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South Asia Forum For
Infrastructure Regulation

**South Asia Forum for Infrastructure Regulation (SAFIR) and
South Asia Regional Energy Partnership (SAREP)**

Conference Proceedings

**Deepening Cross Border Electricity Trade
and Regional Electricity Market Development
for Sustainable Energy in the South Asia Region**

March 02-03, 2023



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USAID's SAREP Program

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South Asia Forum for Infrastructure Regulation (SAFIR)

The South Asia Forum for Infrastructure Regulation (SAFIR) was established in May 1999. SAFIR aims at providing high quality capacity building and training on infrastructure regulation & related topics, in South Asia and to stimulate research on the subject by building a network of regional and international institutions & individuals that are active in the field. It also aims at facilitating effective and efficient regulation of Utility and infrastructure industries, initiate beneficial exchange of knowledge and expertise, and set the trend of rapid implementation of global best practices.

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South Asia Regional Energy Partnership (SAREP)

The South Asia Regional Energy Partnership (SAREP) serves as a flagship program of USAID to advance objectives of the U.S. Government's Clean Asia Enhancing Development and Growth through Energy (EDGE) initiative. SAREP is working on developing regional power markets, improving coordination and planning, strengthening national and regional institutions, building consensus on power trade, and institutionalizing a supporting framework and mechanisms. SAREP activities are supporting expansion of cross-border power trade by supporting stakeholders to participate in trilateral, multilateral, and exchange-based markets.

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I Program Schedule

2nd and 3rd March 2023, Le Meridien, New Delhi

Day 1: 2nd March 2023

Session 1: Inaugural Session

09:30-
10:15 IST

- Lamp Lighting Ceremony and Group Photograph
- Welcome Address by Mr. Harry Kriz, Director, Indo Pacific Office, USAID/India
- Special Address by Mr. Harpreet Singh Pruthi, Secretary, SAFIR and CERC
- Special Address by Chief Guest, Mr. Alok Kumar, Secretary (Power), Government of India
- Special Address by Mr. Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan
- Special Address by Mr. John Smith-Sreen, Deputy Mission Director, USAID/India
- Vote of thanks by Ms. Monali Zeya Hazra, Regional Energy and Clean Energy Specialist, USAID

Working Session 1: Conducive Policies and Facilitating Regulations for advancing Cross Border Energy Trade, and Regional Electricity Market development for fostering Sustainable Energy

11:15-
13:00 IST

Session Chair: Mr. Ghanshyam Prasad, Chairperson, Central Electricity Authority (CEA)

Session Panelists:

- Mr. Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan
- Ms. Shilpa Agarwal, Joint Chief (Engineering), Central Electricity Regulatory Commission, India
- Mr. Dilli Bahadur Singh, Chairman, Electricity Regulatory Commission, Nepal
- Mr. Chamath Goonawardena, Director-Regulatory Affairs, Public Utilities Commission of Sri Lanka

Working Session 2: Creating Transmission Infrastructure - Developing a South Asia Regional Power Grid for Sustainable Energy and Greening the Grid for cross border clean energy trade

14:30-
16:15 IST

Session Chair: Mr. S. S. Barpanda, Director, Market Operation, Grid Controller of India Limited

Session Panelists:

- Mr. Durga Nanda Bariyait, Director, Transmission Directorate, Nepal Electricity Authority (NEA), Nepal
- Mr. Sonam Tobjey, CEO, Bhutan Power Corporation, Royal Government of Bhutan
- Mr. Abdur Rashid Khan, Project Director (Chief Engineer), Power Grid Company of Bangladesh (PGCB), Bangladesh
- Mr. Rajesh Kumar, Senior General Manager, Power Grid Corporation of India Ltd
- Mr. Pankaj Khurana, Programme Specialist, International Solar Alliance, New Delhi, India

Day 2: 3rd March 2023

Working Session 3: Strategy for transitioning gradually to Trilateral / Multilateral Power Trade and Development of Regional Power/Energy Market for advancing Sustainable Energy

10:00-11:30 IST	Session Chair: Mr. Mohammad Hossain, Director General, Power Cell, Ministry of Power, Energy & Mineral Resources, Government of Bangladesh Introductory presentation before panel discussion: Key findings of the study on “Transition of bilateral power trade to trilateral and multilateral power trade in South Asia and International Experiences ” by Mr Rajiv Ratna Panda, Power Market Specialist, SAREP Session Panelists: • Mr Ashok Kumar Rajput, Member (Power System), Central Electricity Authority, India • Mr. V K Agrawal, Senior Advisor, SAREP • Ms. Dawa Chhoedron, Chief Engineer, Department of Energy (DoE), Ministry of Economic Affairs, Royal Government of Bhutan • Mr. Rohit Bajaj, Head, Business Development, Regulatory Affairs & Strategy, Indian Energy Exchange Limited (IEX)
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Working Session 4: Building New Energy Infrastructure: Emerging Clean Energy Innovations, Technologies for Energy and accelerating clean energy transition

11:45-13:00 IST	Session Chair: Mr. Arun Goyal, Member, Central Electricity Regulatory Commission, (CERC), India Session Panelists: • Mr. S. S. Barpanda, Director, Market Operation, Grid Controller of India Limited • Mr. V K Agrawal, Senior Advisor, SAREP • Mr. Vikram Gandotra, Head Utilities sales and strategy, Siemens • Mr. Awdhesh Kumar Yadav, Chief (Engineering), CERC, India (Regulating and incentivizing the adoption of Clean Energy Innovations and technologies for accelerating clean energy transition) • Mr. Debi Prasad Dash, India Energy Storage Alliance (IESA), India (Innovative Energy Storage Technologies)
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2 Executive Summary

Cross Border Electricity/Energy Trade (CBET) possess an immense opportunity and can trigger rapid decarbonisation of power/energy sector and foster energy security in South Asia through further market development in the region.

There are significant opportunities for regional optimization of diverse energy resources in a sustainable manner through the development of interconnected and integrated power system by advancing CBET in the region. The South Asian countries have recognized the importance of regional energy cooperation and CBET and are undertaking transmission interconnections and development of hydro power for five decades.

In the BBIN (Bhutan, Bangladesh, India, and Nepal) sub-region, CBET has been underway between Bangladesh, Bhutan, India, and Nepal. In case of India-Bhutan, Bhutan is exporting sustainable clean hydro power to India. Many export-oriented hydro power plants are also under construction in Nepal. Various CBET projects at bilateral, trilateral, and regional level are under discussion and construction stage.

The role of energy is relevant to the socio-economic development of South Asian countries. It is imperative to ensure access and availability of energy, especially in the form of electricity. However, in the quest towards improvement of energy access, the sustainability of incremental energy sources and energy infrastructure will also have to be considered.

Against this backdrop South Asia Forum for Infrastructure Regulation (SAFIR) along with US Agency for International Development's (USAID) South Asia Regional Energy Partnership (SAREP) program, organized SAFIR-SAREP conference on "Deepening Cross Border Electricity Trade and Region Electricity Market Development for Sustainable Energy security in the South Asia Region" on 2nd – 3rd March 2023 at the Hotel Le Meridien, New Delhi, India. Various distinguished officials from the government, government departments, regulators, utilities and multilateral organizations of South Asian countries actively participated and shared their views on various topics in the conference. The two-day conference comprised of an inaugural session and four working sessions. The working sessions covered the following topics:

1. Conducive Policies and Facilitating Regulations for advancing Cross Border Energy Trade, and Regional Electricity Market development for fostering Sustainable Energy
2. Creating Transmission Infrastructure - Developing a South Asia Regional Power Grid for Sustainable Energy and Greening the Grid for cross border clean energy trade
3. Strategy for transitioning gradually to Trilateral/Multilateral Power Trade and Development of Regional Power/Energy Market for advancing Sustainable Energy
4. Building New Energy Infrastructure: Emerging Clean Energy Innovations, Technologies for Energy and accelerating clean energy transition.

At the event inaugural, in his welcome address, Harry Kriz, Director, Indo Pacific Office, USAID India, said that CBET can trigger rapid decarbonization of energy sector in South Asia through the development of large scale clean, green, and sustainable energy infrastructure across the region. He also highlighted the important role of regional institutions such as SAFIR in advancing a regionally integrated grid.

The keynote address for the conference was delivered by Mr. Alok Kumar, Secretary, Ministry of Power, Government of India. This was followed by special addresses by Harpreet Singh Pruthi, Secretary, SAFIR, and Central Electricity Regulatory Commission (CERC); Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan; and John Smith-Sreen, Deputy Mission Director, USAID/India.

They talked about the importance of regional energy grids and their potential to exploit diversity in time zones and peak load hours in various regions, visibility of market access and the importance of CBET in harnessing green energy, and the importance of regional organizations and partnerships in providing a push for regional power cooperation.

The inaugural session was followed by the four working sessions spread over two days, where senior officials and experts from public and private sectors in the power market in South Asia shared their views. The event included sharing of key findings of the study on 'Transition of Bilateral Power Trade to Trilateral and Multilateral Power Trade in South Asia and International Experiences', in Working Session-3. Rajiv Ratna Panda, Power Market Specialist, SAREP, presented the main findings of the study, which covered key learnings from international experiences and also suggested a modern framework for trilateral and multilateral trade in South Asia.

The conference ended on March 3 with a vote of thanks by Mr Harpreet Singh Pruthi. He said that there exists diversity, complementarity of demand, and diversity of energy sources, in the South Asian region. He noted that the discussions here at this conference have strengthened the understanding of huge opportunities to deepen cross border electricity trade.

Some of the key aspects that emerged from the discussions during the event are summarized below:

1. There is a broad consensus that the presence of new transmission interconnections will play a key role in the deepening of CBET.
2. Opening of power exchanges in India to cross border participation has been widely viewed as a very effective step towards regional energy integration.
3. There is eagerness to explore market models beyond bilateral agreements, including models in which more than two countries participate in CBET.
4. Cross border electricity trade and growth in economy cannot be undertaken at the cost of sustainability. Availability of sustainable energy will be a key factor that will govern the nature of future trajectory of CBET growth.
5. SAFIR will continue to have a major role to play in enabling further deepening of CBET in the region, and further regional energy integration, especially in terms of quick implementation of policy measures through facilitating and supporting regulation, knowledge sharing etc.

3 Introduction

3.1 Background

The South Asia Forum for Infrastructure Regulation (SAFIR) was established in May 1999. SAFIR aims at providing high quality capacity building and training on infrastructure regulation & related topics, in South Asia and to stimulate research on the subject by building a network of regional and international institutions & individuals that are active in the field. It also aims at facilitating effective and efficient regulation of Utility and infrastructure industries, initiate beneficial exchange of knowledge and expertise, and set the trend of rapid implementation of global best practices.

SAFIR aims to

- a) provide a platform for experience sharing amongst the regulators of the region;
- b) build regulatory decision-making and response capacity in South Asia;
- c) facilitate the regulatory process;
- d) conduct training programmes to serve regulatory agencies and other stakeholders;
- e) spur research on regulatory issues; and
- f) provide a databank of information relating to regulatory reform processes and experiences.

In the South Asian region, the United States Agency for International Development (USAID) funded South Asia Regional Energy Partnership (SAREP) Program serves as a flagship program of USAID to advance objectives of the U.S. Government's Clean Asia Enhancing Development and Growth through Energy (EDGE) initiative. SAREP is working on developing harmonised policy and regulatory framework, facilitating regulatory cooperation and coordination, regional power markets, improving coordination and planning, strengthening national and regional institutions, building consensus on power trade, and institutionalizing a supporting framework and mechanisms. SAREP activities are supporting the expansion of cross-border power trade (CBET) by assisting various stakeholders to participate in trilateral, multilateral, and exchange-based markets.

While SAREP has been focusing on promotion of CBET in the South Asia region, the South Asia Forum for Infrastructure Regulation (SAFIR) has been offering a platform for the infrastructure regulators in the region, including energy sector regulators, to share their knowledge, deliberate ideas and improve their capacity.

USAID, through its erstwhile South Asia Regional Initiative for Energy Integration Initiative (SARI/EI) Program, has been partnering with SAFIR in various areas. Since late 2022, activities of SARI/EI have transitioned to the SAREP program. SAFIR and USAID's SAREP Program jointly organised the SAFIR annual conference for the year 2023. This SAFIR-SAREP conference was titled, "**Deepening Cross Border Electricity Trade and Region Electricity Market Development for Sustainable Energy security in the South Asia Region**" and was held on 2nd – 3rd March 2023 at the Hotel Le Meridien, New Delhi, India. Speakers included representative from government, ministries/departments of power, regulators, SAFIR members, energy, planning authorities and other policy making bodies, load dispatch centres, power exchanges, power generation companies, transmission and distribution utilities members, power equipment manufacturers and suppliers, traders, USAID, SAREP. The list of speakers is attached as Annexure-I.



3.2 Context

South Asia (SA) region is one of the most vibrant and diverse regions in the world. It comprises of the 21% of the world's population and 5.21% (US\$ 4.47 trillion) of the global economy, as of 2021. Access to reliable, affordable, clean, and sustainable energy is a high priority not only to support rapid economic growth and improved welfare of more than 1.8 billion population¹ of the SA region but also to ensure energy and climate security in the region.

Over the past few years, SA has experienced a sustained economic growth (average of ~ 6 %) that has lifted many from poverty and contributed to notable strides in health and education and other development indicators and in striving to achieve suitable development goals. Rapid industrialization, modernization, and urbanization lead to the rising energy demand across all the countries of the SA region. However, the current level of annual per-capita electricity consumption of the SA region is 915 kWh against the global average 2674 kWh.² There is an urgent need, and a tremendous opportunity, for enhancing per capita consumption of electricity, in the SA region. Adequate supply of energy is a pre- requisite for all human pursuits ranging from economic progress to scientific research endeavours, education, healthcare, and recreational activities.

SA Region has tremendous hydro potential (~350 GW) and significant solar (~939 GW) and wind (967 GW) energy potential. While SA is endowed with large (> 350 gigawatts) hydropower potential, only around 18 percent has been exploited so far.³ Increased regional energy cooperation on a sustained basis among countries can bring economies of scale, strengthen electricity/energy sector financing capability, enhance competition, market development, improve sector efficiency and greening the South Asia Power Grid.

Cross Border Electricity/Energy Trade (CBET) possess an immense opportunity and can trigger rapid decarbonising of power/energy sector and fostering energy security in SA through the development of largescale sustainable energy infrastructure across the region. There are significant opportunities for regional optimization

¹ <https://www.adb.org/news/op-ed/how-south-asia-can-continue-world-s-fastest-growing-subregion-lei-lei-song>

² <https://sarepenergy.net/wp-content/uploads/2022/12/Cross-Border-Electricity-Trade-in-SAARC-Region-Current-Status-Future-Outlook-by-Rajiv-Ratna-Panda-Technical-Head-SARI-EI-IRADe.pdf>

³ <https://sarepenergy.net/wp-content/uploads/2022/07/brief-report-09march.pdf>

of diverse energy resources in a sustainable manner through the development of interconnected and integrated power system by advancing CBET in the region. Hydro power potential of Nepal and Bhutan can help in better hydro-thermal ratio of the whole SA region.

The South Asian countries have recognized the importance of regional energy cooperation and CBET and are undertaking transmission interconnections and development of hydro power for five decades. In the BBIN (Bhutan, Bangladesh, India, and Nepal) sub-region, CBET has been underway between Bangladesh, Bhutan, India, and Nepal. In case of India-Bhutan, Bhutan is exporting sustainable clean hydro power to India. Many exports oriented hydro power plants are also under construction in Nepal. Various CBET projects at bilateral, trilateral, and regional level are under discussion and construction stage. There is also a small quantum of power supply between India and Myanmar.

While CBET started as early as the 1950s in the SA region, it is only in the last ten years that the region has witnessed a many-fold increase in CBET, from 1400 MW in 2012 to 3900 MW in 2022. With an upsurge in cross-border transmission interconnections, power trade is expected to increase to about 43.8 GW by 2040. With the One Sun, One World, One Grid (OSOWOG) initiative pioneered by the Government of India and Green Grids Initiative (GGI)-OSOWOG, the region will get interconnected beyond SA. Large scale cross border transmission needs to be developed to tap the large-scale solar potential.

India's role in CBET and grid integration is crucial due to the country's central geographic location. India has promulgated forward-looking guidelines, regulations, and procedures for facilitating CBET. The "Guidelines for Import/Export (Cross Border) of electricity" have allowed CBET through Indian power exchanges and trilateral CBET through tripartite agreements.

As a first step, Bangladesh plans to import 500 MW of electricity from a hydropower project in Nepal through India. The 1125 MW Dorjilung hydropower project in Bhutan might also export power to Bangladesh via India. In a major change, Nepal has taken the lead on market based CBET by importing electricity from the power exchange in India starting in April 2021. Such imports of electricity by a country from a neighbouring country's power exchange are not only unique in SA but possibly a first of their kind across various subregions of Asia. With the success of imports, Nepal is exporting electricity in the Indian Power Exchange (PX). Bhutan bought around 240 GWh of electricity from the Indian PX in the year 2022 and imports have also started from January 2023. Bangladesh is also expected to trade through India's PX platform soon.

The development of hydropower, a sustainable form of energy in the region would increase by 2.7 times over the next two decades if the region could facilitate an unconstrained flow of electricity across the borders in South Asia.⁴

India has come up with a very ambitious plan to develop large scale sustainable energy infrastructure, to reach a target of 500 GW of Renewable energy (RE) by 2030, arguably the most ambitious plan in the world. Other SA countries also have plans for increased RE in the energy basket. Because of resource diversity between countries, to manage the RE intermittency and grid balancing, hydro resources of Bhutan and Nepal can supplement the sustainable grid integration of RE in India and other countries. Recent initiative by India for One sun One world and One Grid (OSOWOG) can further deepen power system integration in SA and beyond.

Energy system is undergoing rapid transformation across the globe due to various socio, economic, technological, and environmental factors and SA region is also impacted by this change. Future of CBET and regional energy cooperation must navigate the global and regional context. For this, building a technology ecosystem for fostering energy technology innovation will be critical. Building new energy infrastructure will be dependent largely on the emerging energy innovations, and adoption of advanced energy technologies for ensuing energy security and

⁴ <https://openknowledge.worldbank.org/bitstream/handle/10986/29986/WPS8513.pdf?sequence=1&isAllowed=yhttps://sarepenergy.net/wp-content/uploads/2022/07/brief-report-09march.pdf>

accelerating clean energy transition. Various technologies such as smart grid transmission technologies, innovative energy storage technologies, developing a hydrogen economy, technologies for integrated power system operation and innovation in regional electricity market will play an important role in deepening CBET and regional electricity market development in SA region. For example, renewable power could be utilised to produce green hydrogen in a large scale. With predicated rise in RE and the renewed prospect of hydropower, generation of hydrogen through electrolysis using electricity generated from such green energy sources would help in development of green hydrogen economy in SA region. Creating technology partnerships will also be helpful among countries to accelerate the speed and scale of innovation.

The CBET across the SA region will promote economic growth and improve the quality of life for all the nations and shall balance the diversity of primary energy sources and differences in seasonal patterns of supply and demand. CBET particularly in the SA can also play an incredibly significant role in achieving the social, economic, and developmental objectives of the region and in a way shall enhance the overall stability in the region.

3.3 Objective of the Conference

The key objective of the conference was to provide a platform for dialogue, discussion, and exchange of ideas and to carry out deliberation on the following aspects:

- Key policy and regulatory design and frameworks for advancing Cross Border Energy Trade (CBET), and Regional Electricity Market development for fostering Sustainable Energy Security in the South Asian region.
- Opportunities and Challenges offered by the region in CBET and regional electricity market, need for coordinated policies and regulation for advancing CBET.
- Developing a South Asian Regional Power Grid and Greening the Grid for cross border clean electricity trade.
- Strategy and potential benefits of gradually transitioning from bilateral to trilateral / multilateral power trade, development regional power market.
- Showcase the 'win-win' benefits offered by bilateral/trilateral/multilateral electricity trade.
- A regional planning approach - Regional Transmission master plan, integrated system operation.
- State of energy market development in each South Asian country and strategy for development of regional electricity market.
- Modernizing Regional Power Grid – Smart Grid Transmission Technologies, Innovative Energy Storage Technologies, Hydrogen Economy and National Green Hydrogen Mission of India, Smart Technologies for Integrated power system operation.
- Innovation in Regional Electricity Markets - Opportunities and challenges.



Day 01



4 Inaugural Session

- **Lamp Lighting Ceremony and Group Photograph**
- **Welcome Address** by Mr. Harry Kriz, Director, Indo Pacific Office, USAID/India
- **Special Address** by Mr. Harpreet Singh Pruthi, Secretary, SAFIR and CERC
- **Special Address** by Chief Guest, Mr. Alok Kumar, Secretary (Power), Government of India
- **Special Address** by Mr. Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan
- **Special Address** by Mr. John Smith-Sreen, Deputy Mission Director, USAID/India
- **Vote of thanks** by Ms. Monali Zeya Hazra, Regional Energy and Clean Energy Specialist, USAID



Mr. Harry Kriz, Director, Indo Pacific Office, USAID / India



Mr. Harry Kriz, welcomed all the speakers and participants to the conference. At the very outset, he emphasised upon the pivotal role played by energy in the socio-economic development of the South Asian nations. He stated that it is critical to ensure access and availability of energy especially in the form of electricity to compliment and sustain expanding economies. However, in the quest towards improving energy access it is important to consider the sustainability of the energy sector. South Asia is vulnerable to climate change and pollution, causing major economic and health losses. Therefore, it becomes imperative to meet the region's rising energy demand through sustainable forms of energy and proactively adopt clean

energy and modern energy technologies along with making encouraging policy commitments for decarbonisation and adoption of green energy.

He gave the example of India, where the Government has ambitious plans to install 500 GW of non-fossil fuel energy by 2030. Other South Asian countries also have plans to increase the share of renewable energy. Even though not all countries in the region are bestowed with green energy resources, regional energy cooperation provides an avenue to take advantage of cleaner resources such as hydro power and renewable energy generously available within the region. Increased energy cooperation on a sustained basis can bring economies of scale, strengthening energy sector's financing capabilities and help in greening the South Asian power grid. He reiterated the instrumental role played by USAID in enhancing the regional energy cooperation in South Asia.

Mr. Harry further noted that USAID's South Asia Regional Initiative for Energy Integration (SARI/EI) program has helped to build consensus on benefits of power trade. The SARI/EI program had undertaken various technical studies and engaged with key stakeholders to develop regional frameworks.

While the SARI/EI program has come to a successful end, USAID's efforts continue through its new flagship South Asia Regional Energy Partnership (SAREP) program which advances the objectives of US Government's clean edge enhancing growth and energy development in the South Asia region. SAREP aims to improve access to affordable, secure, reliable, and sustainable energy in six countries in South Asia namely Bangladesh, Bhutan, India, Maldives, Nepal, and Sri Lanka to strengthen systems and processes in line with the economic and energy security priorities of these countries. This program furthers US Government's Indo-Pacific vision of facilitation and collaboration among the six countries to operate and accelerate the transition to clean energy, mitigate climate change and promote energy security, economic development, and self-reliance. CBET represents an immense opportunity and can trigger rapid decarbonization of the energy sector of South Asia. There are huge opportunities for regional optimization and diversifying energy resources in a sustainable manner and to have an interconnected power system. SAFIR has an important role to play in advancing a regionally integrated grid.

He stated that USAID would like to continue to strengthen the long and strong partnership with SAFIR, to facilitate knowledge sharing, addressing cross cutting regulatory issues and building capacity to facilitate a transparent regulatory framework in the South Asian region. Mr. Harry noted that the conferences such as this serve as a great platform for knowledge sharing and to learn from the leading practices within the region as well as other parts of the world. This will pave the way for sustainable regional cooperation. Before concluding he thanked the dignitaries and experts for joining the conference. He also thanked SAFIR secretariat and SAREP for hosting the conference.

Mr. Harpreet Singh Pruthi, Secretary, SAFIR and CERC



Mr. Harpreet Singh Pruthi began his address by welcoming all the speakers and participants to the conference and acknowledging the efforts of SAFIR and SAREP for organising the conference. He stated that although the demand for electricity in the South Asian region is growing, the per capita consumption of electricity is way below the global average. Hence, there is an urgent need and tremendous opportunity for enhancing the per capita consumption in the South Asian region.

He emphasised that the South Asian region has tremendous potential for clean energy. The region has hydro potential of 350 GW, Solar potential of 900 GW and then 960 GW of wind potential. India has ambitious plans to develop 500 GW of non-fossil fuel-based generation plants. Other South Asian countries also have plans to increase renewable energy in their portfolio. So therein lies immense opportunities to optimize the diverse energy resources available in the region through CBET.

Large, interconnected grid across South Asia can bring far away resources to load centres and utilise the diversity of peak hours and time zone differences and seasonal differences for meeting the energy demand. Interconnected grids also offer opportunities to replace costly generation with relatively cheaper imported power. Even in deficit and surplus scenario the demand diversity helps. Hence, CBET assumes very significant role.

Mr. Pruthi also briefly mentioned about the key facilitating role of SAFIR. He noted that SAFIR was setup with the objective of providing a platform for exchange of information, building regulatory capacity, conducting training programs and research on regulatory issues. There are working groups in SAFIR on various matters such as capacity building programmes, regulations, compilation of regulatory newsletters, common grid code for member countries and regional markets etc. He expressed his gratitude towards SAFIR and stated that this conference provides an important platform for South Asian countries to share their experiences and knowledge. He thanked all colleagues from India and neighbouring countries, SAFIR secretariat and USAID and wished success for the conference.



Shri Alok Kumar, Secretary (Power), Government of India



Mr. Alok Kumar commenced his keynote address by welcoming all the delegates and participants to the conference. He congratulated SAFIR and USAID for organising the conference. He stated that South Asia is a very important region in the world. It has sizeable energy resources which are yet to be exploited and it has a huge potential for renewable energy generation.

Meanwhile, the requirement of energy for the economy and the per capita consumption for growth of people is tremendous. There have been several initiatives which try to encourage, promote and strengthen the regional or sub regional cooperation in terms of CBET and grid interconnections.

He emphasised further on the pivotal role played by SAFIR in the policy and regulatory spheres which serve as the foundation for investments required for the development of our untapped energy resources and also for a harmonized framework for the operations and development of the grid. He also acknowledged the contributions of USAID which has been working in this area. He talked about India's guidelines and procedure for CBET which has been released by the Government of India. In the last year CBET has moved from bilateral arrangements to Power Exchange (PX) based transactions. He noted that a proposal of long-term export of 500 MW of hydro power from Nepal to Bangladesh is also there.

He stated that the recent developments in CBET are very encouraging and show that South Asia is on the way towards utilising its potential and contributing to the economic growth of the region. He emphasised on the fact that investments in the region will come only if there is certainty and visibility of access to larger markets. In that context, these type of conferences and development frameworks are very important. A robust interconnected grid and access to markets will also lead to reduction in storage requirements, lower costs and aid in transitioning move towards clean energy sources.

He spoke about India's initiative of One Sun One World One Grid which aims at going beyond the South Asian region. He also said that substantial finance can be attracted by the development of a sound regulatory framework. He requested SAREP to create a robust business model based on the best practices and experiences from around the world which can assist in quick decision making for grid interconnection in the region. He concluded by extending his best wishes for the success of the conference.



Mr. Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan



Mr. Nima's speech focused on the various activities that SAFIR and USAID have carried out in the region in the past. He emphasised that South Asia is one of the most vibrant regions of the world. It has a high population along with a high growth rate. However, the current per capita consumption of electricity is low in the region as compared to international standards. This shows us that the energy and power sectors of this region have a lot to achieve. The South Asian region has a tremendous solar, wind and hydro potential which is yet to be harnessed.

Mr. Nima stated that CBET has existed in the region since 1950s. Currently, the CBET has increased to 3900 MW. He also stated that the One sun One world One grid program piloted by Government of India is well themed and timely to this region. In the year 2022 Bhutan imported 240 MU of electricity from Indian power exchange for the first time. In 2023 the imports are expected to increase significantly from India's power Exchange Markets. Bangladesh is also planning to increase import and is also expected to trade in Indian Power Exchanges. Nepal has taken a lead in the market based CBET since April 2021. He believes that the region is moving towards an unprecedented scale of regional power market integration and CBET both bilaterally and through power exchange platforms. He also enumerated the various achievements of SAFIR which have helped develop the region.

He stated that in order to further accelerate the regional power market development, SAREP has been established by the USAID. SAREP is actively supporting the activities of SAFIR for CBET and regional power market development. He said he believed that through institutions such as SAFIR and USAID, and with support of government and the people, South Asia will be able to advance its regional energy diversification and optimization. He highlighted that this conference is an important platform which will help catapult regional power market development. He thanked USAID, SAREP, SAFIR, all the dignitaries and participants for gracing the event with their presence and wished for the success of the conference.

Mr. John Smith-Sreen, Deputy Mission Director, USAID/India



Mr John Smith-Sreen highlighted the importance of USAID's partnership with SAFIR. He said that South Asia is one of the most vulnerable regions of the world and it has been severely impacted by climate change. Hence, there is a need to adapt and strengthen our resilience to mitigate these impacts. Recognising these threats, countries across South Asia are working in close cooperation with the US.

The South Asian region is blessed with enormous clean energy resources and there is tremendous potential for expansion and energy cooperation particularly in CBET. He stated that the countries along the Himalayan belt have a combined hydro resource potential of 350 GW. However only 18% of this potential has been tapped so far. He suggested that energy cooperation can lower the cost of power, reduce green-house gas emissions and help in optimal utilisation of resources available in the region. He quoted a world bank study which states that unrestricted electricity trade in the region could save nearly 9 billion USD every year in the region and reduce carbon dioxide emissions by nearly 8%. He stated that a common and coordinated set of regulations will help facilitate cross border interconnections and develop a bigger regional power market. He suggested that similar regional bodies and forums of like-minded institutions such as SAFTU, SAFSO, SAFEM, SAFEI and other regional forums and think tanks must come to gather to generate a broad consensus and support for cooperation within the region. He

hoped for enriching discussions during the course of the conference which will help pave the way for regional cooperation within the region. He thanked all the dignitaries, colleagues and SAFIR for their partnership and support. He concluded by saying that he truly believed that through regional energy cooperation high levels of economic growth and social development can be achieved in the region.

Ms. Monali Zeya Hazra, Regional Energy and Clean Energy Specialist, USAID

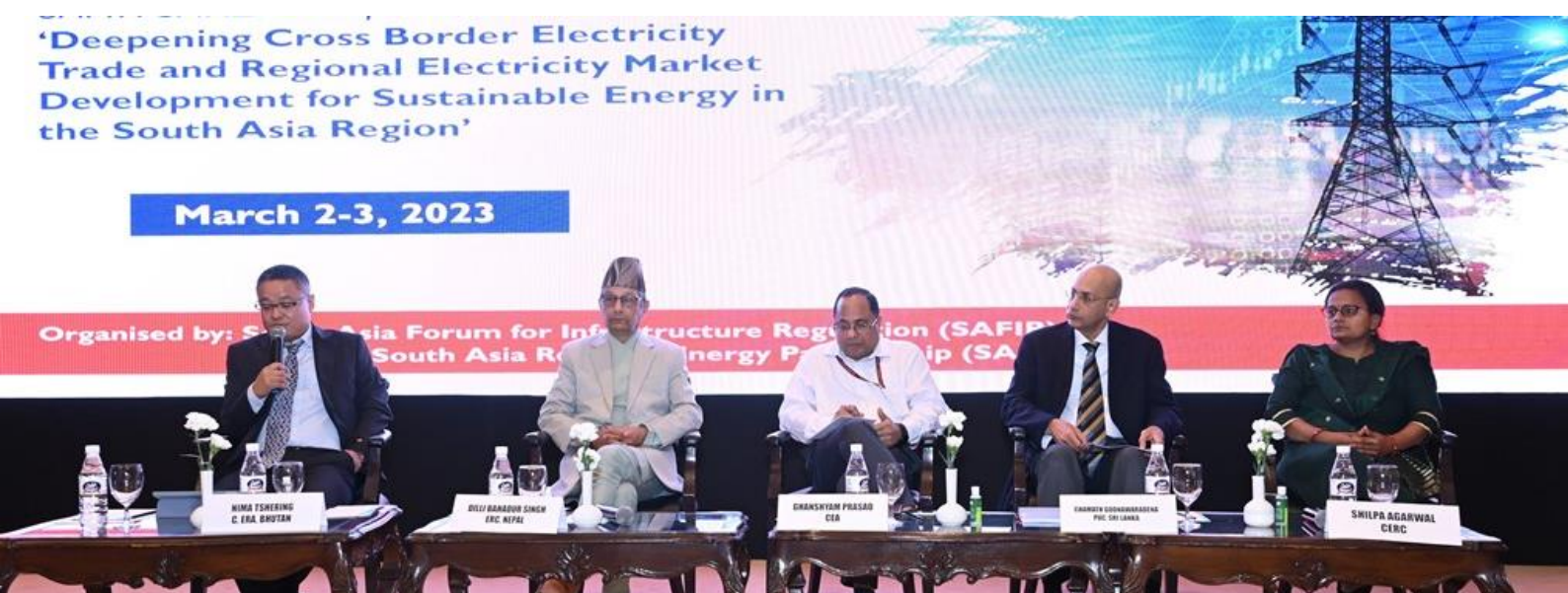


Ms. Monali Zeya Hazra stated that the complementarity in the region in terms of resources and demand is a compelling case for CBET. Power trade and markets have a huge potential to offer especially in enabling optimal utilization of clean energy resources. She thanked the guest of Honour Mr. Alok for gracing the event with his presence and stated that his guidance is looked forward to as the region continues to integrate. She thanked other guests and dignitaries, SAFIR secretariat, SAREP and the organizing team. She wished for the success of the event and hoped to look forward to the enriching discussions during the conference.



5 Working Session I: Conducive Policies and Facilitating Regulations for advancing Cross Border Energy Trade, and Regional Electricity Market development for fostering Sustainable Energy

- **Session Chair:** Mr. Ghanshyam Prasad, Chairperson, Central Electricity Authority (CEA)
- **Session Panelists:**
 - o Mr. Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan
 - o Ms. Shilpa Agarwal, Joint Chief (Engineering), Central Electricity Regulatory Commission, India
 - o Mr. Dilli Bahadur Singh, Chairman, Electricity Regulatory Commission, Nepal
 - o Mr. Chamath Goonawaradena, Director-Regulatory Affairs, Public Utilities Commission of Sri Lanka
- **Key focus areas:**
 - o Initiatives taken by South Asian (SA) countries in policy, regulatory and legislation reforms/initiatives to accelerate
 - o Cross Border Electricity Trade (CBET) and development of Regional Electricity Market (REM).
 - o Sharing of key experiences and lessons learned by each SA countries in designing of appropriate policy/regulatory
 - o instruments and their impacts on Energy Security.
 - o Role of CBET in development of Energy Secure South Asia.
 - o Way forward to develop robust coordinated/harmonized regional framework and mechanisms across policy, regulatory, legal, commercial, market and institutional aspects for deepening CBET and enhancing Energy Security.
 - o Need for and importance of building regional institutional mechanism across policy, regulatory, technical level for long term development of Energy Secure region.



Mr. Ghanshyam Prasad, Chairperson, Central Electricity Authority (CEA)



Mr. Ghanshyam expressed his view that if all the people in the region come together, the individual country targets of that region will be easier to achieve. He cited the example of India where earlier each state had its own targets and met their own requirements, running a separate grid. Gradually the states were integrated, which created five regions within the country by combining fewer states together. Then 1991 onwards, gradually even the regions were also integrated and by 2013 all the regions were integrated. Despite regional integration market splitting was happening due to congestion in the system due to capacity and imbalance issues in the system. However, gradually over a period of time, now India has reached at a point where there is no market splitting that happens mainly due to adding up of enough transmission lines across the regions and states throughout the country which has brought stability into the system. Integration and interconnections helped in achieving the goal of One grid in India. Currently, in South Asia, there are a limited number of cross-country interconnections, and until and unless there are enough interconnections the goal of one market and optimal utilisation of regional resources cannot be realised. On that note he invited the panellists to share their experiences and thoughts on the subject.

Mr. Nima Tshering C, Director, Bhutan Electricity Authority, Bhutan



Mr. Nima highlighted that to enhance CBET, the compatibility of technologies should be focused upon, and the upcoming smart technologies may also be incorporated. He stated that in order to enhance CBET, there is a need to address questions such as channelising power through one or multiple avenues such as power exchange markets, bilateral and multilateral arrangements etc. He stated that to enhance CBET, Bhutan is also trying to streamline its own domestic regulations to bring efficiency in supply service, demand and generation forecasting.

SAFIR-SAREP Conference on
'Deepening Cross Border Electricity
Trade and Regional Electricity Market
Development for Sustainable Energy in
the South Asia Region'

March 2-3, 2023

Organized by South Asia Forum for Infrastructure Regulation (SAFIR)
USAID's South Asia Regional Energy Partnership (SAREP)



Mr. Dilli Bahadur Singh, Chairman, Electricity Regulatory Commission, Nepal



Mr. Dilli Bahadur Singh from Nepal started his address by thanking all the organizers and the dignitaries present at the conference. He spoke about the Nepalese perspective. He shared the development history of Nepal's CBET with respect to various acts and regulations that have evolved since 1991.

He stated that in case of Nepal, the Electricity Act, 1992 has provided a legal framework to authorise licenses to import and export electricity with approval from the Nepalese government. Nepal's Hydropower Policy, 2001 sought to develop electricity as an exportable commodity and also gave a direction to Nepal to establish itself as an exporter of electricity. Currently, the Nepal Electricity Authority (NEA)

imports and exports power. But for CBET and regional electricity market to foster, Nepal shall optimise a multi-buyer system and welcome private players. The Electricity Regulatory Commission (ERC) Act 2017 and the ERC Rules 2018 provides responsibility to ERC to determine terms and conditions for operation of electricity for power traders. Most recently, a new Electricity Bill which provides for license to power traders and a legal framework for cross border electricity trade was introduced by the Nepalese Government in the federal parliament. It is expected to pass by the end of this year.

He also informed that ERC, Nepal is at the verge of releasing a grid code which facilitates CBET. The new grid code is in line with SAFIR's common minimum grid code for the South Asian region. After being affected by electricity crisis for almost a decade, Government of Nepal realised that there is a need to take concrete steps towards development of electricity sector. ERC since its inception in 2019 has focused on facilitating the private sector to take on greater roles to contribute in the electricity sector in Nepal. Cross border connectivity and CBET has helped Nepal in mitigating power shortages. Even today, Nepal fulfils its energy shortfall in winter by importing energy. In monsoon, when Nepal has surplus power, it exports it to India. This has been made possible by CBET. Hence, CBET provides security against vulnerability caused by overdependence in a specific energy source. Cross border connectivity and CBET helps increase reliance, resilience of grid, as a widely connected grid is capable of maintaining stability even in unprecedented circumstances.

CBET also provides options to source electricity cheaply and affordably. He stated that it is important for the governments of South Asian nations to enter into agreements with each other and set specific targets to achieve a single regional electricity market in South Asia. Attempts must be made to create a South Asian power pool in this region. He also stated that in the future, the South Asian power pool can also be connected to the ASEAN countries in the east and the GCC countries in the west. This will also help achieve the aims of One Sun, One World, One Grid. Development of regional institutions can help in dissemination of information, creation of a framework for financing and sharing of infrastructure, harmonising policies and regulations and sharing of technical expertise and best practices. SAFIR and SAREP with the help of USAID can achieve this by bringing together all stakeholders. He also stated that Nepal is blessed with abundant resources of clean energy, which it can supply to the rest of South Asia when a regional grid is created. He thanked SAFIR and USAID for organising the conference.

Mr. Chamath Goonawaradena, Director-Regulatory Affairs, Public Utilities Commission of Sri Lanka



Mr. Chamath Goonawaradena said that Sri Lanka has been exploring the possibility of electricity grid interconnection with India and CBET. He talked about several notable recent developments such as the example of 15th of February 2023 when Sri Lankan High Commissioner to India stated that within 2 months Sri Lanka and India will sign a pact to link power grids.

Mr. Chamath also stated that the key part of Sri Lanka's economic recovery plan rests on the developing its renewable energy resources in the islands north from where power can be transferred into southern India through cross border transmission cable. He also hoped that the Sri Lanka will get its transmission lines in place within the next

2-3 years so that renewable power produced can be exported to India.

He further spoke about a few additional developments. On 22nd February 2023 the board of investment for Sri Lanka has issued letter of approval to India's Adani Green Energy Ltd. for two wind power plants to be set up in two of the islands in the north of Sri Lanka at an investment of US\$ 442 billion. In 2014, Sri Lanka had signed the SAARC framework agreement for Energy Cooperation. In 2019, the Ministry of Power of Sri Lanka published the revised National Energy Policy and Strategies of Sri Lanka requiring the study and documentation of the feasibility of CBET. At legislative level in December 2022 the cabinet of ministers of Sri Lanka decided to carry out institutional reforms in the power sector including legislative amendments as maybe necessary to facilitate CBET. He further stated that at the regulatory level, the common minimum harmonized and standardized template of the electricity regulations for energy cooperation proposed under the USAID's SAREP program will be considered by the commission in establishing its regulatory framework. He suggested that a regional institutional framework with multilateral participation is the way forward to achieve desirable progress.

Ms. Shilpa Agarwal, Joint Chief (Engineering), Central Electricity Regulatory Commission, India



Ms. Shilpa stated that transmission is the main backbone of the cross-border energy trade. She highlighted several changes that were worked upon by CERC in transmission sector in Indian context. She mentioned that CERC has come up with two products in transmission booking – Gross Network Access (GNA) and Temporary GNA (TGNA). She explained both the products in detail. She stated that CERC has already issued the CBET Regulations which presents a very well-defined framework, with multiple options on markets, tariff, procurement mode etc. She emphasised on the need for a strong transmission network so that there can be seamless integration of the grid. She talked

about the various upcoming ventures of CERC including the modification of the grid code where in there is a proposal of compensation for reactive power.

6 Working Session II: Creating Transmission Infrastructure - Developing a South Asia Regional Power Grid for Sustainable Energy and Greening the Grid for cross border clean energy trade

- **Session Chair:** Mr. S. S. Barpanda, Director, Market Operation, Grid Controller of India Limited
- **Session Panelists:**
 - o Mr. Durga Nanda Bariyait , Director, Transmission Directorate, Nepal Electricity Authority (NEA), Nepal
 - o Mr. Sonam Tobjey, CEO, Bhutan Power Corporation, Royal Government of Bhutan
 - o Mr. Abdur Rashid Khan, Project Director (Chief Engineer), Power Grid Company of Bangladesh (PGCB), Bangladesh
 - o Mr. Rajesh Kumar, Senior General Manager, Power Grid Corporation of India Ltd
 - o Mr. Pankaj Khurana, Programme Specialist, International Solar Alliance, New Delhi, Delhi, India
- **Key focus areas:**
 - o Creating Infrastructure for deepening regional power market development-Developing a South Asia Regional Power Grid -Opportunities and Challenges
 - o Accelerating the development of cross border transmission interconnections
 - o Future plans for cross border transmission interconnections and vision of South Asia Regional Power Grid
 - o Role of the South Asia Regional Power Grid in enhancing Sustainable Energy
 - o Planning the Grid for CBET and Transmission System for Integration of large-scale renewable energy capacity in South Asia.
 - o Establishment of South Asia Regional Power Grid under 'One Sun One World One Grid': Challenges and Prospects
 - o A regional planning approach -developing Regional Transmission master plan, integrated system operation.



S. S. Barpanda, Director, Market Operation, Grid Controller of India Limited



Mr. Barpanda greeted all the delegates. He stated that before the power exchanges were operationalised in 2008, in 2004, Open Access was operationalised. Thus, while theoretically people could access power anywhere in the country, in practice there was perpetual congestion towards southern region in India. After optimizing the power exchange, it was found that there was market splitting and the price in rest of the country was lower and price in the southern region was higher. Gradually after all the transmission interconnections were developed, the congestion reduced. Presently, there is practically no congestion and there is same price throughout the country and even internationally with Nepal.

He stated that the interconnection with Nepal has become quite strong, referring to the Muzaffarpur-Dhalkebar line. He stated that owing to this transmission line, the two nations are able to exchange power. Nepal is exporting power to India whenever they have surplus and is also able to import power from India when required. Nepal is also able to access the power exchanges in India. He cited that Bhutan also exports power to India, except for winter months wherein imports from India were also depended upon. In case of Bangladesh, he stated that the HVDC interconnection from its very inception has been running at nearly full utilization. Bangladesh was able to replace their costlier power through import from India and utilization has been very good.

He stated that the interconnection within BBIN (Bangladesh-Bhutan-India-Nepal) countries has become quite strong. Currently, there are plans to enhance interconnections beyond the BBIN subregion, and connections are planned with Sri Lanka and Myanmar. He highlighted that initially the transmission costs may seem a bit high because it may not seem feasible but once there is a transmission line in place, we can interchange power and get access to cheaper power from different sources. He once again cited the example of the southern region of India which used to face congestion and price went up to ₹20 per kWh. But once the interconnections were in place, the price in the entire country was at par and even southern region of India was able to access cheaper power for ₹4 per kWh to ₹5 per kWh. Hence, even if the transmission cost may end up to be higher initially, it pays off by itself in the long run.



He also stated that in the case of renewable power plants, line utilization will be less than that of thermal power stations where utilization was observed to be around 85%. He stated that we are in the midst of an energy transition which can be managed with new forms of storage. With this he invited the fellow participants to share their perspectives on the topic.

Abdur Rashid Khan, Project Director (Chief Engineer), Power Grid Company of Bangladesh (PGCB), Bangladesh



Mr. Khan stated that it is essential that we recognise the importance of collaboration cooperation among the neighbouring countries. So, one of the key topics of this session is the creation of the transmission infrastructure and development of a South Asia regional power grid. This presents us with both, opportunities, and challenges. There are some contractual and regulatory issues among the countries, there exist a lot of regional political issues, harmonization of bureaucracy and many other challenges. But it is important to understand that the development of the South Asian regional power grid is needed to improve energy security, increase efficiency, and reduce costs in the region. Accelerating the development of cross border transmission interconnections is another vital aspect of developing a South Asia regional power grid.

He stated that Bangladesh has already made significant progress in this area with the construction of various transmission lines. As we plan for the future of cross border interconnection it is essential to have clear vision on the South Asia regional power grid. This vision must consider the unique energy needs and challenges of each country and ensure that it benefits all participating nations equally. The South Asian regional power grid will help in enhancing sustainable energy utilisation and the development of renewable energy sources critical for the region's sustainable energy future. The South Asian regional power grid can facilitate the integration of large-scale renewable energy capacity. Most of Bangladesh's power generation is from fossil fuels, almost 49% is from gas, 32% is oil based and almost 11% is coal fired. Hence, there is need to utilise more hydro and solar power resources. A regional grid will be very useful for Bangladesh such cases and it will also help in cost saving. He stated that Bangladesh is committed to work with its neighbours to develop a sustainable energy market in the South Asian region. He suggested that the establishment of a South Asian regional power grid can help in achieving these goals.



Sonam Tobjey, CEO, Bhutan Power Corporation, Royal Government of Bhutan



Mr. Tobjey stated that Bhutan is endowed with rich hydro power resources with capacity of 33,000 MW out of which currently 2034 MW has been harnessed and 3042 MW is under construction and is at various stages of completion. Bhutan also has a considerable renewable energy generation potential.

He remarked that the success of the cross-border trade between India and Bhutan has demonstrated the benefits of regional cooperation. During the monsoons, when Bhutan has surplus generation, it exports to India which is from May-December and because of its increasing domestic load especially coming from industries, in winter Bhutan imports power from India. Since last year, Bhutan imported around 240 MU and this year January 23 onwards it is still reporting an average of around 4.5-5 MU per day of import. This will go on till Bhutan's generation is able to pick up. Hence, the cross-border interconnection between India and Bhutan really has benefited both the countries.

He also stated that one can have a great connectivity with those countries with whom we share international border but doing trade with those with whom interconnectivity is very difficult, and there lies the real challenge. To address these issues there has to be strong political commitment and good will of the government from every participant country so that it gets connected. Legal and policy framework should be harmonised and put into place for providing equal level training period for all the participants in the market. We should be able to make electricity available like any other goods. If there is no market access nobody comes to invest because when somebody wants develop power projects the question of market availability arises. From this perspective general grid interconnection is key. He summarised by saying that regional energy connectivity within the South Asia region has the potential to bring significant benefits in terms of energy security, economic development and environmental sustainability in the region by promoting regional cooperation investment in energy infrastructure

and technology. This process can be realised, and the region can move towards a more sustainable and resilient energy future. It is therefore important to continue to promote regional cooperation and investment and energy infrastructure to unlock these benefits.



Mr. Durga Nanda Bariyait, Director, Transmission Directorate, Nepal Electricity Authority (NEA), Nepal



Mr Bariyait began by talking about Nepal's electricity crisis of 2014-15, where huge load shedding was taking place as the Nepal Electricity Authority was not able to supply round the clock power. However, within the next two years, Nepal completely transformed its situation. With active government intervention, efficient demand side management and utilisation of cross border links with India (Dhalkebar- Muzaffarpur line which helped to commence import of 150 MW) Nepal was able to meet its internal demand. He emphasised on the importance of having cross border interconnections.

Nepal now has surplus power for 7 months in a year, and it even exports power to India. In the dry season, when the hydro power generation is less, Nepal imports power from India. This indicates the vitality of a robust cross border interconnection system. He pointed out that currently, in its peak generation months, even after exports, Nepal has surplus power which it is not able to completely utilise, and it is wasted as spillage.

He stated that Nepal with its past experiences is now emphasising on building more cross border transmission lines. He explained the geography of Nepal and said that currently, Nepal has only tapped into a mere 3% of its total hydro power potential. Nepal aims to increase its installed generation capacity to 3000 MW within the next 3 years and to 5000 MW within the next 5 years. Nepal aims to become a power surplus nation (in all 12 months) by 2025-26. Nepal will then require robust transmission interconnections, especially with India. Nepal

has already formed a joint venture / signed agreements with a relevant Indian PSUs and the Indian government, to commission new transmission lines. He noted that internally too, Nepal is constructing 6,000 Circuit Km transmission lines within the next 5 years to increase the robustness of its system and boost the per capita consumption of electricity. Nepal has estimated that it requires USD 4 billion of investment, in order to construct these transmission lines. So, the country is focusing on building a strong business model to attract more investment. So, with the upcoming policy, regulatory and infrastructure development, Nepal aims to become a key exporter of power in the South Asian Region.

He mentioned that Nepal is currently using three modes of trading with India – power exchange, short term bilateral contracts, and day ahead market participation. He stated that Nepal and Bhutan have huge untapped hydro power potential, which can be utilised to meet the huge power demand in India and Bangladesh. There are demand complementarities that further strengthen the business case for power trade in the region. However, this will only be possible, if we have a robust transmission network and policy framework that allows for CBET in the region. He also stated that in order to have a truly regional power grid, it is also important to create transmission links, directly between Nepal and Bhutan and Bangladesh, so that the concept of a regional grid can be truly materialised. He suggested that there should be an institutional setup at the regional level along with a regional masterplan which will help in achieving the goal of a single regional grid.



Mr. Rajesh Kumar, Senior General Manager, Power Grid Corporation of India Ltd



Mr. Kumar stated that a lot of work has been done in the past to pave the way for these cross-border interconnections. But now there is an urgent need to further strengthen these existing systems, so that the region can transition to clean and renewable energy sources.

He stated that identification of location and getting investment are the two key aspects for any cross-border interconnection. Having a clear financing mechanism will reduce the time required in implementation. He remarked that currently the region has multiple types of links developed through different modes, so for them the cost recovery mechanisms are also different. He suggested that if the region has strong interconnections, the resource and demand complementariness can be

utilised to its fullest. These interconnections can help the nations access untapped markets, wherein they can sell and purchase electricity.

He then talked about the funding mechanisms for these interconnections. He stated that a clear funding mechanism with a defined cost recovery mechanism will help develop the transmission links at a faster pace in the region. He also stated the currently there is emphasis on One Sun, One World and One Grid. So, if the South Asian Region connects with Southeast Asia and the Gulf region, this will be even more beneficial to the region. This will help South Asia utilise the time and resource diversity among multiple regions to its fullest. This will help the nations achieve their clean development targets at the earliest.

Mr. Pankaj Khurana, Programme Specialist, International Solar Alliance, New Delhi, Delhi, India



At the very outset, Mr. Khurana gave a brief background about the International Solar Alliance (ISA). He stated that the ISA is an intergovernmental organisation having 114 member countries. One Sun, One World, One Grid is the flagship program of the ISA. The aim of this program is to connect all the regional grids and form a common grid, which will be used to supply renewable energy. This initiative will help in mitigating risk associated with intermittencies of resources by allowing flow of power from one region to another. ISA already had BBIN nations as its members and it is implementing multiple programs in these countries.

He suggested that facilitating CBET will help address the unavailability of power at the receiving end, and this can be supplied from the energy surplus states like Nepal and Bhutan to states with high demand like India and Bangladesh. He stated that combining the domestic renewable energy generation with CBET will accelerate decarbonisation. He suggested that sustained cooperation, harmonised legal and regulatory frameworks, will help in increasing the CBET in the region. This will provide energy security to the region. CBET will also make power more economical, and it will also help in achieving the climate goals. However, for the robust development of regional grids and CBET, it is essential to address technical and commercial barriers. Issues such as technical assessments for laying of transmission lines, political scenarios, costing mechanisms, cyber security concerns must be tackled to ensure the development of a robust CBET system. In this ISA is providing support and assistance to relevant parties to help implement CBET in the region.



Day 02



7 Working Session III: Strategy for transitioning gradually to Trilateral/Multilateral Power Trade and Development of Regional Power/Energy Market for advancing Sustainable Energy

- **Session Chair:** Mr. Mohammad Hossain, Director General, Power Cell, Ministry of Power, Energy & Mineral Resources, Government of Bangladesh.
- Key findings of the study on “Transition of bilateral power trade to trilateral and multilateral power trade in SOUTH ASIA and International Experiences ” by Mr Rajiv Ratna Panda, Power Market Specialist, SAREP
- **Session Panelists:**
 - o Mr Ashok Kumar Rajput, Member (Power System), Central Electricity Authority, India
 - o Mr. V K Agrawal, Senior Advisor, SAREP
 - o Ms. Dawa Chhoedron, Chief Engineer, Department of Energy (DoE), Ministry of Economic Affairs, Royal Government of Bhutan
 - o Mr. Rohit Bajaj, Head, Business Development, Regulatory Affairs & Strategy, Indian Energy Exchange Limited (IEX)
- **Key focus areas:**
 - o Opportunities and challenges in transitioning gradually from Bilateral to Trilateral/Multilateral Power Trade (TMPT) for advancing Sustainable Energy through Cross Border Energy/Electricity Trade (CBET).
 - o Key findings of the study on” Transition of bilateral power trade to trilateral and multilateral power trade in South Asia and International Experiences”
 - o State of Energy market development in each SA country and strategy for development of Regional Power Market.
 - o Key ingredients required in each country to enable TMPT, Learnings from CBET through power exchange.
 - o Model for Regional Power/Energy Market development in South Asia.



Mohammad Hossain, Director General, Power Cell, Ministry of Power, Energy & Mineral Resources, Government of Bangladesh



Mohammad Hossain gave the opening remarks and stated that this journey of bilateral trade had started in 1950s itself, it has picked up pace in the last decade. Currently, we have bilateral trade between India and Nepal, Bhutan, Bangladesh, particularly in BIMSTEC countries. But this trade is not exactly regional, as it is happening only between India and other countries. It is centred around India. If this trade is to be truly regional there is no other way than going for trilateral and multilateral trade. However, it is a building block, no less. It is high time we go for trilateral and multilateral trade. India has made lot of change in regulatory framework in power sector, enabling it to go for this kind of trade. India's role has been crucial for opening this trade.

He then introduced the panellists. He also stated that Bangladesh is trying to obtain approval for participating in Indian power exchanges. He also mentioned about the impending final signing of an agreement of purchasing 500 MW of power from Nepal and for arrangements for import of 50 MW from the India Energy Exchange (IEX). He remarked that Laos is the only country in ASEAN that is recognized as the “battery of ASEAN”, but we have other countries in South Asian region that have even more resources which are yet to be harnessed.



Rajiv Ratna Panda, Power Market Specialist, SAREP



Mr. Rajiv presented key findings of the study on “Transition of bilateral power trade to trilateral and multilateral power trade in South Asia and International Experiences”. The study consists of four parts -

1. Intro and context
2. Overall approach
3. Key learnings from review of international experiences.
4. Modern framework for trilateral and multilateral trade in South Asia

Some points from the presentation he covered were as follows: -

- In South Asia, the cross-border electricity trade is 24 BU. This is limited as compared to Europe which has a CBET of 240 BU. Hence, there is scope for enhancing the cross-border electricity trade in the South Asia region. Upon compilation of various plans, we can see that there will be a capacity of 43.8GW of cross border trade, by 2040. It is expected that CBET will be 10 times the current trade of 4.5GW.
- There needs to be power market diversity. The market has not progressed much except for India and to some extent in Pakistan. In other countries, reforms haven't progressed beyond allowing Independent Power Producers (IPP) and competition in generation. However, presence of power exchanges and traders in India opens up potential opportunities to support trilateral and multilateral trade. Pakistan too has recently made some promising changes in its existing regulations.
- In trilateral trade – Bangladesh plans to import 1GW from Bhutan and 3GW from Nepal via India. In South-Central Asia, Pakistan is going to export from Tajikistan and others under the (CASA project), where Afghanistan is transit country. There will be a transit charge levied by Afghanistan.
- This study aimed to learn from international experience and use such learnings towards development of a model regional framework to facilitate transition towards trilateral and multilateral power trade in South Asia. The study assessed the current status of the power pools in the Gulf countries (GCC), South Africa (SAPP), European market, Nord pool, ASEAN, Mekong Subregion etc.
- Upon assessment of the aforementioned power-pools, the study found that there exists strong inter-governmental cooperation in these regions. There is extensive coordination and cooperation in the regional regulatory and technical mechanisms.
- In other regions around the globe, there are permanent regional institutional mechanisms that play a key role in trilateral and multilateral power markets. However, they have evolved over time. They are a result of the sustained regional efforts and have been shaped over a long period of time.
- The study cited the example of Laos - Laos is said to be the “battery of ASEAN”, it sells hydropower to many ASEAN countries such as Singapore, even without having any regional institutions. This was made possible by the extensive cooperation amongst the 4 ASEAN nations of Laos, Thailand, Malaysia, and Singapore. Energy Purchase and Wheeling Agreement (EPWA) governs these multilateral transactions.
- The study has tried to develop a broad, model framework having various components such as– strategic and political, legal, policy and regulatory, technical, and operational, commercial, institutional, and sustainability. This framework may be utilised by the South Asian region to formulate its own structure for CBET and create a regional power market. For trilateral transaction to happen there is a need to finalise the transmission and wheeling arrangements in a cross border regional context. The detailed presentation is attached as Annexure-2

V K Agrawal, Senior Advisor, SAREP



Mr Agrawal reiterated the objective of carrying out the study on “Transition of bilateral power trade to trilateral and multilateral power trade in South Asia and International Experiences”, it was to find out how we can address the barriers to trilateral and multilateral trade. He noted that for the purpose of the study, 11 different power pools were examined. The factors that facilitated power trade in the regional pools were studied. Some of these factors are –

- Sharing of reserves, reduction in marginal generation capacity and security of supply.
- Sharing of norms for surpluses or wanting to optimize costs.
- Power trade to make use of resource complementarities
- Increasing competition and choice

There are two main categories of energy trading – either the trade was going through markets (Europe and America), or through inter-governmental agreements (SAPP, GCC, ASEAN, GMS etc.)

Mr Agrawal then discussed the case of South Asian Region. He said he believes that South Asia wants to trade so as to be able to transition to clean and green energy, have resource adequacy, and utilise its complementarity of resources. He stated that market availability is essential to have competition and choices. He emphasised on the support required from the governments in order to create institutional mechanisms and sign the relevant agreements for ease of power trade. He also remarked that changes are happening and that the trade has increased over the past few years.

He flagged the lack of adequate transmission capacity as a potential barrier for CBET. He also stated that initially, if a transmission corridor is pushed well in advance, it may appear that it is not being utilized fully. However, once it is created it would compel the countries (involved) to go forward with the trade. These transmission corridors need to be strengthened. In the power exchange, multilateral options are already open, trilateral would be also come up in near future. But we have to keep the corridors ready for this to take place.



Dawa Chhoedron, Chief Engineer, Department of Energy (DoE), Ministry of Economic Affairs, Royal Government of Bhutan



Ms. Dawa spoke about the huge potential of trilateral and multilateral trade within South Asia region. She highlighted that Bhutan is aware of regional diversity of resources and the need for regional interconnection is undisputed. There is now talk globally about realignment of energy mix, especially in light of the recent energy crisis.

She stated that Bhutan now has five decades of hydropower cooperation with India on win-win modalities. Bhutan has developed cross border transmission links between the two countries and 1 GW is also on way to commission. Bhutan has 33 GW and 12

GW of hydro and solar power potential. The maximum power trade in the region happens between India and Bhutan and that is because they are synchronously connected to India's grid. However, full capacity of transmission developed so far is still to be utilized. Hydropower is flexible, and renewable energy from sun and wind is intermittent – Bhutan realises that the full potential of these interconnected sources can only be realized through an interconnected grid. The entire South Asian region can survive with simply Bhutan and Nepal's hydropower resources itself.

She further invited the attention to the fact that Bhutan despite being net surplus in power creation has also had to face power deficit. In 2022, Bhutan had to buy power from India for the first time. Bhutan bought power from India this year too. It looks like it will have to continue this for several years now. Over the years, Bhutan has gained trading and demand-supply management experience by accessing India's market. She stated that there is need for not just creating new infrastructure, but also enhancing and building on existing infrastructure. The power exchange market of India has already opened up for neighbouring countries. It is only a matter of extending it beyond the current level to transform it into a regional market. She then talked about the MoU with Bangladesh. It is a big development in trilateral cooperation which has built upon the existing bilateral cooperation.

She suggested that the example of Laos can be emulated in this region as well. South Asia needs to determine the charges. Even in the absence of regulatory framework, for the mechanism have all the right ingredients to move into Laos example or even something better than that. Bhutan has the right experience for the regional power market, both import and export. Bhutan is adhering to all India's regulations, and recently signed Settlement Nodal Agency (SNA) agreement for settlement of grid related charges. She stated that Bhutan stands in full support of India's frameworks put in place to bring grid discipline. Bhutan is preparing its own internal discipline mechanism to be fully prepared to participate in regional trade.



Rohit Bajaj, Head, Business Development, Regulatory Affairs & Strategy, Indian Energy Exchange Limited (IEX)



Mr. Rohit highlighted how the market has evolved. In the past 10 years, all countries have added renewable capacity. He stated that merely 10 years ago, most of the South Asian nations were in a continuous deficit scenario, but now there are seasonal deficits only in some pockets.

He remarked that in bilateral and multilateral trade, we want to be doubly sure of the security as we enter long-term agreements and pay a high cost for it. He explained this with an example – “If I have shortage for only three months, I will still be buying through a contract for a whole year. You are thus paying four times the capacity to meet your requirements.” This has been the experience of many countries.

He also stated that in case of many power pools such as the European market, the dependence on power exchange has increased over the years from a miniscule 10% to more than 90% in some cases. This is because

there is enough infrastructure and lines available, that they are confident of coming to market to buy whenever they need. This is because there is enough liquidity in the market.

He remarked that unless South Asia has a robust transmission network, nothing will work. If the transmission network is put in place, the markets will flourish on their own. Today, when Nepal has surplus power generated during monsoon, it is sold out. In last five years, demand in India grew by 3.8%, this entire dependence is on long term. Short term market grew by 9.5%. Within the short-term market, above 50% is in exchanges today, which grew by 20%. As confidence of transmission corridor availability improves, people are moving from long term procurement to exchange platform.

Sellers have also started relying on exchanges. Discoms also want to buy from exchanges. They want to avoid fixed charges. This has happened since 2013-2014 when India synchronized our grid across the country. In South India, there was lot of splitting in market because there wasn't enough transmission. He suggested that South Asia should work on the fundamentals and leave the rest to the market. He stated that South Asia has a good market that can be used by everybody.

Ashok Kumar Rajput, Member (Power System), Central Electricity Authority, India



Mr. Ashok spoke about the way forward to accelerate trilateral and multilateral power trade. He stated that the foremost requirement is that developmental activities have to be promoted and demand needs to be developed in some of the countries. In India, intense electrification is still required for higher economic growth. For this, resource assessment, potential, and safe exploitation has to develop. Bhutan and Nepal are doing this. He stated that India has lots of renewable energy now and will be in a position to help its neighbours by exporting power. Greater interconnection will also help in system requirements. The intermittency of renewables will certainly have ramping requirements and flexibility needs. Flexibility can be met with hydropower and retrofitted thermal plans. Capacity installation and its utilization is also important.

He emphasised on the importance of having a strong transmission network. A strong and robust transmission system with inbuilt contingency mechanisms is very important. In the face of different regions and difficult terrains, we need strong communication systems so that proper utilisation of resources can take place and we can manage systems in a safer way. Pertinent issues and sustainable solutions should be shared and arrived at.

He also suggested that on the technological side, the latest technology must be utilised to build a robust system for a long-term. To ensure safety of the system it is essential to have a trouble free and a secure system. South Asia has different types of terrains and natural events, and these must be considered while designing the systems. He also remarked that building the institutional capacity building is necessary - all forms of rules and regulations have to be studied, brought to a common forum, and all resource complementarities should be utilised.

He also suggested that power exchanges need to be strengthened and built with adequate and latest infrastructure. He further remarked that personnel training is also necessary to ensure smooth functioning. He suggested that the policies should be flexible and have provisions for modification. This arrangement will facilitate development of trade and market and it will be beneficial for concerned countries.

He noted that some areas are still unelectrified or sparsely electrified, which necessitate upgrades in downward sub-transmission capacity as well. He suggested that the rising demand in our region indicates growth. He suggested that we should have appropriate methods and load forecasts available. We also need to ensure energy

security. Mr. Ashok cautioned that simply having growth at the cost of sustainability is not advisable. We also need to achieve our energy transition and sustainability goals.

He suggested that green hydrogen and its derivatives are developing now, and we can think of them as an alternative to battery energy storage, which remains expensive. He also suggested that smart technology and smart grid must be made a part of the infrastructure.

It is essential for people to people connect to improve both cooperation and coordination. These actions will have meant only when activities happen at the ground level. He also suggested that the processes should be simplified, we should understand each other better, the changes required should be formulated in a time-bound, transparent manner. He also stated that the overall cooperation should be people centric, and the economy should not be the only factor.



8 Working Session IV: Building New Energy Infrastructure: Emerging Clean Energy Innovations, Technologies for Energy and accelerating clean energy transition

- **Session Chair:** Mr. Arun Goyal, Member, Central Electricity Regulatory Commission, (CERC), India
- **Session Panelists:**
 - o Mr. S. S. Barpanda, Director, Market Operation, Grid Controller of India Limited Mr. V K Agrawal, Senior Advisor, SAREP
 - o Mr. Vikram Gandotra, Head Utilities sales and strategy, Siemens
 - o Mr. Awdhesh Kumar Yadav, Chief (Engineering), CERC, India (Regulating and incentivizing the adoption of Clean Energy Innovations and technologies for accelerating clean energy transition)
 - o Mr. Debi Prasad Dash, India Energy Storage Alliance (IESA), India (Innovative Energy Storage Technologies)
- **Key focus areas:**
 - o Need for accelerating clean energy transition and Opportunities and challenges of Building New Energy Infrastructure
 - o Building a technology ecosystem for fostering energy technology innovation
 - o Modernizing Regional Power Grid – Smart Grid Technologies in Transmission Sector
 - o Innovative Energy Storage Technologies (Batteries, Thermal, Mechanical Storage, Hydrogen, Pumped Hydropower)
 - o Developing a Hydrogen Economy and National Green Hydrogen Mission of India
 - o Smart Technologies for Integrated power system operation
 - o Innovation in Regional Electricity Markets- Opportunities and challenges
 - o Creating Regional Energy Technology Innovation and Transfer Center- BIMSTEC Technology Transfer Facility (TTF)
 - o Regulating and incentivizing the adoption of the Clean Energy Innovations, Technologies for Energy & Climate Security



Arun Goyal, Member, Central Electricity Regulatory Commission, (CERC), India



Mr. Goyal stated Prime Minister Modi's ambitious aim of making India a net zero emitter of carbon by 2070. He further elaborated upon the targets and said that the PM has also set two short term targets – non fossil fuel capacity of 500GW by 2030 and achieving 50% of India's energy requirement from Renewables by 2030. He stated that India's per capita consumption of electricity is expected to grow tremendously, so this will require a lot of capacity addition. Plan is to have more than 800GW of installed capacity within the next 10 years.

Currently, 72% of India's energy requirements are being met by coal, but still its per capita carbon emissions are some of the lowest in the world. South Asia has a huge potential of renewable sources. South Asia's solar potential is estimated to be nearly 950GW, wind potential is estimated to be 1,300 GW and Hydro potential is around 350GW. It is estimated that less than 5% of the solar and wind potentials has been harnessed till date, and only 18% of the hydro potential has been utilised. If South Asia aims to have round the clock electricity from renewables it needs interconnection of regional grids, and energy storage systems. The ministry has issued guidelines and CERC has provided a robust regulatory procedure for grid interconnection. With this, an enabling environment has been created in which exchange can take place. This enabling framework that has made it possible for neighbouring countries to participate in exchange and day ahead market. He stated that last year in 2022, nearly 1 billion unites were exchanged through this system.

Currently, India too is importing power from Bhutan. The traffic is both ways. He suggested that we can even think of going beyond South Asia and integrate our regional grids with ASEAN and GCC. The advantage of this is that the baseload stations in India and Gulf in early morning can be used to power South-East Asia during the peak hours. There is almost 5-hour time difference between these two regions which enables their integration.

Coming to energy storage, Government of India is focusing substantially on the same. Under Production Linked Incentive (PLI) scheme, special focus is on energy storage as well. India is planning to have approximately 50GW of energy storage. India requires 150GW energy storage systems. Currently, the emerging technologies such as green hydrogen are being deliberated upon. Hydrogen can be used as feedstock for industry and emission-free fuel source for heat, energy, transportation. For green hydrogen, the Government of India has already committed a budget outlay of INR 20,000 crores.

He also stated that the surplus hydro power from Bhutan and Nepal can be used for electrolysing green hydrogen that is likely to come up in India. Energy storage and hydrogen electrolyser can be variable load which will be helpful in regulating frequency. Similarly, energy storage systems can also act as generators when we have no access to renewable energy.

He also suggested that South Asia needs to have an enabling framework and ease of doing business to get more investments and more movement towards clean energy. He also stated that CERC and the Government of India is deliberating on issues related to accelerating clean energy transition and opportunities and challenges, particularly on regional power grid technology, innovative energy storage technology, etc.

S. S. Barpanda, Director, Market Operation, Grid Controller of India Limited



Mr. Barpanda discussed challenges in integrated renewable energy in grid. He stated that renewable energy has been largely integrated in India. Currently, in India, in 2021-22, 9.5% of energy in annual terms was from renewable sources.

In Karnataka, the maximum daily renewable energy penetration has reached 72%. At one point, the instantaneous Renewable penetration in Karnataka had even reached 132%.

He then discussed several key challenges –

1. Resource adequacy – variability and intermittency will be there. Despite having a large generation capacity, sometimes it falls to very low levels, due to factors such as weather conditions. In case of solar energy, a good transmission system is required to deal with cloud cover and other variations in one part of the country.
2. Seasonal imbalance can also be there, and at times, sunlight can be very low. If we depend more on variable renewable energy (VRE), we need balancing resources. Coal may have to continue for quite some time, especially as a balancing resource.
3. Network adequacy – Optimum siting of VRE is very important. In India, renewable energy generation is concentrated in pockets, so the power has to be evacuated through high-capacity lines, which is a challenge.
4. Demand flexibility has to be there – Storage is also very important. So far, we've had pumped storage and BESS. Pumped hydro has added advantage of providing inertia and but, Inertia has been coming down over the past few years. This may increase the frequency fluctuations.
5. Voltage frequency – to control voltage, reactors have to be taken into service.

6. Compliance to standards – as per regulations all renewable energy generators have to be standard compliant but they are not always found to be so.
7. Cyber security also has to be ensured.
8. Visibility – Renewable Energy Management Centres (REMC) have been set up to provide visibility to system operators and assist in forecasting. Forecasting is essential, as reserve is deployed based on these forecasts, hence, the load, demand and generation forecasting is done. Multiple Phasor Measurement Units have also been installed in the country. This provides additional visibility to the system operator and helps analyse the disturbances in the system and take quick remedial actions.
9. Market - Real time and DAM is available and people now have freedom of choice. They can enter into long-term or medium-term contracts of their choice. Green DAM market has also been introduced. There are multiple products. We may even have to go for 5-min metering given the increased renewable energy integration. As we expand our footprint, renewable energy integration will be easier due to diversity, and larger area, more generation, more integration in system.

Debi Prasad Dash, India Energy Storage Alliance (IESA), India (Innovative Energy Storage Technologies)



Mr. Debi Prasad participated as panellist virtually. He stated that Grid integration has happened over last 20 years, any issues will resolve automatically given the multiple generation sources. But criticality will develop as load is also increasing due to more appliances like Electric cookers, EVs, etc. These new load patterns will impact our peak and off-peak time also. Our load and generation mix will have a different mismatch going forward. We may need to ramp up and ramp down during the day. There are ramping issues with solar which need to be addressed. The peak shifting also has to be managed. In hybrid projects, its seasonal generation (e.g., Wind) needs to be accounted for. Intra-day and intra-year generation is always varying irrespective of technology. We should now focus on grid reliability, resiliency etc.

In tier 2 cities in India, consumers have to pay a huge amount to not just to Discoms, but also for diesel generators, stabilisers etc. The grid might have to address this too going forward. Some universities in United States have their own grid that is synchronized with main grid. This acts as a backup plan. The new version of Grid Code which will be released soon in India is now emphasizing more on demand management. This will modernize our grid further. From policy side, the kind of support that was provided to deployment is also now coming to energy storage. Consumer awareness and expectation, and grid requirement is increasing. Consumers expect more and better. He stated that across the value chain of the electricity ecosystem, be it at the generation, transmission or distribution stage, energy storage systems will play a vital role.



Vikram Gandotra, Head Utilities sales and strategy, Siemens



Mr. Vikram stated that the reliability of power supply is important for economic growth. He remarked that unless we improve power supply, per capita consumption will remain low. Electricity is the engine of developed economies. It is up to us to see that power supply is made reliable, economical, for growth. When we talk about grid integration, we are trying to cash in on the possibility of arbitrage.

Climate change has affected all countries in South Asia, we are all facing this unprecedented change and it is expected to continue. Availability of reliable electricity supply in such a situation is important for all of us. He said that the power grids will be very different from what they are today in 20 years as more inter country links, HDVC, HVAC will be made more available. Renewables will occupy a predominant position as compared to the current scenario where we have more of grid connected large scale power plants. Once we have more rooftop solar, the situation will call for new type of technology and models for many dispatchable units. Both technology and policy will have to come together and that is how rooftop will also be integrated well.

Digitalisation is also essential. We are going to shift from copper based to fibre optic cables. Lot of data which is now unavailable will now be available in some form of another. This data must be protected. Cyber security of key infrastructure is essential. Cyber-attacks are a real threat, and we need to strengthen our systems to be safe.

For renewable management we must take inputs from weather forecasts as well in order to be able to safely integrate and generate such energy. There will be flexibility in generation as coal will still stay around. Ramping down and ramping up will remain.

On distribution side, our customers are more aware and demanding and have higher aspirations from power suppliers. They are not going to accept a failure of the electricity system. We have to make sure we engage with them. With technology, it is possible to make them partners when the grid is under stress. Technology is going to play a very crucial role in demand response program. In Asia, we have large manufacturing base, we should make use of technology developed for Asian conditions. India has one of the largest pools for power sector R&D in a concentrated location. We should utilise this to the maximum possible extent.



Awdhesh Kumar Yadav, Chief (Engineering), CERC, India



Mr Yadav talked about the challenges in decarbonization and net zero emissions. He stated that the foremost challenge is the production of enough clean energy. Secondly, that energy must be simultaneously consumed, for which we need demand loads. He stated that grid interconnection will lead to a larger load. Simultaneous consumption can be attained by integration of grids, or else we will need develop enough storage systems.

In solar, we need lot of barren land, which may be limited. In wind also, only few suitable sites are available onshore. Furthermore, offshore wind may be shallow or deep

water. Hence, innovation will be required to have offshore fixed bottom or floating wind power plants. In floating wind power plants, innovation can give access to deep seas, and a lot of clean energy production can take place.

For long term storage, battery is key technology for low-emission mobility and storage. They are highly flexible and rapid in responding to signals, can respond from within milliseconds to a few hours. They can handle short-term flexibility needs. Major innovations in battery energy storage are bringing down production costs, making it cost-effective. India too has planned renewable energy capacity additions to 500GW by 2030 towards its NDC commitments.

Grid integration or transmission will be leading capacity generation. We have planned transmission system for solar energy, spread across few areas in India. These renewable energy generators have to be integrated in the main grid. Hence, a lot of battery storage will be required.

Keeping that in mind that we have to create transmission infrastructure and enabling frameworks to have access to these systems, which is where regulators can come in to take initiatives to promote integrated renewable energy. Apart from general network access, CERC has framed tariff regulations for renewable energy technology and has created frameworks considering the variability of renewable energy sources, introduction of ancillary services, enabling market frameworks etc. He stated that the Indian electricity grid code is expected to be finalized shortly.

For some sector of consumers, GNA has been proposed. There exist such provisions that no transmission charges will have to be paid by some generators. Demand response as an ancillary service can be taken forward in future. He believes that cross border trade with lot of interconnections with neighbouring countries provides immense opportunities and can trigger rapid decarbonization. South Asia needs to utilise its untapped resource potential in hydropower, wind and solar sectors. Initiatives for grid integration and interconnection like India's are vital to the success of a robust interconnected grid.



9 Vote of Thanks

Mr. Harpreet Singh Pruthi delivered the vote of thanks. He stated that the 2-day conference had strengthened our understanding that there are huge opportunities to deepen cross border electricity trade in South Asia. There is complementarity of demand, and diversity of clean energy sources that makes a strong case for regional integration.

He stated that the main pillars that will support CBET have been identified. The first pillar is the Grid itself. Countries are working towards making their grids more robust and resilient. Over the past few years, many inter country interconnections have also been commissioned which have helped further integrate the region.

Secondly, consistent and predictable regulatory approaches will form the backbone of regional integration. In this direction, the CERC issued cross border trade regulations, 2019 which had institutional framework, access to Indian grid, tariff, framework for stable operation of the grid, payment security mechanism, dispute redressal mechanisms etc. Before these regulations were enacted, the ministry of Power had issued guidelines for cross border trade in South Asia. These guidelines also covered the trade through power exchanges. In 2021, CEA has also issued Procedure for approval and facilitating Import / Export (Cross Border) of Electricity. These guidelines and frameworks have helped create a robust framework for cross border power trade.

He acknowledged the role SAFIR and SAREP are playing in making common minimum grid code so that the regulations of all nations in this region are aligned. He noted that this conference is hence a very timely step. Learnings from this conference are very important. He further noted that the chief guest (Secretary Alok Kumar) also highlighted the importance of getting investments into the region by having sound regulatory frameworks and business models.

He thanked the SAFIR members from South Asia who took time to join in person. He expressed his hope and interest to work with these South Asian regional stakeholders towards deepening cross border electricity trade and creating a regional electricity market for the development for sustainable energy security in the South Asian region.



10 Way forward

The key objective of the conference was to provide a platform for dialogue, discussion, and exchange of ideas and to carry out deliberation on the following aspects. This objective has been fully achieved with the efficient coordination between SAFIR and SAREP teams, and with the eager participation of SAFIR member organizations, speakers and other panellists.

Some of the key aspects that emerged from the discussions during the event are summarized below:

1. There is a broad consensus that the presence of new transmission interconnections will play a key role in the deepening of CBET.
2. Opening of power exchanges in India to cross border participation has been widely viewed as a very effective step towards regional energy integration.
3. There is eagerness to explore market models beyond bilateral agreements, including models in which more than two countries participate in CBET.
4. Cross border electricity trade and growth in economy cannot be undertaken at the cost of sustainability. Availability of sustainable energy will be a key factor that will govern the nature of future trajectory of CBET growth.
5. SAFIR will continue to have a major role to play in enabling further deepening of CBET in the region, and further regional energy integration, especially in terms of quick implementation of policy measures through facilitating and supporting regulation, knowledge sharing etc.



SOUTH ASIA FORUM FOR INFRASTRUCTURE REGULATION AND USAID's SOUTH ASIA REGIONAL ENERGY PARTNERSHIP
CONFERENCE PROCEEDINGS: DEEPENING CROSS BORDER ELECTRICITY TRADE AND REGIONAL ELECTRICITY MARKET
DEVELOPMENT FOR SUSTAINABLE ENERGY IN THE SOUTH ASIA REGION



II Annexure I: List of speakers

SI no.	Name	Designation	Organization
1	Mr. Harry Kriz	Director	Indo Pacific Office, USAID-India
2	Mr. Harpreet Singh Pruthi	Secretary	SAFIR and Central Electricity Regulatory Commission (CERC)
3	Mr. Alok Kumar	Secretary	Ministry of Power, Government of India
4	Mr. Nima Tshering C	Director	Bhutan Electricity Authority, Bhutan
5	Mr. John Smith-Sreen,	Deputy Mission Director	USAID-India
6	Ms. Monali Zeya Hazra	Regional Energy Manager and Clean Energy Specialist	Indo Pacific Office, USAID-India
7	Mr. Ghanshyam Prasad	Chairperson	Central Electricity Authority (CEA)
8	Ms. Shilpa Agarwal	Joint Chief (Engineering)	Central Electricity Regulatory Commission (CERC), India
9	Mr. Dilli Bahadur Singh	Chairperson	Electricity Regulatory Commission, Nepal.
10	Mr. Chamath Goonawardena	Director-Regulatory Affairs	Public Utilities Commission of Sri Lanka (PUCSL)
11	Mr. S. S. Barpanda	Director, Market Operation	Grid Controller of India Limited
12	Mr. Durga Nanda Bariyait	Director, Transmission Directorate	Nepal Electricity Authority (NEA), Nepal
13	Mr. Sonam Tobjey	CEO	Bhutan Power Corporation, Royal Government of Bhutan
14	Mr. Abdur Rashid Khan	Project Director (Chief Engineer)	Power Grid Company of Bangladesh (PGCB), Bangladesh
15	Mr. Rajesh Kumar	Senior General Manager	Power Grid Corporation of India Ltd
16	Mr. Pankaj Khurana	Programme Specialist	International Solar Alliance, Delhi, India
17	Mr. Mohammad Hossain	Director General	Power Cell, Govt. of Bangladesh
18	Mr Rajiv Ratna Panda	Power Market Specialist	SAREP
19	Mr. V K Agrawal	Senior Advisor	SAREP
20	Mr Ashok Kumar Rajput	Member (Power System)	Central Electricity Authority, India
21	Ms. Dawa Chhoedron	Chief Engineer	Department of Energy (DoE), Ministry of Economic Affairs, Royal Government of Bhutan

SOUTH ASIA FORUM FOR INFRASTRUCTURE REGULATION AND USAID's SOUTH ASIA REGIONAL ENERGY PARTNERSHIP
 CONFERENCE PROCEEDINGS: DEEPENING CROSS BORDER ELECTRICITY TRADE AND REGIONAL ELECTRICITY MARKET
 DEVELOPMENT FOR SUSTAINABLE ENERGY IN THE SOUTH ASIA REGION

SI no.	Name	Designation	Organization
22	Mr. Rohit Bajaj	Head, Business Development, Regulatory Affairs & Strategy	Indian Energy Exchange Limited (IEX)
23	Mr. S K Soonee	Former-CEO	POSOCO
24	Mr. Vikram Gandotra	Head - Utilities sales and strategy	Siemens
25	Mr. Awdhesh Kumar Yadav	Chief (Engineering)	Central Electricity Regulatory Commission (CERC), India
26	Mr. Debi Prasad Dash	Executive Director	India Energy Storage Alliance (IESA)



I2 Annexure 2: Presentation on “Transition of bilateral power trade to trilateral and multilateral power trade in South Asia and International Experiences”



USAID
FROM THE AMERICAN PEOPLE

South Asia Regional Energy Partnership (SAREP)

Presentation

on

Study on the Transition to Trilateral and Multilateral Power Trade in South Asia

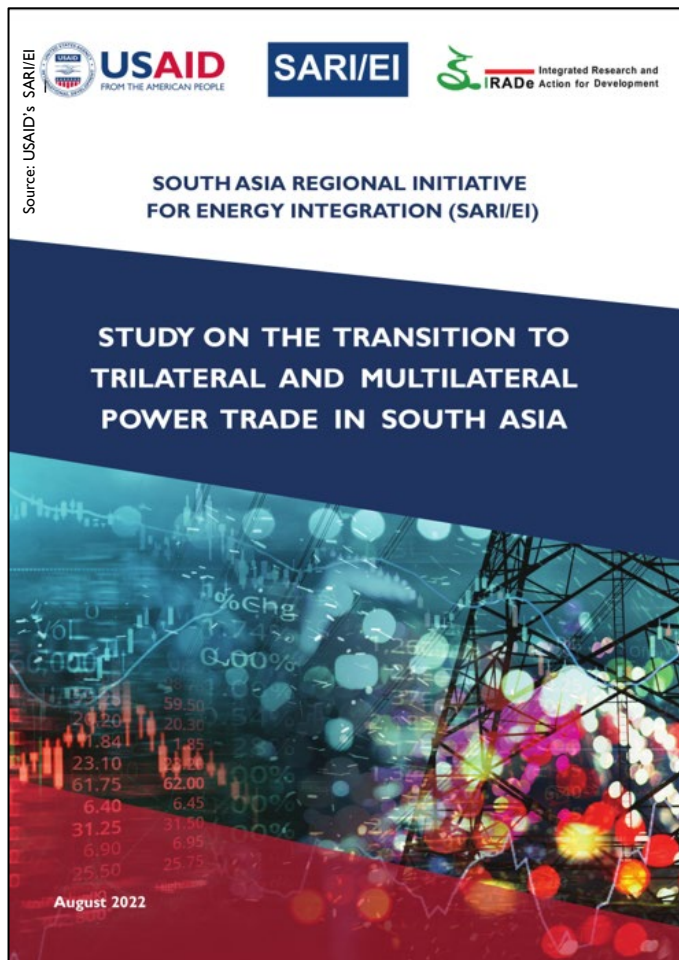
SOUTH ASIA REGIONAL INITIATIVE
FOR ENERGY INTEGRATION (SARIEI)

STUDY ON THE TRANSITION TO
TRILATERAL AND MULTILATERAL
POWER TRADE IN SOUTH ASIA

Working session 3: “Strategy for Transitioning gradually to Trilateral/Multilateral Power Trade and Development of Regional Power/Energy Market for Advancing Sustainable Energy”

SAFIR-SAREP Conference on “Deepening Cross Border Electricity Trade and Regional Electricity Market Development for Sustainable Energy in the South Asia Region”, 2nd and 3rd March, 2023, Hotel Le Meridien, New Delhi, India

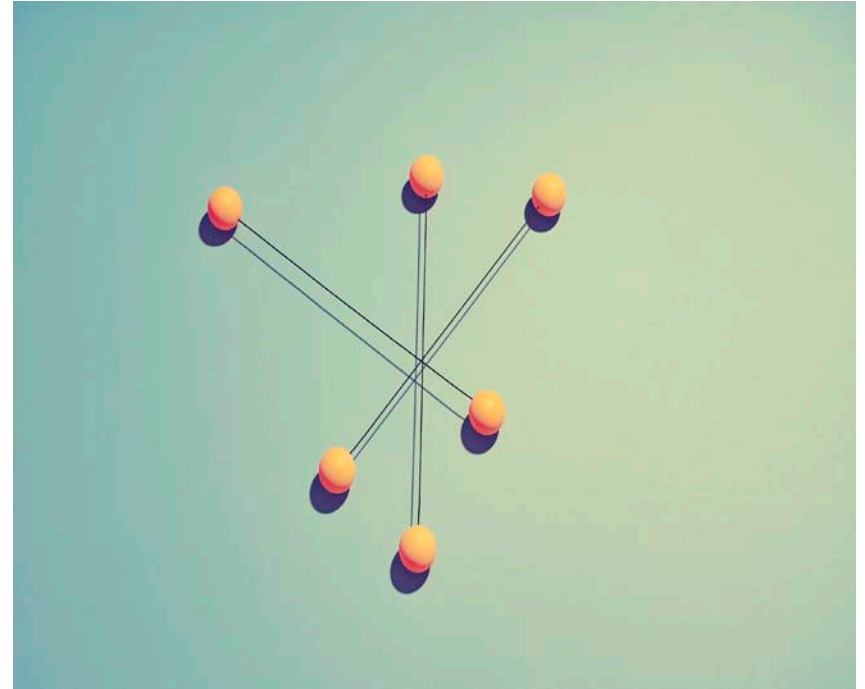
**Presented by
Rajiv Ratna Panda
Power Market Specialist, SAREP**



Contents

- 01 → Introduction and Context
- 02 → Overall Approach to the Study
- 03 → Key Learnings from Review of International Experience and Present Scenario in South Asia
- 04 → Model Framework for Trilateral and Multilateral Power Trade in South Asia

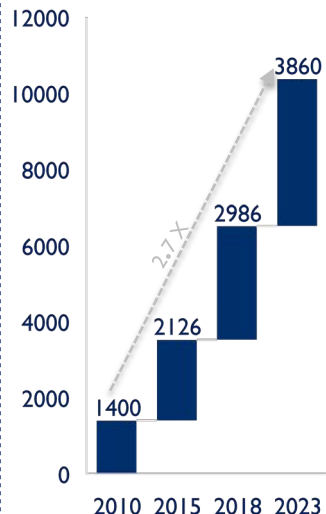
01 → Overall Approach to the Study



Cross Border Electricity Trade (CBET) in South Asia : Current Scenario

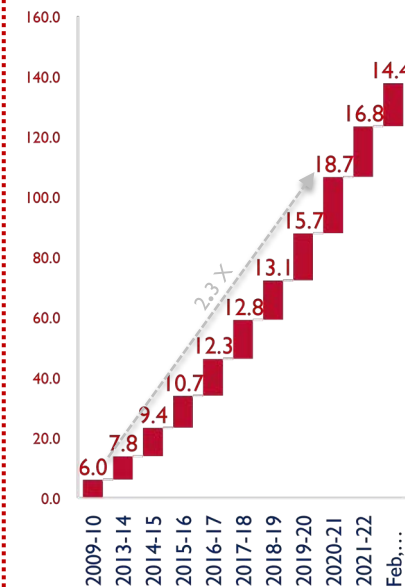
Bhutan-India ~2100 MW
India- Bangladesh ~1160 MW
Nepal-India ~ 600 MW

South Asia
CBET* (~ 3860 MW)



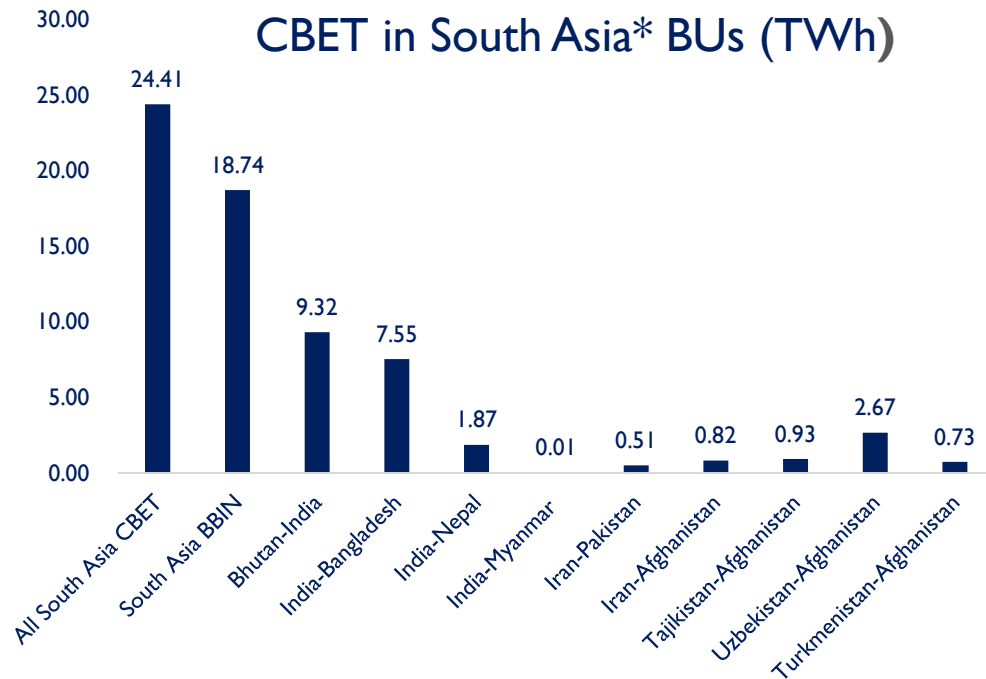
* ~ Maximum Peak Trade Data Source-CERC, POSOCO, NEA, MEA, NSB and Other Sources

South Asia (BBIN)
CBET BUs (TWh)



Data Source-CERC, POSOCO, MEA, NE, NSB etc. BUs-Billion Units

CBET in South Asia* BUs (TWh)

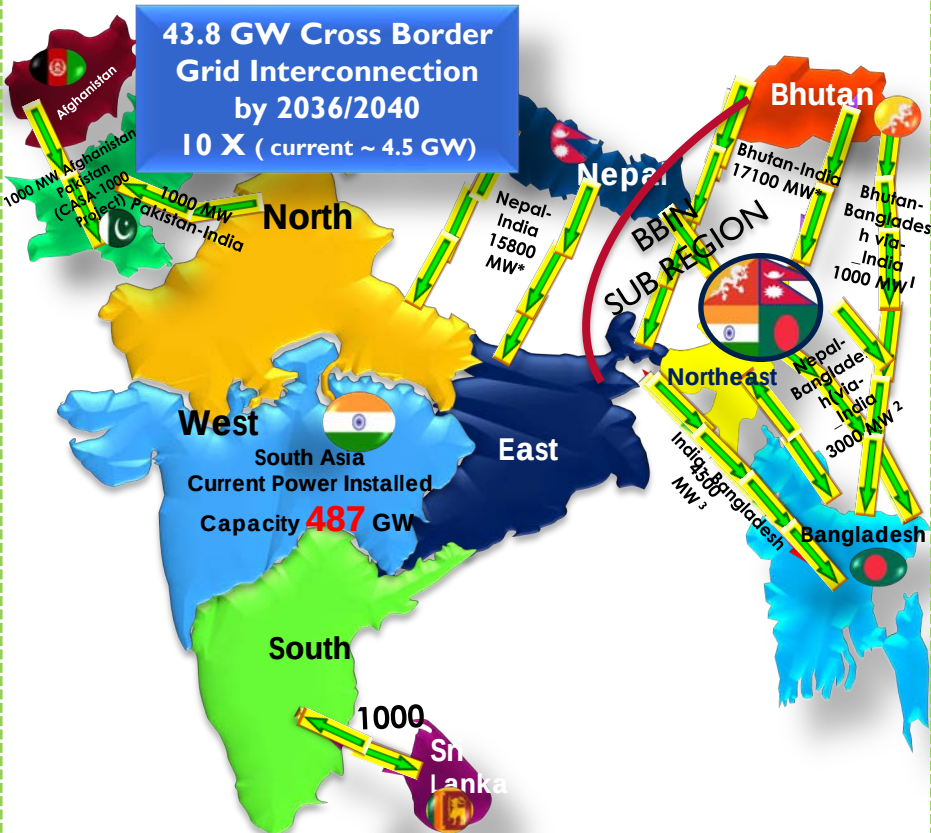


* BBIN & Trade with Neighbouring Region's Countries i.e. Afghanistan's CBET with Central Asian Countries and Iran, Pakistan's CBET with Iran, India's CBET with Myanmar
Data Source- Compile by Author from various Sources -CERC, POSOCO, NEPA, Afghanistan Statistics, CBET-Cross Border Electricity Trade I BUs-Billion Units

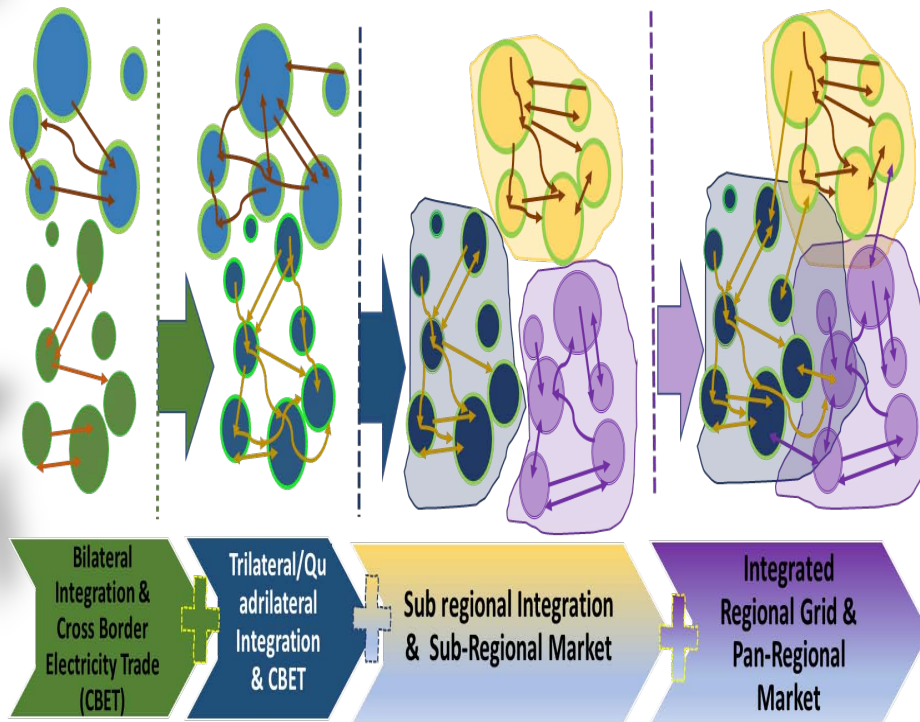
CBET Doubled | Potential Remains Large | EUROPE > 240 TWh of CBET in 2021

Cross Border Electricity Trade (CBET) in South Asia : Future Scenario

**43.8 GW Cross Border
Grid Interconnection
by 2036/2040
10 X (current ~ 4.5 GW)**



Transition of Cross Border Electricity Grid Integration Bilateral-Trilateral-Multilateral-Regional Electricity Market Development



Source: Conceptualised and developed by the Author

Power Market Diversity in South Asia

Power markets in South Asian countries other than India and Pakistan has not progressed a lot beyond allowing IPPs and competition in generation. However, the presence of power exchanges and power traders in India open up potential opportunities to support trilateral and multilateral trade.

Country	 Removal of single buyer model	 Wholesale competition (IPPs)	 Open access to transmission	 Separate system operator	 Power traders (other than single buyer)	 Power exchange/Market
 Afghanistan		☒				
 Bangladesh		☒		☒		
 Bhutan		☒		☒		
 India	☒	☒	☒	☒	☒	☒
 Maldives		☒				
 Nepal		☒			☒	
 Pakistan	☒	☒	☒	☒	☒	☒
 Sri Lanka		☒				



Advance stage of
launching market platform

Future Transition to Trilateral and Multilateral Power Trade

**\$2 billion , 1125 MW
Dorjilung Project**

**Proposed Trilateral
Project**

**Bangladesh will import 500
MW of electricity from 900
MW Upper Karnali Hydro
Project in Nepal**

(@ 7.72 cents/unit for 25 years##)

*(Price Negotiation is Concluded, Discussion on
transmission and other aspects is under consideration)*

**Bangladesh Master Plan[#]
envisaged to import from Bhutan
(1 GW) & Nepal (3 GW) through
India**

Power System Master plan 2016 (Final)- <https://powerdivision.gov.bd/site/page/f68eb32d-cc0b-483e-b047-13eb81da6820/Power-System-Master-Plan-2016>
<https://kashmandupost.com/money/2020-02/09/bangladesh-issues-letter-of-intent-to-purchase-500-mw-from-upper-karnali-hydro-project>

Potential Planned Trilateral Transactions

500 MW from
Upper Karnali
HPP Nepal

Bangladesh
Buyer

Nepal
Supplier

India
Transit and buyer

1125 MW
Dorjilung HPP

Bangladesh
Buyer

Bhutan
Supplier

India
Transit

CASA-1000

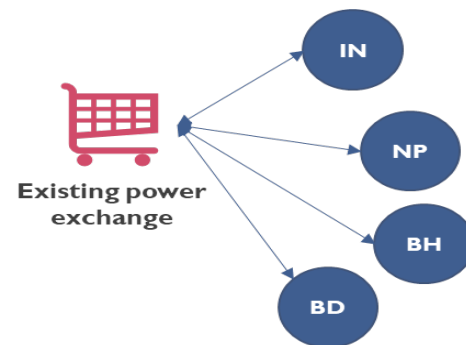
Pakistan
Buyer

Tajikistan
Supplier and Transit

Krygystan
Supplier

Afghanistan
Transit and buyer

Multilateral transactions (existing or upcoming)

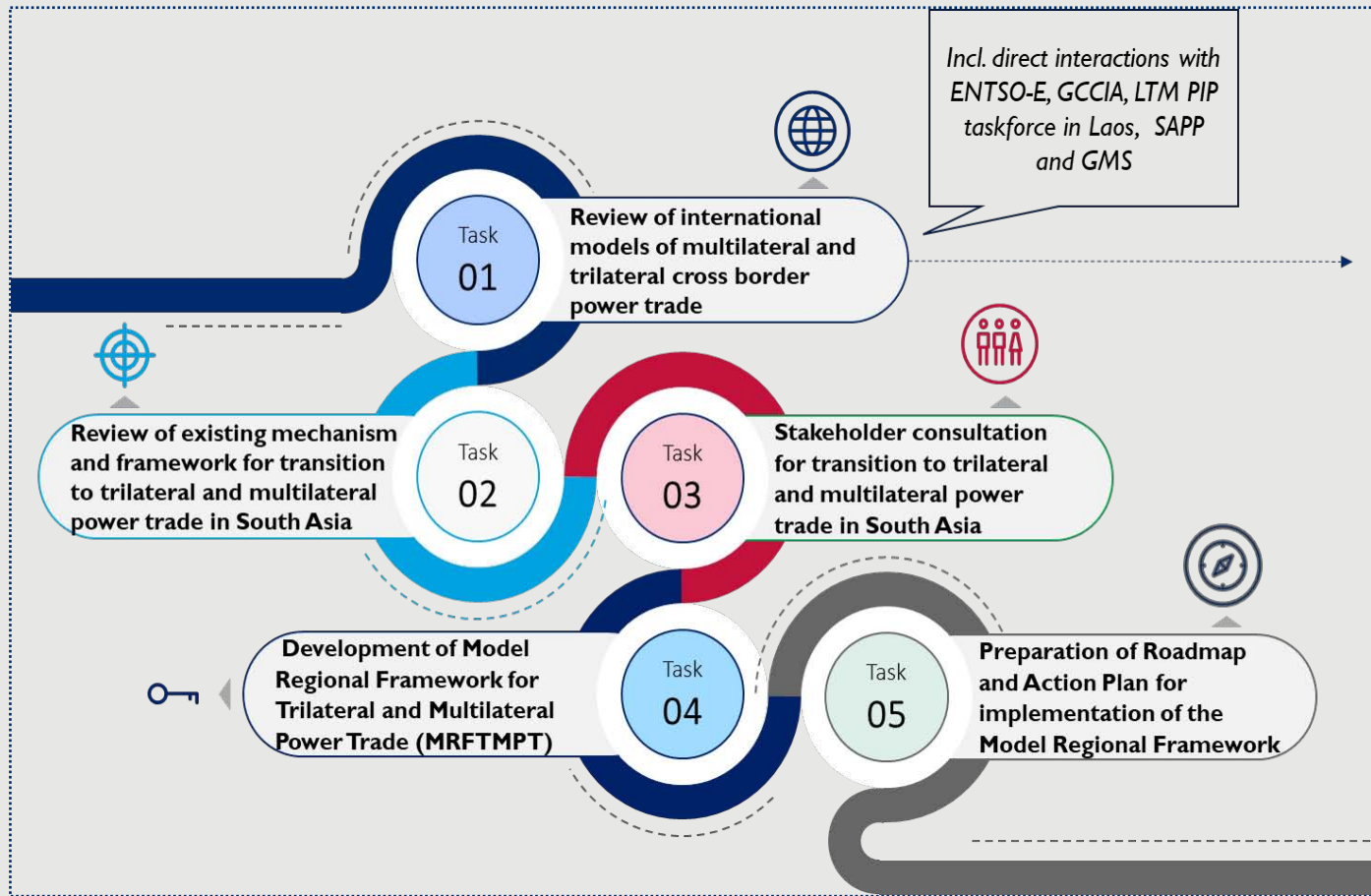




Overall Approach to the Study

Overall Approach to the Study

Study aimed to learn from **international experience in trilateral and multilateral power trade** and use such learnings towards the development of a model regional framework to facilitate transition towards **trilateral and multilateral power trade in South Asia.**



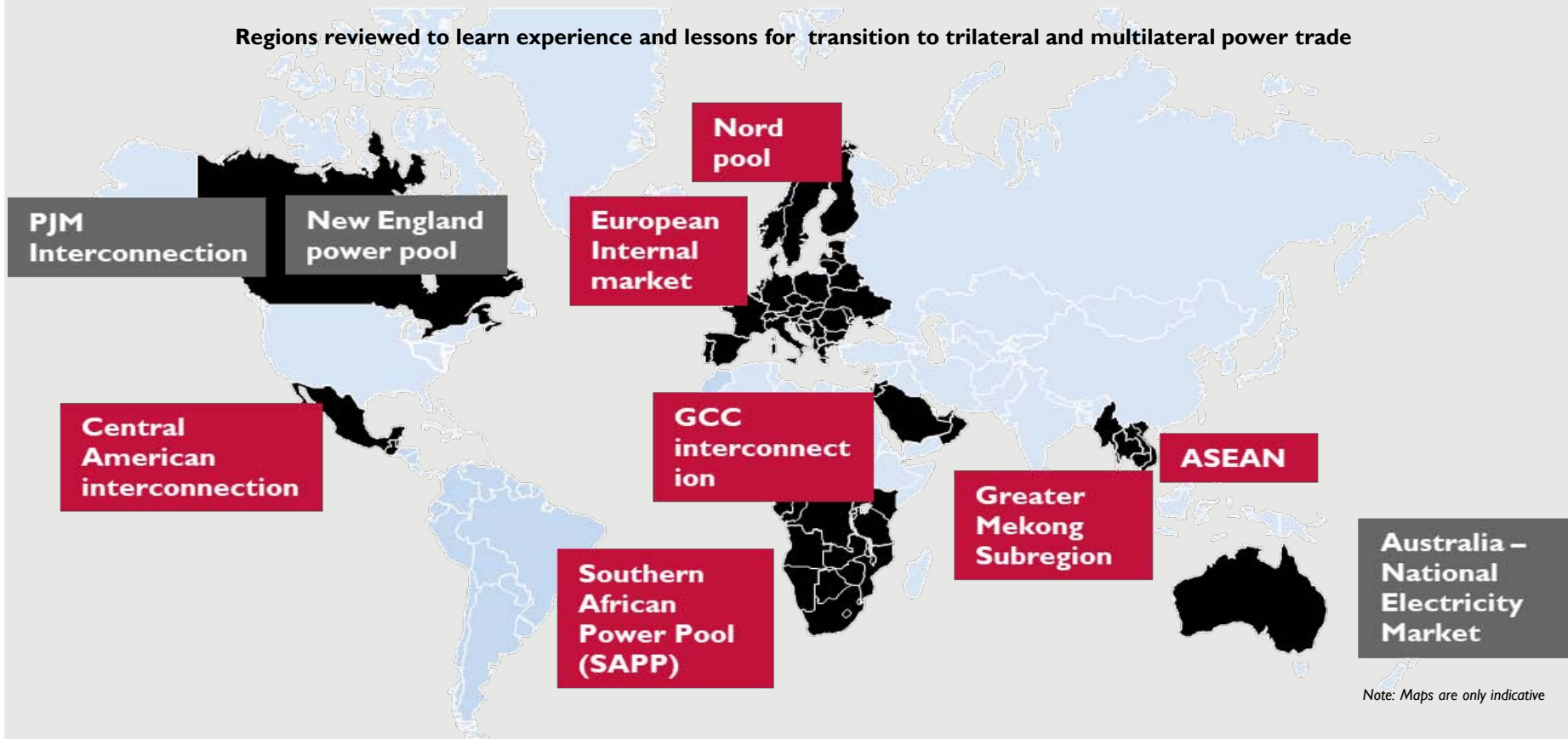
03

Key Learnings from Review of International Experience and Present Scenario in South Asia



Review of International Experience on Transition to Trilateral/Multilateral Trade (1/3)

Regions reviewed to learn experience and lessons for transition to trilateral and multilateral power trade



Institutional Mechanisms (2/3)

		SAPP	GCC	Central America	European Union	ASEAN
	Inter-governmental coordination	Energy Ministers of SADC	GCC Ministerial Committee	Steering Committee of the Regional Electricity Market (CDMER)	European Commission	ASEAN Ministers on Energy Meeting
	Regional regulatory mechanisms	Regional Electricity Regulators Association of Southern Africa (RERA)	Advisory and Regulatory Committee (ARC)	Comisión Regional de Interconexión Eléctrica (CRIE)	Agency for the Cooperation of Energy Regulators (ACER)	HAPUA working group on policy and commercial development
	Regional technical mechanisms	SAPP Coordination Centre	GCC Interconnection Authority (GCCIA)	Ente Operador Regional (EOR)	European network of transmission system operators for electricity (ENTSO-E)	Head of ASEAN Power Utilities (HAPUA) and ASEAN Power Grid Consultative Committee (APGCC)
	Other key institutions	Southern African Development Community (SADC)	GCC Supreme Council	Empresa Propietaria de la Red (EPR)	Regional Security Coordination Initiatives (RSCI)	ASEAN Center for Energy

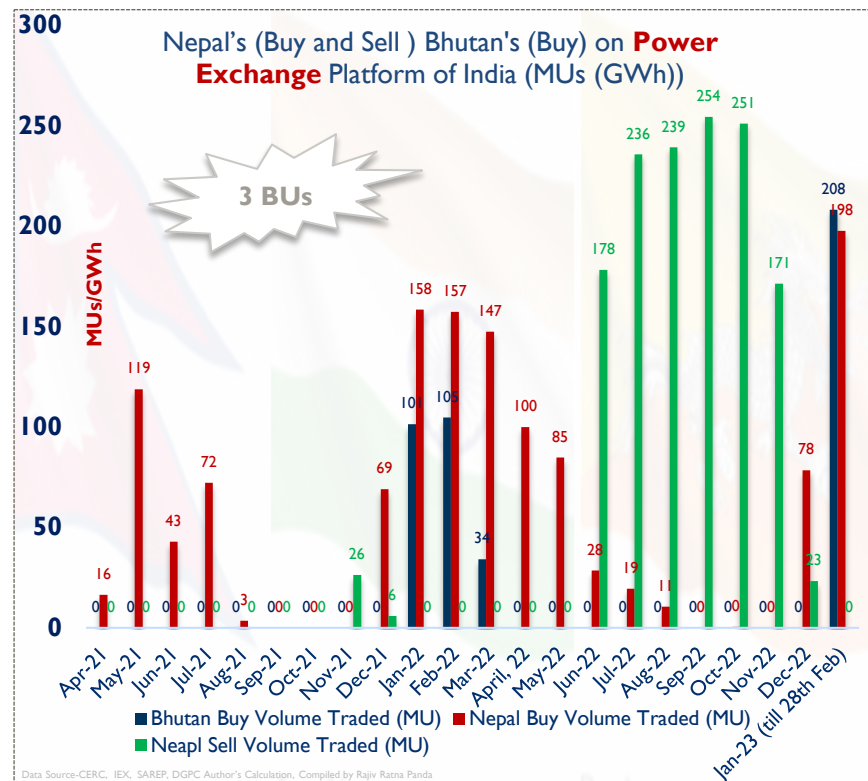
Permanent Regional institutional mechanisms play a key role in trilateral and multilateral power markets.

Review of International Experience (3/3)

	SAPP	GCC	ASEAN	Central America	European Union
Cross border trade volume (GWh)	8205 (2021)	1098 (2021)	49,000 (2022)	3109 (2022)	240,000 (2021)
Exchange trade (%)	18%	3%	Nil	29%	30%*
Bilateral/OTC trade (%)	82%	97%	100%	71%	70%
Type of trade products	Day ahead, intraday, forward physical market - monthly and weekly	Capacity market, spinning reserves and energy market	PPAs	Firm Contracts, Non-Firm Financial Contracts, Opportunity Market	Day ahead, intra-day, forward and balancing products
Wheeling charge mechanism	Transaction based identification of asset usage and charges	A fixed amount set by GCCIA per MWh	Negotiated bilaterally/Trilaterally Energy Purchase and Wheeling Agreement (EPWA)	Variable Transmission Charge (CVT), the Toll and the Supplementary Charge, determined by CRIE	Country wise transmission pricing along with Inter TSO compensation mechanism
Deviation settlement	Linked to frequency and pool generation costs	Settled in kind (<25 MW) or in cash (>25 MW) on weekly basis	As per PPA terms	Linked to average hourly price determined for the market	Managed by TSOs through procurement of balancing energy

Source: Compiled from Various Sources, SAPP, GCC, ASEAN, CRIE, EU quarterly electricity market reports. * Overall Europe, (value not only for CBET)

Market (Power Exchange) form of CBET (South Asia) & Multilateral CBET (South-East Asia): A Beginning of a New Renaissance



Nepal has earned over Nepalese Rs 11 billion (6.87 billion INR) by selling excess power to India from early June 2022 through December 2022

January 1 and March 16, 2022, Bhutan imported 240MU of electricity from India through the energy exchange at a cost of Nu 798 M.

Lao PDR, Thailand, Malaysia, Singapore (LTMS) Multi Lateral Trade Project



Phase-I
100 MW
Trilateral
Lao-Thailand
Malaysia
32.8 GWh
traded between
2018-21

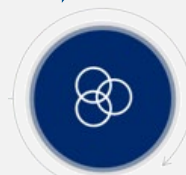
Phase-II
100 MW
Multilateral
Lao-Thailand
Malaysia-
Singapore
23 June 2022

Singapore-fully
liberalised
power market
4 GW import
Plan by Singapore

Energy Purchase
and Wheeling
Agreement
(EPWA)



Key Learnings for South Asia from Review of International Examples



Political and Intergovernmental Support

Signing of follow-on protocols to already signed agreements instead of signing of a new regional agreement



Legal, Policy and Regulatory Frameworks for CBET

A common framework / guideline for legal, policy and regulatory matters without affecting the independence and rights of national institutions.



Technical Guidelines, Operating guidelines & Standards etc.

Regional planning documents, and common operational procedures/ guidelines for system operators.



Commercial Framework

Power market platforms as a facilitator of multilateral trade, Wheeling tariffs, energy accounting, deviation settlement etc.



Institutional Frameworks

Presence of permanent regional coordination bodies

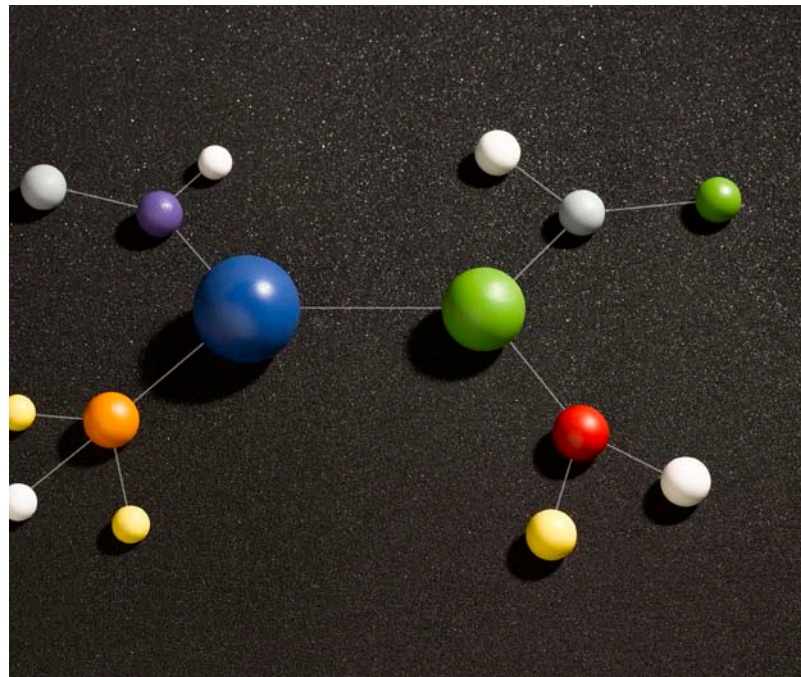
04

Model Framework for Trilateral and Multilateral Power Trade in South Asia

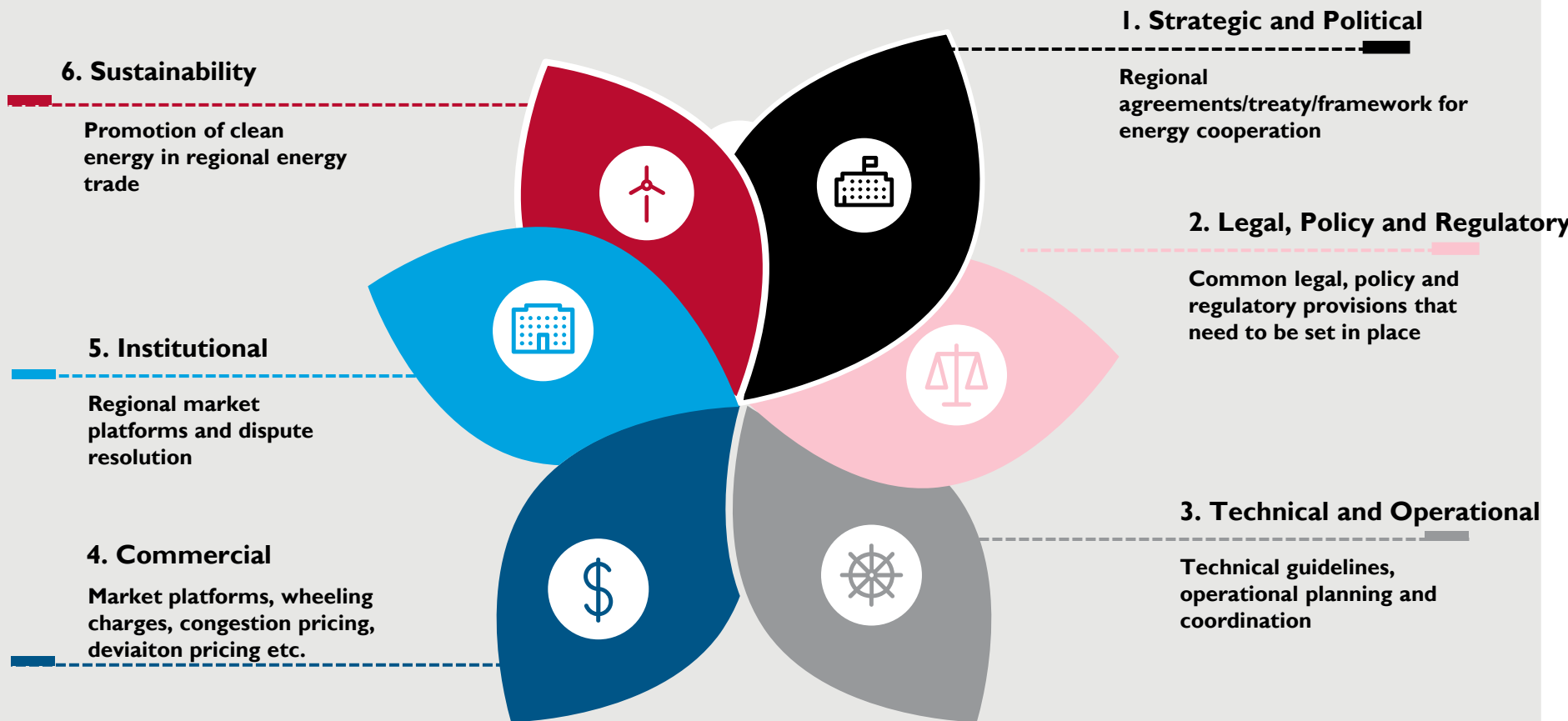


04

Model Framework for Trilateral and Multilateral Power Trade in South Asia



Components of Model Framework



Component I: Strategic and Political

- Model regional framework as a template, which can be customized by each of the countries as per the need and depending on the existing frameworks if any
- Provides flexibility to governments on policy matters
- Does not rule out eventual expansion of existing regional agreements / signing of new agreements

SAARC Framework Agreement on Energy Cooperation (Electricity)

- Member States may enable cross-border trade of electricity on voluntary basis subject to laws, rules and regulations of the respective Member States and based on bilateral/trilateral/mutual agreements between the concerned states.
- Member States shall enable Buying and Selling Entities to engage in cross-border electricity trading subject to the laws and regulations of the concerned Member States.
- Member States may enable the transmission planning agencies of the Governments to plan the cross-border grid interconnections through bilateral/trilateral/mutual agreements between the concerned states based on the needs of the trade in the foreseeable future through studies and sharing technical information required for the same.
- Member States may enable the respective transmission agencies to build, own, operate and maintain the associated transmission system of cross-border interconnection falling within respective national boundaries and/or interconnect at mutually agreed locations.

Component 2: Legal, Policy and Regulatory



Define Key Institutional Framework

- Countries to designate Approving Authority, Regulatory Authority, System Operator, Transmission Planning Agency, National Transmission Utility, Settlement Nodal Agency.



Define Nature of CBET Approval

- Type of approval, duration, one-time or recurring etc.



Eligibility for Approval

- Eligibility for entities within and outside country.
- Identify market intermediaries who may be allowed to participate.



Process

- Process for approval of cross-border electricity trade and cross-border interconnections.
- Open access approval procedures.



Transmission Pricing and Cost Recovery

- Transmission pricing and cost recovery for cross border transmission lines.



Transit

- Approval in transit countries.

Component 3: Technical and Operational



Regional Transmission Plan

- Cross border transmission plans for each country may be discussed and harmonized to arrive at a regional transmission plan.
- Development of such plans may be coordinated by the national transmission utilities.



Regional Operational Procedure

- The existing agreed-upon bilateral operational procedures and guidelines developed under intergovernmental mechanisms may be consolidated to develop the regional operational procedures including common minimum grid codes.
- The development of such plans may be coordinated by the regulators/national system operators.



Harmonized Grid Codes

- Overall compliance with the “Common Minimum Grid Code Template”.

Component 4: Commercial



Market Platform and Products

- Countries to allow entities in other countries also to participate in the power exchange market, through market intermediaries.
- Regional power exchange / market coupling to be explored in long term.



Wheeling Fees for Transit

- Domestic component – For wheeling within country :To be decided by regulatory. It may be ensured that such charges are not lesser than similar transactions if undertaken entirely within the country.
- Regional component – Charge for use of cross border networks: regulator approved or negotiated.



Financing and Cost Recovery of Regional Transmission Lines

- To be dealt at intergovernmental level.



Congestion Management

- To be managed by respective system operators within each country.



Deviation Pricing

- Allow countries to decide on the applicable deviation settlement mechanism for each such peripheries (for example: India-Nepal, India-Bhutan etc.), rather than trying to impose a common mechanism.

Component 5: Institutional



Exchange & Consultations (Informal)

- Coordination and consultations at inter-utility and inter-regulator level
- Preferably by regional platforms/networks/forums such as South Asia Forum of Transmission Utilities (SAFTU), South Asia Forum of System Operators (SAFSO) and South Asia Forum of Electricity Market (SAFEM).



Consultations (Formal)

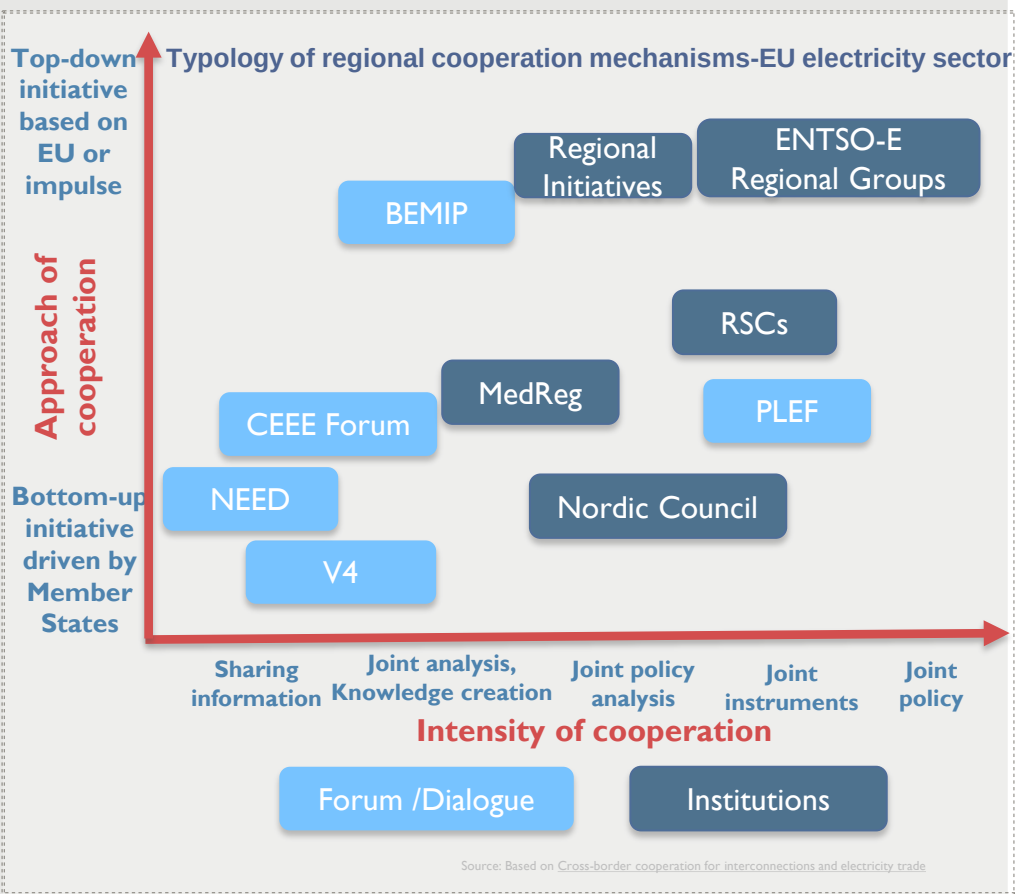
- Intergovernmental coordination mechanisms such as JSC, JWG and JTT



Dispute Resolution

- Agreement related – As provided under respective agreements / arbitration
- Intergovernmental – Discussed at JSC, JWG
- Commercial disputes where no procedure is specified in commercial documents – International arbitration (*Matters totally within country border to be decided by respective regulators*)

Regional Cooperation Approach



Component 6: Sustainability



Promotional Measures for Clean Energy

- Promotional measures to ensure level playing field for clean energy transactions in regional power trade.
- The promotional measures can be decided by the respective countries.
- Promotional measures subject to limitations on account of system security.



Reserve Sharing to Manage RE

- The countries may also consider arriving at a separate reserve sharing agreement, rather than each country building its own dedicated reserves to manage intermittent renewable energy.
- A commercial mechanism for such reserve sharing may also be determined, so that the country offering such reserves get compensated from the countries that utilize such reserves.

Thank You



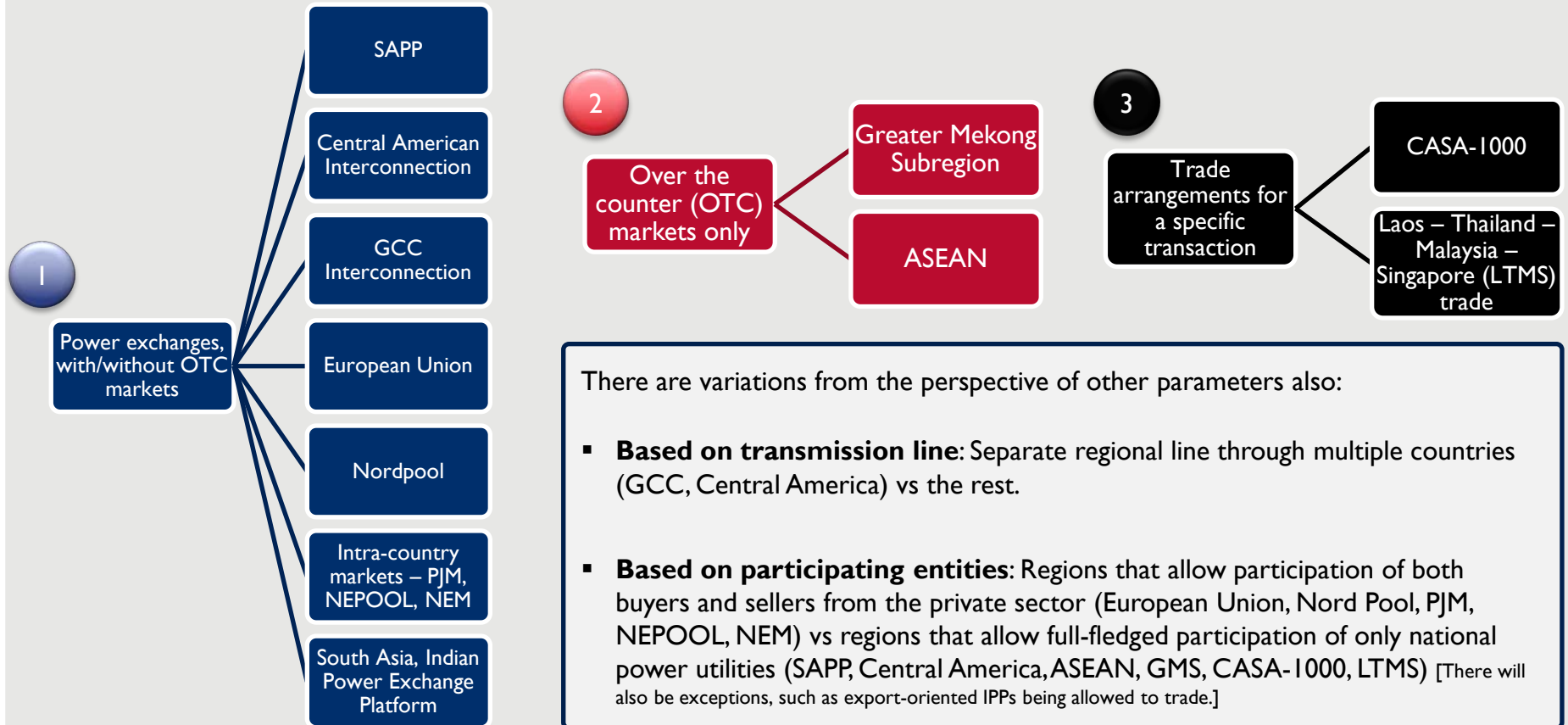
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Back up Slides

Different models of power trade

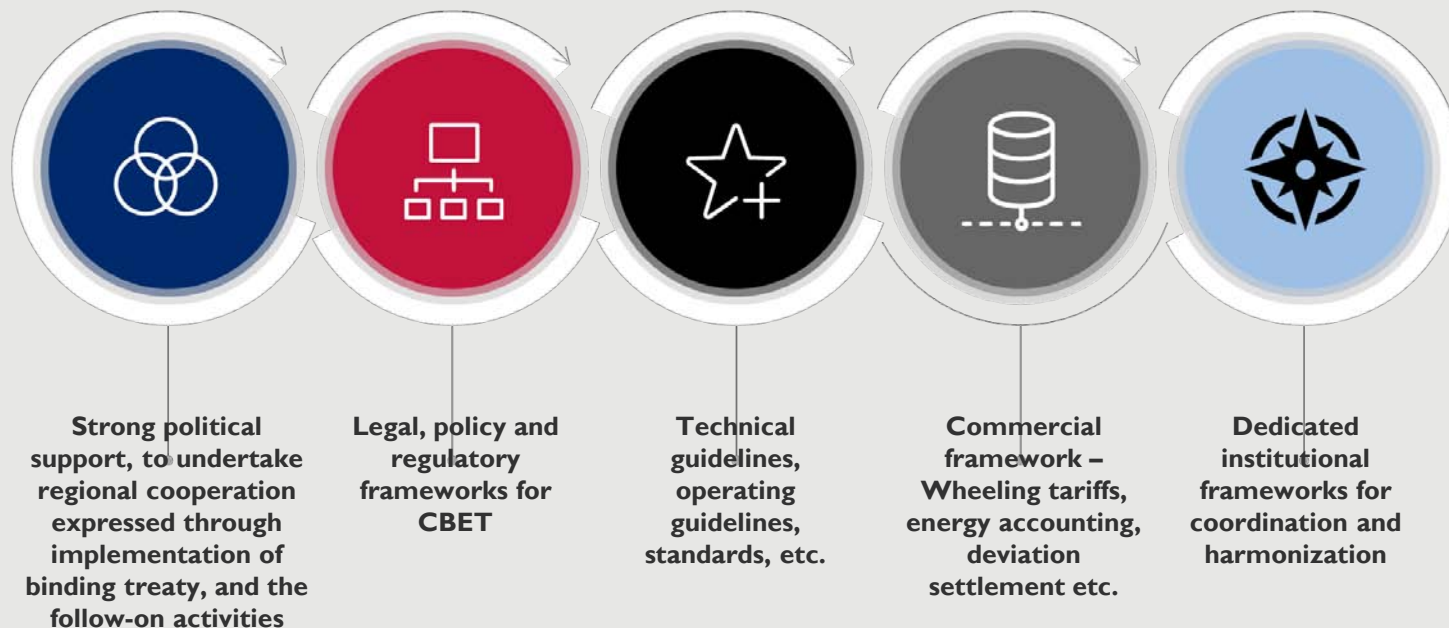


There are variations from the perspective of other parameters also:

- **Based on transmission line:** Separate regional line through multiple countries (GCC, Central America) vs the rest.
- **Based on participating entities:** Regions that allow participation of both buyers and sellers from the private sector (European Union, Nord Pool, PJM, NEPOOL, NEM) vs regions that allow full-fledged participation of only national power utilities (SAPP, Central America, ASEAN, GMS, CASA-1000, LTMS) [There will also be exceptions, such as export-oriented IPPs being allowed to trade.]

Key ingredients to enable trilateral/multilateral power trade

Based on the review of various international examples of trilateral/multilateral power trade, the following enabling ingredients can be identified.



Key learnings from international examples

- In the international power pools/regions, strong political support in the form of an existing regional arrangement (SADC, GCC, ASEAN, GMS) and/or an intergovernmental agreement / MoU is seen as a common factor, creating the enabling conditions, and driving the CBTMPT.

Regional Institutions

	SAPP	GCC	Central America	European Union	ASEAN
 Inter-governmental coordination	Energy Ministers of SADC	GCC Ministerial Committee	Steering Committee of the Regional Electricity Market (CDMER)	European Commission	ASEAN Ministers on Energy Meeting
 Regional regulatory mechanisms	Regional Electricity Regulators Association of Southern Africa (RERA)	Advisory and Regulatory Committee (ARC)	Comisión Regional de Interconexión Eléctrica (CRIE)	Agency for the Cooperation of Energy Regulators (ACER)	HAPUA working group on policy and commercial development
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 Other key institutions	Southern African Development Community (SADC)	GCC Supreme Council	Empresa Propietaria de la Red (EPR)	Regional Security Coordination Initiatives (RSCI)	ASEAN Center for Energy

- Most of the international power pools/ regions are supported by an Inter-governmental agreement/ MoU and a set of detailed agreements/ procedures/ guidelines/ rules that govern the power trade.
- All the international/regional power pools can be found to have some form of regional-level coordination in planning and operations.
- Regional institutions form a key facilitator and driver of regional power trade.

Key learnings from international examples

- Most of the regions, which did not have a dedicated regional transmission infrastructure (thereby excluding models such as MER and GCCIA) can be seen to **have grown in phases in terms of market products and options**. For example:
 - ***GCCIA initially served as a mechanism to provide reliability and sharing of reserves. Power trade through an exchange platform was initiated in the pilot phase only after multiple years of operation.***
 - ***GMS has a clear roadmap for transitioning from bilateral to multilateral model in phases.***
 - ***ASEAN power market was initially under only bilateral model. Trilateral transactions started with the commencement of LTMS PIP in 2018.***

European Union Common Market for Electricity



Key drivers and enablers

- A long history of regional energy cooperation, supported by EU's vision for regional cooperation;
- The existence of regional bodies such as **ACER** and **ENTSO-E** for coordinated development of regional frameworks and documents such as the network codes;
- Issuance and updating of '**Energy Package**' legislations /directives of the European Commission;
- Development of competitive markets and **power exchanges** within countries and sub-regions of EU.



Key technical and commercial framework

- **European Commission regulations and directives**
- **ENTSO-E network codes**, approved by ACER
- **Projects of Common Interest (PCI)** – Key cross border infrastructure projects, with a right to apply for funding from the Connecting Europe Facility (CEF).

27 countries

Multiple regional markets (Central West Europe, Central Eastern Europe, Baltic market, Iberian market etc.) and power exchanges (European Power Exchange, Energy Exchange Austria, Independent Bulgarian Energy Exchange etc.)

> 240 TWh of CBET in 2021

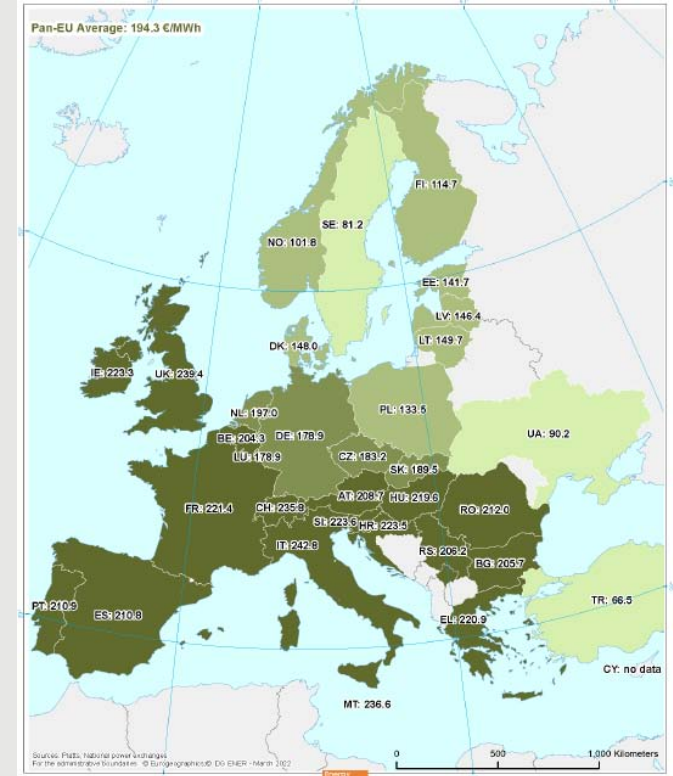
10363 TWh total trade in 2021 (*30% power exchange and 70% OTC/bilateral*)

European Union Common Market for Electricity

Seven Regional Markets within EU:

- Central Western Europe (Austria, Belgium, France, Germany, Luxembourg, the Netherlands, Switzerland)
- British Isles (GB, Ireland)
- Northern Europe (Denmark, Estonia, Finland, Latvia, Lithuania, Sweden, Norway)
- Apennine Peninsula (Italy, Malta)
- Iberian Peninsula (Spain and Portugal)
- Central Eastern Europe (Czechia, Hungary, Poland, Romania, Slovakia, Slovenia)
- South Eastern Europe (Bulgaria, Croatia, Greece and Serbia)

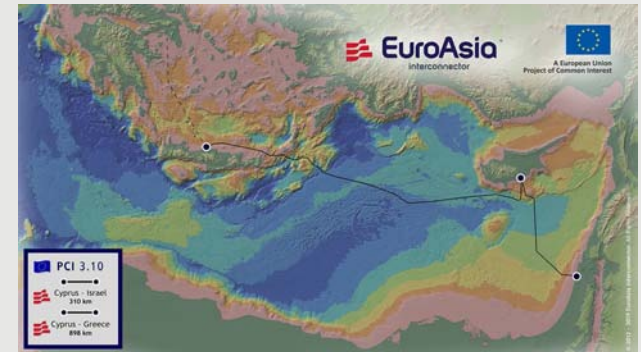
CBET also with countries outside the union, such as Ukraine, Belarus, Russia, and Morocco.



European Union Common Market for Electricity

Proposed expansion

- The EuroAsia Interconnector will start near Hadera in Israel and take the sub-sea route to Cyprus where it will connect at the Kofinou station. From there it will head west and take a sub-sea route to Korakia point in Crete, Greece.
- The EuroAsia interconnector is a Project of Common Interest (PCI) under the 5th Union List comprising a 1,200 km undersea cable from Israel to Crete via Cyprus. As a second phase, once the link to Crete is completed, an electricity link between Cyprus and Israel will be constructed.
- The first phase of the project, with total estimated construction costs of €1.57 billion, received a €657 million EU grant under the Connecting Europe Facility (CEF).



South African Power Pool



Key drivers and enablers

- Strong **IG support**, through Southern African Development Committee (SADC)
- **Resource complementarity** (South African thermal vs hydro in Zimbabwe, Zambia etc.)
- Many **interconnections** were developed even prior to SAPP
- Presence of Regional Electricity Regulators Association (**RERA**) and SAPP coordination center
- A well-established **regional regulatory framework**, recommended by RERA



Key technical and commercial framework

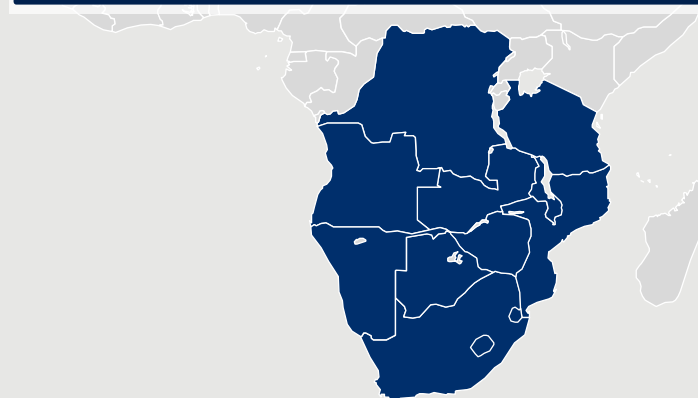
- Wheeling path is reserved in advance for each transaction.
- Wheeling charges determined centrally by the SAPP, using transaction based load flow analysis, and cost of assets used for wheeling of power.
- Frequency based deviation settlement mechanism, based on marginal generation cost and average generation cost.

9 countries

Multiple interconnections: **110 KV – 533 KV**

8205 GWh traded in 2021 (*18% competitive and remaining bilateral*).

Market trading platform: day ahead, intraday, forward physical market - monthly and forward



Central American Interconnection



Key drivers and enablers

- Political will of the countries to enter into **MARCO treaty** for Regional Energy Market (MER);
- Availability of interconnection, running through all the member states, managed by a **separate entity (EOR – Transmission Operator)**;
- Institutional framework for regional market, through **CRIE (Regulator), EOR**, and **EPR** (Transmission line developer);
- Well defined **Regional Energy Market Regulations** of CRIE; and
- Surpluses/deficits of respective countries.



Key technical and commercial framework

- Company for development of transmission line (EPR) formed by Government utilities of participating countries, along with utilities in Colombia, Mexico and Spain.
- Uses the concept of “Transmission Right” which gives the holder of the same, the right to use the network.
- Regional transmission rates determined by regional regulator (CRIE).

6 countries

230 KV, 1790 KM line

Supports trade of up to 300 MW

Bilateral medium/long term trades, and trade through a short-term opportunity market.



Gulf Cooperation Council (GCC) interconnection



Key drivers and enablers

- Availability of GCC **interconnection** running through all the member states, managed by a separate entity (**GCCIA**);
- **Political will** of GCC member states for cooperation in electricity;
- Well established track record for **reserve sharing and emergency support** in the initial years, which thereby enabled further transition to scheduled energy trades; and
- Commencement of operation of trading system (**Power Exchange**) for GCC power market.



Key technical and commercial framework

- GCC interconnection – countries sharing the costs in proportion to the present value of reserve capacity savings.
- Transmission prices are approved by the Advisory and Regulatory Committee.
- General Agreement and Power Exchange and Trading Agreement (PETA).
- GCCIA Market Procedures and GCCIA Exchange Market Terms and Conditions.

6 countries

400 KV, 1200 KM line

Supports trade of **400 – 1200 MW** depending on the country.

Day Ahead Continuous and Intra-Day Continuous Market. Also supports reserve sharing and emergency support.



Laos – Thailand – Malaysia – Singapore (LTMS) in ASEAN



Key drivers and enablers

- The decision to commence trade on existing available transmission capacity.
- Formation of LTMS Power Interconnection Project (**LTMS PIP**) **Working Group**.
- Signing of **IG MoU** in 2016, during 34th ASEAN Ministers of Energy Meeting.
- Payment based on actual energy delivered. Both buyer and seller can choose to reduce the quantum.



Key technical and commercial framework

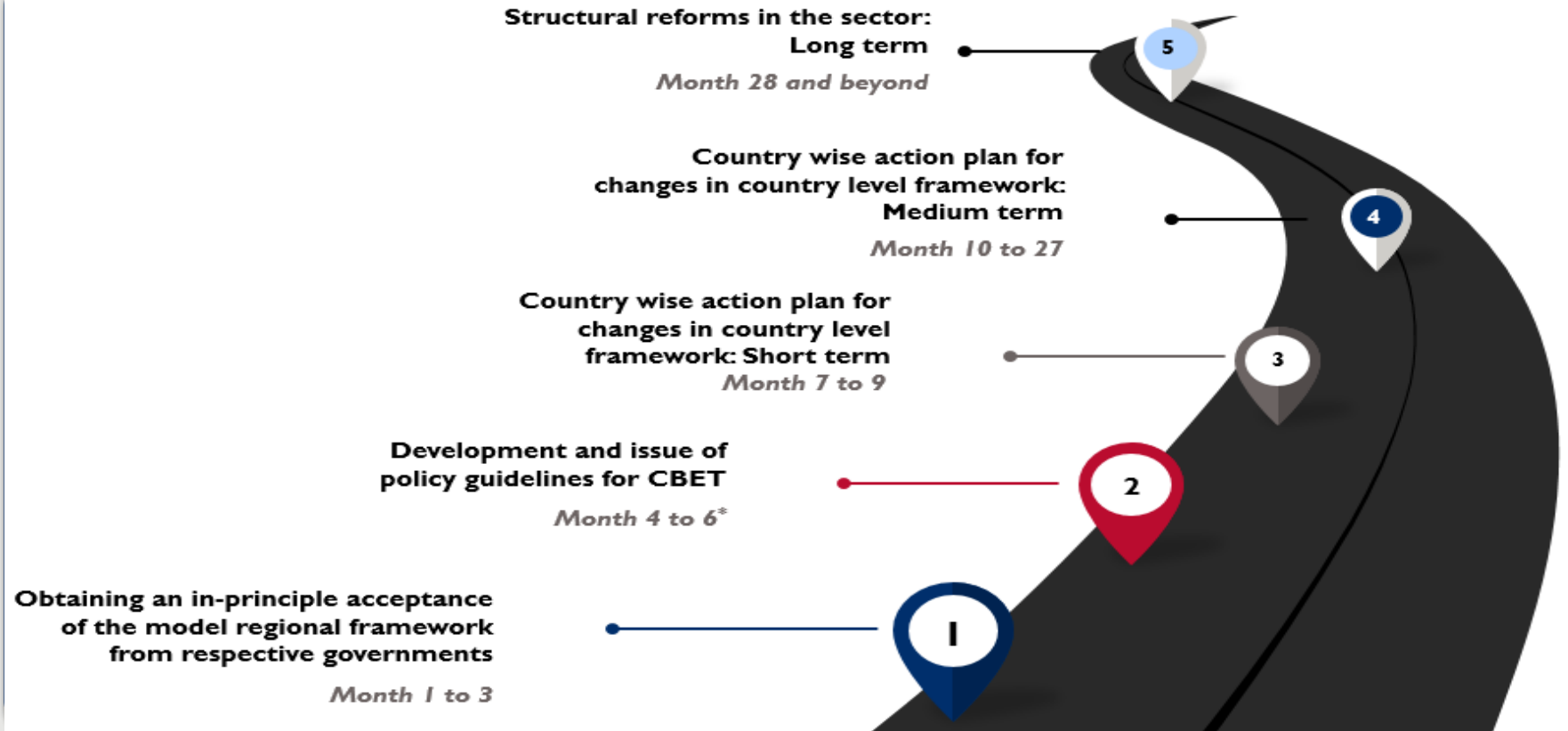
- Trade undertaken through margins available in **existing transmission system**.
- **Energy Purchase and Wheeling Agreement (EPWA)** signed between utilities in Laos, Thailand and Malaysia – Medium term agreement, renewed every two years.
- **Wheeling charges** for use of Thailand's network paid by Laos, as per EPWA provisions.



Phase 1: 100 MW from Laos to Malaysia already operation since Jan 2018, with expansion to 300 MW planned.

Phase 2: Extension to Singapore planned (currently 100 MW import commenced with existing line).

Implementation Plan (I/2)



Implementation Plan (2/2)

1. Preferable for the national transmission utilities and regulators to **seek an in-principle concurrence on the regional framework, from the respective governments.**
2. Once there is an in-principle acceptance of the framework, policy guidelines for CBET for the countries would be required to be developed and issued. Successful completion of these two activities would pave the way for implementation of country wise action plans, which have been divided into short term and medium term.
3. Based on the guideline document, some of the key regulatory, operational and commercial modifications required in the respective frameworks to support trilateral and multilateral trade, will have to be undertaken initially. These will mostly relate to amendments in existing documents, rather than the creation of a new document.
4. Post this, during the next 18 months (i.e., medium term) various relevant regulations and mechanisms (for example, transmission pricing) would be developed and issued to create the required regulatory framework for enabling and supporting CBET.
5. Thereafter, long term sectoral reforms can be focussed upon by the respective countries in the long term.

Country-wise summary of suggested actions in addition to adoption of model framework Afghanistan

- Policy guidelines for CBET to be issued by Govt. of Afghanistan
- Grid code to be developed
- Transmission planning mechanism and operational procedures for CBET to be established through regulatory provisions
- Process for obtaining approval for access to the transmission grid, to undertake CBTMPT to be developed
- The Ministry of Energy and Water (MEW) may consider issuing a notification that will allow the utility, DABS, and the regulator to interact with other similar institutions in the region, so as to allow greater regional energy cooperation.
- While developing the transmission pricing methodology, the regulator may consider a kWh linked tariff (instead of KW), or a discounted tariff for solar power, due to its low utilization factor vis-à-vis other sources.
- Further, all clean energy sources, including hydro may be considered as must-run sources (except reservoir-based hydro).

Country-wise summary of suggested actions in addition to adoption of model framework

Bangladesh

- Policy guidelines for CBET to be issued by Govt. of Bangladesh.
- In order to deal with regional planning of transmission lines, and development of regional operational procedures, amendments in chapter 4 (transmission planning) and chapter 7 (scheduling and dispatch) may be considered in BERC (Electricity Grid Code) Regulations, 2019.
- Open access regulations to be prepared
- Transmission pricing to be extended to 400 KV voltage
- Mechanism for sharing of deviation settlement mechanism charges on account of CBTMPT transactions, to be specified by BERC
- The Ministry of Power, Energy and Mineral Resources may consider issuing a notification that will allow the utilities, BPDB and PGCB, and the regulator to interact with other similar institutions in the region, so as to allow greater regional energy cooperation.
- All clean energy sources, including hydro may be considered as must-run (except reservoir-based hydro).

Country-wise summary of suggested actions in addition to adoption of model framework

Bhutan

- Policy guidelines for CBET to be issued by Govt. of Bhutan
- Open access regulations to be prepared to define procedure to obtain access to the transmission grid for undertaking cross border electricity trade.
- Mechanism for sharing of deviation settlement mechanism charges on account of CBTMPT transactions, to be specified by BEA.
- The Ministry of Economic Affairs may consider issuing a notification that will allow DHPS, and the utilities, BPC and BPSO, and the regulator to interact with other similar institutions in the region, so as to allow greater regional energy cooperation.
- All clean energy sources, including hydro may be considered as must-run (except reservoir-based hydro).

Country-wise summary of suggested actions in addition to adoption of model framework

India

- Possibility towards determining a separate transmission tariff for third party (third country) wheeling transactions can be explored.
- The Ministry of Power may consider supporting the institutional mechanism whereby the utilities in the power sector such as the system operator and the transmission utility etc. may interact with the counterpart utilities belonging to the other countries in the region, so as to allow sharing of best operational practices and promoting harmonization and excellence in the technical matters related to power system and transmission network.

Country-wise summary of suggested actions in addition to adoption of model framework

Nepal

- Electricity Act, 1992 to be amended for incorporating the provision associated with power trading and CBET.
- Policy guidelines for CBET to be issued by Govt. of Nepal
- Electricity Rules, 1993: Section 42 and 43 to be amended
- The utility may consider publishing revised master plan at least once in every three years. To that extent, amendments may be made in NEA's Grid Code, in chapter 3 (Grid planning).
- Open access directives to be issued by ERC
- Transmission pricing framework to be prepared by ERC
- Mechanism for sharing of deviation settlement charges on account of CBTMPT transactions, to be specified by ERC
- The regulator may specify the manner in which deviation charges billed by India on Nepal, are further distributed among entities within Nepal, if entities other than NEA are allowed to undertake CBET.
- The Ministry of Energy, Water Resources and Irrigation may consider issuing a notification that will allow the utilities, NEA, RPGCL, and the regulator to interact with other similar institutions in the region.
- For transmission, kWh linked tariff or a discounted tariff for solar power, to compensate for low utilization factor.
- All clean energy sources, including hydro may be considered as must-run (except reservoir-based hydro).

Country-wise summary of suggested actions in addition to adoption of model framework

Pakistan

- Policy guidelines for CBET to be issued by Govt. of Pakistan
- NEPRA's Grid code regulations, 2005 to be amended (PC 4.2 - Procedure for Transmission System Expansion) to ensure that the revised Transmission System Expansion plan is published at least once in every three years; and to ensure that the plan is discussed with relevant neighboring countries.
- Open access for CBTMPT transactions to be clarified by NEPRA.
- Mechanism for sharing of deviation settlement mechanism charges on account of CBTMPT transactions, to be specified by NEPRA.
- The Ministry of Energy may consider issuing a notification that will allow WAPDA, Central Power Purchasing Agency – Guaranteed (CPPA-G), NTDC and the regulator (NEPRA) to interact with other similar institutions in the region, so as to allow greater regional energy cooperation.
- To promote clean energy sources with low capacity utilization/load factor as compared to thermal plants, the regulator may consider a purely kWh linked use of system charge (instead of KW), or a discounted use of system charge, for clean energy sources.
- All clean energy sources, including hydro may be considered as must-run (except reservoir-based hydro). This could be incorporated by amending the Scheduling and Dispatch code, of Grid Code, 2005.

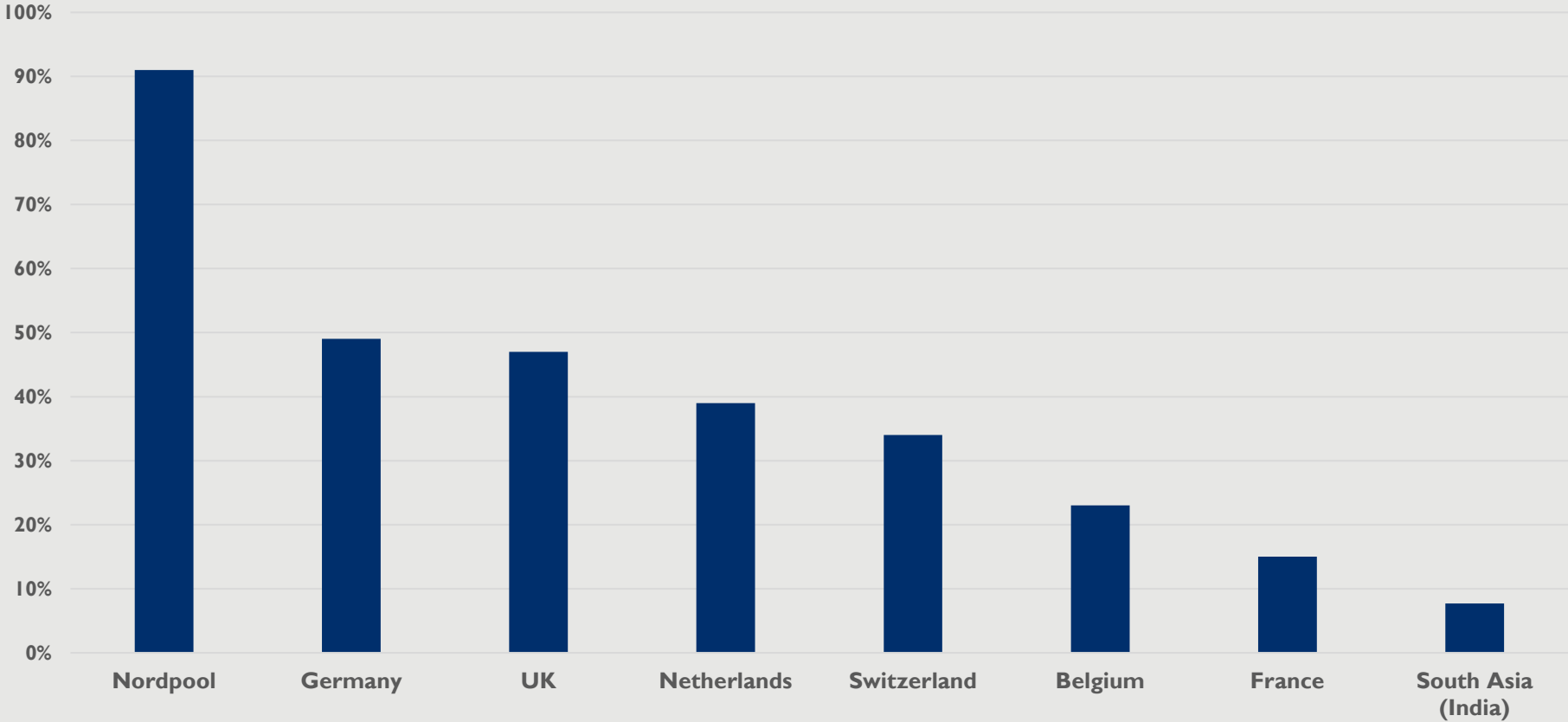
Country-wise summary of suggested actions in addition to adoption of model framework

Sri Lanka

- Amend section 43 of Electricity Act, to enable Transmission Licensee to participate in CBET
- Policy guidelines for CBET to be issued by Govt. of Sri Lanka
- PUCSL's Grid code (2014) to be amended (Chapter 2, Grid Planning Code) to ensure that Transmission Development plan for CBET lines is discussed with relevant neighbouring countries.
- Open access regulations to be issued
- Mechanism for sharing of deviation settlement mechanism charges on account of CBTMPT transactions, to be specified by ERC.
- The Ministry of Power and Renewable Energy may consider issuing a notification that will allow CEB and the regulator (PUCSL) to interact with other similar institutions in the region, so as to allow greater regional energy cooperation.
- While developing the transmission pricing methodology, the regulator may consider a kWh linked tariff (instead of KW), or a discounted tariff for solar power, due to its low utilization factor vis-à-vis other sources.
- All clean energy sources, including hydro may be considered as must-run (except reservoir-based hydro). This could be incorporated by amending the Grid Code.

Power Exchange in EUROPE Power Exchange Based Electricity Trade as % of total Trade

Power Exchange Based Electricity Trade as % of total Trade





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