operators of India and of neighboring country pertaining to events that have occurred (like details of fault events etc.) and are likely to occur (like prior operation protocol messages etc.) needs to be developed. Before any operation is carried out, which is likely to impact the power flow across the cross border interconnection, the details of the operation to be carried out is to be shared between both the participating countries through the respective System Operators. A system of exchanging 'operational codes' is to be evolved and used for exchanging any operating instructions between the System Operators of the participating countries. Thus the procedure related to coordination and other activities between the power system operators of the various countries have been well defined.

Similarly, Reactive Power compensation and/or other facilities shall be provided by respective countries at the point of interconnection as far as possible, including the low/high voltage systems close to the interconnection points, thereby avoiding the need for exchange of Reactive Power and maintaining interconnection node voltages within the specified range. Similarly, there are provisions related to assistance in emergency and maintaining proper record of transmitted energy.

For settlement of Grid operation related charges, Settlement Nodal Agency (SNA) will be responsible. Accordingly, SNA shall be member of deviation pool, reactive energy pool and other regulatory pools for payment and settlement of corresponding charges in the pool accounts. Subsequently, NTPC Vidyut Vyapar Nigam Limited (NVVN) was appointed as SNA vide Ministry of power, Government of India order dated 26th November'2019 (Annexure-1).

2.3.2 One of the most important aspect of power trading, including trading through the exchanges, is the assessment of the Total Transfer Capability (TTC), Transmission Reliability Margins (TRM) and Available Transfer Capability (ATC) for the cross border interconnection. The respective power system operators of the concerned countries have to assess the same and exchange information with each other. These will be reviewed periodically, and as and when required, and the information shared with the counterpart in the neighboring nation. The DA shall be informed of the same on a monthly basis and as and when revision takes place.

2.3.3 Approval to participating Entity (ies) proposing to Import/Export (Cross Border) of Electricity

a) For Inter Government Agreement signed by India and neighboring country for specific project.

All Import/ Export of electricity shall take place only after approval of the Government of India. Approval of DA is not required in case of trade taking place under any agreement in which Indian Government is a party.

The Indian Entity of such transaction would submit the necessary information as per given format to the DA at least 30 days prior to start of the transaction. The Designated Authority will advise the concerned entities/NLDC to facilitate scheduling of such cross border transaction.

b) Eligibility of Applicant for Import of electricity by Indian Entities

Energy can be imported by an Indian Entity nominated by Government of India to import electricity from generating projects of neighboring country and sign PPAs with DISCOMs for the power being imported. Further, the Indian entity can also import electricity after obtaining approval of DA from Government or a Government Company or a licensed trader of that country. Some restrictions have been placed on the generation entities supplying power, where the beneficial owner, is situated in/ citizen of a third country with whom India shares land border and that third country does not have a bilateral agreement on power sector cooperation with India. In such cases, the Designated Authority will consult Ministry of Power and Ministry of External Affairs. The applicant shall submit an undertaking on affidavit that any change in the equity pattern (after the date of approval by the Designated Authority) of the generating company/trading licensee of the neighboring country from where electricity to be imported, shall be intimated to the Designated Authority, within thirty (30) days of such change. This provision will work as a deterrent for change in the ownership of the generating company, after DA's approval has been granted.

Additionally, the generation project(s) of the neighboring country are required to submit the permission to export power to India from the respective Government of the neighboring country and the Applicant shall submit a copy of Power Purchase Agreement (PPA)/ or of Letter of Intent (LOI) from generator of neighboring country, for import of such power. In case of exchange based trading, after the permission for trading is granted to an entity, the system and procedure of the exchange is followed.

c) Eligibility of Applicant for Export of electricity by Indian Entities

The provisions state that Generating Companies/ Distribution Companies of India may export electricity generated by coal or gas or renewable energy or hydropower, to Entities of neighboring country (ies), directly or through trading licensee(s) of India, after taking approval of the Designated Authority. In case the export is from a coal based generating plant, then the electricity has to be

generated utilizing imported coal or spot e-auction coal or coal obtained from commercial mining. Similarly, for gas based generating plants, export of electricity from India will be allowed only if electricity is generated utilizing imported gas. In case of exchange based trading, after the permission for trading is granted to an entity, the system and procedure of the exchange is followed.

d) Eligibility of Applicant for Trading in Indian Power Exchange(s)

With the issuance of these guidelines, first in 2016, later revised in 2018, the subsequent CERC Regulations and Procedure for approval by the Designated Authority, all necessary enablement for power exchange based CBTE is now in place.

The Indian power trader is allowed to trade the power of a generating station located outside the country, subject to two conditions.

i. The generation station is located in a country, with which India has a bilateral agreement on Power Sector Cooperation. And

ii. Restriction placed on ownership and control of the generating station as mentioned earlier are not breached.

Further, for trading in the Day Ahead Market (DAM), no permission from DA is required for Indian entities. However, for other market segments, where establishment of one to one transaction is possible, approval from DA is required, up to specified quantum (MW) and duration.

The Indian power trader, on behalf of any Entity of neighboring country, is also allowed to trade in Indian Power Exchanges, after obtaining approval from the Designated Authority, up to specified quantum (MW) and duration, provided, however that the entity on behalf of where the Indian Power Trader is trading belongs to the neighboring country which has an agreement on cooperation in the power Sector with India, and the generating asset from which power is being traded is also owned/ controlled by the said country having agreement on Power cooperation with India. The consent of respective government of the neighboring country for allowing trade of power is also required.

A maximum time period of one year will be allowed for trading from the date of approval of the Designated Authority.

In case, there is a change in the equity pattern of the participating Entity of the neighbouring country, the Indian Entity who has been granted approval by Designated Authority or GoI shall intimate the Designated Authority within thirty (30) days from such change in equity pattern for continuation of the approval. Failure to notify this change may be considered by the Designated Authority as a ground for revocation of the approval. The Applicant should obtain similar undertaking from the participating Entity of the neighbouring country in its contract.

The Designated Authority will send the proposal for concurrence of Govt. of India (GoI), within 60 days from the date of receipt of the final application complete in all respects. The approval or otherwise of DA shall be communicated to the Applicant within 15 days from final communication received from GoI. After approval of the Designated Authority, the participating entity shall approach concerned authorities in respective country for transmission access.

The office of the Designated Authority shall be same as the office of Member (Power System), Central Electricity Authority.

The address for correspondence with the Nodal officer will be that of the Chief Engineer (PSPA-II) Central Electricity Authority. The Nodal Officer shall assist the Designated Authority in exercising delegated power by the Designated Authority.

2.3.4 Transaction of electricity through Indian Grid under tripartite agreement

Such transactions are allowed if the Entity seeking such transactions has obtained either STOA/MTOA/ LTA from appropriate agencies in India as per CERC regulations, and meets the conditions related to third country ownership and control on the generating stations.

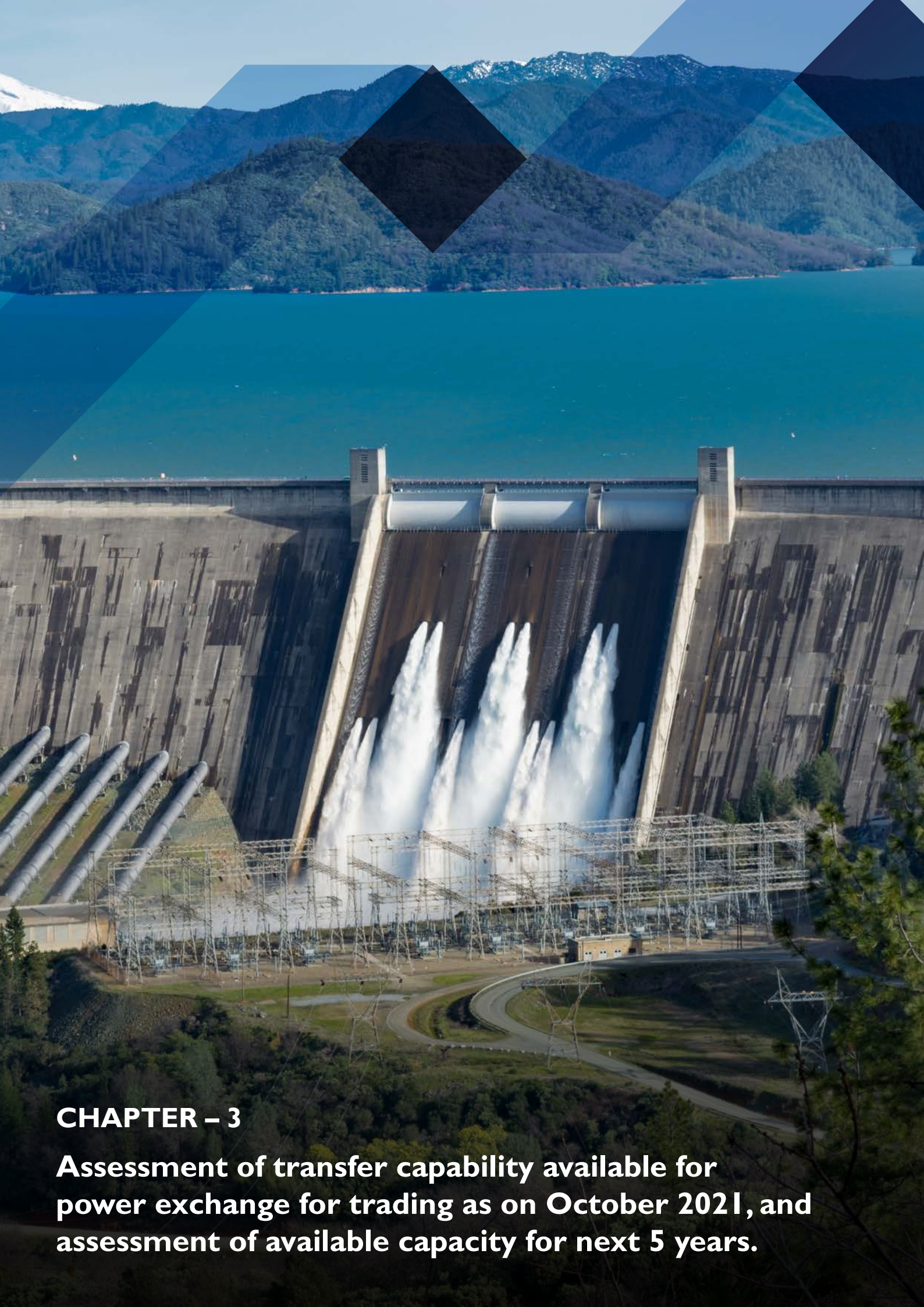
2.3.5 Operating system and Procedure related to CBTE and exchange based trades in particular.

India has a robust power system and suitable operating system and procedures are in place at present within the nation and also for CBTE with Nepal, Bhutan and Bangladesh. As Nepal has started participating in the Indian Energy Exchange, for dealing with these trades also suitable operating system and procedures have been developed.

In the CERC regulation on CBET, clause no 4(4) it is mentioned that "National Load Dispatch Centre shall act as the System Operator for cross border trade of electricity between India and the neighboring countries and shall be responsible for granting short-term open access and for billing, collection and disbursement of the transmission charges for short-term open access transactions in accordance with the Sharing Regulations."

In the CEA procedure, Clause 5.12, it is mentioned that "The Total Transfer Capability (TTC), Transmission Reliability Margins (TRM) and Available Transfer Capability (ATC) for the cross border interconnection shall be assessed and exchanged by the System Operators of the participating countries." Similarly, in Clause no 5.4 and 5.6 also coordination and protocol development between the system operators of India and neighboring countries is mentioned.

It is understood that the above regulatory and procedural requirements are being met suitably by the system operator.



CHAPTER – 3

Assessment of transfer capability available for power exchange for trading as on October 2021, and assessment of available capacity for next 5 years.

CHAPTER – 3

The details of Cross Border Transfer Capability are published by Indian National Load Dispatch Center (NLDC) and uploaded on its website. The capacities for Oct'2021 issued on 28th Sept'2021 has been taken as the source of this information ***(Annexure-2)*****. The NLDC document also provides information on the constraints limiting these Transfer Capabilities.*

3.1 India – Bangladesh

The presently available Cross Border connections between India and Bangladesh are as given below

1. Baharampur (India) – Bheramara (Bangladesh) 400kV D/C lines along with 2x500 MW HVDC back-to-back terminal at Bheramara.

2. Surajmaninagar (Tripura) - Comilla (Bangladesh) 400kV (operated at 132KV) interconnection

As per information available in NLDC website, the details of the Total Transfer Capability (TTC) and capacity available (known as Available Transfer Capability) for Short Term Open Access (STOA) **(India to Bangladesh)** including for exchange based trades, for the month of October'2021 are as mentioned below:

- HVDC Bheramara - Behrampore TTC is 1000 MW. Long Term Open access (LTOA) and Medium Term Open access (MTOA) has been granted for 760 MW and therefore the balance 240 MW is available for STOA including exchange based trades. Inter State Transmission system (ISTS) to cross-border TTC/ATC is for security & market purpose only

- Tripura (Surjananinagar) – Comilla 132 KV line. TTC 200 MW. Although the entire capacity is shown in the NLDC website to be available for STOA including exchange based trades. It has been ascertained that a medium term Agreement has been signed between the ONGC Tripura plant for export of 160 MW power flow + 20% (totaling 192 MW) radially to Bangladesh through this line.

The earlier agreement has been renewed on 3rd Dec'2021till Mar'2026.

Therefore, the Total Capacity available for STOA is 240 MW from India to Bangladesh. In the reverse direction the total capacity available for STOA is 1000 MW.

3.2 India – Bhutan

Presently available Cross Border connections between India and Bhutan are as below (132 KV and above).

Connected to Eastern Region (ER)of India

1. 400kV, 2xD/C Twin Moose line, Tala-Siliguri with LILO of one circuit at Malbase S/S;
2. 220kV, 1xD/C line, Chukha- Birpara
3. 220kV, 1xS/C line, Chukha- Malbase-Birpara
4. 400kV, 1xD/C Quad Moose, Jigmeling to Alipurduar.
5. 400kV, 1xD/C Quad Moose line Punatsangchu II - Lhamoizingkha – Alipurduar

**https://posoco.in/market/monthly-atc-inter-country/inter-country-2021-22/*

Connected to North Eastern Region (NER) in India

1. 132 kV, 1xS/C line, Motanga-Rangia

2. 132kV, 1xS/C line, Gelephu-Salakati.

As per information available in NLDC website, the details of the TTC for the month of October'2021 is as mentioned below:

- From Bhutan to ER ISTS TTC 2380 MW. 50 MW of the same is reserved for reliability margin. LTOA and MTOA has been granted for 2196 MW and therefore 134 MW is available from Bhutan to India for STOA including exchange based trades.
- From ER ISTS to Bhutan, the TTC is 550 MW. 10 MW of the same is reserved for reliability margin. The balance capacity of 540 MW is available for STOA from India to Bhutan, including exchange based trades.
- From Bhutan to NER ISTS, the TTC is 158 MW. The entire capacity is available for STOA including exchange based trades.
- From NER ISTS to Bhutan the TTC is 158 MW. The entire capacity is available for STOA including exchange based trades.

Therefore, the Total Capacity available for STOA 292 MW from Bhutan to India. In the reverse direction, the total capacity available for STOA is 698 MW.

3.3 India – Nepal

The presently available Cross Border connections between India and Nepal are as below (132 KV and above).

1. Connected to ER in India Muzaffarpur (India) - Dhalkebar (Nepal) - 400kV D/C transmission line.
2. Connected to NR in India Tanakpur (India)- Mahendranagar (Nepal) 132KV Line
3. Other lines of rating 132 KV and below connecting Nepal to India in Northern Region and Eastern Region, in particular from Bihar state grid, such as132KV Nepal to Bettiah (Nepal) -DMTCL (Motihari) (Bihar, India) D/C line and 132kv Raxaul (Bihar, India)-Parwanipur(Nepal) S/C line

As per information available in NLDC website, the details of the TTC for the month of October'2021* is as mentioned below:

- From ER India (Bihar) to Nepal TTC 395 MW (TTC is the sum of individual maximum permissible load as Nepal is fed radially & declared by SLDC Bihar), Reliability Margin 7.9 MW, Capacity booked in LTA/MTOA nil. Balance 387.1 MW available for STOA. These figures are cumulative figure of individual line details like 132kv Raxaul-Parwanipur S/C line, 132KV Nepal - Bettiah-DMTCL (Motihari) D/C etc. Figures in the reverse direction are not available as these are radial feeders with unidirectional flow of power. This capacity is not available for exchange based trades. The rate and quantum of power flow from India to Nepal is determined by the power exchange committee having members from MoP India, CEA, Bihar state and NEA.
- From India NR ISTS to Nepal through the Mahendranagar (India) Tanakpur (Nepal) line TTC 65 MW. LTOA and MTOA has been granted for 14 MW (for transfer for 70 Mus free power under Mahakali treaty as mentioned) and 51 MW is available for STOA. including exchange based trades. .
- From Nepal to India NR ISTS through the Mahendranagar (India) Tanakpur (Nepal) line. TTC 65 MW. Entire capacity is available for STOA including exchange based trades
- From India ER ISTS to Nepal through the Muzaffarpur (India) - Dhalkebar (Nepal) line. TTC 350 MW. The entire capacity is available for STOA including exchange based trades

**https://posoco.in/market/monthly-atc-inter-country/inter-country-2021-22/*

- From Nepal to India ER ISTS through the Muzaffarpur (India) - Dhalkebar (Nepal) line. TTC 350 MW. The entire capacity is available for STOA including exchange based trades
- Additional lines of 132KV and 33KV have been listed in Annexure 2-a

Total Capacity available for STOA 401 MW from India to Nepal. In the reverse direction, 415 MW capacity is available as per this report.

3.4 Conclusions on availability of Cross Border Transfer Capacities for short term trades including exchange based trades in particular.

It can be seen from the information above, that adequate capacities are available for Cross Border Transfer Capacities for short term trades including exchange based trades.

3.5 Expected increase in Cross Border Transfer Capacity in the near future (Next 5 years or so)

India- Bangladesh

1. 400 kV DC Baharampura - Bheramara -2nd link. (For ensuring meeting of N-1 security criterion in the interconnection, hence this will not increase transfer capacity of power)
2. 765kV Double Circuit cross-border electricity interconnection between Katihar (India), Parbotipur (Bangladesh) is under discussion in the Joint Working Group (JWG) and Joint Steering Committee (JSC).

India – Nepal

1. 400 KV New Butwal-Gorakhpur. Agreement signed in Sept'2021 between NEA and PGCIL.
2. Sitamarhi – Dhalkebar –400kV D/c (Quad) line for Arun-3 HEP
3. 400 KV evacuation lines for export oriented Upper Karnali hydropower plants.

The above status existed in October 2021. The NLDC document related to the Cross Border Transmission Capacities and other matters is attached as **Annexure-2**

CHAPTER – 4

Collection and analysis of past data of cross border trade through exchanges in India and assessment of benefits to Nepal due to exchange based trading up to 31.07.2021.

CHAPTER – 4

4.0 Monthly data and analysis of Nepal Power Purchase from Indian Energy Exchange (IEX)-All Data courtesy IEX

Nepal has started participating in Indian Energy Exchange from 18th April 2021, after getting approval of the Designated Authority. Nepal initially applied for permission to buy power upto 350MW, received the same and started buying power from the power exchange w.e.f. 18th April, 2021. It then sought permission to sell power in the power exchange. After replying to queries raised by the Designated Authority, Nepal was also allowed to sell 39 MW power in the power exchange from electricity produced by the 24MW Trishuli Hydropower Project and the 15MW Devighat Hydropower Project on 1st November 2021. It started selling 39 MW power in the power exchange w.e.f. 4th November 2021.

It may be noted that the transmission charges, losses, system operation charges etc. are also applicable additionally.

As on 31.07.2021, the month-wise data of purchase of power from the power exchange, and its interpretation is given below:-

4.1 April'2021 (From 18th April onwards)

Day wise drawal and Round The Clock (RTC) Avg. Price

Table - 1

Delivery Date	Drawal (MWh)	RTC (Round the Clock) Avg. Price (Rs./Mwh)
18-04-2021	1040.70	3094.96
19-04-2021	1505.23	3729.27
20-04-2021	598.49	4035.43
21-04-2021	1236.76	3689.36
22-04-2021	1535.76	3534.15
23-04-2021	2045.71	3237.79
24-04-2021	2314.74	3115.7
25-04-2021	1385.00	2961.94
26-04-2021	870.00	3358.09
27-04-2021	681.91	3628.61
28-04-2021	1210.00	3250.58
29-04-2021	1211.25	3401.21
30-04-2021	842.48	3857.59

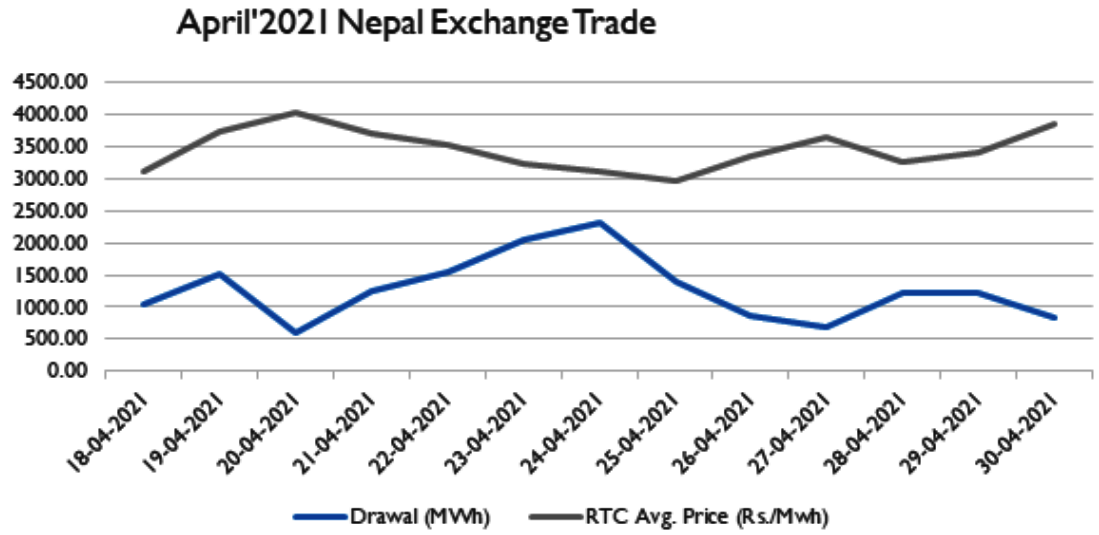
The Total power purchased was 16.478 Mus in the month if April at an weighted average rate of approximately Rs 3.40 per unit.

The minimum quantum bought was 0.60 MU on 20th April'2021 when the Average Round-the-clock (RTC) price was highest at Rs 4.04 per unit. The maximum quantum bought was 2.31 MUs on 24th April'2021 when the Average RTC price was at Rs 3.12 per unit, which is the thirdlowest price for the month of April'2021 for days on which Nepal has bought power from the exchange. The power bought by Nepal is not constant for 24 hours. It would have bought power of varying quantum, during the different 15-minute time blocks over the day, each time block of which would have the price determined

independently. Hence, comparing the quantum bought over the day to the RTC price is strictly not correct. However, in view of the confidentiality of commercial transactions, these 15 minute trades could not be obtained. Therefore, the daily transactions have been compared with the RTC price.

The daily variation of the Average RTC price and purchase volume can be seen in the graph below.

Graph - 1



4.2 May'2021

Day wise drawal and RTC Avg. Price

Table - 2

Delivery Date	Drawal (MWh)	RTC Avg. Price (Rs./Mwh)
01-05-2021	7125.95	3256.21
02-05-2021	6990.00	2950.71
03-05-2021	6940.00	3162.82
04-05-2021	6890.00	3103.75
05-05-2021	6370.00	3050.84
06-05-2021	5940.00	2901.98
07-05-2021	4360.00	3220.59
08-05-2021	4650.00	3087.37
09-05-2021	3780.00	2902.04
10-05-2021	4455.00	3051.09
11-05-2021	5097.50	2808.35
12-05-2021	5097.50	2698.22
13-05-2021	2445.00	2485.69
14-05-2021	1695.00	2659.52
15-05-2021	1307.50	2954.83
16-05-2021	3580.00	2666.85

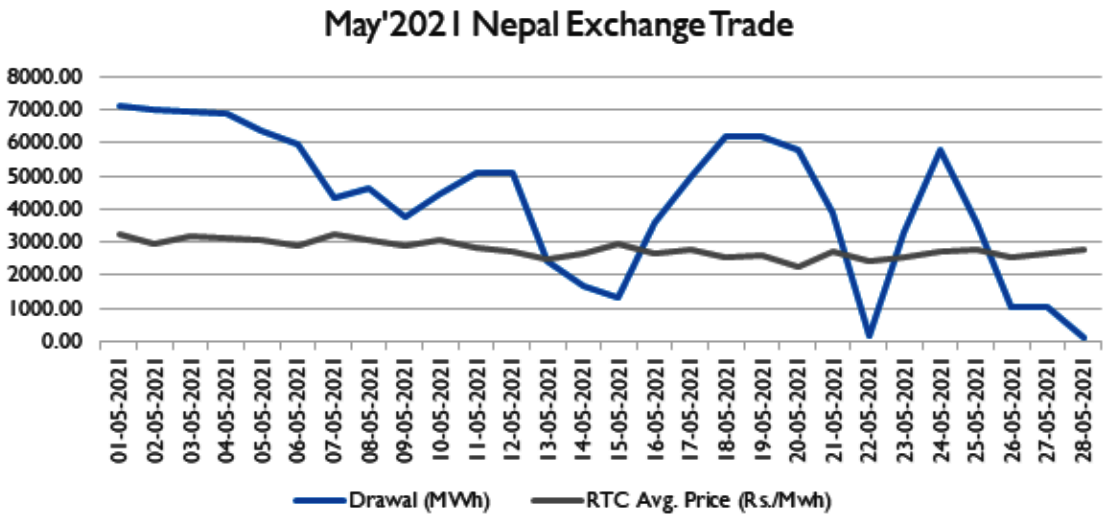
Delivery Date	Drawal (MWh)	RTC Avg. Price (Rs./Mwh)
17-05-2021	4975.00	2767.11
18-05-2021	6170.00	2557.54
19-05-2021	6170.00	2604.62
20-05-2021	5770.00	2255.16
21-05-2021	3895.00	2699.19
22-05-2021	175.00	2411.35
23-05-2021	3320.00	2543.49
24-05-2021	5812.50	2718.64
25-05-2021	3575.00	2757.32
26-05-2021	1010.00	2565.15
27-05-2021	1010.00	2652.79
28-05-2021	125.00	2744.81

The Total power purchased was 118.73 Mus in the month of May, at a weighted average rate of approximately Rs 2.85 per unit.

The minimum quantum bought was 0.18 MU on 22nd May'2021 when the Average RTC price was at Rs 2.41 per unit. The maximum quantum bought was 7.13 MUs on 1st May'2021 when the Average RTC price was at Rs 3.26 per unit . This shows that Nepal has purchased as per their requirement of power as well as based on commercial conmsiderations.

The daily variation of the Average RTC price and purchase volume can be seen in the graph below.

Graph - 2



4.3 June'2021

Day wise drawal and RTC Avg. Price

Table- 3

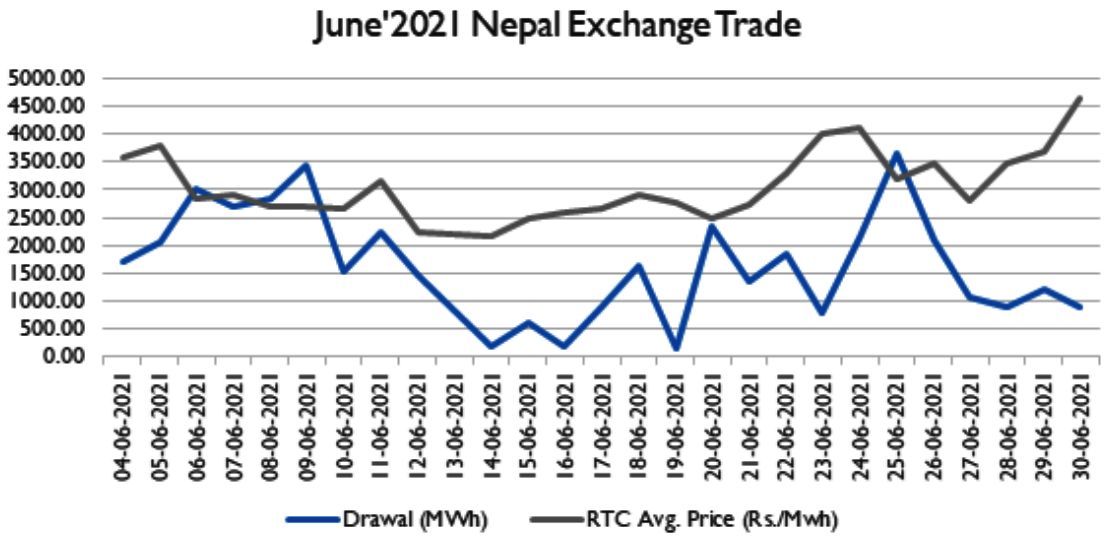
Delivery Date	Drawal (MWh)	RTC Avg. Price (Rs./Mwh)
04-06-2021	1702.50	3589.98
05-06-2021	2057.50	3781.45
06-06-2021	3010.00	2834.2
07-06-2021	2685.00	2899.43
08-06-2021	2835.00	2709.61
09-06-2021	3432.50	2694.05
10-06-2021	1540.00	2652.28
11-06-2021	2250.00	3151.76
12-06-2021	1447.50	2249.54
14-06-2021	175.00	2171.33
15-06-2021	605.00	2473.47
16-06-2021	175.00	2601.42
17-06-2021	897.50	2661.71
18-06-2021	1630.00	2906.26
19-06-2021	142.50	2772.75
20-06-2021	2342.50	2482.96
21-06-2021	1357.79	2729.16
22-06-2021	1852.08	3299.16
23-06-2021	789.89	4009.4
24-06-2021	2120.00	4119.55
25-06-2021	3641.20	3186.65
26-06-2021	2102.50	3465.28
27-06-2021	1086.44	2799.51
28-06-2021	892.50	3475.56
29-06-2021	1222.50	3688.21
30-06-2021	900.00	4645.81

The Total power purchased was 42.892 Mus in the month of July at an weighted average rate of approximately Rs 3.09 per unit.

The minimum quantum bought was 0.18 MU on 14th and 16th June'2021 when the Average RTC price was at Rs 2.18 and Rs 2.60 per unit respectively. The maximum quantum bought was 3.64 MUs on 25th June'2021 when the Average RTC price was at Rs 3.19 per unit. This would be as per requirement of Nepal and on commercial considerations.

The daily variation of the Average RTC price and purchase volume can be seen in the graph below

Graph- 3



4.4 July'2021

Day wise drawal and RTC Avg. Price

Table - 4

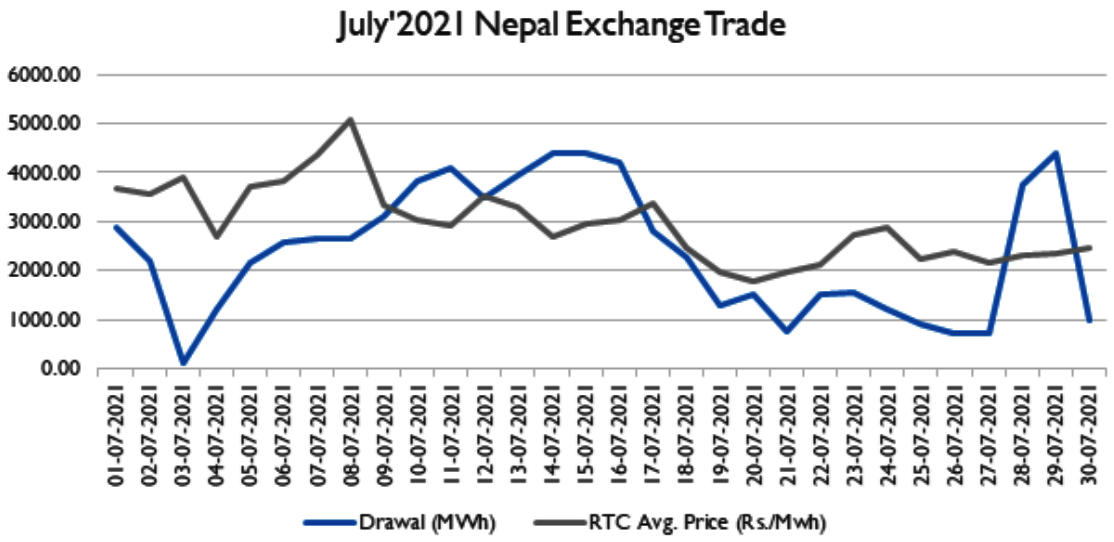
Delivery Date	Drawal (MWh)	RTC Avg. Price (Rs./Mwh)
01-07-2021	2862.50	3669.75
02-07-2021	2203.59	3562.82
03-07-2021	100.52	3888.58
04-07-2021	1225.00	2679.96
05-07-2021	2150.00	3702.46
06-07-2021	2582.25	3830.71
07-07-2021	2641.00	4343.98
08-07-2021	2663.75	5086.16
09-07-2021	3096.05	3338.53
10-07-2021	3820.00	3045.94
11-07-2021	4097.50	2909.95
12-07-2021	3472.50	3519.97
13-07-2021	3935.08	3301.72
14-07-2021	4397.50	2706.16
15-07-2021	4397.50	2960.72
16-07-2021	4203.46	3022.32
17-07-2021	2795.30	3381.02
18-07-2021	2267.50	2480.03
19-07-2021	1267.50	1975.99

Delivery Date	Drawal (MWh)	RTC Avg. Price (Rs./Mwh)
20-07-2021	1527.50	1785.71
21-07-2021	770.00	1985.81
22-07-2021	1527.50	2135.87
23-07-2021	1535.00	2745.93
24-07-2021	1202.50	2898.31
25-07-2021	898.75	2239.52
26-07-2021	726.25	2379.06
27-07-2021	726.25	2173.1
28-07-2021	3762.50	2308.68
29-07-2021	4392.50	2365.85
30-07-2021	985.00	2452.41

The Total power purchased was 72.23 Mus in the month of July at an weighted average rate of approximately Rs 3.07 per unit.

The minimum quantum bought was 0.73 MU on 26th and 27th July'2021 when the Average RTC price was at Rs 2.38 and Rs 2.18 per unit respectively. The maximum quantum bought was 4.40 MUs on 14th and 15th July'2021 when the Average RTC price was at Rs 2.70 and 2.96 per unit. The daily variation of the Average RTC price and purchase volume can be seen in the graph below.

Graph - 4



4.4 Summary of Trade and April'2021 (From 18th April) to 31st July, 2021

The summary of Trade or power bought by Nepal from Indian Energy Exchange can be seen in the Table Below.

Table-5

Month	No of days on which power purchased	Total Power Purchased in the month from Exchange Mus	Equivalent Flow on a RTC Basis* MW	Approx. Wt Avg RTC price in Rs/ Unit	Approx. Total Cost of Power Purchased Rs Crs
April'2021	13	16.48	53	3.39	5.59
May'2021	28	118.73	177	2.85	33.84
June'2021	26	42.98	69	3.09	13.28
July'2021	30	72.23	100	3.06	22.10
Total	97	250.42		3.01	74.81

**The power purchased from Exchange will vary from day to day and also from time block (of 15 minutes) to time block, in a particular day. However, these figures are calculated based on continuous and constant flow for the entire day on which power was purchased by Nepal.*

As mentioned earlier, Nepal has also started exporting power from 4th Nov'2021. As per news reports from Nepal, NEA has sold electricity worth Nepali Rupees 139.26 million over a period of a month.

Comparison of total energy imported by Nepal from India and the share of Exchange based import in the same.

Table-6

Month	Exchanged based Power Purchased in the month Mus	Total Power Purchased in the month * Mus	Share of Exchange based Power in Total Power Purchased %
May'2021	118.73	276.28	42.97%
June'2021	42.98	193.94	22.16%
July'2021	72.23	164.53	43.90%
Total	250.42	634.75	39.45%

**Source NLDC monthly report of July.2021*

4.5 Assessment of benefits to Nepal due to Trading through Exchange

As per information available in the public domain*, in Jan'2021, the Nepal Electricity Authority (NEA) had received permission to import additional 15 MW of electricity from Tanakpur at 4.14 Rs per unit. Similarly, The NEA and Indian company NTPC Vidyut Vyapar Nigam (NVVN) had signed a power purchase agreement (PPA) for Dhalkebar-Muzaffarpur cross-border transmission line up to 250 MW in July-November, 2020, 350 MW in December 2020-April 2021 and 200 MW in May-June 2021. The PPA has been renewed in June'2021 for a further period of one year and Nepal can draw upto 350 MW as per the agreement. The per unit price of electricity purchased was 4.18 Indian rupees, as per the contract.

Compared to the cost of these imports, Nepal has been able to purchase power from the Indian Energy Exchange at a rate at least 20% less than these import costs or about Rs 1.00 per unit. Thus the purchase of about 250 Mus during the four months' period has led to a saving of about INR 25 Crs, as compared to the PPA rate. As the details of the Nepal bids are not available, the actual consumer surplus figures

https://myrepublica.nagariknetwork.com/news/nea-receives-permission-to-import-15-mw-more-electricity/

can't be calculated but the same will be equal or more than Rs 25 Crs as Nepal has recently signed PPAs where the cost of power is Rs 4.18 per unit. It is quite apparent that that the savings have been very significant.

The exchange-based purchase of power has also enabled Nepal to fine tune their import from India on a day ahead basis. The Day Ahead Market gives an option to the buyer to buy energy as and when required, without the mandatory payment of fixed charged, which is usually a compulsion in PPA based imports. The variation in the daily power purchase figures of Nepal indicates that this feature has been utilized by Nepal not only to meet their power requirement close to real time but also at a reasonable rate, depending on price of power in the power exchange.

The above analysis is based on the exchange based cross border trades conducted through Indian power exchange during the period April'2021 to July'2021.

Chapter- 5

Projecting opportunities missed out by Bangladesh by not participating in Exchange based trading. Quantifying the benefits that Bangladesh could have reaped by exploiting such opportunities. And Assessment of future opportunities for Bangladesh for participating in the Power Exchange in India (For next 5 years).

Chapter- 5

As earlier mentioned in the report, Nepal had gained significantly by participating in the Exchange, both by buying and selling power. Similarly, Bhutan has also benefited by selling power in the exchange during the outage of the Tala Hydro Power Plant. As per the current scenario, and expected developments in the next five years, Bangladesh is likely to purchase power from the exchange. The sale of power may not be feasible to any significant extent, because of the relatively higher variable cost of power, as compared to the normal price in the power exchange. Hence the following reports focuses on purchase of power from exchanges by Bangladesh.

Facts and Figures (As on Oct'2021)

Bangladesh is importing power through two interconnections, Baharampur- Bhedamara and Commila-Tripura link. Based on discussions held with Bangladesh stakeholders, further increasing import from the Commila- Tripura link is not possible at present as the Commila area is being fed in a radial mode and to increase imports, further area of the Bangladesh grid will have to be isolated. Such isolation appears to be difficult as of now as the extended area will include many generating stations also from which BPDP is sourcing the generation. In the link of Baharampur- Bhedamara, the current import of about 800 MW as against the capacity of 1000 MW, due to some issues with one of the PPAs signed by them. This additional 200 MW can be bought from Indian Power Exchanges. Further the Baharampur- Bhedamara second link has been commissioned recently. However this additional link is for meeting the N-1 security criterion, hence this will not increase the transfer capability of power at Behramara. Thus the maximum power that can be purchased from exchanges is limited to 200 MW. It also needs be to be appreciated that due to various factors, Bangladesh bids may not be cleared some times in the exchange for reasons of abnormally high prices in the exchange such as those experienced due to shortage of coal in India as seen in Oct'2021. Also other factors like transmission constraints on Indian, Bangladeshi or cross border interconnection, the quantum of power actually bought may be somewhat less. In view of the above, it is assumed that Bangladesh will be able to purchase power at least 95% of their requirement. This means:-

Average power that can be bought by Bangladesh = 190 MW

Average energy that can be bought by Bangladesh in a day = 190*24/1000 = 4.56 Mus

Average energy that can be bought by Bangladesh in a year = 4.56*365 = 1,664 Mus (Say 1600 Mus)

The power bought by Bangladesh is expected to replace the generation from costliest variable cost power plant in Bangladesh. As can be expected, variable cost of the substituted domestic power of Bangladesh will vary from time to time in a day and day to day in a year. Moreover, the exchange based power purchase can also prevent the startup and stoppage of some plants which is being used to meet the peak demand.

As per information obtained from reliable sources, the variable cost of the costliest generating plants is about INR 15.50. Out of a total installed generating capacity of about 25000 MW, this accounts for about 1300 MW of power which use HSD as fuel. Next, in order of decreasing fuel charges, comes the HFO plants with about 6000 MW capacity and gas plants with 11500 MW capacity. These plants together account for more than 80% of the generating capacity in Bangladesh. It also needs to be mentioned that HSD and HFO plants are used sporadically and do not reflect the average cost of the costliest power on a daily basis even in the peak season. Further with number of coal based plant being in under construction stage, the share of HSD, HFO and gas based power can be expected to reduce over the next 5 years. Gas based plants, using imported LNG, would then become the costliest power after those using liquid fuel. Imported gas prices (in the form of LNG) are subject to fluctuations and can consequently lead to a change in the variable cost of power generated from gas.

Further, for the year 2020-2021, about 83% of the total energy generation has come from gas, furnace oil or diesel based plants. Thus in the winter months, when the demand is reduced significantly (by even 50% at times), some of these plants have to run and thus the variable cost of the costliest plant on bar is not significantly reduced.

In view of the above, we assume that the variable cost of the costliest power in Bangladesh that can be replaced by power purchased from exchange can to be around INR 10 at present.

The Natural gas spot price has been on the increase in the recent past. As per a report published by Reuters*, Bangladesh has paid about USD 36 per MMBTU for purchase of LNG in October'2021. The report also mentions that Asia spot LNG prices LNG-AS had surged to a record of more than $56 per MMBTU. This was due to increase in demand in Europe.

A very recent report published by 'The financial Express' reports* that Petrobangla had not imported LNG during five months since October 2020 till January 2021 as it did not get suitable price quote. Before that Petrobangla has been importing LNG from long-term suppliers at around USD 11.5 per MMBTU. Recently Bangladesh has reportedly bought LNG at an all-time high price of around USD 36 MMBTU in Oct'2021. Thus it can be seen that there is a lot of volatility in the LNG prices and in future procurement of LNG at USD 11.5 per MMBTU will be quite difficult. Hence it is assumed that LNG price may increase to USD 16 to 18 per MMBtu over the next 5 years leading to a similar increase in the generation cost. The anticipated cost of power over the next 5 years is as given below.

Yearly Average variable price saving due to replacement of power based on liquid and imported gas based plants by power bought from exchange.

Table-7

Year	2021	2022	2023	2024	2025	2026
Replaced power price in Rs/unit	10.00	11.00	12.00	13.00	14.00	15.00

Yearly Average RTC price in Day Ahead Market in Indian Energy Exchange **

Table-8

Year	2017	2018	2019	2020	2021
Average RTC Price in Rs/unit	3.02	3.94	3.12	2.62	3.95

The average price in 2020 was exceptionally low due to the prevailing situation. Hence the average price for the rest of the years is calculated and found to be

**https://thefinancialexpress.com.bd/trade/bangladesh-to-buy-lng-at-double-the-price-from-two-months-ago-1624718126*

***https://www.iexindia.com/marketdata/market_snapshot.aspx*

3.51 Rs/unit. It may also be mentioned that in October'2021, the monthly average RTC price was exceptionally high at 8.02 Rs/Unit. This was again due to reduction in generation from coal plants due to coal related issues.

In the next five years, the price is expected to be reasonably stable in this range as cheaper power from renewable sources will increase which will nearly compensate for the inflation dependent components of power pricing. Further the hydro generation from Bhutan and Nepal will also come to the exchange platform, increasing the supply and hence reducing the cost of the power in the power exchange.

Further the CAGR (Compound Annual Growth Rate) Average yearly RTC price in Day Ahead Market for 4 years from 2017 to 2021 is calculated as -

CAGR = 6.9%

In view of the above, for calculation purposes, rate increase at 6. 9% per year have been assumed over the next 5 years.

**https://www.reuters.com/article/bangladesh-lng-imports-idUSL1N2R4086*

The projected Yearly Average RTC price in Day Ahead Market in Indian Energy Exchange

Table - 9

Year	2022	2023	2024	2025	2026
Average RTC Price in Rs/unit	4.22	4.51	4.82	5.16	5.51

Projecting opportunities missed out by Bangladesh by not participating in Exchange based trading

As mentioned above, the variable cost of the costliest power in Bangladesh that can be replaced by power purchased from exchange can be assumed to be INR 10 at present. Similarly the Yearly Average RTC price in Day Ahead Market in Indian Energy Exchange for the year 2021 was INR 3.95 per unit.

The landed cost in Bangladesh will be a bit more due to addition of transmission charges and losses and various fees etc. Thus the landed cost of power for Bangladesh can be assumed to be about INR 4.50 per unit

In case Bangladesh had bought power from Indian Exchanges, a saving of INR 5.5 per unit would have accrued. Nepal started buying power from Indian exchange from mid-April'2021. In case Bangladesh had started power purchase from May'2021, power could have been bought for 8 months in 2021.

Estimated quantum of power that could have been purchased from Exchange during 8 months in 2021 = 1664*8/12 = 1109 Mus (say 1100 Mus)

Estimated average saving per unit of power purchased from exchange = INR 5.5 per unit

Total savings in 8 months in 2021 = 1100*5.5 = 6050 Million INR or INR 605 Crs

Quantifying the benefits that could have reaped by Bangladesh by purchasing power from Exchanges over the next 5 years.

As discussed above, the landed cost of power purchased from Exchanges and the variable cost of the domestic power replaced by this over the next 5 years are summarized in the table below.

Table- 10

Year	2022	2023	2024	2025	2026
A) Average Landed Price of Exchange power. (RTC price + other charges)* INR per Unit	4.22+0.5 =4.72	4.51+0.5 = 5.01	4.82+0.5 =5.32	5.16+0.5 =5.66	5.51+0.5 =6.01
B) Average variable price of domestic power replaced INR per Unit	11.00	12.00	13.00	14.00	15.00
C) Average savings per unit in INR (B-A)	6.28	6.99	7.68	8.34	8.99
D) Average quantum of power purchased from Exchange in Mus	1600	1600	1600	1600	1600
E) Amount saved by Bangladesh (C* D) Million INR	10,048	11,184	12,288	13,344	14,384

**Other charges (Transmission charges, System Operation charges etc) assumed fixed at INR 0.50 per unit*

Thus it can be seen that a huge quantum of money can be saved by Bangladesh through Exchange participation. The total amount over next 5 years is INR 61,248 Million. Even if 50% of the estimated opportunity is actually harnessed, the saving is over INR 30,000 Million or INR 3000 Crs.

At the current exchange rate of 1 INR = 1.147(June'2021) Bangladesh Taka, this translates into a saving of over 3400 Crs taka.

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Building consensus among Bangladesh stakeholders to begin trading in the Indian power exchange

Bangladesh Stakeholder Consultations

Gist of Discussion

10th and 11th January 2022

The Stakeholder Meetings for "Building consensus among Bangladesh stakeholders to begin trading in the Indian power exchanges" was held on 10th and 11th January'2022 through virtual mode where stakeholders from different organizations participated in the discussion as mentioned below.

- With Bangladesh Power Cell, 10th Jan 2022 2.30 PM
- With Bangladesh Electricity Regulatory Commission (BERC), 10th Jan 2022 4.30PM
- With Bangladesh Power Development Board (BPDP), 11th Jan 2022 9.30 AM
- With Power Grid Company of Bangladesh (PGCB), 11th Jan 2022, 2.30 PM

The complete list of Participants is attached at **Annexure-3.**

Agenda: The primary objectives of stakeholder consultation was to interact with stakeholders in Bangladesh to understand the reasons for not participating in power exchange based trading and finding solution for any hurdle being faced by Bangladesh on this matter, showcasing the benefits accrued to Nepal and Bhutan due to exchange based trading to the Bangladesh stakeholders and projecting opportunities missed out by Bangladesh by not participating in Exchange based trading.

Introduction by Participants: All participants from IRADe/SAREP were introduced by Mr. Pankaj Batra, Project Director, SARI/EI, IRADe. The Bangladesh participants were also requested to give a brief introduction about themselves and their function in their organization.

Mr. Pankaj Batra, Project Director, SARI/EI, IRADe welcomed the stakeholders and initiated the proceedings. He started the discussions by mentioning that the neighboring nations have now been allowed to participate in the Indian power Exchanges. He mentioned that the cost of power purchased from Indian exchanges is likely to be about INR 4.0 including all losses and charges, based on the current prices being discovered in the Day Ahead Market (DAM) of Indian Energy Exchange (IEX). Further the capacity charges has to be paid by Bangladesh, even if the domestic power is not scheduled by them. The variable charges may be avoided, if it is higher than the exchange traded power's landed cost. He also mentioned to the stakeholders about the prices discovered in the Real Time Market (RTM) were brought to the notice of the Bangladesh participants. The RTM gives an option to buy power just one hour before delivery. The option of trading in the power exchange for only selective blocks, as required, was mentioned, which therefore offers a lot of flexibility for buying or selling of power in the power exchange. Exchange provides a mechanism of optimization of power resources. Mr. Batra stated that there are a number of products in the power exchange, i.e. Day Ahead Market, the Real time market, the contingency market and the intra-day market. There is also a weekly market. But the most popular product is the Day Ahead Market, where buy bids and sell bids are aggregated and the intersection of the aggregated buy curve and the intersection of the aggregated sell curve gives the common market price. All buyers would get the power at a price that they have bid or a lower price, whereas all sellers would get a price of what they had bid or a higher price

Mr Batra emphasized that the trading of power in exchange was a win-win situation for all nations, as it basically leads to the optimizing of resources over a larger geographical area. He also mentioned how India and Nepal both benefited from the power exchange and expressed his belief that Bangladesh will also similarly benefit from the exchange based trading. When the power exchange started within India, the buyers and sellers in India too have benefitted by trading in the power exchange He also explained that as only Indian trader comes under the jurisdiction of the Central Electricity Regulatory Commission (CERC) of India, hence at present to trade in the Indian Power Exchange, the neighboring nations, including Bangladesh, would have to go through an Indian trader for buying or selling power.

On a query by Mr. Mohammad Hossain, on the method of participating in the Indian power exchange, it was mentioned that this has to start with obtaining permission from the Designated Authority to buy or sell power. Just getting the permission to buy or sell power from the power exchange does not lead to any financial implication, nor does it compel an entity to buy or sell power. Power can be bought or sold as and when required for as short a time period as fifteen minutes. The concept of collective transaction in the Power Exchange was explained and that in the Day Ahead Market (DAM), the specific seller is not identified for power bought by the buyer. Further the exchange provides for the option to bid for different quantum of power at different rates. It provides an option to mitigate the consequences of unexpected incidents like tripping of a generator, as the corresponding power can be bought in the RTM in the power exchange, with a lead time of one hour. There is also market surveillance and monitoring to ensure that there is no gaming by any participants. The settlement mechanism and how that leads to

payment security was also explained. The exchange acts as an intermediary in the financial transaction. The buyer's trade is only confirmed once the payment is secured by the exchange and hence the amount payable to the seller is already available with the exchange before trade confirmation. This amount is paid to the seller by the exchange.

Mr Subhajit Kumar Ray, Sr, Consultant IRADe presented the salient features of Nepal's experience in exchange participation during the period May to July'2021.**(Annexure 5-A)** Nepal bought power in the DAM as per their requirement. It was mentioned that Nepal had reduced power purchase from a short term trade agreement and increased power purchase from exchange, as they were getting more competitive prices in the exchange. About 40% of power purchased by Nepal from India came from Exchange based trades due to benefits it got by buying power from exchanges. The graph of daily variation of quantum of power purchased and price for each of the months were explained, bringing out the benefits of exchange based trades. Mr Ray explained that the exchange based trade had also benefited Bhutan when they bought power from the exchange at a very reasonable to overcome the energy shortage in their system. Bangladesh representatives appreciated that flexibility that the exchange provides and that there is no commitment charges. Mr Ray also explained in brief about the SARPEX mock exercise carried out in the previous phase of SARI/EI and the participation of Bangladesh representatives in the same. He also explained how scarcity of power adversely affects the economy and the GDP

Mr Vinod Kumar Agarwal Technical Director, SARI/EI, IRADe mentioned that in the Annexure-III of the CEA procedure gives the forms required to be filled in their application to trade in the Indian exchanges. He further suggested that Bangladesh may consider selecting a suitable trader in India, who can then trade in the exchange on their behalf and also support them in other related activities. He also suggested that Bangladesh may initially seek approval for import and subsequently for export as there are separate requirements for each of them, and it may be advisable for Bangladesh to go for import first.

Mr Batra further mentioned that Bhutan's purchase of power from the exchange from Jan'2022 has allowed them to overcome shortage in domestic generation due to outage of the Tala power plant for about 3 monts. It was explained that Bhutan has bought power during off-peak time from the power exchange, when the cost of power at the exchange is low, while during the peak time they have used their own hydro resources, when the price at the Power exchange is high.

Bangladesh representatives mentioned that the option of participating in the power exchange has been discussed at their end. They also expressed the view that the exchange based trading is mutually beneficial for all participating nations. The discussions they have had with IEX officials on this issue were mentioned. It was mentioned that of the total capacity of 1000 MW on the India- Bangladesh HVDC link, only 800 MW is being actually imported by them. The balance capacity of 200 MW which is not being used by them, due to certain issues of non-supply by the Meenakshi power plant , can be used by them through the exchanges. BPDP also have a separate department, which is dealing with Independent Power Producers, as well as power imports. It was mentioned in response to a query from Bangladesh that the about 4% of the total power generated in India is traded through exchange but that the same is a significant amount in MU terms. The present quantum is in the order of 200 Mus or so per day.

It was mentioned by Bangladesh that they have certain transmission limitations or constraints, because of which, power stations needs to be run at different locations due to system requirement. At present they can import maximum of about 10% from one substation. As their demand is at present about 10,000 MW, they can import about 1000 MW through the HVDC link against the current import of about 800 MW. This additional 200 MW can be bought from Indian Power Exchanges. As far as import from Tripura- Comilla line is concerned, the same is being imported in a radial mode. The maximum possible import at present is in the range of 160-180 MW and it is not feasible to increase the same in the near future. Bangladesh is in the process of upgrading its transmission system, and number of lines and substations are likely to be commissioned by 2025. It is also likely that synchronous operation of Indian and Bangladesh grid will be possible by 2030. They are also trying to diversify the generation sources and for import, they have signed an MOU with Nepal through NVVN. They further mentioned that the prices in the power exchange are lucrative for them to buy power, in view of the high cost of imported LNG, that they are currently using for generating power.

The Bangladesh participants desired to know how to initiate action for purchase of power from exchanges in India. It was explained that they need to obtain approval from the Designated Authority (DA), as per the Procedure for both buying and selling power, by applying in the given format. It was clarified that

presently they have to trade through an Indian trader as the exchange is under the jurisdiction of Central Electricity Regulatory Commission (CERC) and only Indian trader is covered under this. For this purpose, Bangladesh can choose any trader in India. The role of trader and the Settlement Nodal Agency (SNA) was explained and the steps to be taken to start trading in Indian Energy Exchanges were also mentioned.

The Bangladesh participants desired to know the time it will take to go through the process of seeking permission to participate in the exchange. The process to be followed for applying was explained and it was mentioned that it may take about a couple of months to get permission. This will vary a bit, in case there are any queries from the DA on the application submitted. It was also mentioned that BERC is ready to formulate new regulations if Bangladesh Governments instructs them to do so. Once we have a South Asian Regional Power Exchange then a decision to formulate the market rules can be taken together. However, this is expected to take some time as the quantum of Cross Border power traded through exchange is not so high at present. . On a query on whether synchronous operation between Bangladesh and India is being thought of, PGCB mentioned that the same is being planned for 2030.

Both Mr. Mohammad Hossain, Director General, Power Cell, and Mr. Bazlur Rehman, Member BERC, stated that discussions are on to start trading in the power exchange in India .It was mentioned by BPDP that Bangladesh is planning on holding of a high level seminar on this issue in Bangladesh. This was welcomed by Mr Batra, as a good platform for disseminating and experience sharing. He also assured all support from the SARI/EI project at IRADe, for the seminar.

On behalf of SARI project, Mr Batra assured continued support to Bangladesh in this matter and also thanked the participants for sparing their valuable time for the meeting. Bangladesh representatives appreciated the study and requested that the report may be shared with them once it is finalized.

Meeting with Power Cell

Meeting with BERC

Meeting with PGCB

Meeting with BPDB

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Capacity building programs for Bangladesh participation in Indian power exchanges

12th and 13th January 2022

A Capacity building program for Bangladesh participation in Indian power exchanges was held for two half days on 12th and 13th January'2022, through virtual mode, where delegates from different organizations such as Power Cell, Bangladesh Electricity Regulatory Commission (BERC), Bangladesh Power Development Board (BPDP), and Power Grid Company of Bangladesh (PGCB) participated. The speakers were experienced professionals from IEX, CEA, POSOCO etc. Ms Anuradha Das, Program Coordinator, IRADe compered the program.

The complete list of Participants is attached at **Annexure-4.**

The agenda of the program is attached at **Annexure - 5**

Agenda: The primary objectives of stakeholder consultation was to familiarize and build capacity of the Bangladesh participants, in order for them to understand the entire procedure for participating in exchange based trading and the related systems and procedures, rules and regulations. The benefits accrued to Nepal due to participation in exchange based trading was also presented to them. The speakers included officials from Indian Energy Exchange (IEX), Central Electricity Authority (CEA), Power System Operation Corporation (POSOCO) and URJA Nepal.

Inaugural Session- The welcome address was delivered by Mr. Pankaj Batra, Project Director, SARI/EI program at IRADe. He welcomed all the delegates to the program. He mentioned that the program was conceived to bring out the benefits to Bangladesh if they participate in the power Exchanges in India. He enumerated the benefits that have accrued to Nepal and Bhutan by trading in Indian Power Exchanges and how they have utilized the flexibilities offered by exchange based trades to meet their power requirements in an economical manner. He briefly explained the topics of the presentations planned in the Capacity Building Program and their relevance to Bangladesh delegates.

The Keynote Address was delivered by Mr Mohammad Hussain DG, Power Cell, Bangladesh, representing Mr. Md. Habibur Rahman, Secretary, Power Division, Government of Bangladesh, who could not come due to a concurrent meeting. He expressed his gratitude to SARI/EI for their continuous endeavor for promoting Cross Border Trade in Electricity over the last few years. He mentioned that participation in the Power Exchange was under active consideration of the Bangladesh authorities. He mentioned that Bangladesh now has a peak generating capacity of about 20,000 MW and peak demand for about six months is little over 14,000 MW for about 2 to 3 hours a day. To fulfil this peak demand, certain generating stations have to be run and this leads to increase in cost. Exchange based power purchase can help ease this situation. He emphasized that the exchange based trades will be beneficial to all nations, in view of the regional diversity of demand, and shall also lead to reduction in carbon emission, due to harnessing of the regional hydro potential. He mentioned that the capacity building program will be useful for the Bangladesh delegates who are from different organizations, having a key role to play in this issue.

Introductory Presentation by Mr. S. K. Ray, Sr. Consultant, IRADe- He started by mentioning that the Indian Power Exchange is operational for a long time now and have benefited the participants. Further even in off-peak hours, if Bangladesh can buy power at less than the variable cost of the costliest plant on bar then that can lead to significant savings for Bangladesh. He elaborated on how the bidding can be done to ensure this. He presented an overview of the program and familiarized the participants with the exchange based trading done by Nepal and Bhutan. He summarized the details of power bought by Nepal from the exchange during the period April to July' 2021. He detailed how Nepal has shifted partly from PPA based power purchase to Exchange based power purchase. He mentioned that the benefit to Bangladesh will be much more as the variable cost of their domestic power is much higher.

The Vote of Thanks was delivered by Ms. Monali Zeya Hazra, Regional Energy Manager and Clean Energy specialist, IPO USAID/India. She mentioned that she was pleased to know that Bangladesh is planning to take part in trading through the Power Exchange and assured of support and facilitation by USAID in their endeavor. She also mentioned that. based on the study being conducted by SARI with Mr Ray as consultant, a road map will be developed and implemented in this matter. She thanked Mr Md. Hossain and other participants for participating in the capacity building program. She thanked the speakers for sparing their valuable time and sharing their experiences. She also thanked Mr Ray for the study and to the SARI/EI project team at IRADe for conducting the capacity building program. She requested the Bangladeshi stakeholders to provide their feedback on what more can be done by USAID on this issue.

Mr. Pankaj Batra, Project Director, SARI/EI, IRADe welcomed the stakeholders and initiated the proceedings. He started the discussions by mentioning that the neighboring nations have now been allowed to participate in the Indian power Exchanges. He mentioned that the cost of power purchased from Indian exchanges is likely to be about INR 4.0 including all losses and charges based on the current prices being discovered in the Day Ahead Market (DAM) of Indian Energy Exchange (IEX). The capacity charges have to be paid by Bangladesh, even if the domestic power is not scheduled by them, however the variable charges could be avoided, which are likely to be more than the exchange traded power's landed cost. The prices discovered in the Real Time Market (RTM) were also mentioned. A typical average rate of INR 2.61 was brought to the notice of the Bangladesh participants. The RTM gives an option to buy power just one hour before delivery. The option of trading in the power exchange for selective blocks were mentioned along with the flexibility this offers. The Power Exchange provides a mechanism of optimization and sharing of resources.

Mr Batra emphasized that the trading of power in the power exchange is a win-win situation for all nations, as it basically leads to the optimizing of resources over a larger geographical area. He also mentioned how India benefited from the power exchange and expressed his belief that Bangladesh will also similarly benefit from the exchange based trading. He also explained that as only Indian traders come under the jurisdiction of the Central Electricity Regulatory Commission (CERC) of India, hence at present to trade in Indian Power Exchange, the neighboring nations, including Bangladesh, have to go through an Indian trader.

The opportunities provided by the participating in the power exchange were elaborated. In particular, it was mentioned that obtaining permission for trading does not lead to any compulsion to buy. That power can be bought as and when required, for as short a time period as fifteen minutes. The concept of collective transaction was explained, and that in a DAM, the specific seller is not identified for the power bought by any buyer. Further the exchange provides for the option to bid for different quantum of power at different rates. It provides an option to mitigate the consequences of unexpected incidents like tripping of lines or generator as the corresponding power can be traded in the DAM or the RTM. There is also market surveillance and monitoring to ensure that there is no gaming by any participants. The settlement mechanism and how that leads to financial security was also explained.

Mr Subhajit Kumar Ray, Sr, Consultant IRADe presented the salient features of Nepal's experience in exchange participation during the period May to July'2021. Nepal has bought as well as sold power in the DAM as per their requirement. It was mentioned that Nepal had reduced power purchase from a short term trade agreement and increased power purchase from exchange as they were getting more competitive prices in the exchange. About 40% of power purchased by Nepal from India came from Exchange based trades due to benefits it got by buying power from exchanges. The graph of daily variation of quantum of power purchased and price for each of the months was presented by Mr. Ray, while explaining the benefits of exchange based trades. Bangladesh representatives appreciated that flexibility that the exchange provides and that there is no commitment charges. Mr Ray also explained in brief about the SARPEX mock exercise carried out in the previous phase of SARI/EI and the participation of Bangladesh representatives in the same. He also explained how scarcity of power effects the economy and the GDP. The presentation is attached as **Annexure – 5 -A**

Mr Vinod Kumar Agarwal Technical Director, SARI/EI, IRADe mentioned that Annexure- III of the CEA procedure clearly mentions all actions needed to be taken, in order to trade in the Indian power exchanges. He further suggested that Bangladesh may consider selecting a suitable trader in India, who can then trade in the exchange on their behalf, and also support them in other related activities. He also suggested that Bangladesh may initially seek approval for import and subsequently for export, as there are separate requirements for each of them and it may be advisable for Bangladesh to go for import first.

Mr Batra further mentioned that Bhutan's purchase of power from the exchange from Jan'2022 has allowed them to overcome shortage in domestic generation due to outage of the Tala hydro power plant. It was explained that Bhutan has bought power during off-peak time when the likely cost of power at the exchange is low and during the peak time they have used their own resources.

Session-1: Products in the Power Exchanges in India, their need and features By Mr. Rohit Bajaj, Head, Business Development, IEX

Mr Bajaj started his presentation with a brief about the development of exchange operations in India from the launching of DAM to the start of CBTE. He presented the shares of different types of trades through which power is being procured in India and the growth of exchange based trades over the years. He enumerated the various benefits of exchanges such as voluntary participation, providing a neutral platform, risk mitigation etc. He gave an overview of the various products in the exchange and explained the DAM in details. He also briefly explained the Real Time Market and the Green Markets.

He presented the price and the volume of power traded in the DAM over the years. He elaborated how the exchange has enabled the distribution companies (DISCOMS) in India to economize their cost of power purchase. Discussing the evolution of CBTE, he briefly discussed the regulatory and the policy framework present in India for CBTE. He familiarized the delegates with the procedure to be adopted by Bangladesh for participation in the exchange. He presented a case study on Nepal's power trade in the exchange and how they have benefited from participation in the exchange.

He touched upon the various upcoming products in the exchange such as long term markets, derivatives in electricity market. He ended his presentation by expressing his hope to see Bangladesh participating in the exchanges in the near future. The presentation is attached as **Annexure – 5 -B**

Session-2: Key Features of MOP Guidelines, CERC Regulations and CEA Procedures related to Participation of South Asian Nations in Indian Energy Exchanges. By Mr. B.S.Bairwa, Director, Power System Planning, CEA

Mr Bairwa started his presentation by explaining the various objectives and Provisions of the MOP Guidelines. He discussed the institutional framework which has been put in place covering the roles of various bodies like CERC, CEA, SNA (Settlement Nodal Agency), etc. He detailed the various procedures being adopted by the Designated Authority (DA) related to CBTE. He elaborated on the various provisions for bilateral trade involving export and import of power by an Indian entity. He mentioned the conditions applicable to such entities for participating in bilateral trade in electricity with neighboring nations. He presented the details of the current power trade between India and Bangladesh through the Behrampur – Bheramara and Tripura- Comilla interconnections.

Elaborating on the exchange based trades, he mentioned the various provisions and applicable conditions which are relevant for Bangladesh to participate in the Indian Power Exchanges. He mentioned some key milestones in this regards such as NVVN (Indian Trading Licensee) being accorded approval to buy power for Nepal through the Power Exchange-DAM (transaction started 18.04.2021), Approval for sale of power from Nepal generators (Trisuli (24MW) and Devighat (15MW)) to PX-DAM through NVVN and Approval to PTC for buy power from the DAM for Bhutan (01.01.2022). He also briefly explained the salient features related to trilateral contracts, i.e. transaction of electricity through Indian Grid in the context of CBTE in general and in case of exchange based trades in particular. The presentation is attached as **Annexure – 5 -C**

Session-3: Role of System Operator in Power Exchange Based Trading in India and anticipated role of South Asian System Operators for Trading in the Indian Power Exchanges. By Mr. R. K. Porwal, CGM (SO), NLDC, POSOCO India

Mr Porwal discussed the benefits and issues related to International Interconnections. He mentioned the present and upcoming cross border connections between India and the neighboring countries. He discussed the recent policy and regulatory developments in this field. He discussed about the cross border operational coordination being carried about by POSOCO including cross border transfer capacity declaration by NLDC. He discussed about the long term, medium term and short term access and the settlement of various charges and losses related to the transactions.

He gave an overview of the expected developments in the field of CBTE. More Synchronous or Asynchronous Interconnections in future would help in the optimization of generation resources in the Region and growth of region-wide economy. Further harmonization of grid standards, scheduling and dispatch procedures will happen in the future along with building of consensus on the legal, regulatory, technical and commercial aspects of CBTE. He also mentioned the likely challenges that may arise in future in grid management. The presentation is attached as **Annexure – 5 -D**

Session-4: Experience of Nepal in trading in the Indian Power Exchange, Role of Trader and Settlement Nodal Agency (SNA) in Exchanges based Trades involving South Asian Nations. By Mr. K.S. Bandyopadhyay, Independent Consultant - Urja Nepal, EX - ED, NVVN

Mr. Bandyopadhyay mentioned the developments leading to participation of Nepal in the Indian Energy Exchange. NEA had signed power Exchange Agreement with Indian Trader in April 2019. Subsequently, NEA Signed SNA Agreement with NVVN in October 2020 for settlement of Grid Operation related charges and DSM. He shared the DA Approval obtained for Purchase / Sale of Power by NEA through power exchange. He presented the CBET transaction flow diagram.

He shared the learning from Nepal's experience in participation in exchanges in India. He suggested that filing separate application for permission for buying and selling of power is desirable. To get maximum benefit, Bangladesh may consider having both bilateral agreement and exchange trades. He also elaborated on the role of SNA and mentioned the various functions of SNA. He further shared the details of SNA functions Performed by NVVN in various transactions. The presentation is attached as **Annexure – 5 -E**

Session-5: Perspective of Stakeholders from Bangladesh on Participating in the Indian Power Exchange Moderated by Mr. Pankaj Batra, Project Director, SARI/EI program at IRADe

Mr Batra invited the Bangladesh stakeholders to raise any queries that they may wish to. Mr Balzur Rehman, Member BERC expressed his appreciation for the speakers and mentioned that the various participants have got an excellent learning opportunity. Mr Batra pointed out that given the variable cost of the power plants in Bangladesh and the current exchange prices, participation in exchange by Bangladesh will be beneficial. The presently un-utilized capacity in the cross border link can be used for exchange based trades. Mr Batra thanked all the speakers and participants from Bangladesh.

Concluding Remarks. By Mr. Shayan Shafi, Senior Energy Advisor, USAID/Bangladesh

Mr Shafi expressed his pleasure for holding the capacity building program. He thanked all the speakers on behalf of USAID Bangladesh. He mentioned that globally there has been large scale integration of power market and all participating nations have benefited from the same. While appreciating the Indian Power Exchange, he mentioned the need of a regional power exchange in the South Asian Region. He mentioned that exchange participation will benefit Bangladesh in meeting its target of reduction in carbon emission. He also appreciated the capacity building program mentioning that it will enable the delegates for participation in the exchange.

Vote of Thanks Mr. V K Agrawal, Technical Director, SARI/EI program at IRADe

Mr Agrawal mentioned that there is a consensus that Bangladesh's participation in the exchange will be beneficial. He mentioned that all the departments of Bangladesh participated and expressed his belief that they will take the matter ahead. He thanked the speakers and the Bangladesh participants. He expressed to gratitude to IRADe and USAID team members for their contribution.

Steps and Roadmap for Bangladesh to start trading in the Power Exchange in India. Suggest steps required on immediate basis and long term basis to start trading in the Indian power exchange, including changes in policies and regulations required to facilitate the same. The Roadmap details sustainable measures for Bangladesh to engage on Power Trade in India..

As earlier mentioned in the report, Nepal had gained significantly by participating in the Exchange, both by buying and selling power. Similarly, Bhutan has also benefited by selling power in the exchange during the outage of the Tala Hydro Power Plant. It has also been mentioned that as per the current scenario, and expected developments in the next five years, a huge quantum of money can be saved by Bangladesh by buying power through Indian Exchanges. At times there may be opportunities to sell power also and this will be an additional benefit to Bangladesh.

With this background, it is felt that enumerating the steps that Bangladesh needs to take in order to start trading in Indian Exchanges will be useful. As of now, Bangladesh is importing power from India through two interconnections, Baharampur- Bhedamara and Commila- Tripura link. The quantum of power being exported, the currently signed PPAs and the available transmission capacity has already been enumerated in the report.

It is felt that the following steps should be taken by Bangladesh to start participating in exchanges in India

Step 1 – Quantification of the quantum of power that can be imported/exported.

Bangladesh need to quantify the quantum of power that they can import and export from the presently available links. Along with the capacity available in the CBTE, the evacuation and injection capacity of Bangladesh grid also needs to be ascertained. This assessment should be done on yearly, monthly and on day ahead basis and reviewed and revised from time to time. Based on the same, Bangladesh can go for medium and short term arrangements for power trade including trading through exchange. For very short term trades, from a few hours to a few days, including exchange based trading, there are no commitment charges involved. Power bought has to be paid for, only when it is bought. However the fine tuning of buying or selling of power more near to the real time, can be done only in exchange based trades

Step 2 – Internal approvals to be obtained

In line with the Procedure for Approval and Facilitating Import/Export (Cross Border) of Electricity by the Designated Authority (CEA India's procedure), consent of Bangladesh government is required for allowing trading of power in Indian Exchanges. BPDP is the single buyer in Bangladesh. For purchase of power, BPDP appears to have the required authorization from the Bangladesh Government. It needs to be checked by BPDP, if the authorization to import power from India is general in nature or PPA specific. In case such authorization is PPA specific, BPDP needs to obtain approval to buy power from exchanges also. It is felt that such an approval, will not pose any hindrance and can be obtained with ease, but should be obtained to meet the requirement of CEA India's procedure.

For sale of power, a different approach is required. So far Bangladesh has not exported power mainly due to their own demand and also due to the high cost of power that can be traded. However, it has been seen that the prices in Indian Power Exchanges have shown spikes at times and this can be viewed as opportunity of selling power by Bangladesh through the Indian Power Exchanges.

In order to benefit from such opportunities, BPDP will need authorization for the same. Such authorization from BERC and/or the Ministry should be obtained beforehand as these sale opportunities are not very predictable and in the power exchange, immediate decision needs to be taken to benefit from the same.

Step -3 Setting up of coordination procedures between agencies within Bangladesh

For trading of power through Indian Exchanges, various agencies in Bangladesh will be involved. There has to be a proper coordination between them. Assuming that BPDP is the single importer and exporter of power, the following procedure described in brief below can be adopted.

a) The National Load dispatch center of Bangladesh should publish the available transfer capacities for export and import of power to/from India, based on the available transfer capacities published on the Indian side by the Indian system operator, POSOCO, and PGCB's own assessment on the Bangladesh

side. This may be published on a monthly basis initially, then on a weekly basis and on a day ahead basis. These transfer capacities should be reviewed at regular intervals and revised if required.

b) The demand supply position in Bangladesh for the short term should be carefully analyzed, the next day for the Day Ahead Market, the next week for the weekly market and the immediate need for the Real Time Market . The quantum of power that can be bought or sold on a dispatch period basis and the corresponding rates has to be assessed at least two days in advance and reviewed on a day ahead basis, also considering the other factors like if it is a holiday in India and/or Bangladesh, which is likely to impact the demand vs supply position in the power exchange market. Based on the above, suitable bids need to be formulated and placed on the exchange.

c) A suitable procedure for distribution of imported power been various Discoms has to be worked out. Similarly, the generating stations whose power is being sold has to be identified and it need to be ensured that adequate generation from these stations are available when the trade is being executed. This is a requirement as per CEA India procedure also.

d) The entity responsible for conducting exchange based trading in Bangladesh will need to ensure availability of funds for buying exchange based power, as the funds for the same are blocked by the power exchange, so that exchange based trades take place seamlessly.

Step 4 – Approvals to be obtained from India

As explained earlier in the report, the CEA procedure is very clear about the necessary approvals that needs to obtain from India for exchange based import and export. As of now, Bangladesh entities are not allowed to bid in the exchanges directly. In view of the Indian regulations, system and procedure etc, the following steps are suggested to be adopted.

a) A suitable Indian trader needs to be identified in India for conducting exchange based trades in the Indian Energy Exchange on behalf of Bangladesh. This is not only a requirement but would also benefit Bangladesh, as the Indian Trader will be familiar with the Indian Power sector and will be able to advise Bangladesh on all matters related to exchange based trades. A suitable agreement has to be signed with the trader.

b) The Settlement Nodal Agency (SNA) should be involved in this matter as the settlements arising out of exchange based trades also have to be dealt by SNA. SNA will also be in a position to advise Bangladesh on all matters related to exchange based trades.

c) The CEA India's Procedure for approval and facilitating (Import/Export (Cross Border) of Electricity) by the Designated Authority has clearly given a format in Annex- III "Application format for approval of Designated Authority for participation in Indian Power exchanges."

d) All applicable details like quantum of power, duration of trade etc as detailed in the application format has to be agreed between BPDP and the Indian Trader by mutual discussion.

e) The Indian Trader would have to apply for the approval of the Designated Authority for trading of Bangladesh power in Indian power Exchange.

f) In addition to the efforts of the Indian Trader, Bangladesh government and other organizations may also pursue the matter with their Indian counterparts for expediting the matter.\

Once the approval is obtained, the Indian Trader can then trade power in the Indian Energy Exchanges on behalf of Bangladesh.

Once the trading through exchange commences, it will be necessary from the trader and BPDP to keep track of all changes in rules and regulation that take place in India, which may have an impact on the trades. Similarly, the power plant data regarding quantum of power and its cost needs to be updated on a regular basis especially as the gas and HFO and diesel prices change very frequently and this input is very important while formulating the bids. Further the trader should be regularly made aware of any event that may take place in the Bangladesh grid or the cross border interconnection. Such events may change the import/export/evacuation and injection capabilities of the Bangladesh power system. This will lead to changes in the bids placed at the exchange and also may at times, change in schedule by POSOCO India and NLDC Bangladesh.

On an immediate term, while initiating the process of obtaining approval for participation in the exchange, a comprehensive training session is recommended to be arranged by Bangladesh to train the respective organization's officials in all aspects of exchange based trades. The participants should be from BPDP, PGCB, BERC and the finance department of the organization dealing with the financial transactions. The speakers should be from the Indian trader (preferably those who has been assigned to trade on behalf of Bangladesh), POSOCO, IEX/ PXIL, CEA, CERC, SNA, a major buyer and a major seller of power in the Indian exchanges. Involving representatives from Nepal and Bhutan who are participating in the Indian exchanges will also be useful.

Bangladesh may also consider appointing an expert for starting the trade through Indian Exchanges and for the initial period of about one year of exchange participation. The expert should have good overall knowledge of the respective field and should be in a position to guide and advise Bangladesh officials on all matters related to exchange based trades.

In the long term, Bangladesh, in coordination with the other South Asian countries, may explore the possibility of establishing a Regional Power Exchange, which may be a multi-national independent body for trading of Cross Border Power. The geographic location of Bangladesh is such that Bangladesh can be a link between the SAARC/BIMSTEC and ASEAN grid. Proper planning and implementation can make Bangladesh a hub of cross border power trade, including exchange based trade between SAARC/ BIMSTEC and ASEAN countries.

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20 YEARS Integrated Research and IRADe Action for Development

Nepal stakeholder's consultation covering all aspects of their participation in Indian power exchange

Nepal Stakeholder Consultations

Gist of Discussion

10th and 11th January 2022

The Stakeholder Meetings for "Nepal stakeholder's consultation covering all aspects of their participation in Indian power exchange" was held on 20th and 21st July'2022. Consultations were held with various stakeholders from different organizations as mentioned below.

1. With Independent Power Producers' Association, Nepal (IPPAN), 20th July 2022
2. With Electricity Regulatory Commission of Nepal (ERC of Nepal), 20th July 2022
3. With Mr. Prabal Adhikari, Director, Power Trade Department, Nepal Electricity Authority (NEA), 21st July 2022

Agenda: The primary objectives of stakeholder consultation was to interact with stakeholders in Nepal to understand their experience of participation in exchange based trading and to understand their future plan of trading through Power Exchanges. Their bid formulation methodology was discussed and certain suggestions were also given to improve upon the same. The future of exchange based power trade in Nepal as well as in the South Asian Region was also discussed and their views on this matter were ascertained.

The consolidated Gist of Discussions in the meetings are enumerated below.

Introduction by IRADe: All participants from IRADe/USAID/SAREP were introduced by Mr. Pankaj Batra, Project Director, SARI/EI, IRADe. The Nepal participants also gave a brief introduction about themselves and their function in their organization.

Mr. Pankaj Batra, Project Director, SARI/EI, IRADe welcomed the stakeholders and initiated the proceedings. He started the discussions by mentioning that Nepal has been participating in the Indian power Exchanges and have sold and bought power as per its requirement. Other neighbouring nations of India have also started to participate in the exchange or are taking steps to do so. He briefly mentioned about the study being conducted and the activities completed so far including the discussions held with Bangladesh participants in brief.

He mentioned about the benefits of participation in exchanges. The average cost of power purchased from Indian exchanges is likely to be about INR 4.0 per unit, including all losses and charges, based on the current prices being discovered in the Day Ahead Market (DAM) of Indian Energy Exchange (IEX). However, this price can vary during the day, seasonally and on a day to day basis. This variability of the price gives the participant an opportunity to optimize their power trade, buying and selling power as per their requirement and benefit from the same. The working and the prices discovered in the Real Time Market (RTM) were brought to the notice of the Nepal stakeholders. The RTM gives an option to buy power just one hour before delivery. The option of trading in the power exchange for only selective blocks, as required, was mentioned, which therefore offers a lot of flexibility for buying or selling of power in the power exchange, without payment of commitment charges. Exchange provides a mechanism of optimization of power resources.

Mr Batra further mentioned about Bhutan's experience of purchase of power from the Indian power exchange and highlighted that the same has allowed them to overcome shortage in domestic generation due to outage of their largest hydro power plant, the Tala hydropower plant for about 3 months. It was explained that Bhutan has bought power during off-peak time from the power exchange, when the cost of power at the exchange is low, while during the peak time they have used their own hydro resources, when the price at the Power exchange is high.

Mr Batra emphasized that the trading of power in exchange was a win-win situation for all nations, as it basically leads to the optimizing of resources over a larger geographical area.

Mr Subhajit Kumar Ray, Sr, Consultant IRADe mentioned about the salient features of Nepal's experience in exchange participation. Nepal bought power in the DAM as per their requirement. He mentioned that Nepal had reduced power purchase from the short term trade agreement they had with India and increased power purchase from the power exchange, as they were getting more competitive prices in the exchange. In certain months, about 40% of power purchased by Nepal from India came from Exchange based trades as it was beneficial for Nepal to buy power from the exchange. Nepal representatives appreciated the flexibility that the exchange provides and the fact that there are no commitment charges. They also mentioned that they were largely satisfied with their experience of participation in the Indian Energy Exchanges. Mr Ray also explained in brief about the SARPEX mock

exercise carried out in the previous phase of SARI/EI and the participation of Nepal representatives in the same. He also explained how scarcity of power adversely affects the economy and the GDP

The Independent Power Producers' Association, Nepal (IPPAN) meeting was held with their CEO and others. They gave a short presentation covering the Nepal power sector broadly and explaining the role of IPPAN in the same. They mentioned that Nepal is surplus by about 400 MW in wet season at peak load and about 1000 MW in wet season at off-peak load. Out of this, GOI has approved only about 360 MW for sale in Indian exchanges and approval of the DA for a further 200 MW has been requested for RTC sale, but the same is yet to be approved by GOI. Even after taking all these into consideration, a quantity of more than 400 MW remains for which market is yet to be identified. Further the quantum of surplus is projected to increase to about 3500 MW by 2026. Even in the near term, in a next year or so, about 300 MW capacity is likely to be added. . They also expressed the hope that the appropriate authority in Nepal shall issue the trading license to them, as applied for by them and also consider the option of setting up of a power exchange either for Nepal or for the South Asian Region, at a later stage.

The Electricity Regulatory Commission meeting was held with their Chairman and Members. The present status of cross border trade with India including exchange based trading was discussed. They mentioned that for CBTE, Nepal has to go through India even if they want to trade power with any third country due to Nepal's geographic location.

They mentioned that they have developed a roadmap for the next 4 years. which is a rolling plan. The present Chairman has a balance tenure of two years and then the new chairman shall take the rolling plan ahead. They expressed their view that at present the regional energy market is in a transition phase and they are in favour of a regional power exchange in the long run, once the current phase is over. They were also looking forward to the Government of Nepal issuing a policy on open access. Subsequently, regulations and guidelines for power trading and trading license would be issued. ERC Nepal has also taken up with their government for augmenting the manpower resources that they have as they will need adequate manpower for proper discharge of their functions

They further mentioned that at present they do not foresee keeping any portion of the energy portfolio solely for exchange based trading. However, they may look into this once Nepal is adequately power surplus and also after gaining some exposure to Cross Border Power Trading. They were also in favour of having a regional power exchange but felt that it will take some time for it to be established and till then they will continue with the participation in the Indian Energy Exchanges.

Mr Prabal Adhikari, Director, Power Trade Department, NEA met SARI/EI/IRADE team and the SAREP member for a discussion of the matter.

Mr Adhikari briefly mentioned their experience of participation in the Indian Power Exchange. Mr Ray shared the Nepal related data available with him. The logic of change in bidding price and volume and also the nature of the trade was explained by Mr Adhikari. The bid formulation methodology being adopted by Nepal was discussed broadly. Mr Ray mentioned that the manner in with Nepal has been utilizing the exchange was close to perfection. He mentioned that at present they have not reserved any generation for exchange based trade and are bidding as per their requirements. Mr Adhikari also mentioned the earlier training programs arranged by USAID previously and also the participation in the SARPEX mock exercise to have been beneficial to them.

Mr Ray mentioned how the variation of price during different dispatch periods can be utilized for optimization of the energy portfolio by Nepal. In particular, in case Nepal has a storage/pondage plant, this benefit can be optimally used by Nepal. Mr Adhikari was also of the opinion that a regional power exchange is desirable, but till the time the same is established, they will continue to participate in the Indian Energy Exchanges.

On behalf of SARI/EI project, Project Director, IRADe assured continued support to all the Nepal stakeholders in this matter which would be continued by the new USAID program, SAREP, after the SARI/EI program got over in September 2022 also thanked the stakeholders for sparing their valuable time for the meetings. Nepal stakeholders also appreciated the support being provided by SARI/EI project and expressed their view that the same will be available in future also.

Conclusion

This study was started in August'2021 and the various activities were completed in phases over a period of about one year. The objective of the study was to promote cross-border electricity trade (CBET) through the Power Exchange in India. At the time of the start of the study, Nepal had just trading in the Day Ahead Market of Indian Energy Exchange. No other South Asian nation was participating in the exchange. As such, this was the focus of the study. Soon after the commencement of the study, Bhutan also started participating in the exchange. As Sri Lankan grid is not electrically connected to any other nation, they are not in a position to participate in CBET. Thus the main focus of the study was on building consensus among Bangladesh stakeholders to begin trading in the Indian power exchange.

The study covers salient features of the Indian government guidelines, CERC regulations, CEA procedure related to CBTE, and understanding of these are necessary to initiate CBTE through exchange or otherwise. Thus a recap of the same is included in the study, but it may be noted that the actual documents have many further details. The provisions of the same should be well understood for initiating any CBET involving India, through exchange of otherwise.

Since Nepal has already started trading in the exchange, the trade data was procured for study and analysis. As detailed in the study, it was seen that the benefit to Nepal was significant (about 25 Crs INR in about 4 months from April to July 2021 and they preferred the exchange based trading option over other options of CBTE available to them to a significant extent. Subsequently when Bhutan participated in the Indian exchanges, the buyers benefited as there was some shortage of power and, at the same time, sellers got an opportunity to sell power thus getting benefiting financially. The exchange based CBET involving India, Nepal and Bhutan clearly demonstrated the benefits to all participants either in terms of meeting power deficient or generating revenue, without making any long term commitments.

The benefits as detailed above were showcased to the Bangladesh officials in the stakeholder consultations. In these discussions also, it was felt that Bangladesh participants were mostly aware of the benefits but the quantification of the same was helpful in further strengthening their faith in exchange based CBTE. The main fuel used in Bangladesh is oil and given the cost of oil, the domestic generation is very costly. Even if variable cost is considered, purchase of power through exchange is definitely feasible and desirable.

Another aspect that will impact CBTE, is the availability of transmission system, not only cross border system but also the system in the Bangladesh national grid. Bangladesh has plans for augmentation of the national grid and some of the work on the same is also in progress. A roadmap for Bangladesh to start trading in the Power Exchange in India was prepared and forms a part of the report.

In case of Nepal, it is apparent from the data available that their bidding in the Indian Energy Exchange has been well thought out and reflects an in-depth knowledge in the matter. There may be scope to further improve it, but that needs that the trend of prices in the power exchange, block-wise, and the corresponding bidding data to be studied in detail, dispatch period/ day/ week and month wise. Such data is not available in public domain and even otherwise the exercise will be time consuming as the data will be quite voluminous. However, it is understood that Nepal is internally doing this analysis and using the results so obtained. The private sector in Nepal have many operational power plants and many more are in the pipeline. They need to find buyers for this power and Nepal is very unlikely to utilize the whole power internally. The establishment of a power trading company and exchange in Nepal is being pursued by them. Further, at present Nepal do not have any pumped storage plant but they have identified locations where such plants can be built. The optimum utilization of such plants was discussed, but till the time the various hurdles are removed, the idea will not see the day of light.

One of the major conclusion from the study is that all nations desire that matters, which are adversely impacting cross border trade, including exchange based trades, needs to addressed and resolved. There is almost complete awareness of the benefits of CBTE in general and exchange based CBTE in particular. People also appreciate the concept of SARPEX at least as a long term goal and appreciated the work done by USAID and IRADe on the same. Nepal and Bangladesh officials repeatedly raised the issue of wheeling of power traded between them through Indian grid.

Finally, it appears that getting all the nations on a single platform to discuss and solve all issues related to exchange based CBTE may be the best way forward, and in the long run, establishment of a Regional Power Exchange for the South Asian Region, with full support and participation of all South Asian Nations, with grid connectivity, should be the goal.

ANNEXURES

ANNEXURES I

No. 14/1/2017-Trans-Pt(1)
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi- 110 001.

Dated, 26th November, 2019

To

Shri Asim Kumar Poddar, CEO,
NTPC Vidyut Vyapar Nigam Ltd.
SCOPE Complex, 7 Institutional Area,
Lodhi Road, New Delhi-110003.

Subject: Nomination of Settlement Nodal Agency (SNA) under Guidelines for Import/Export (Cross Border) of Electricity 2018- reg.

Sir,

I am directed to state that as per the clause 8.8 of the Guidelines for Import/Export (Cross Border) of Electricity 2018, M/o Power, Govt. of India has nominated NTPC Vidyut Vyapar Nigam Ltd. (NVVN) as Settlement Nodal Agency (SNA) for settlement of grid operation related charges with neighbouring countries, namely, **Bangladesh**, **Bhutan**, **Nepal** and **Myanmar**.

2. This issues with the approval of Competent Authority.

Yours faithfully,

26/11/19

(Bihari Lal)
Under Secretary (Trans)
Tele-fax: 2332 5242
Email: transdesk-mop@nic.in

Copy to:

1) Secretary, CERC, New Delhi.
2) Member(PS), CEA, New Delhi.
3) Joint Secretary(North), MEA, New Delhi.
4) Joint Secretary(BM), MEA, New Delhi.
5) Joint Secretary(Hydro), M/o Power, New Delhi.

ANNEXURES 2

National Load Despatch Centre, New Delhi

Cross Border Transfer Capability for October 2021

Issue Date: 28th September 2021 Issue Time: 1700 hrs Revision No. 0

Cross-Border Corridor	Date	Time Period in IST (hrs)	TTC	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Limiting constraint	Comments
India (ER ISTS) to Bangladesh *	1st October 2021 to 31st October 2021	00:00-17:00	1000	0	1000	760	240		Limited to HVDC Bherama-Behrampore rated capacity	
		17:00-21:00	1000		1000	760	240			
		21:00-24:00	1000		1000	760	240			
Bangladesh to India (ER ISTS) #	1st October 2021 to 31st October 2021	00:00-17:00	1000	0	1000	0	1000		Limited to HVDC Bherama-Behrampore rated capacity	
		17:00-21:00	1000		1000	0	1000			
		21:00-24:00	1000		1000	0	1000			
India (Tripura) to Bangladesh #	1st October 2021 to 31st October 2021	00:00-17:00	200	-	200	0	200		Limited to terminal bay rating at 132 kV Surjamaninagar (TSCL)	
		17:00-21:00	200		200	0	200			
		21:00-24:00	200		200	0	200			
Bangladesh to India (Tripura) #	1st October 2021 to 31st October 2021	00:00-17:00	200	-	200	0	200		Limited to terminal bay rating at 132 kV Surjamaninagar (TSCL)	
		17:00-21:00	200		200	0	200			
		21:00-24:00	200		200	0	200			
India (ER ISTS) to Bhutan *	1st October 2021 to 31st October 2021	00:00-17:00	550	10	540	0	540		Outage of 400 kV Binaguri-Malbase S/C will over load 220 kV Birpara-Malbase S/C	
		17:00-21:00	550		540	0	540			
		21:00-24:00	550		540	0	540			
Bhutan to India (ER ISTS) *	1st October 2021 to 31st October 2021	00:00-17:00	2380	50	2350	2196	154		N-1 of Chukha-Birpara will overload the other circuit	
		17:00-21:00	2380		2350	2196	154			
		21:00-24:00	2380		2350	2196	154			
India (NER ISTS) to Bhutan *	1st October 2021 to 31st October 2021	00:00-17:00	158	-	158	0	158		Limited to overloading limit of 132 kV Salaktai-Gelephu & 132 kV Rangia-Motonga	
		17:00-21:00	158		158	0	158			
		21:00-24:00	158		158	0	158			

National Load Despatch Centre, New Delhi

Cross Border Transfer Capability for October 2021

Issue Date: 28th September 2021 Issue Time: 1700 hrs Revision No. 0

Cross-Border Corridor	Date	Time Period in IST (hrs)	TTC	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Limiting constraint	Comments
Bhutan to India (NER ISTS) *	1st October 2021 to 31st October 2021	00:00-17:00	158	-	158	0	158		Limited to overloading limit of 132 kV Salaktai-Gelephu & 132 kV Rangia-Motonga	
		17:00-21:00	158		158	0	158			
		21:00-24:00	158		158	0	158			
India (Bihar) to Nepal ##	1st October 2021 to 31st October 2021	00:00-17:00	395	7.9	387.1	0	387.1		(i) Constraints at 220/132kv, 2x160MVA ICTs at Kishanganj New (ii) Constraints at 132KV D/C Supaul-Madhepura & 132KV D/C Supaul-Laukahi T/L (iii) Cinstraint at 132kv Ramnagar-Surajpura T/L (iv) Constraint at 132kv D/C Raxaul-DMTCL (Motihari) T/L	
		17:00-21:00	395		387.1	0	387.1			
		21:00-24:00	395		387.1	0	387.1			
India (NR ISTS) to Nepal *	1st October 2021 to 31st October 2021	00:00-17:00	65	-	65	14	51		Limited to ampacity of 132 kV Tanakpur-Mahendranagar S/C line	
		17:00-21:00	65		65	14	51			
		21:00-24:00	65		65	14	51			
Nepal to India (NR ISTS) #	1st October 2021 to 31st October 2021	00:00-17:00	65	0	65	0	65		Limited to ampacity of 132 kV Tanakpur-Mahendranagar S/C line	
		17:00-21:00	65		65	0	65			
		21:00-24:00	65		65	0	65			
India (ER ISTS) to Nepal *	1st October 2021 to 31st October 2021	00:00-17:00	350	0	350	0	350		Limited on account of transformation capacity at 220/132 kV Dhalkebar S/s	
		17:00-21:00	350		350	0	350			
		21:00-24:00	350		350	0	350			
Nepal to India (ER ISTS) #	1st October 2021 to 31st October 2021	00:00-17:00	350	0	350	0	350		Limited on account of transformation capacity at 220/132 kV Dhalkebar S/s	
		17:00-21:00	350		350	0	350			
		21:00-24:00	350		350	0	350			
India (Manipur) to Myanmar #	1st October 2021 to 31st October 2021	00:00-17:00	3.4	-	3.4	0	3.4		Limited to overloading limit of 11 kV Moreh -Tamu	
		17:00-21:00	3.4		3.4	0	3.4			
		21:00-24:00	3.4		3.4	0	3.4			

National Load Despatch Centre, New Delhi

Cross Border Transfer Capability for October 2021

Issue Date: 28th September 2021 Issue Time: 1700 hrs Revision No. 0

Cross-Border Corridor	Date	Time Period in IST (hrs)	TTC	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Limiting constraint	Comments
Myanmar to India (Manipur) #	1st October 2021 to 31st October 2021	00:00-17:00	3.4	-	3.4	0	3.4		Limited to overloading limit of 11 kV Moreh -Tamu	
		17:00-21:00	3.4		3.4	0	3.4			
		21:00-24:00	3.4		3.4	0	3.4			

Note 1:	In case of operation of SPS, Transfer Capability will be revised accordingly.
Note 2:	Schedule between India and Bangladesh will be prepared using the above table till the next revision
Note 3:	Transfer Capability between India and Bangladesh in the above table has been evaluated ignoring the constraints from Bangladesh side.
Note 4:	LTA of Bangladesh is considered as 300 MW from DVC, 250 MW from Sembcorp Energy India Limited and 210 MW from ISGS allocation (excluding auxiliaries+losses).
Note 5:	* ISTS to cross-border TTC/ATC is for security & market purpose only
Note 6:	# Intra-state to cross-border TTC/ATC is for security purpose only
Note 7:	## TTC is the sum of individual maximum permissible load as Nepal is fed radially & declared by SLDC Bihar.
Note 8:	The above limits are considering the network limitation on Indian side. In case cross-border NLDC also declare the TTC/ATC considering the netowrk limitation on their respective side, the lower of this values vs values in above table would be reckoned for the purpose of scheduling.
Note 9 :	In case any other constraint would be intimated by respective cross-border NLDC, these figures would be revised accordingly.
Note 10 :	NLDC India would approve the transactions in line with the GOI guidelines of Dec 2018, CERC Cross Border regulations and the CBTE procedure issued by DA.
	http://powermin.nic.in/sites/default/files/uploads/Guidelines_for_ImportExport_Cross%20Border_of_Electricity_2018.pdf
	http://www.cercind.gov.in/2019/regulation/CBTE-Regulations2019.pdf
	https://cea.nic.in/wp-content/uploads/2021/02/Final_DA_Procedure_26022021.pdf

Cross Border Transfer Capability for October 2021

Revision No	Date of Revision	Period of Revision	Reason for Revision

ANNEXURES 2A

132 KV and 33 KV interconnectors between India and Nepal

Sl. No.	Name	Voltage level in KV
1	**Kataiya- Kusaha I**	132
2	**Kataiya- Kusaha II**	132
3	**Ramnagar - Gandak**	132
4	**Raxual - Parwanipur**	132
5	**Kataiya - Rajbiraj**	33
6	**Sitamadi- Jaleshwor**	33
7	**Raxual - Birgunj**	33
8	**Jaynagar - Siraha**	33
9	**Nanapara- Nepalgunj**	33

ANNEXURES 3

List of Participants in Bangladesh Stakeholder Consultation

Sl. No.	Name	Designation & Organization	email ID if available
	Stakeholder Consultation with Bangladesh Power Cell, 10th Jan 2022 2.30 PM		
1	**Mr. Mohd Hossain**	Director General, Powercell	dg@powercell.gov.bd
2	**Ms. Afrin Abdullah**	Assistant Director, Planning & Development, Powercell	ad.pd@powercell.gov.bd
3	**Mr. S.K.Ray**	Consultant	skrayraja@gmail.com
4	**Mr. Pankaj Batra**	Project Director, SARI/EI/IRADe	pbatra@irade.org
5	**Mr.V.K.Agrawal**	Technical Director, SARI/EI/IRADe	vkagrawal@irade.org
6	**Mr.Vishnu Pandey**	Sr. Research Analyst	vpandey@irade.org
7	**Mr. Rajiv Ratan Panda**	SAREP	rpanda@sarep-southasia.org
8	**Mr. Mohammad Tahsin Nawaz**	SAREP	tahsin.nawaz@egenconsultants.com
9	**Mr. Shah Sujat Hossain**	SAREP	sujat.hossain@egenconsultants.com
	Stakeholder Consultation with Bangladesh Electricity Regulatory Commission (BERC), 10th Jan 2022 4.30 PM		
1	**Mr. Mohammad Bazlur Rahman**	Member (Power), BERC	engr.mbr@gmail.com
2	**Mr. Md. Kamruzzaman**	Member (Petroleum), BERC	kamruzzaman61@yahoo.com
3	**Md. Rezaul Karim Khan**	Director (Power), BERC	mrkk.ipdb@gmail.com
4	**Mr. Md. Haronur Rashid**	Deputy Director (Power), BERC	mhrashid09@gmail.com
5	**Mr. Md Firoz Zaman**	Deputy Director (Consumer Affairs), BERC	firozberc@gmail.com
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7	**Mr. Pankaj Batra**	Project Director, SARI/EI/IRADe	pbatra@irade.org
8	**Mr.V.K.Agrawal**	Technical Director, SARI/EI/IRADe	vkagrawal@irade.org
9	**Ms. Reema Bardhan**	Communication Specialist, SARI/EI/IRADE	rbardhan@irade.org
10	**Mr.Vishnu Pandey**	Sr. Research Analyst	vpandey@irade.org
11	**Mr. Rajiv Ratan Panda**	SAREP	rpanda@sarep-southasia.org
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13	**Mr. Shah Sujat Hossain**	SAREP	sujat.hossain@egenconsultants.com
	Stakeholder Consultation with Bangladesh Power Development Board (BPDP), 11th Jan 2022, 9.30 AM		
1	**Mr. Muhhammad Bellal Hossan**	XEN, BPDB	
2	**Mr. N.M.S.Kabir**	Director, IPP Cell-1, BPDB	
3	**Mr. Morshed Alam**	BPDB	mharshid09@gmail.com
4	**Mr.ANM Obaidullah**	Director, Directorate of System Planning, BPDB	obaidanm@yahoo.com
5	**Mr.Tanvir Ahamed**	Sub Divisional Engineer, Directorate of System Planning	
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Sl. No.	Name	Designation & Organization	email ID if available
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10	**Mr. Rajiv Ratan Panda**	SAREP	rpanda@sarep-southasia.org
11	**Mr. Mohammad Tahsin Nawaz**	SAREP	tahsin.nawaz@egenconsultants.com
12	**Mr. Shah Sujat Hossain**	SAREP	sujat.hossain@egenconsultants.com
	Stakeholder Consultation with Power Grid Company of Bangladesh (PGCB), 11th Jan 2022, 2.30 PM		
1	**Mr. Golam Kibria**	Managing Director, PGCB	md@pgcb.gov.bd
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3	**Md.Yeakub Elahi Chowdhury**	Executive Director (P&D), PGCB	pd2.pgcb@gmail.com
4	**Md. Monzurul Islam**	Superintending Engineer (LDC), PGCB	se.ldc@pgcb.gov.bd
5	**Mr. B.M. Mizanul Hassan**	Chief Engineer (O&M), PGCB	ce.so@pgcb.gov.bd
6	**Mr. Didarul Islam**	Sub-Divisional Engineer (System Planning), PGCB	didar057@gmail.com
7	**Mr. S.K.Ray**	Consultant	skrayraja@gmail.com
8	**Mr. Pankaj Batra**	Project Director, SARI/EI/IRADe	pbatra@irade.org
9	**Mr.V.K.Agrawal**	Technical Director, SARI/EI/IRADe	vkagrawal@irade.org
10	**Mr.Vishnu Pandey**	Sr. Research Analyst	vpandey@irade.org
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12	**Mr. Mohammad Tahsin Nawaz**	SAREP	tahsin.nawaz@egenconsultants.com
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ANNEXURES 4

Capacity Building Program for Bangladesh participants

Sl. No.	Name	Designation & Organization	email ID if available
		12th Jan 2022	
1	**Md. Zubayer Alvi**	SDE, System Planning , PGCB	zubayeralvi@outlook.com
2	**Mr. Mohd Hossain**	Director General, Power cell	dg@powercell.gov.bd
3	**Ms. Afrin Abdullah**	Assistant Director, Planning & Development, Powercell	ad.pd@powercell.gov.bd
4	**Mr. Md. Kamruzzaman**	Member (Petroleum), BERC	kamruzzaman61@yahoo.com
5	**Mr. Didarul Islam**	"Sub-Divisional Engineer System Planning, PCGB"	didar057@gmail.com
6	**Mr. Md Firoz Zaman**	Deputy Director (Consumer Affairs),BERC	firozberc@gmail.com
7	**Mr. Mohammad Bazlur Rahman**	Member (Power), BERC	engr.mbr@gmail.com
8	**Mr. Rajiv Porwal**	POSOCO	rk.porwal@posoco.in
9	**Mr. Eratosh Chakma**	AE, IPP Cell-1	
10	**Mr. Jyoanta Kumar Basu**	SDE, IPP-1	
11	**Md. Monower Zahid Khan**		
12	**Mr. Muhammad Bellal Hossan**	XEN, BPDB	
13	**Mr. Md. Monzurul Islam**	Se. NLDC	se.ldc@pgcb.gov.bd
14	**Mr. NMS Kabir**		
15	**Mr.Eratosh Chakma**	AE, IPP Cell-1	
16	**Mr. Tanvir Ahmad**	System Planning, BPDB	
17	**Mr. Chandan Sinha**		
18	**Ms. Monali Zeya Hazra**	Regional Energy and Clean Energy Specialist, USAID-India	mhazra@usaid.gov
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20	**Mr. Pankaj Batra**	Project Director, SARI/EI/IRADe	pbatra@irade.org
21	**Mr. V.K. Agrawal**	Technical Director, SARI/EI/IRADe	vkagrawal@irade.org
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23	**Ms. Reema Bardhan**	Communication Specialist, SARI/EI/IRADe	rbardha@irade.org
24	**Ms. Phalguni Dasgupta**	Program Administrator, SARI/EI/IRADe	pdasgupta@irade.org
25	**Mr. Vishnu Pandey**	Sr. Research Analyst, SARI/EI/RADe	vpandey@irade.org
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30	**Mr. Shah Sujat Hossain**	SAREP	sujat.hossain@egenconsultants.com
31	**Mr. B.S. Bairwa**	CEA	bs.bairwa@nic.in
32	**Mr. Rohit Bajaj**	IEX	Rohit.Bajaj@iexindia.com

Note- Total participants were about 40. Some of the partcipants from various organisations joined but the details are not available

Sl. No.	Name	Designation & Organization	email ID if available
		13th Jan 2022	
1	**Ms. Afrin Abdullah**	Assistant Director, Planning & Development, Powercell	ad.pd@powercell.gov.bd
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3	**Mr. Didarul Islam**	"Sub-Divisional Engineer System Planning, PCGB"	didar057@gmail.com
4	**Mr. Md Firoz Zaman**	Deputy Director (Consumer Affairs),BERC	firozberc@gmail.com
5	**Mr. Mohammad Bazlur Rahman**	Member (Power), BERC	engr.mbr@gmail.com
6	**Md. Monower Zahid Khan**		
7	**Mr. Md. Monzurul Islam**	SE, NLDC	se.ldc@pgcb.gov.bd
8	**Md. Sarower Murshed**		
9	**Mr. Tanvir Ahmad**	System Planning, BPDB	
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14	**Ms. Anuradha Das**	Project Coordinator, SARI/EI/IRADe	anuradhad@irade.org
15	**Mr. Vishnu Pandey**	Sr. Research Analyst, SARI/EI/RADe	vpandey@irade.org
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27	**Mr. Rajiv Porwal**	POSOCO	rk.porwal@posoco.in
28	**Mr. K.S. Bandyopadhyay**		
29	**Mr. Prabhankar Porwal**		

ANNEXURES 5

"Promoting (CBET) through the Power Exchange"
Capacity Building Program for Bangladesh
12 -13 Jan 2022, 14:30 – 17:15 (IST), Virtual

Agenda	
Day 1: 12 Jan, Wednesday	
14:30 - 15:15	**Inaugural Session**
	▪ Welcome Address by Mr. Pankaj Batra, Project Director, SARI/EI program at IRADe ▪ Address by Mr. Md. Habibur Rahman, Secretary, Power Division, Govt. of Bangladesh ▪ Introductory Presentation by Mr. S. K. Ray, Sr. Consultant, IRADe ▪ Vote of Thanks by Ms. Monali Zeya Hazra, Regional Energy Manager and Clean Energy Specialist, IPO USAID/India
15:15 - 16:45	**Session-1: Products in the Power Exchanges in India, their need and features** **By Mr. Rohit Bajaj, Head, Business Development, IEX**
	▪ Various products in the power exchange in India approved by the CERC – Day Ahead market (DAM), Contingency contracts, Intra-Day contracts, Real time contracts, Term Ahead Contracts (Weekly contracts), Green Term Ahead Contracts, Green Day Ahead Market – their need and features. ▪ Experience sharing in trading within India. The prices discovered in these contracts in the last one year. ▪ Nepal experience of trading in the Indian Energy Exchange. Challenges faced and overcome in inclusion of Nepal in the IEX. ▪ Anticipated inclusion of other nations in Exchange based trading in India.
16:45 – 17:15	**Session-2: Key features of MOP Guidelines, CERC Regulations and CEA procedures related to Participation of South Asian Nations in Indian Energy Exchanges** **By Mr. B.S. Bairwa, Director, Power System Planning, Central Electricity Authority (CEA), India**
	▪ Relevant Salient features of MOP guidelines, CERC Regulations and CEA procedures ▪ Steps that led to participation by NEA in IEX. ▪ Suggestion for inclusion of other nation in Indian Energy Exchange
End of Day 1	

Day 2: 13 Jan, Thursday	
14:30 –14:40	**Introduction and Summary of Day 1** **By Mr. Pankaj Batra, Project Director, SARI/EI program at IRADe**
14:40 - 15:10	**Session-3: Role of the System Operator in Power Exchange based trading in India and anticipated role of the South Asian System Operators for trading in the Indian Power Exchange** **By Mr. R.K. Porwal, CGM(SO), NLDC, Power System Operation Corporation (POSOCO), India**
	▪ Declaration of Cross Border Transmission Capacities ▪ Applicable Transmission charges and losses etc. on Cross Border Trades ▪ System and procedures related to coordination with other NLDCs
15.10 - 16:00	**Session-4: Experience of Nepal in trading in the Indian Power Exchange, Role of Trader and Settlement Nodal Agency (SNA) in Exchanges based Trades involving South Asian Nations** **By Mr. K.S. Bandyopadhyay, Independent Consultant - Urja Nepal, EX - ED, NVVN**
	▪ Participation by NEA in IEX - Experience sharing ▪ Role of Indian and Non- Indian Traders in CBET ▪ Roles and responsibility of SNA in CBET ▪ Issues specific to Exchanges based Trades involving South Asian Nations
16:00 – 17:00	**Session-5: Perspective of Stakeholders from Bangladesh on Participating in the Indian Power Exchange** **Moderated by Mr. Pankaj Batra, Project Director, SARI/EI program at IRADe**
	▪ Stakeholders from Bangladesh
17:00 – 17:10	**Concluding Remarks** **By Mr. Shayan Shafi, Senior Energy Advisor, USAID/Bangladesh**
17:10 – 17:15	**Vote of Thanks** **Mr. V K Agrawal, Technical Director, SARI/EI program at IRADe**

ANNEXURES 5A

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SARI/EI

20 YEARS Integrated Research and IRADe Action for Development

Introductory Presentation

"Promoting (CBET) through the Power Exchange" Capacity Building Program for Bangladesh 12 -13 Jan 2022, 14:30 – 17:15 (IST), Virtual

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SARI/EI

20 YEARS Integrated Research and IRADe Action for Development

Sessions in Brief

Session-1: Products in the Power Exchanges in India

By Mr. Rohit Bajaj, Head, Business Development, IEX

Session-2: Key relevant features of MOP Guidelines, CERC Regulations and CEA procedures

By Mr. B.S. Bairwa, Director, Power System Planning, Central Electricity Authority (CEA), India

Session-3: Role of the System Operator in Power Exchange based trading

By Mr. R.K. Porwal, CGM(SO), NLDC, Power System Operation Corporation (POSOCO), India

Session-4: Experience of Nepal in trading in the Indian Power Exchange, Role of Trader and Settlement Nodal Agency (SNA)

By Mr. K.S. Bandyopadhyay, Independent Consultant - Urja Nepal, EX - ED, NVVN

Orders, Regulations etc. of GOI

1 Guideline for Import / Export (Cross Border) of Electricity- 2018 issued by Government of India, Ministry of Power December, 2018

2 Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019

3 Procedure for approval and facilitating Import/Export (Cross Border) of Electricity) by the Designated Authority. (CEA) Dated 26.02.2021

These orders and regulations have paved the way for neighboring nations to participate in exchange based trades.

Exchange Based Cross Border Trading

1 Nepal has started participating in Indian Energy Exchange from 18th April' 2021

2 Nepal bought power from April'2021 to July'2021. Initially Nepal was permitted only to buy power.

3 Nepal sold power from 4th November'2021 after Nepal was permitted to sell power also. As per news reports from Nepal, NEA has sold electricity worth Nepali Rupees 139.26 million over a period of a month. This is equivalent to about INR 87 million.

4 Bhutan has started buying power from January'2022

5 Participation by Nepal and Bhutan has been in the Day Ahead Market (DAM) only

USAID FROM THE AMERICAN PEOPLE SARI/EI 20 YEARS Integrated Research and IRADe Action for Development

Summary of power purchased by Nepal.....1

Summary of power bought by Nepal from Indian Energy Exchange
From April'2021 (From 18th April) to 31st July'2021

Month	No of days on which power purchased	Total Power Purchased in the month from Exchange Mus	Equivalent Flow on a RTC Basis MW	Approx. Wt Avg RTC price in Rs/Unit	Approx. Total Cost of Power Purchased Rs Crs
April'2021	13	16.48	53	3.39	5.59
May'2021	28	118.73	177	2.85	33.84
June'2021	26	42.98	69	3.09	13.28
July'2021	30	72.23	100	3.06	22.10
Total	97	250.42		3.01	74.81

USAID FROM THE AMERICAN PEOPLE SARI/EI 20 YEARS Integrated Research and IRADe Action for Development

Exchange Based Cross Border Trading

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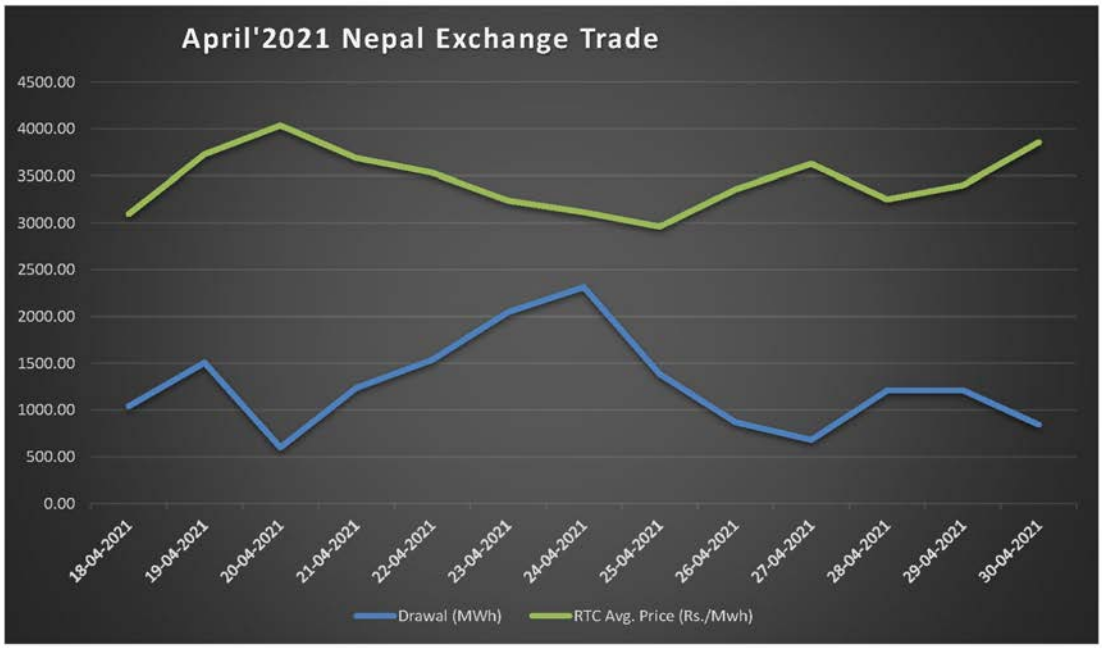
The daily variation of the Average RTC price and purchase volume for Nepal

April'2021



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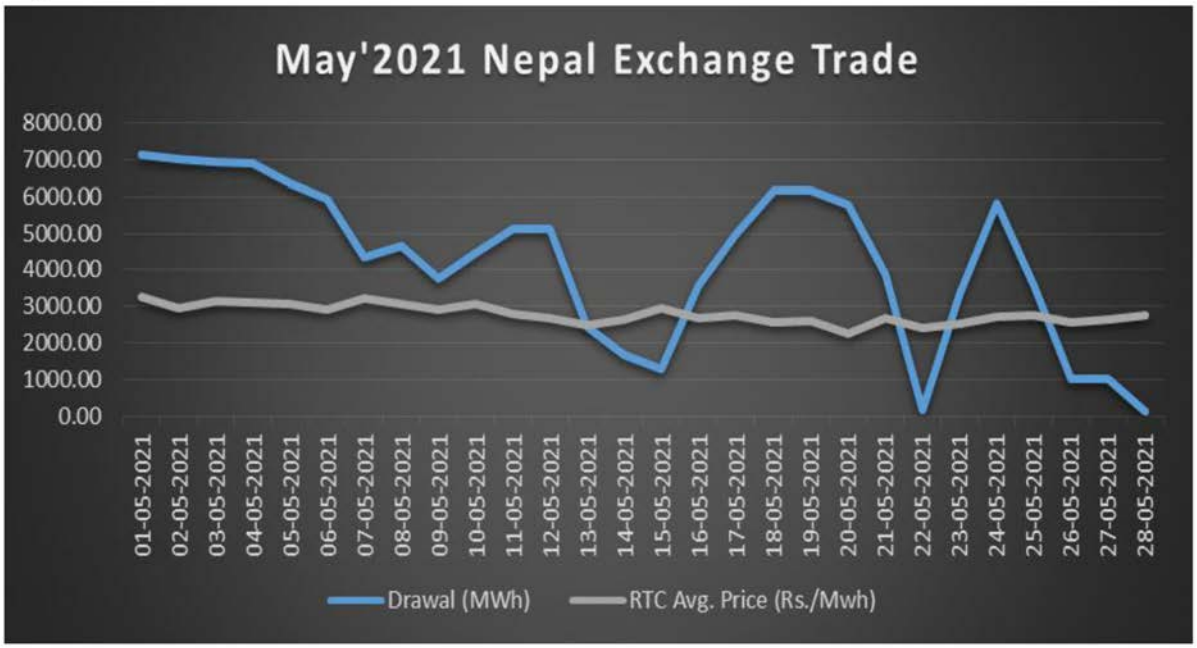
The daily variation of the Average RTC price and purchase volume for Nepal

May'2021



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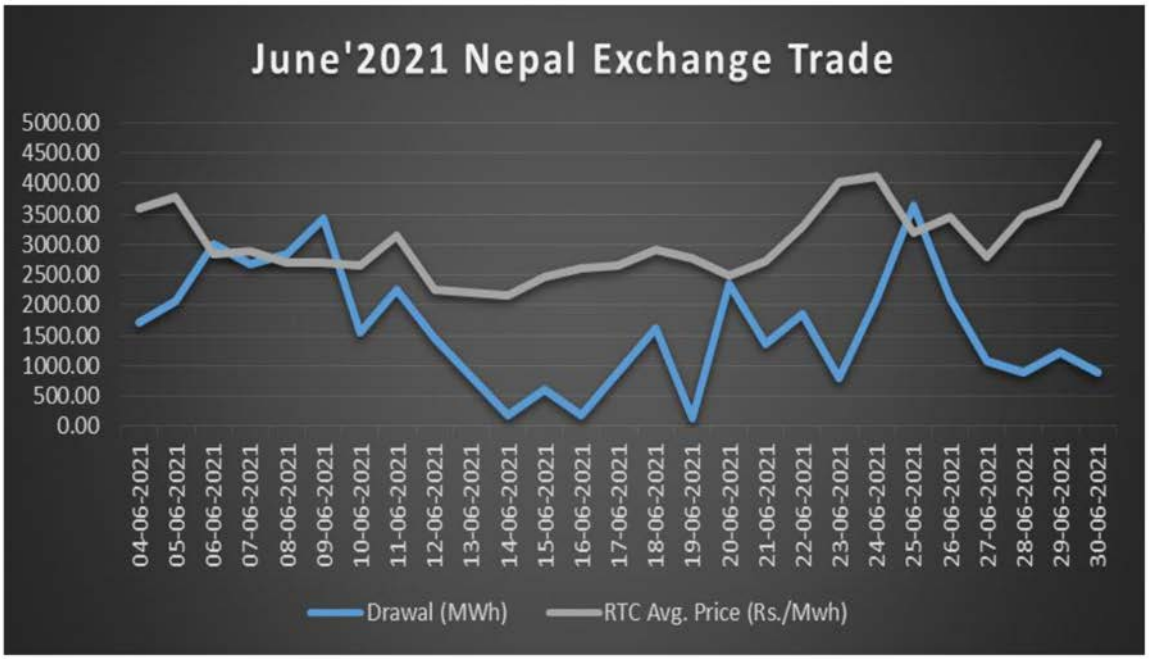
The daily variation of the Average RTC price and purchase volume for Nepal

June'2021



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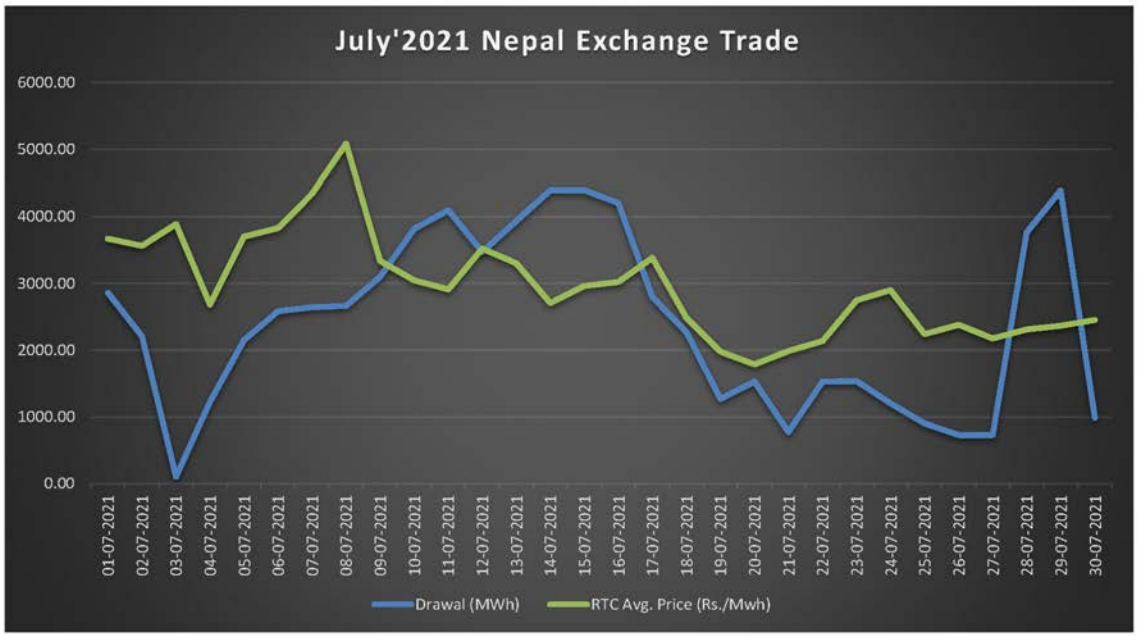
20 YEARS Integrated Research and IRADe Action for Development

The daily variation of the Average RTC price and purchase volume for Nepal

July'2021



Estimated Cross Border Transmission Capacity Available for Exchange Based Trades

1 India – Bangladesh

Total Capacity available for STOA 240 MW from India to Bangladesh In the reverse direction the total capacity available for STOA is 1000 MW

2 India – Bhutan

Total Capacity available for STOA 292 MW from Bhutan to India. In the reverse direction, total capacity available for STOA is 698 MW

3 India – Nepal

Total Capacity available for STOA 401 MW from India to Nepal. In the reverse direction, 415 MW capacity is available as per this report.

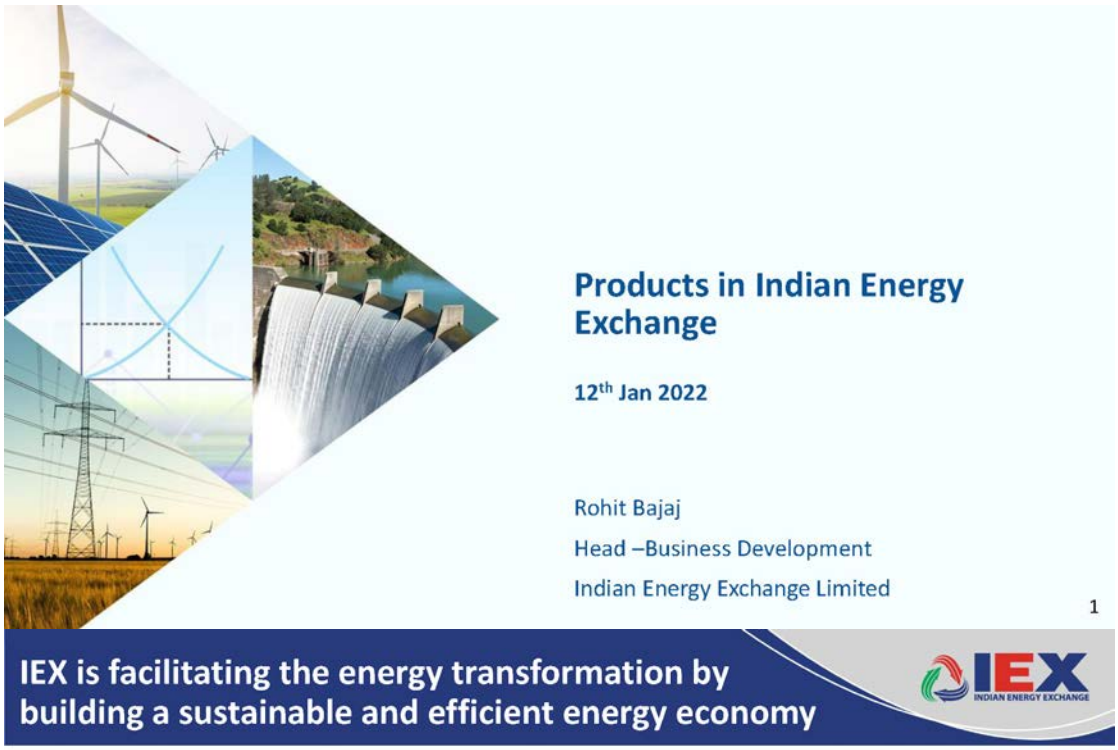
Source of information – POSOCO data for availability of STOA for the month of Oct'2021.

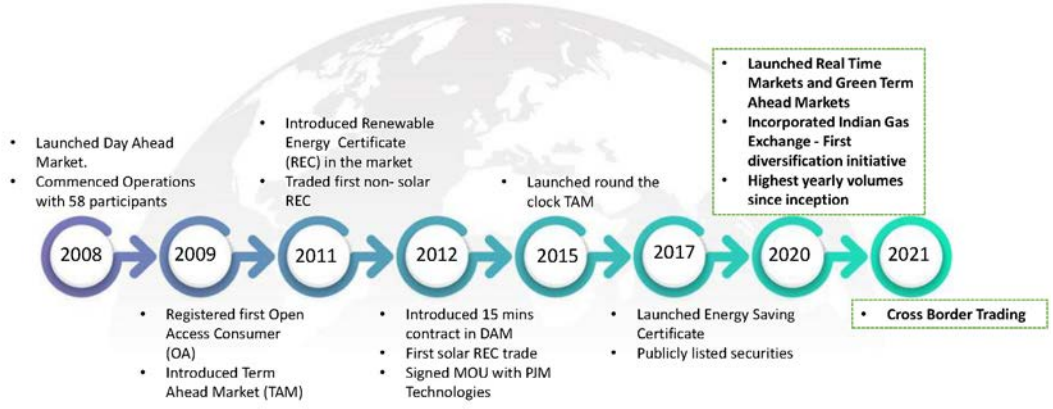
Link - https://posoco.in/market/monthly-atc-inter-country/inter-country-2021-22/

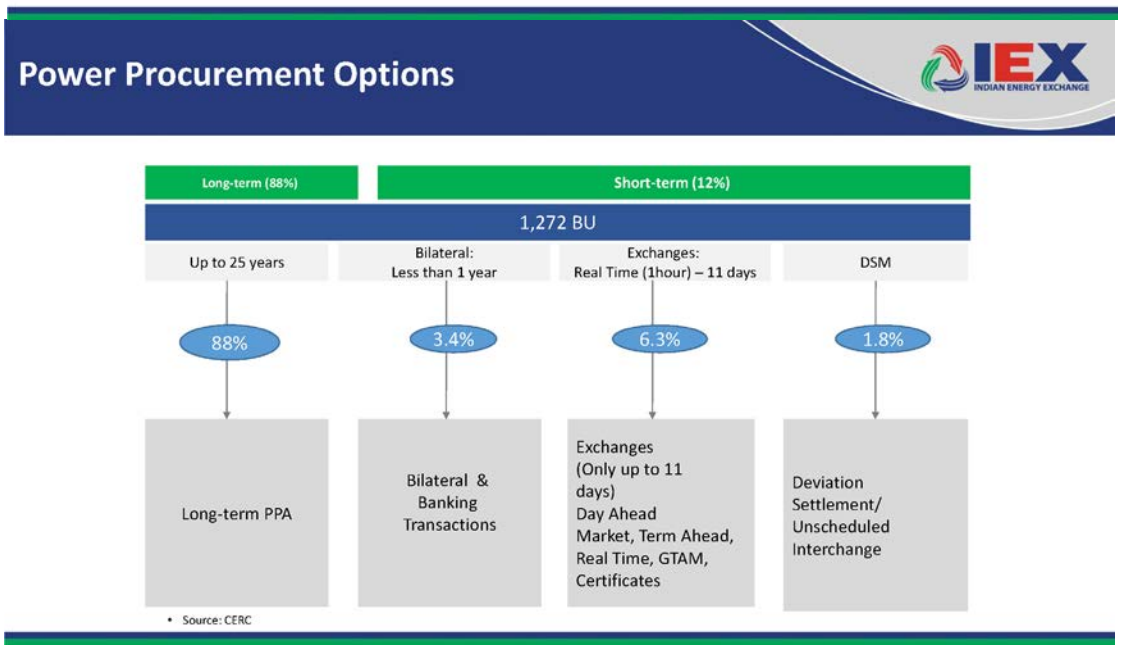
Thank You

Subhajit Kumar Ray
Sr. Consultant, IRADe
Email – skrayraja@gmail.com
Mobile - +91 9971792136

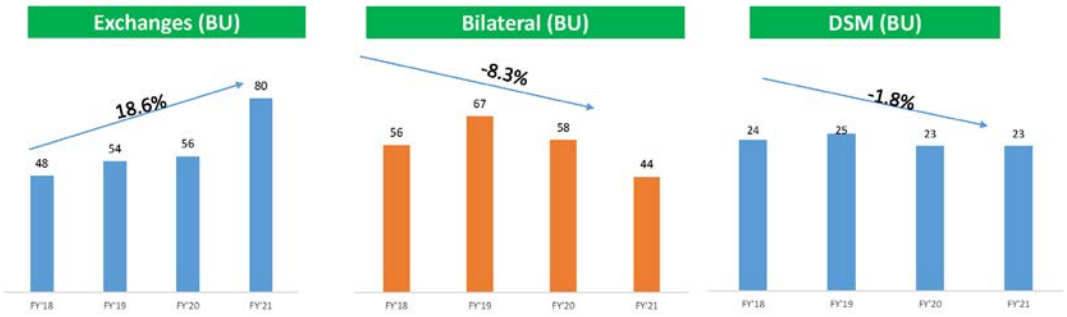
ANNEXURES 5B







Fast growing Exchange Markets



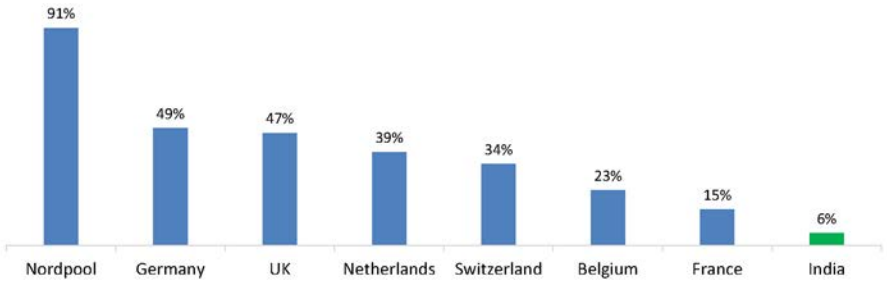
Driven by competition and flexible procurement, the Exchange markets constitute >50% of power market.

- Source: CERC

Data till July 021, CAGR for Last 3 Years

4

Deepening India's Power Markets



Markets are in the range of 30-80% in developed economies.
At 6%, India has an opportunity to deepen the power market.

Source: CRISIL Study

Since its inception in 2008, Power Exchanges have been benefitting the entire power sector

- ✓ Helps **match demand and supply** of energy
- ✓ Provides **benchmark prices** for all electricity transactions
- ✓ **Transparent** Mechanism for Price Discovery
- ✓ High liquidity ensures **lowest prices**
- ✓ **Transparent process** and price discovery
- ✓ **Payment Security**

Generation

Signals for Generating Capacity addition (~35 GW Merchant plants)

Transmission

Investments in transmission-congestion free – One Grid One Price

Non-discriminatory access to transmission grid

Distribution

- **Lower power prices** for consumers.
- **Avoids buying under take-or-pay**
- **Flexibility** on quantum and duration(15-min basis)

Value Proposition

24X7 Power | Transparency | Flexibility in Power Procurement | Competitive Price | Payment Security | Cost Saving

Robust Eco-system

4400+ INDUSTRIES

55+ DISTRIBUTION UTILITIES

500+ GENERATORS

99% MARKET SHARE IN DAM

99% MARKET SHARE IN RTM

32% CAGR SINCE 2008

The Green Market and the Real-time Markets are poised to build India as a sustainable energy economy.

Understanding the Exchange

A Neutral Platform

- Provides the necessary **electronic trading platform** and associated infrastructure to facilitate buying and selling of electricity by the participants.
- The Exchange in **no way influences the price determination process**, which is dependent on the offers and bids placed by the market participants i.e., the sellers and buyers.

Voluntary Participation

- In India, the participation in any of the markets – bilateral or the Power Exchanges is purely voluntary.

Competition and Anonymity is maintained

- Trading on Exchanges is a **non-cooperative game**. Both the sellers and the buyers place bids on the electronic platform **independent of each other** and compete in the market.

Understanding the Exchange

Regulatory Oversight

- In India, Power Exchange is **under the Regulatory oversight of CERC.**

Risk Mitigation

- The exchange **acts as the counterparty in the trade** and absolves the participants of any risk of payment defaults.

Standardized Contracts

- The contracts traded on the Power Exchange are standardized contracts, **terms and conditions of which are well known upfront to all the market players.**

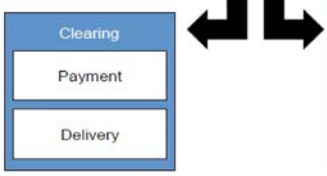
Operates on inherent transmission margins

- Delivery of the trades discovered on the Power Exchanges is facilitated by the System Operator **utilizing the spare margins available on the transmission system**. These **margins are declared and made public upfront transparently on the websites of the System Operator**.

Power Exchange Mechanism

Surveillance Function:
- Performed from a secure 'Surveillance Room' with restricted access
- Surveillance Committee reports to CERC quarterly

C&S Function:
- Separate Clearing & Delivery cells
- Risk Mgmt. Committee reports to CERC half yearly



Surv. Function:
- Results displayed on trading terminals
- Market results, including curves published online
- Monthly report to CERC

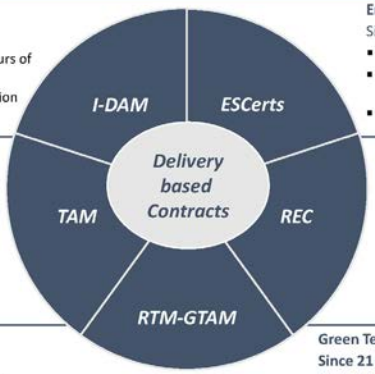
Market Segments

Integrated Day-Ahead Market^
Conventional Since June, 08 GDAM since 26 Oct 21
- Delivery : any/some/all 15- minute time blocks in 24 hours of the next day
- Price and quantum discovery: double-sided closed auction
- Green: Bid category for sellers-NS, SL & Hydro

Term-Ahead Contracts
- **Products & Delivery:**

Since Sep., 09 :
Daily Contracts* -T+2 to T+11
Weekly Contracts# - Next Week
Since Jul., 15 (RTC) :
Intraday * -04:00 to 24:00 hrs same day
Day-Ahead Contingency* - all hrs following day

Real Time Market^
Since 01 Jun'20
- **Bid sessions Half Hourly market; 48 times per day**
- **Delivery: 30 minutes in two time blocks of 15 minutes each**
- **prices and quantum discovery: Double sided closed auction.**



Energy Saving Certificates^
Since Sep., 17
- 1 Escert = 1 Mtoe (Metric Tonne Oil Equivalent)
- **Trading Frequency** : Once a week (every Tuesday)
- **Price Determination :** Double-sided closed auction

Renewable Energy Certificates^
Since Feb., 11
- 1 MWh = 1 Certificate
- attributes of electricity generated from renewable resources
- **Sellers:** RE generators not under feed in tariffs
- **Buyers:** Obligated entities; 1MWh equivalent to 1 REC

Green Term Ahead Market
Since 21 Aug' 20
Products & Delivery :
- **Intraday * -04:00 to 24:00 hrs same day**
- **Day-Ahead Contingency* - 00:00 to 24:00**
- **Daily Contracts* - T+2 to T+11; 10 rolling contracts**
- **Weekly Contracts# - Next Week**

***Note - ** Continuous Trading; # Double side Open Auction; ^ Double Side closed auction*

Features of Day Ahead Market

Closed double-sided anonymous auction for **each 15-min time block** for the following day

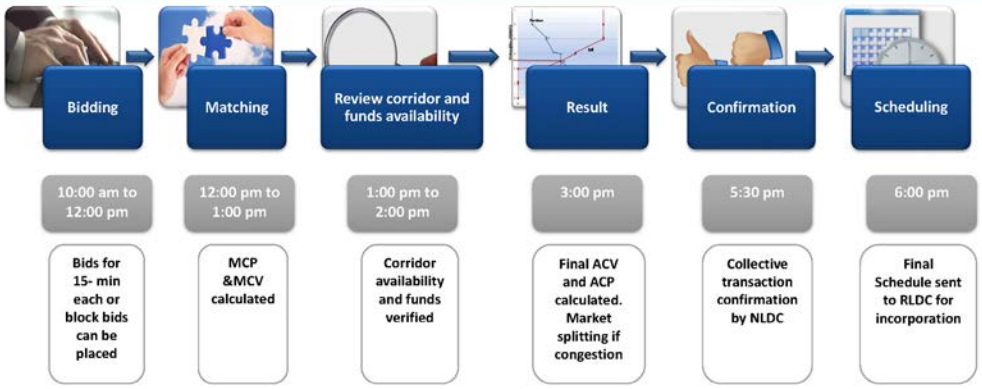
Intersection between the aggregated sale and purchase curves defines the market clearing price (MCP)

13 Bid area defined on PX for Price Discovery

Congestion Management through market splitting and determining Area Clearing Price (ACP) specific to an area

Bid types: Portfolio/Single Orders or Block Orders
Minimum bid=Re.1 for 0.1MWh
Minimum Price & Volume Step = 0.1p * 0.1 MWh

DAM Trading Process



Bid types in Day Ahead Market

Single Bid:

- Bids for each 15 min can be entered
- Varying price and quantum pairs
- Allow partial execution

Block Bid:

- Block Bid for any 15 min
- Mother or child bid
- No circular links
- No partial execution

Profile Block Bids: (DAM)

- flexibility for Renewable generators to model their bidding pattern and also help the Discoms for their demand side management.

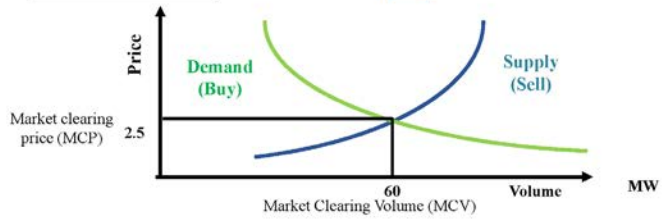
Minimum Quantity Block Bids: (DAM)

- facility would be provided to define minimum quantity. Balance Quantity will be placed in multiple block bids as a sub-set of the entire bid

14

Model Price Calculation Algorithm

Price Tick (Rs.)		0	1	1.1	2	2.1	2.5	3	3.1	4	4.1	5	---	---	----	20
Bid Quantum by different portfolios	Portfolio A, MW	20	20	20	20	20	20	20	10	0	0	0	0	0	0	0
	Portfolio B, MW	60	60	60	60	50	40	40	40	40	40	20	20	20	20	20
	Portfolio C, MW	40	20	0	0	-40	-60	-80	-81	-120	-120	-120	-120	-120	-120	-120
Total Buy Quantum received, MW		120	100	80	80	70	60	60	50	40	40	20	20	20	20	20
Total Sell Quantum received, MW		0	0	0	0	-40	-60	-80	-81	-120	-120	-120	-120	-120	-120	-120
Net Transaction, MW		120	100	80	80	20	0	-20	-21	-80	-100	-100	-100	-100	-100	-100



Single Bid Concept

Time Block	Bid Volume (MW)	Buy Bid Price	Clearing Price	Result
1	100	Rs 4	Rs 1	
2	100	Rs 4	Rs 5	
3	100	Rs 4	Rs 3	
4	100	Rs 4	Rs 5	
Average		Rs 4	Rs 3.5	

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Block Bid Concept

Time Block	Bid Volume (MW)	Buy Bid Price	Clearing Price	Result
1	100	Rs 4	Rs 1	
2			Rs 5	
3			Rs 3	
4			Rs 5	
Average		Rs 4	Rs 3.5	

17

TAM Market Segments

Weekly
Trade power for an entire week
Open Auction

Daily
Trade power for an entire day
Continuous

TAM / GTAM

DA Contingency
Trade power for an entire day ahead on hourly/block basis,1day
Continuous

Intraday
Trade power for same day on hourly/block basis
Continuous

Bid Matching in TAM/GTAM

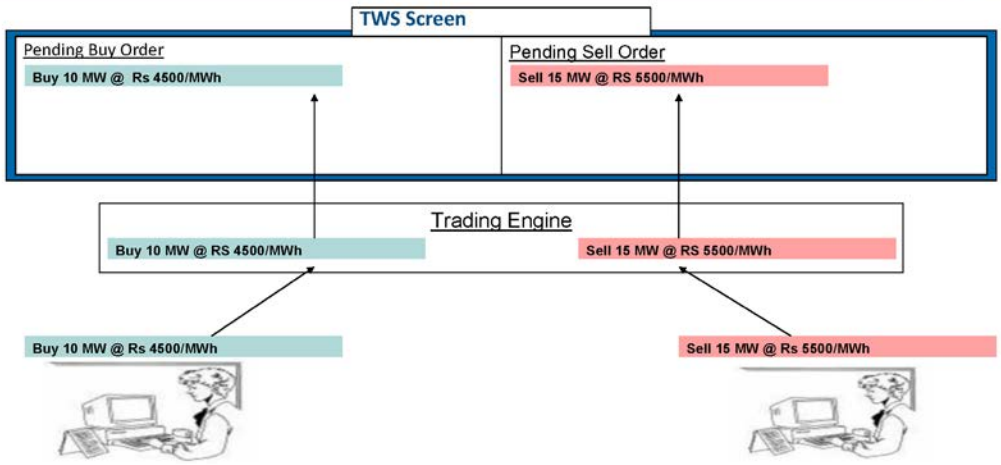
Auction

- Orders accumulated during order accumulation phase (no matching)
- Orders matched after closure of order accumulation period
- Orders are used for calculation common price i.e. Equilibrium Price.
- All successful orders matched at Equilibrium Price.

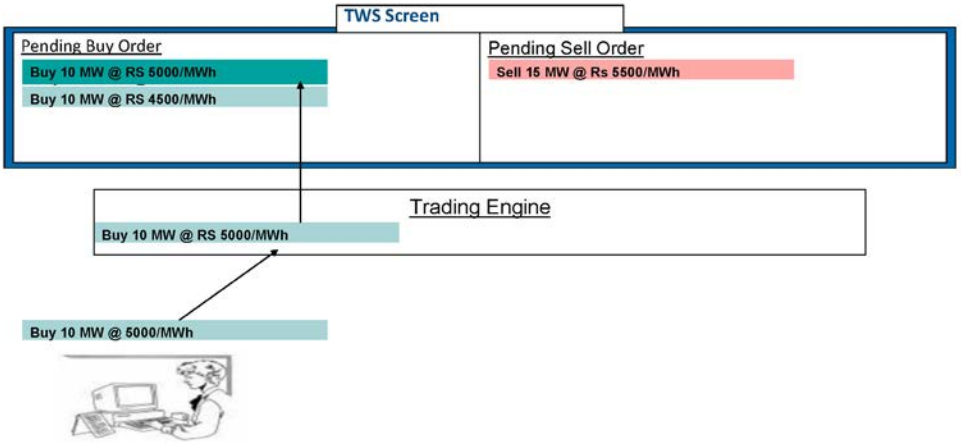
Continuous

- Price-time priority based continuous matching
- The highest Buy order & lowest Sell order gets the priority
- If the prices are same then priority is given to the time of the order

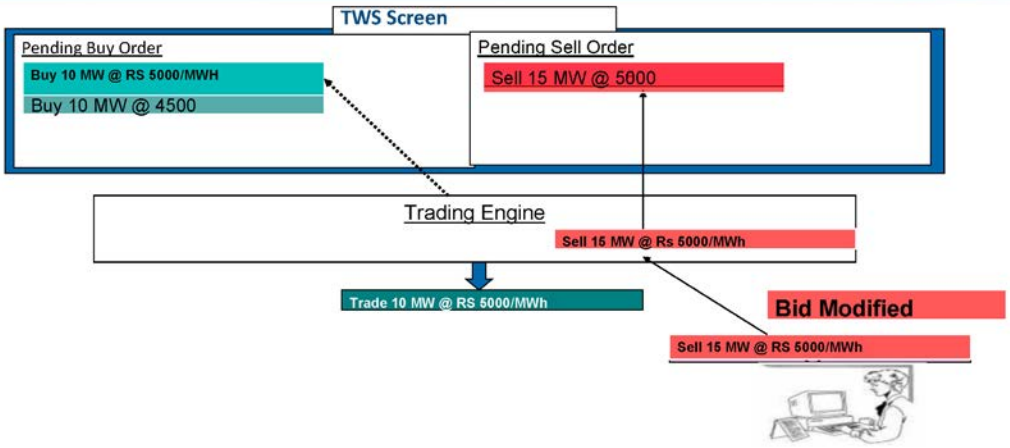
Continuous Matching – Order Entered



Continuous Matching – Order Priority



Continuous Matching – Modify / Trade Matching



Risk Management in DAM/TAM

	Proprietary/Trading Licensee Members		Professional Members	
	Initial Margin	Basis/Additional Margin	Initial Margin	Basis/Additional Margin
Day-Ahead Market	Margin equal to Last 7 Days Average of Buy turnover		As per Bank Balance including Hair Cut Factor	
TAM-Intraday	105% of order	-	105% of order Value	-
TAM-DAC	105% of order Value	-	105% of order Value	-
TAM-Daily	5% of order Value	50% of Trade Value	5% of order Value	50% of Trade Value
TAM-Weekly	5% of order Value	50% of Trade Value	5% of order Value	50% of Trade Value
REC	100% of order Value	-	100% of order Value	-
Member Client RMS	Credit facility can be provided by Trader Member to their clients		No credit or funding facility by Professional Members to their clients	

Building a sustainable energy economy

Real Time Markets

48 auction sessions in a day recurring every 30 mins

- Efficient power demand management at 1-hour notice
- Optimum utilization of generation capacity
- Competitive and transparent power prices
- Renewable energy integration
- Ensuring grid safety and security

Green Markets

Intra-Day, Day Ahead Contingency, Daily and Weekly contracts

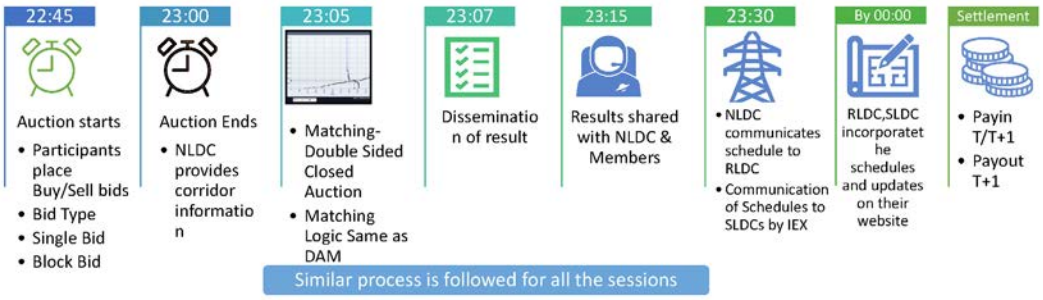
- Market segment for trading in renewable energy
- Facilitating accomplishment of national renewable energy capacity addition and effective integration of green energy in the country
- Price discovery on a continuous basis i.e. price time priority basis.
- Energy scheduled through G-TAM considered as deemed RPO compliance of the buyer

New market segments have put India's power markets at par with global energy markets

26

RTM Trading Process

RTM Session For Delivery Period 00:00-00:30



Similar process is followed for all the sessions

Green Day Ahead Market(G-DAM)- Features

- Bid categories for Sellers – Solar, Non-Solar and Hydro
- Bid categories for Buyers – Renewable Purchase
- There will be separate quantity limit for sellers in each category i.e. Solar, Non-Solar and Hydro as per NOC provided to exchange by participants.
- Participants will have option to choose "Order Carry forward (OCF)" option at the time of placing bid to carry forward remaining bid quantum to DAM.
- OCF bids will be followed by either Premium or Discount for the purpose of altering bid price for carry forward orders to DAM market.
- Only Single / Block Bid types will be available for GDAM market

26

Green Term Ahead Market (GTAM)

Value Proposition

Buyers
- Competitive prices
- Flexible and transparent procurement
- No long-term rigid commitments
- Integrated Energy + RPO fulfilment

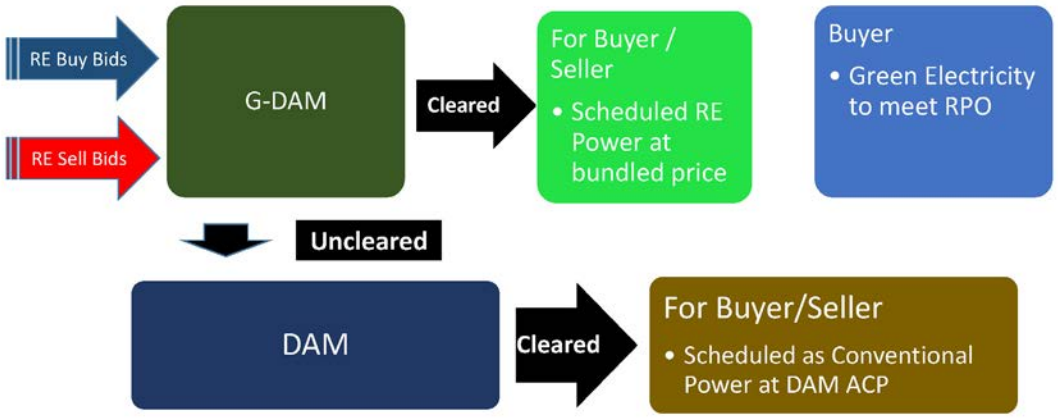
Sellers
- Payment guarantee
- Dispatch certainty
- Additional avenue to sell besides rigid long-term agreements
- Creation of merchant RE capacity
- Pan India market access
- RTM for imbalance settlement
- Portfolio sale by RE rich DISCOMs

Efficient and seamless integration of RE

Key contract specifications

- **National Level Contract**
- **Four types of contracts** segregated into both **solar and non-solar segments** (*Upcoming segment-Hydro)*
  - ✓ **Intraday** -04:00 to 24:00 hrs same day
  - ✓ **Day-Ahead Contingency** - 00:00 to 24:00
  - ✓ **Daily Contracts** - T+2 to T+11; 10 rolling
  - ✓ **Weekly Contracts** - Next Week
- **Matching mechanism**
  - ✓ Continuous trading for Intraday, DAC and Daily
  - ✓ Double-sided open auction for Weekly

G-DAM Scheduling



28

DAM: Price trends

FY-19 : 3.88 | FY-20 : 3.01 | FY-21 : Rs 2.73 l | FY-22 : 4.11 H2(Oct-Mar) FY-19 : 3.67 | FY-20 : 2.78 | FY-21 : Rs 2.97

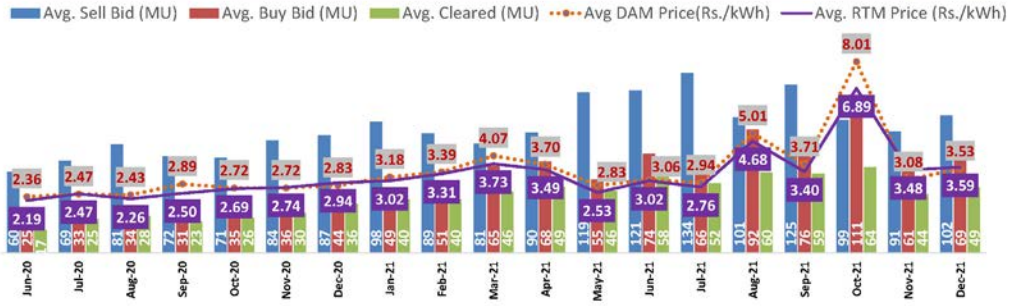
- Monthly average DAM price crossed Rs 3.5/kWh after the gap of 3 years.
- Lower prices in last 3 years helped DISCOMs reduce their power procurement cost

Till 31st Dec'21

DAM: Volume & Price Trends

Till 31st Dec'21

Real Time Market (RTM)- Volume & Price Trends

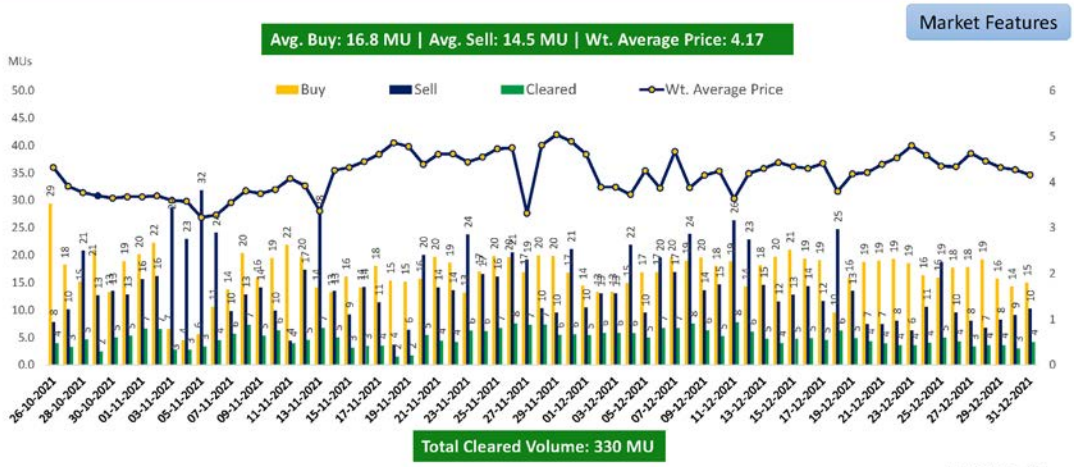


- RTM volume increased from 17 MU/day in Jun'20 to ~49 MU/day in Dec'21.
- RTM witnessed highest avg daily demand in Jul' 21 : 134 MU
- Highest Daily Cleared Volume : 98 MUs on 28th Aug'21
- RTM helped utilities to efficiently manage their demand variations

Till 31st Dec'21

Journey So far : GDAM Market Snapshot

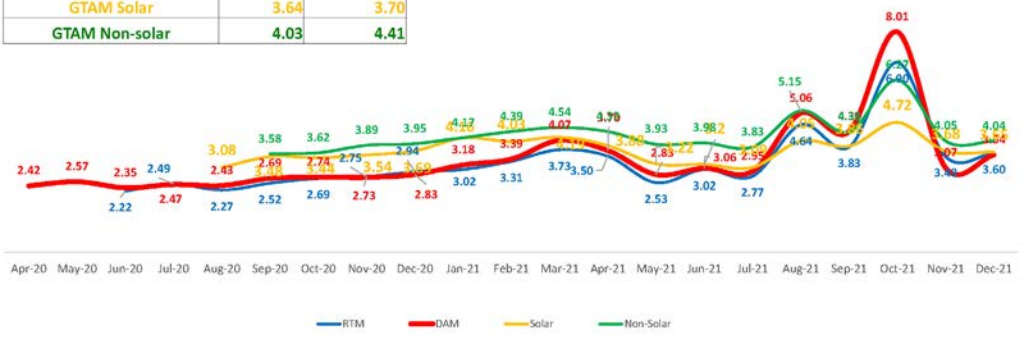
Market Features



Till 31st Dec'21

Synchronised Markets
DAM – RTM – GTAM Price Trends

Average Price (Rs/kWh)	FY 21	FY 22
DAM	2.82	4.07
RTM	2.79	3.81
GTAM Solar	3.64	3.70
GTAM Non-solar	4.03	4.41



Till 31st Dec'21

Providing significant savings to DISCOMs

In April, the first full month of the lockdown, national power demand crashed by 25% year-on-year. Photo: Indranil Bhoumik/Mint

"Andhra Pradesh saves Rs 2,350 crore in power purchases in 2 years" –Times of India – May 24, 2021

Andhra Pradesh has saved around Rs 2,350 crore by purchasing electricity in spot markets at cost effective prices in the last two years, i.e., 2019–20 and 2020–21

The power utilities procured 3,393 million units in 2019-2020 and 8,890 MU in 2020-21 from the open market at cheaper prices 34

"Maharashtra discoms turn to energy exchanges, shun costly PPAs" – PTI – April 12, 2020

"We are increasingly buying power from exchanges, which is cheaper than PPA tariffs," an official from state utility Mahavitaran

Key Developments on CBET during 2012-21

2012-13
India Bangladesh 500 MW HVDC link commissioned

2013-14
India Nepal Power Trade Agreement Signed

2014-15
SAARC framework agreement on energy (electricity) cooperation signed

2017-18
Government of India issued guidelines for import/Export of Electricity

2019
CERC issued the Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019

2021
Procedure for approval and facilitating Import/Export (Cross Border) of Electricity) by the Designated Authority.

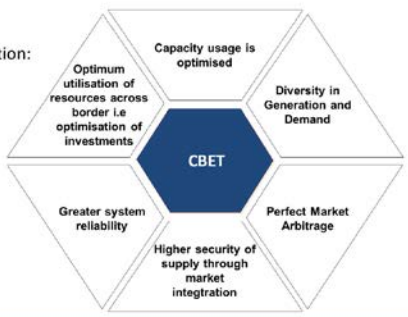
India, being centrally placed in South Asian region and sharing political boundaries with SAARC countries, namely, Nepal, Bhutan, Bangladesh, Sri Lanka, and Pakistan, is playing a major role in facilitating planning of interconnections with these countries for effective utilization of regional resources. India has developed expertise in implementation of HVDC and UHVAC projects and it will be a privilege to connect all the neighbouring countries electrically through HVDC/UHVAC transmission lines.

Cross Border Electricity Trade

GoI had already issued guidelines for Cross Border transactions including those through Indian power exchange in 2018 and CERC had issued regulations. Further, with recent issuance of procedures by CEA for getting approval to trade through Exchange, regulatory framework is now set for trade through exchange.

- Nepal started purchase/Sale of power through Exchange since Apr'21 onwards.
- Bhutan started purchase of power through Exchange since Jan'22

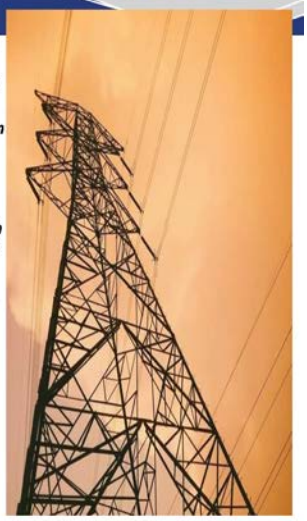
Value Proposition:



IEX starts cross-border electricity trade for integrated South Asian market

This follows notification of cross-border trade electricity (CBET) regulations by the Central Electricity Regulatory Commission (CERC) in 2019 and the recent notification of CBET rules in March-

Economics Times April 19 2021



Cross Border Trade: Enabling Policy and Regulatory Framework

GOI guidelines for import/ export (cross border) of electricity- 2018

- **Section 3.1-**The import/ export of electricity between India and the neighbouring country(ies) through mutual agreements
  - Through bilateral agreement between two countries
  - Through bidding route; or
  - Through mutual agreements between entities
- **Section 5.3-** Any Indian power trader may, after obtaining approval from the Designated Authority, trade in Indian Power Exchanges on behalf of any Entity of neighbouring country

CERC issued the Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019

- **Section 3(2)-**Cross border trade of electricity between India and the neighbouring country(ies) shall be allowed through mutual agreements between Indian entity(ies) and entity(ies) of the neighbouring country(ies)
- Any electricity trading licensee of India may,after obtaining approval from the Designated Authority, trade in the Indian Power Exchanges on behalf of any Participating Entity of neighbouring country.
- **Section 6-**Trade Through Indian Power Exchanges

Procedure for approval and facilitating Import/Export (Cross Border) of Electricity) by the Designated Authority-Feb 2021

- **Section 8-**Transaction of electricity through Indian Grid under tripartite agreement
- **Section 6.5-**Eligibility of Applicant for Trading in Indian Power Exchange(s)
- **Section 6.6-** Process for grant of approval
- **Annexure III**-Application format trading in Indian Power Exchange.
- **Annexure V-**Application format for approval of Designated Authority for transaction of electricity through Indian Grid under tripartite agreement

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Procedure for Facilitating Cross Border Trade on IEX

Objective: To facilitate grant of approval to eligible entities to participate in Import/Export (Cross Border) of Electricity, approval of transmission links with the neighbouring country and approval to Generating company to supply to neighboring country through dedicated transmission line.

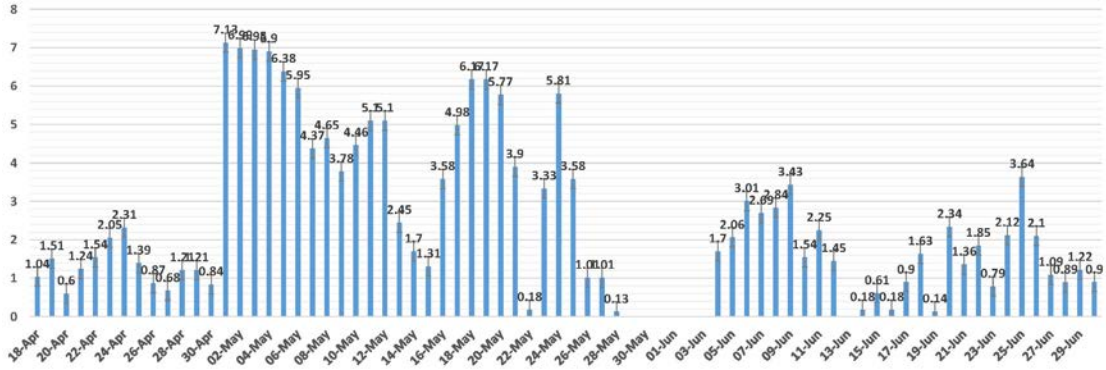
Application filling stage	The Applicant shall submit the application to the Nodal Officer in the format enclosed as Annex-III.
	Applicant (under 6.5(iii)) should furnish PPA/LoI
	Also have consent of respective government of the neighbouring country
Examination Stage	Application will be examined from technical, strategic, national and economic point of view
	Designated Authority will obtain concurrence from Govt. of India
	The Designated Authority may seek the comments from RPCs, CTU,POSOCO etc.
Approval	The approval or otherwise of DA shall be communicated to the applicant within 15 days from final communication received from GoI.

Start Buying from IEX or Sell surpluses to IEX

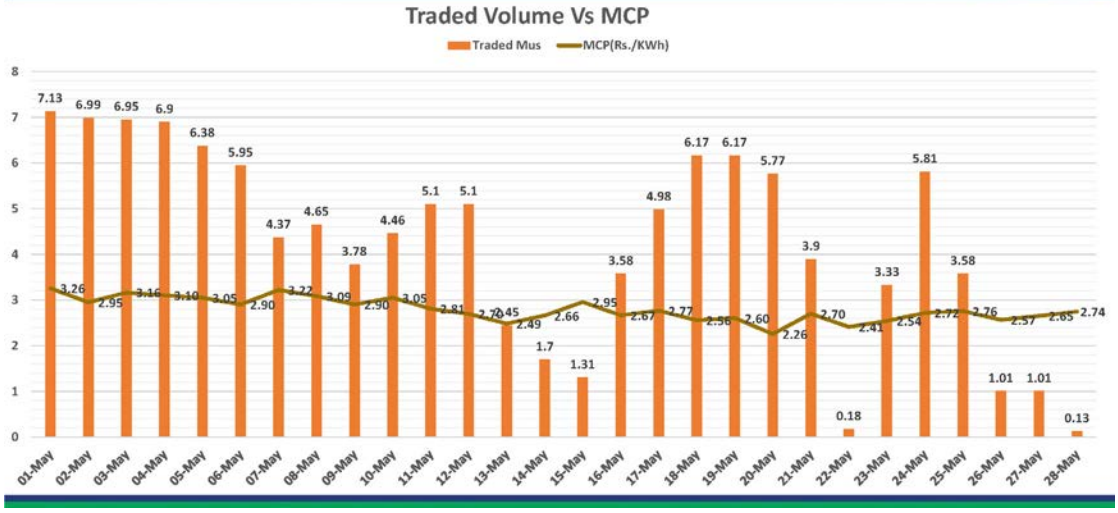
Journey So far-Nepal Case Study

Nepal has started purchasing power through Indian Energy Exchange upto 350MW and taking advantage of competitive price and flexibility in power procurement.

Drawal (MUs)

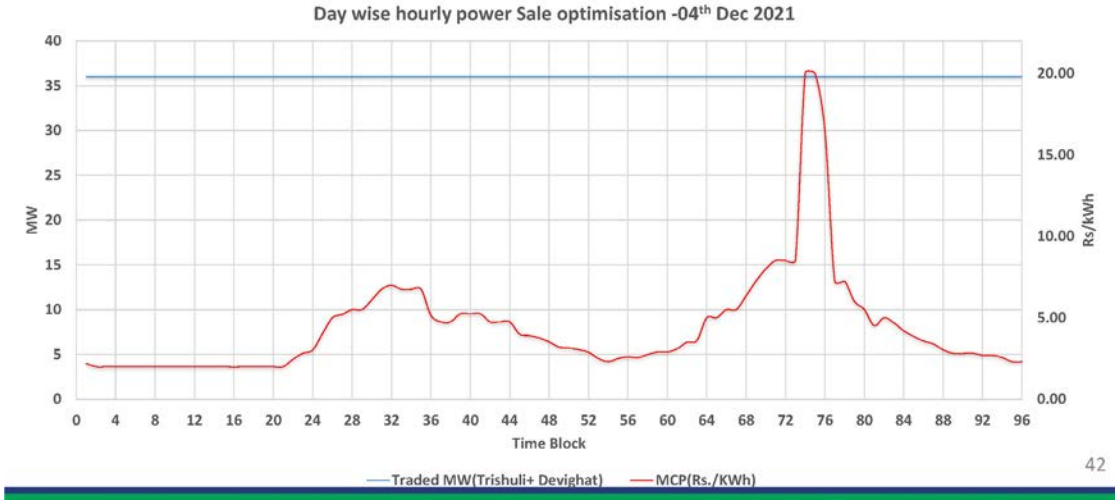


Day wise power purchase optimisation-May'21



Demand Side Optimisation –Meeting the variability through Power Exchange

Power Sale Optimisation



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Power Market's Upcoming Products

Longer Duration Contract

- SEBI and CERC have reached an agreement over the regulatory jurisdiction of electricity derivatives,
- it will allow the introduction of long duration physical deliverable contracts on the power exchanges.
- Product launch expected by EOY
- Exchanges will introduce contracts above 11 days and Discom's shall be able to tie up power for upto 1 yr, at the most competitive prices.

Electricity Derivative

- GOI issued order for allowing electricity to be traded as other commodities.
- Long positions on electricity contracts can be hedged very soon.

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Proposed LDC contracts

Contracts TAM/GTAM	Existing Delivery Period	Proposed Delivery Period	Matching
Daily Contract	T+2 to T+9	T+2 Onwards for number of days prescribed by Exchange	Open uniform price auction/ continuous – As specified by the Exchange
Weekly Contracts	Upto T+11 for Monday to Sunday	Monday to Sunday (Weeks), Monday to Friday (Week-days) and Saturday to Sunday (Weekends) for number of weeks prescribed by Exchange.	
Fortnightly Contracts	N.A.	Block of 15 Days starting from 1st or 16th of a Month	
Monthly Contract	N.A.	Monthly contracts for calendar Months or combination thereof. E.g. Monthly, Quarterly, Half Yearly, Yearly etc.	
Any Day Contract	N.A.	User defined Day(s) and duration (time-blocks).	
Any-Day(s) Single Sided Contracts	N.A.	User defined Day(s) and duration (Hours/time-blocks).	Forward Auction/ Reverse Auction

Thank you

@IndianEnergyExchangeLtdIEX @IEX_India_ @indian-energy-exchange-limited

Phone: 0120 4648100

Email: contact@iexindia.com

Website: www.iexindia.com

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ANNEXURES 5C

INDIA

Guidelines for Import/Export (Cross Border) of Electricity-2018 and DA Procedure

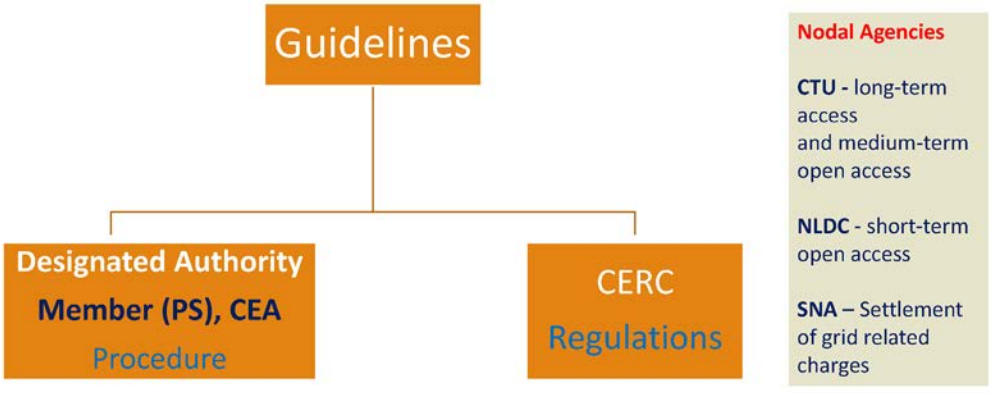
IMPORT / EXPORT – PROVISIONS AND PROCEDURE

12 JANUARY 2022

Objective and Provisions of Guidelines

- **OBJECTIVE**
  - Facilitate import/ export of electricity between India and neighbouring countries;
  - Evolve a dynamic and robust electricity infrastructure for import/ export of electricity;
  - Promote transparency, consistency and predictability in regulatory mechanism pertaining to import/ export of electricity in the country;
  - Reliable grid operation and transmission of electricity for import/ export.
- **INSTITUTIONAL FRAMEWORK**
- **ELIGIBILITY AND TERMS & CONDITIONS FOR PARTICIPATION**
- **FACTORS TO BE CONSIDERED BY THE DESIGNATED AUTHORITY FOR GRANTING APPROVAL**
- **TARIFF**
- **TRANSMISSION SYSTEM, SCHEDULING & ACCOUNTING**

Institutional Framework



Procedure of Designated Authority

- **Cross border transmission links**
  Planning of cross-border link
  Implementation, Monitoring & Coordination of Cross Border Transmission Link
  Commissioning of Cross Border Transmission Link
- **Grid security, safety and coordination between the cross-border grid operators**
  Operating Philosophy, System Security Aspects, Protection Coordination, Manpower Requirements, Operational Liaison, Operating Instructions, Reactive Power Compensation, Outage Planning, Recovery Procedures, Event Information, Assessment of ATC in cross border interconnections, Assistance in Emergency, Record of transmitted energy, Settlement of grid operation related charges
- **Approvals**
  to participating Entity(ies) proposing to Import/Export (Cross Border) of Electricity
  for building dedicated transmission line for connecting to the transmission system of neighbouring country
  For transaction of electricity through Indian Grid under tripartite agreement
- **Office of the Designated Authority, Language for communication etc**

Bilateral Trade - Import by Indian Entity

- Overall Bilateral Agreement - Govt. to Govt.
- G-2-G trade (No DA approval) - GoI may designate an Entity for import,
- Others – Indian entity to apply for approval of DA (format)
  - Agreement between Indian Entity and Entity of neighbouring Country
  - Quantum, Period, injection/drawl points
  - PPA/LoI with generator
  - Generator to have permission from respective Govt.
  - Generator details, shareholding pattern
  - Affidavits/undertakings
  - Application to be submitted well in advance.

Bilateral Trade - Export by Indian Entity

- Overall Bilateral Agreement - Govt. to Govt.
- G-2-G trade (No DA approval) - GoI may designate an Entity for export,
- Others – Indian entity (gen/Discom)to apply for approval of DA (format)
  - Agreement (PPA/LoI) between Indian Entity and Entity of neighbouring Country
  - Quantum, Period, injection/drawl points
  - Generator to qualify Eligibility Criteria (imported coal /spot eauction coal / coal from commercial mining, imported gas, renewable energy or hydropower)
  - Affidavits/undertakings
  - Application to be submitted well in advance.

India – Bangladesh Electricity Trade

- Behrampur – Bheramara link
  - NTPC generating stations – 250 MW
  - DVC (NVVN) – 300 MW
  - Meenakshi Energy (PTC) – 200 MW
  - Sembcorp Energy India Limited – 250 MW
- Import from Indian State grids
  - Tripura (through NVVN) – 160 MW

Trading in Indian Power Exchanges

- Overall Bilateral Agreement - Govt. to Govt.
- Entity of neighbouring country through Indian Trading Licensee
- Agreement between Indian Trading Licensee and Entity of neighbouring Country
- ENC to have permission from respective Govt.
- Indian entity to apply for approval of DA (format)
- Allowed Segments: DAM /TAM
- Quantum, Period (max one year), injection/drawl points
- Generator details, shareholding pattern
- For TAM – India Generator to qualify the Eligibility Criteria.
- Affidavits/undertakings
- Application shall be submitted well in advance.

Trading in Indian Power Exchanges

- NVVN (Indian Trading Licensee) has been accorded approval to buy power for Nepal through PX-DAM (transaction started 18.04.2021)
- Approval for sale of power from Nepal generators (Trisuli (24MW) and Devighat (15MW)) to PX-DAM through NVVN
- Approval to PTC for buy power from PX-DAM for Bhutan (01.01.2022)

Transaction of electricity through Indian Grid

- Overall Bilateral Agreement - Govt. to Govt.
- Tripartite Agreement (PPA/ PSA) – Indian Trading Licensee, Entity of selling country, Entity of Buying country
- Indian entity to apply for approval of DA (format)
- Quantum, Period, injection/drawl points
- Generator details, shareholding pattern
- Affidavits/undertakings
- Application shall be submitted well in advance.

ANNEXURES 5D

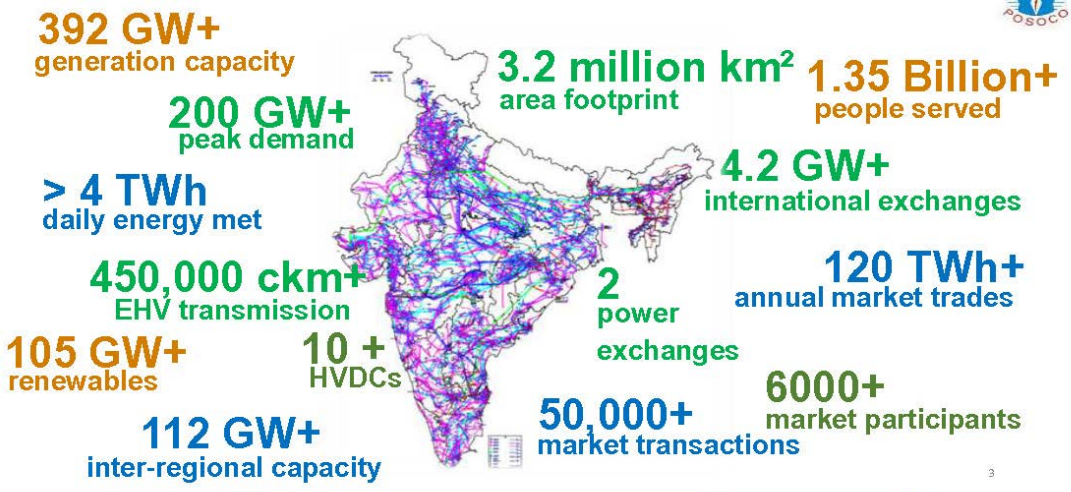
Role of the System Operator in Power Exchange based trading in India and Anticipated Role of South Asian Grid Operator

Power System Operation Corporation Limited

National Load Despatch Center

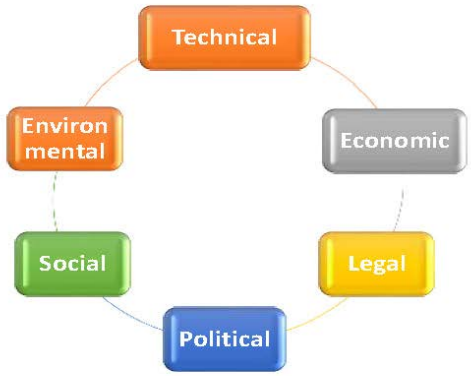
CONTENTS

Indian National Grid- Dimension



Benefits & Associated Issues of International Interconnections

United Nations Report on Multi-Dimensional Issues in International Electric Power Grid Interconnections, 2006 https://sustainabledevelopment.un.org/content/documents/interconnections.pdf



Present Cross border Transactions between India and neighbors

India – Bhutan
- **Chukha HEP (336 MW), Kurichu HEP (60 MW), Tala HEP (1020 MW) and Mangdechu HEP (720 MW)** have long term contracts
- **Dagachhu HEP (126 MW)** participates in short term market
- **400 kV, 220 kV and 132 kV** interconnections

India – Bangladesh
- Transactions
  - **Long Term**
  - **Medium Term**
  - **Short Term**
- **1000 MW HVDC** and **400 kV** (charged at 132 kV) interconnection
- **210 MW** from 13 Nos. of NTPC stations (Ex-Bus)
- **300 MW** power from DVC
- **160 MW** from Tripura
- **250 MW** from Sembcorp Energy

India – Nepal
- Transactions
  - **Long Term**
  - **Short Term**
- 400 kV, 132 kV, 33 kV & 11 kV interconnections
- Upto **350 MW** export through Muzaffarpur-Dhalkebar link
- Upto **40 MW** export through 132 kV Tanakpur-Mahendranagar link

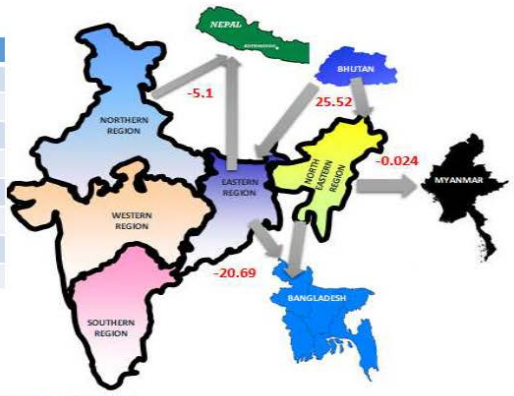
India – Myanmar
- Transactions
  - **Short Term**
- 11 kV interconnection

Transnational Energy Exchange

Daily Average Energy Transaction in MU (2020-21)

Year	Bhutan	Nepal	Bangladesh	Myanmar
2013-14	5555	-702	-1448	-
2014-15	5109	-997	-3272	-
2015-16	5557	-1470	-3654	-
2016-17	5864	-2021	-4420	-3
2017-18	5611	-2389	-4809	-5
2018-19	4657	-2799	-5690	-7
2019-20	6311	-2373	-6988	-9
2020-21	9318	-1865	-7552	-9

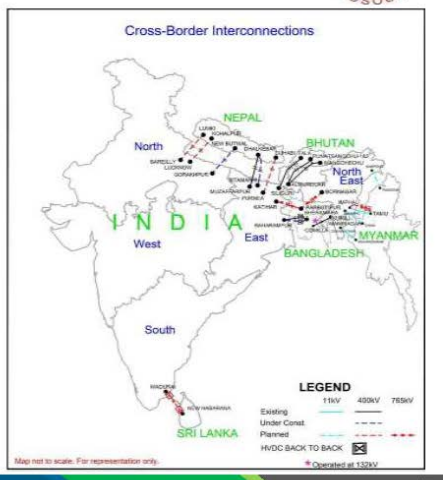
All figures in MU. Sign convention: Import +ve; Export -ve



All figures are in MU
Map not for Scale. For representation only Sign convention: Import +ve; Export -ve

Upcoming Cross-Border interconnection

- India shares its boundaries with many South Asian countries and is currently connected to Nepal, Bhutan, Bangladesh and Myanmar at different voltage levels. Few additional AC and DC links in near future are also under discussion or implementation phase to facilitate cross border exchange.



Under Implementation:

- 765 kV D/c Katihar (Bihar) - Parbotipur (Bangladesh) - Bornagar (Assam) line - Construction & Finance by India, Bangladesh may syncronise at appropriate time if required
- 400 kV Sitamarhi (India) – Dhalkebar (Nepal) D/c line - Expected by 2023
- Development of Indian portion of 400 kV Gorakhpur-Butwal (Nepal) Line (120km.) in 50:50 JV with NEA
  - NEA applied for Foreign Direct Investment (FDI) approval

Proposed Projects:

- Cross border interconnections with Sri Lanka & Myanmar
  - "Madurai (New), India – New Habarana, Sri Lanka ±320kV VSC HVDC Bipole (Phase-1: 500MW)" link.
  - Imphal-Tamu high capacity cross border link (including HVDC back-to-back)

Recent Policy and Regulatory Interventions (1)

Ministry of Power, Government of India Guidelines for Import / Export (Cross Border) of Electricity, 2018

- **Objectives**
  - Facilitate import/ export of electricity between India and neighbouring countries;
  - Evolve a dynamic and robust electricity infrastructure for import/ export of electricity;
  - Promote transparency, consistency and predictability in regulatory mechanism pertaining to import/ export of electricity in the country;
  - Reliable grid operation and transmission of electricity for import/ export.

- **Provisions**
  - Agreements For Trade
  - Institutional Framework
  - Eligibility and Other Terms & Conditions For Participation
  - Factors to be considered by the Designated Authority For Granting Approval
  - Tariff
  - Transmission System, Scheduling & Accounting
  - Dispute Resolution

Recent Policy and Regulatory Interventions (2)

Central Electricity Authority (CEA) - Procedure for Approval and Facilitating Import/Export (Cross Border) of Electricity by the Designated Authority – Feb'21

- **Objectives**
  - To facilitate grant of approval to eligible entities to participate in Import/Export (Cross Border) of Electricity.
  - To facilitate coordination with nodal agencies/authority of neighboring countries (ANC) for transmission system planning, joint system studies, surveys, preparation of feasibility study reports, system development, construction, erection, monitoring, testing, commissioning, operation and maintenance of transmission system for Import/Export (Cross Border) of Electricity in transparent manner, etc.
  - To lay down procedure for safety, security and coordinated operation of the interconnected national grids.
  - To lay down procedure for grant of approval to an Indian generating station, supplying electricity exclusively to neighbouring country for building a dedicated transmission line for connecting to the transmission system of neighbouring country

- **Provisions**
  - Development of cross border transmission links
  - Grid security, safety and coordination between the cross-border grid operators
  - Approval to participate in Import/Export (Cross Border) of Electricity
  - Approval for building dedicated transmission line for connecting to the transmission system of neighbouring country
  - Transaction of electricity through Indian Grid under tripartite agreement
  - Office of the Designated Authority
  - Language for communication
  - Indemnification

Recent Policy and Regulatory Interventions (3)

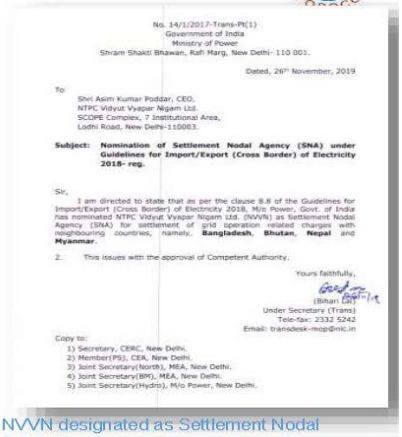
CERC (Cross Border Trade of Electricity) Regulations, 2019

- Institutional Framework
- Tariff Determination
- Planning and Implementation of Cross Border Transmission Link
- Connectivity, Long Term Access, Medium Term Open Access and Short Term Open Access
- Treatment of delay in Transmission system and Generation projects
- Payment Security Mechanism
- Metering Arrangements
- Data and Communication Facilities
- System Recording Instruments
- Reactive Power Compensation

- Cyber Security
- System Security Aspects
- Declaration of Transfer Capability
- Scheduling, Metering, Energy Accounting & Settlement
- Event Information
- Coordination Between System Operators
- Payment of Transmission charges and other charges
- Transmission Losses
- System Operation Fees and Charges
- Dispute Settlement and Resolution mechanism

Settlement Nodal Agency (SNA)

- Power transfer between countries
- NVVN has been nominated as SNA for Bangladesh, Bhutan, Nepal and Myanmar.
- Need for Nodal Agency
  - Settle transactions and deviations in Indian Pool
  - Back to back arrangement with buying entities in participant country
  - Coordinate day-to- day scheduling with Load Despatch Centre in India and participant country
  - Transactions feasible
    - Long term Access/ Medium Term Open Access
      - Schedule to the LDCs on Day ahead basis
      - Revision allowed
    - Short Term Open Access
      - Bilateral transactions - Revision as per Open Access regulations
- Net schedule – datum for exchange of power through the link
- Deviations settled as per CERC Deviation Settlement Regulations



No. 14/1/2017-Trans-Pt(1)
Government of India
Ministry of Power
Shram Shakti Bhawan, Rafi Marg, New Delhi- 110 001.

Dated, 26th November, 2019

To
Shri Asim Kumar Poddar, CEO,
NTPC Vidyut Vyapar Nigam Ltd.
SCOPE Complex, 7 Institutional Area,
Lodhi Road, New Delhi-110003.

Subject: Nomination of Settlement Nodal Agency (SNA) under Guidelines for Import/Export (Cross Border) of Electricity 2018- reg.

Sir,

I am directed to state that as per the clause 8.8 of the Guidelines for Import/Export (Cross Border) of Electricity 2018, M/o Power, Govt. of India has nominated NTPC Vidyut Vyapar Nigam Ltd. (NVVN) as Settlement Nodal Agency (SNA) for settlement of grid operation related charges with neighbouring countries, namely, **Bangladesh, Bhutan, Nepal** and **Myanmar**.

2. This issues with the approval of Competent Authority.

Yours faithfully,

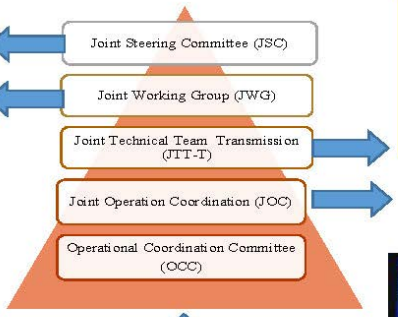
(Bharat Bhushan)
Under Secretary (Trans)
Tele-fax: 2332 5242
Email: transdesk-mop@nic.in

Copy to:
1) Secretary, CERC, New Delhi.
2) Member(PS), CEA, New Delhi.
3) Joint Secretary(North), MEA, New Delhi.
4) Joint Secretary(BM), MEA, New Delhi.
5) Joint Secretary(Hydro), M/o Power, New Delhi.

NVVN designated as Settlement Nodal Agency
http://nvvn.co.in/wp-content/uploads/2020/11/Nomination-of-NVVN-as-SNA.pdf

Multi Layered Coordination & Communication

Constitution of Joint Steering Committee (JSC) and Joint Working Group (JWG) :
- High-level decision making for electricity cooperation
- First activity – establishment of cross-border link



JTT-T has been constituted with the mandate :
- To discuss and coordinate planning/ implementation /monitoring of cross border transmission lines and related matters

- For operation coordination, grid security and reliability
- Held between system operators bilaterally at least once in a year.

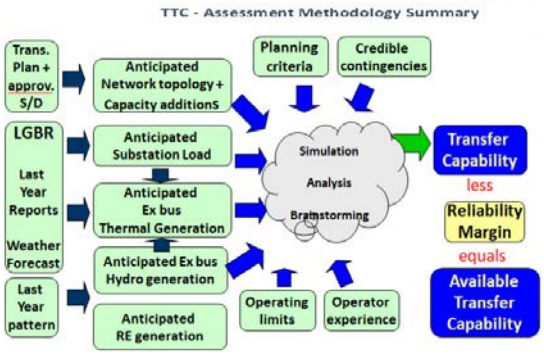
System Operator : Cross Border Operational Coordination

Operation co-ordination is carried out bilaterally to handle :

- System Security Aspects
- Operational & Outage planning
- Transfer Capability Assessment
- Scheduling and Despatch
- Operating instructions
- Congestion management
- Protection
- Recovery Procedures
- Event information
- Formation of coordination groups

Transfer Capability Assessment by System Operators

- Transfer capability is the measure of the ability of the corridor, as a whole, for reliable transfer of power from one region to another which depends upon network topology, load generation balance and strength of the weakest link in the corridor, downstream network etc.
- TTC is generally less than aggregated transmission capacity
- NLDC, India assesses the cross-border TTC/ATC considering network constraint at India side.
- Cross-border node is usually represented as lumped generation or lumped load in case detailed network and LGBR of cross-border country is not available.
- Similar assessment may be carried out by other side and if individual TTC/ATC assessed by respective system operator are not same because of different system constraint, lower of the two values of TTC/ATC assessed by the two countries would be considered for allowing cross border trade of electricity



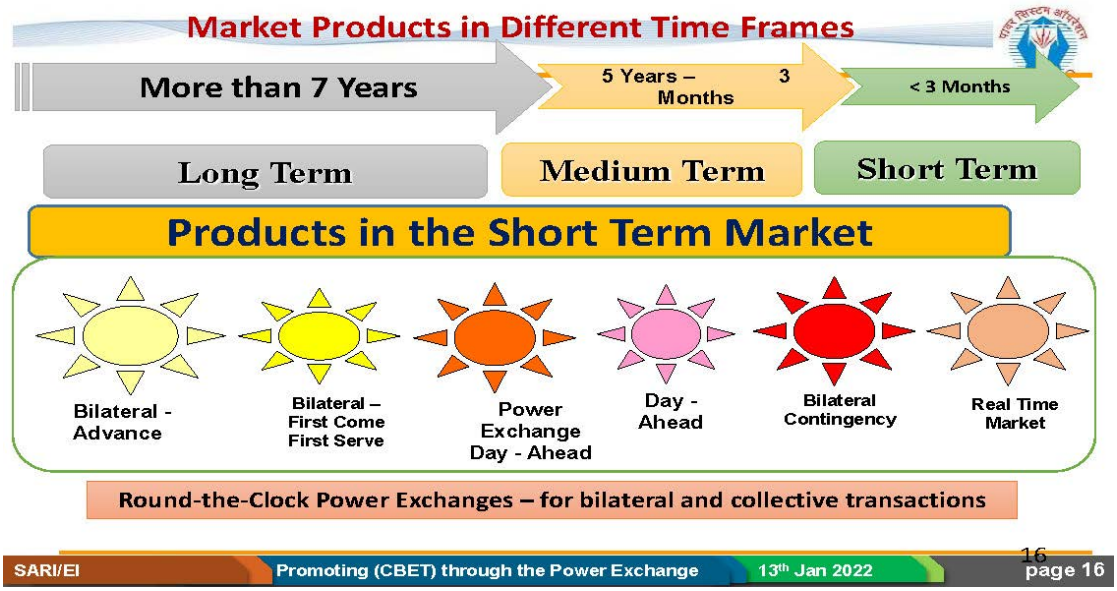
Transfer Capability Declaration by NLDC India

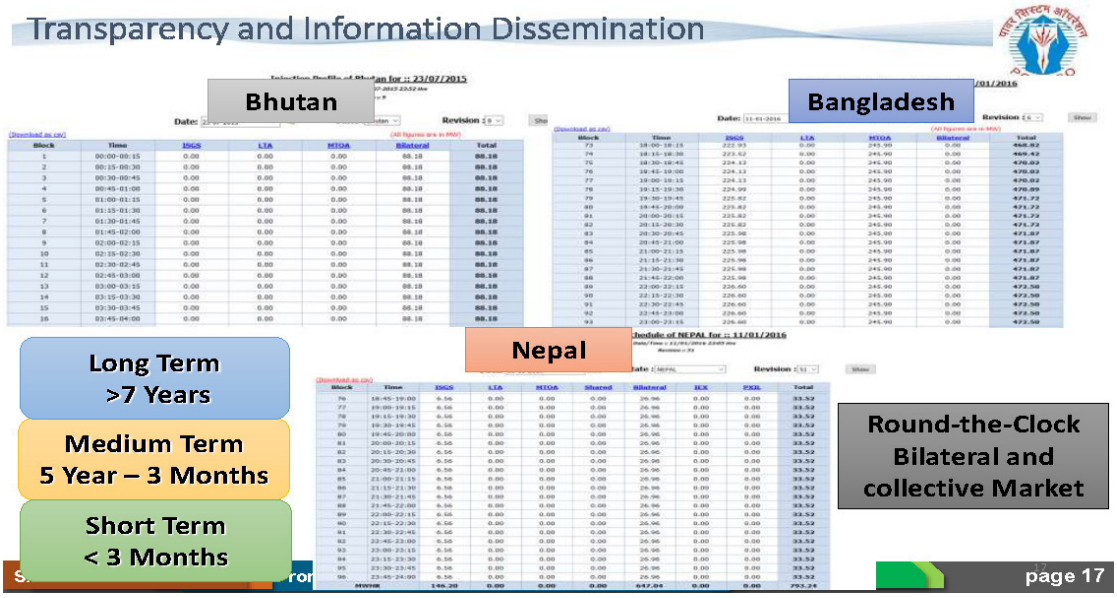
- Transfer Capability for Cross-border connections being declared on 03 month ahead basis.
- Regular revisions, as and when required, based on change in anticipated LGB, Network Topology or STOA margin
- 02 day ahead revisions (D-2) based on approved planned outages
- Same day revisions in real – time because of emergency outages
  https://posoco.in/download/cross-border_ttc_atc-april-2022_rev-1/?wpdmdl=42213
- Periodic information exchange of relevant system data, anticipated network and load generation balance would improve further in carrying out the system study and assessment of system vide critical points.

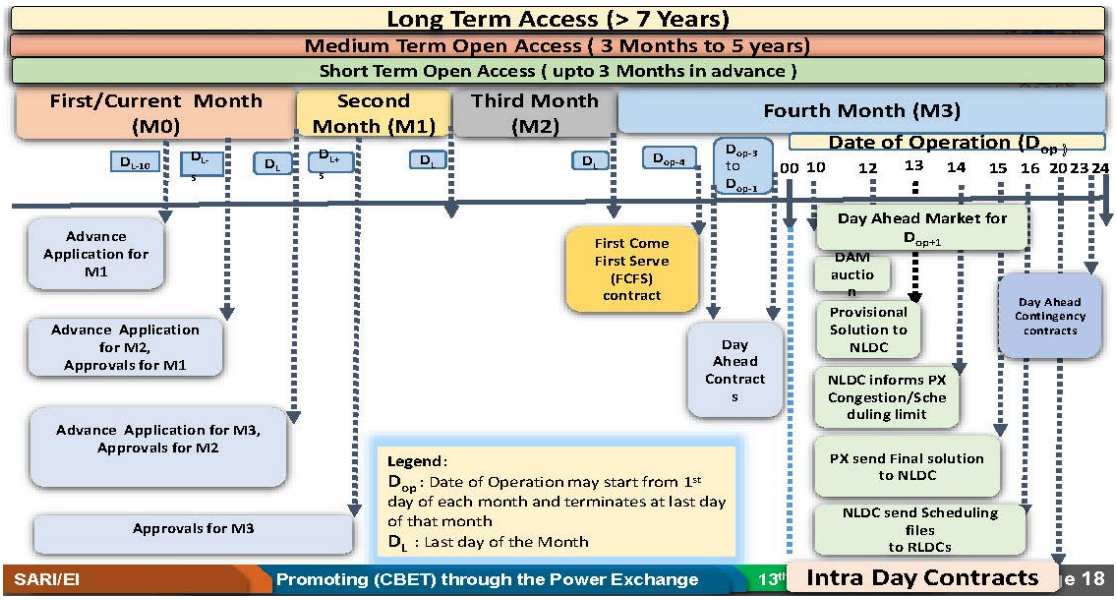
National Load Despatch Centre, New Delhi
Cross Border Transfer Capability for April 2022

Issue Date: 05th January 2022 | Issue Time: 1700 hrs | Revision No. 1

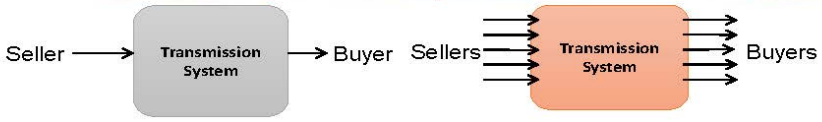
Cross Border Corridor	Date	Time Period in IST (hrs)	TTC	Reliability Margin	Available Transfer Capability (ATC)	Long Term Access (LTA)/ Medium Term Open Access (MTOA) #	Margin Available for Short Term Open Access (STOA)	Changes in TTC w.r.t. Last Revision	Limiting constraint	Comments
India (ER ISTS) to Bangladesh *	1st April 2022 to 30th April 2022	00:00-17:00	1000	0	1000	760	240		Limited to HVDC Bheramara Behrampore rated capacity	
		17:00-21:00	1000		1000	760	240			
		21:00-24:00	1000		1000	760	240			
Bangladesh to India (ER ISTS) #	1st April 2022 to 30th April 2022	00:00-17:00	1000	0	1000	0	1000		Limited to HVDC Bheramara Behrampore rated capacity	
		17:00-21:00	1000		1000	0	1000			
		21:00-24:00	1000		1000	0	1000			
Note 1:	In case of operation of SPS, Transfer Capability will be revised accordingly.									
Note 2:	Schedule between India and Bangladesh will be prepared using the above table till the next revision.									
Note 3:	Transfer Capability between India and Bangladesh in the above table has been evaluated ignoring the constraints from Bangladesh side.									
Note 4:	LTA of Bangladesh is considered as 500 MW from DVC, 250 MW from Sembcorp Energy India Limited and 210 MW from ISGS allocation (excluding auxiliaries+losses).									
Note 5:	* ISTS to cross-border TTC/ATC is for security & market purpose only									
Note 6:	# Intra-state to cross border TTC/ATC is for security purpose only									
Note 7:	## TTC is the sum of individual maximum permissible load as Nepal is fed radially & declared by NLDC Bihar.									
Note 8:	The above limits are considering the network limitation on Indian side. In case cross-border NLDC also declare the TTC/ATC considering the network limitation on their respective side, the lesser of this values vs values in above table would be reckoned for the purpose of scheduling.									
Note 9 :	In case any other constraint would be intimated by respective cross-border NLDC, these figures would be revised accordingly.									
Note 10 :	NLDC India would approve the transactions in line with the GOI guidelines of Dec 2018, CERC Cross Border regulations and the CBTE procedure issued by DA.									


Market Products in Different Time Frames
More than 7 Years
5 Years – 3 Months
< 3 Months
Long Term
Medium Term
Short Term
Products in the Short Term Market
Bilateral - Advance
Bilateral – First Come First Serve
Power Exchange Day - Ahead
Day - Ahead
Bilateral Contingency
Real Time Market
Round-the-Clock Power Exchanges – for bilateral and collective transactions
SARI/EI
Promoting (CBET) through the Power Exchange
13th Jan 2022
page 16


Transparency and Information Dissemination
Bhutan
Bangladesh
Nepal
Long Term >7 Years
Medium Term 5 Year – 3 Months
Short Term < 3 Months
Round-the-Clock Bilateral and collective Market
page 17


Long Term Access (> 7 Years)
Medium Term Open Access (3 Months to 5 years)
Short Term Open Access (upto 3 Months in advance)
First/Current Month (M0)
Second Month (M1)
Third Month (M2)
Fourth Month (M3)
Date of Operation (Dop)
Advance Application for M1
Advance Application for M2, Approvals for M1
Advance Application for M3, Approvals for M2
Approvals for M3
First Come First Serve (FCFS) contract
Day Ahead Contracts
Day Ahead Market for Dop+1
DAM auction
Provisional Solution to NLDC
NLDC informs PX Congestion/Scheduling limit
PX send Final solution to NLDC
NLDC send Scheduling files to RLDCs
Day Ahead Contingency contracts
Legend:
Dop : Date of Operation may start from 1st day of each month and terminates at last day of that month
DL : Last day of the Month
SARI/EI
Promoting (CBET) through the Power Exchange
Intra Day Contracts

Settling Electricity Transactions



- **A Simple transaction**
  - One buyer – one seller, single part settlement
- **Increasing Complexity**
  - Multiple sellers to one buyer
  - Multiple sellers multiple buyers
  - Multiple trades at different rates
- **Solution: Schedule Transactions**
  - Multi part settlement (fixed, variable, deviations)
  - Settle the scheduled quantum as deemed delivered
    - Fixed charges based on availability
    - Variable charges as per schedule
  - Settle imbalances/deviations from schedule separately

Need for Deviation Settlement Mechanism !

More than 8000 Interface Meters !

More than 150 Control Areas !

More than 6000 Market Participant !

Settlement of Charges and losses for any transaction

- **Charges settled directly between buyer and seller**
  - Capacity charges as per availability
  - Energy charges as per schedule

- **Charges settled through System Operator**
  - Charges for imbalance/deviations
  - Transmission charges
    - For inter-state transmission – POC charges for injection and withdrawal
    - For intra-state transmission – As specified by respective SERC
  - Operating Charges
  - Application Fees

- **Transmission Losses**
  - POC losses for inter-state system – (additional losses are applicable - intra-state system)
  - Losses are published by CERC and updated weekly by NLDC, India on its website.
  - To be paid in kind.

Energy Accounting

- Regional Power Committees (RPCs) prepare the following accounts as per Regulations:
  - Weekly Deviation Settlement account
  - Weekly Reactive Energy Charge account
  - Monthly Regional Energy Account
  - Monthly Regional Transmission Account
  - Monthly Regional Transmission Deviation Account

Way Forward

- More Synchronous or Asynchronous Interconnections in future would help in the optimization of generation resources & promotes region-wide economy.
- Synchronously interconnected grid would enhance foot print of sub-continental power system, greater stability, sharing of reserves and ability to integrate more renewables.
- Primary, Secondary and Tertiary control implementation, Reserve regulation ancillary services to conceptualize the large synchronously interconnected grid.
- Close co-ordination at all levels would be required at all levels – Be it Planners, Regulators or Grid Operators.
- Harmonization of grid standards, scheduling and despatch procedures to the extent possible.
- System Modeling, outage, protection and real time co-ordination to tackle the operational challenges of inter-connected grid.
- Scheduling of Transactions (multi buyer – multi seller)
- Consensus on the legal, regulatory, technical and commercial aspects
- Application of (transmission & system operation) charges and losses
- Payment Security & Dispute Resolution Mechanism

Future Grid Management Challenges

Ramping Requirements, Peak-Shaving	Optimization of Grid Operation and Security	Smart Grid, Self-Healing, Resilient, Storm Hardy Grid
Distributed Generation Resources	Cyber-Security, Interoperable Protocols, CIM	Micro-Grids, Demand Response, Prosumers
Energy Efficient, Climate Friendly Grid, Environmental Stewardship	Digital information, Fast Communication ,Automated Real-Time Interactive Controls	Electricity Storage, Plug-in Hybrid Electric Vehicles

Thank you !!

ANNEXURES 5E-

COVERAGE OF PRESENTATION

- ✓ Sharing of Nepal Experience of Participation In Indian PX
- ✓ Role of Indian & Non India Trader in CBET
- ✓ Roles & Responsibility of SNA in CBT

EXPERIENCE OF NEPAL PARTICIPATION IN INDIA POWER EXCHANGE

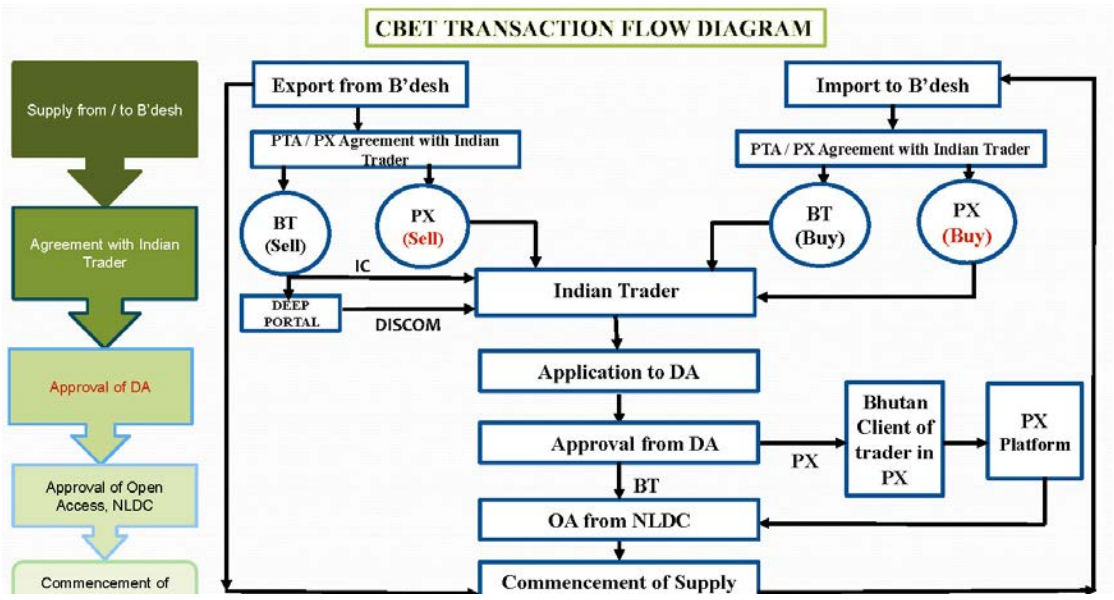
CBET FACT & NEA,NEPAL

- ✓ NEA Signed PX Agreement with Indian Trader in April 2019
- ✓ NEA Signed SNA Agreement with NVVN in October 2020 for settlement of Grid Operation related charges & DSM
- ✓ DA issued procedure for Approval and Facilitating Import / Export of Electricity 26th Feb 2021

DA Approval Purchase / Sale of Power By NEA Through PX

Name of Entity in Nepal	QTM (MW)	Delivery Point	Date of DA Approval	Commencement of Supply	Nature of Transaction
NEA, Nepal	350	Muzaffarpur End of DM Line in India	15.04.2021	18.04.2021	PX - DAM

Name of Generating Company	Name of HEP	QTM (MW)	Delivery Point	Date of Approval	Commencement of sale	Nature of Transaction
NEA, Nepal	Trishuli HEP	24	Muzaffarpur End of DM Line in India	30.10.2021	04.11.2021	PX - DAM
	Devighat HEP	15		30.10.201	04.11.2021	



LEARNING FROM NEPAL EXPERIENCE

- ✓ Splitting of Application for DA Approval is Handy
- ✓ BT Agreement & PX Agreement together helps to get benefit from market
- ✓ Early one participates in PX, early one reaps benefit from market

DA Approval Purchase / Sale of Power By NEA Through PX

Name of Entity in Nepal	QTM (MW)	Delivery Point	Date of DA Approval	Commencement of Supply	Nature of Transaction
NEA, Nepal	350	Muzaffarpur End of DM Line in India	15.04.2021	18.04.2021	PX - DAM

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	Devighat HEP	15		30.10.201	04.11.2021	

SNA & CBET GUIDELINES

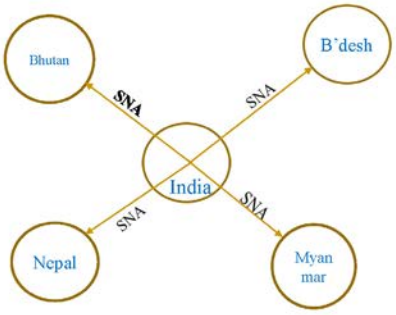
SNA & CBET Guidelines

MOP Guidelines issued in October 2018 on CBET Which States:

- ✓ MOP shall notify Nodal Agency for each neighbouring country which shall be responsible for settlement of Grid Operation Charges as per CERC Regulations.

NVVN was declared Settlement Nodal Agency (SNA) vide MoP order dated 26 Nov 2019 for Nepal, Bhutan, Bangladesh and Mynamar.

SNA & CB Participant



NVVN has been doing SNA function for Nepal in D - M line at Muzaffarpur end in India and for Bangladesh in B-B link at Baharampur end in India since the supply commenced through these lines from Feb 2016 and Oct 2013 respectively.

NVVN had also commenced SNA function for Nepal in Tanakpur line since 1st Apr-2020 and scheduling w.e.f 1st Jul 2020 onwards.

SNA FUNCTIONS

- ✓ Signing of SNA Agreement with Cross Border Entity (ies)
- ✓ Scheduling, revision and congestion management of the transactions
- ✓ Curtailment management and coordination between the countries
- ✓ Weekly DSM settlement for active and reactive power for both Nepal and BPDB
- ✓ Regional Transmission deviation bills for Cross Border Entity
- ✓ RLDC fees and charges bills (SOC and MOC bills)

SNA FUNCTIONS

- ✓ Any other pool account bills such as reactive charges bills etc.
- ✓ Settlement of DSM and other refunds
- ✓ Opening of LC for RLDC
- ✓ Payment of Yearly RPC fees
- ✓ Raising of surcharge bills for late payments.
- ✓ Quarterly settlement and reconciliation with RLDC, PGCIL & cross border entity

Details of SNA functions Performed by NVVN as below transactions:

Indian Entities (IE)		Quantum (MW)	Cross-Border Entity (CBE)	
1	Tripura (NVVN)	160	BPDB	Trader+ SNA
2	DVC (NVVN)	300	BPDB	Trader + SNA
3	NTPC (NVVN)	250	BPDB	Trader +SNA
4	Meenakshi (PTC)	200	BPDB	SNA
5	Sembcorp (Generator)	250	BPDB	SNA
6	PTC	40	NEA	SNA
7	NVVN	350	NEA	Trader + SNA
8	NHPC	70 MU (Free Power of Nepal)	NEA	SNA
9	Manipur	05	Mynamar	SNA
10	TPTCL	120	DGPC	SNA

SNA AGREEMENT

	SNA	Cross-Border Entity	Status of Agreement
1	NVVN	NEA	Signed
2	NVVN	BPDB	Final Stage
3	NVVN	BHUTAN	Discussion Stage
4	NVVN	MYANMAR	In Progress

About SARI/EI

The US Agency for International Development (USAID) initiated the South Asia Regional Initiative for Energy (SARI/E) program in the year 2000 to promote Energy Security in the South Asia region, working on three focus areas: Cross Border Energy Trade (CBET); Energy Market Formation; and Regional Clean Energy development. The program covers the eight countries in South Asia, viz. Afghanistan, Bangladesh, Bhutan, India, The Maldives, Nepal, Pakistan and Sri Lanka. The fourth and current phase of the program, called South Asia Regional Initiative for Energy Integration (SARI/EI), is aimed at advancing regional grid integration through cross border power trade. This phase is being implemented by Integrated Research and Action for Development (IRADe), leading South Asian Think Tank. SARI/EI program was recently extended to 2022 and is a key program under USAID's Asia EDGE (Enhancing Growth and Development through Energy) Initiative. In its extended phase, SARI/EI will focus on moving the region from bilateral to trilateral and multilateral power trade, and establishing the South Asia Regional Energy Market (SAREM).

About USAID

The United States Agency for International Development (USAID) is an independent government agency that provides economics, development and humanitarian assistance around the world in support of the foreign policy goals of the United States. USAID's mission is to advance broad-based economics growth, democracy, and human progress in developing countries and emerging economies. To do so, it is partnering with governments and other actors, making innovative use of science, technology, and human capital to bring the profound results to a greatest number of people.

About IRADe

IRADe, located in Delhi, is a non-profit and fully autonomous institute for advance research. IRADe's multidisciplinary research and policy analysis aid action programs. It is a hub for a network of diverse stakeholders. Established in 2002, the institute is recognized as an R&D organization by the Department of Scientific and Industrial Research and Ministry of Science and Technology of the Government of India. The Ministry of Urban Development has accorded IRADe the status of Centre of Excellence for Urban Development and Climate Change. Through the SARI/EI program, IRADe is pushing the envelope for sustainable energy access through experts and members from South Asia.

For more information, please visit the SARI/EI project website:

Website: https: //sari-energy.org/

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