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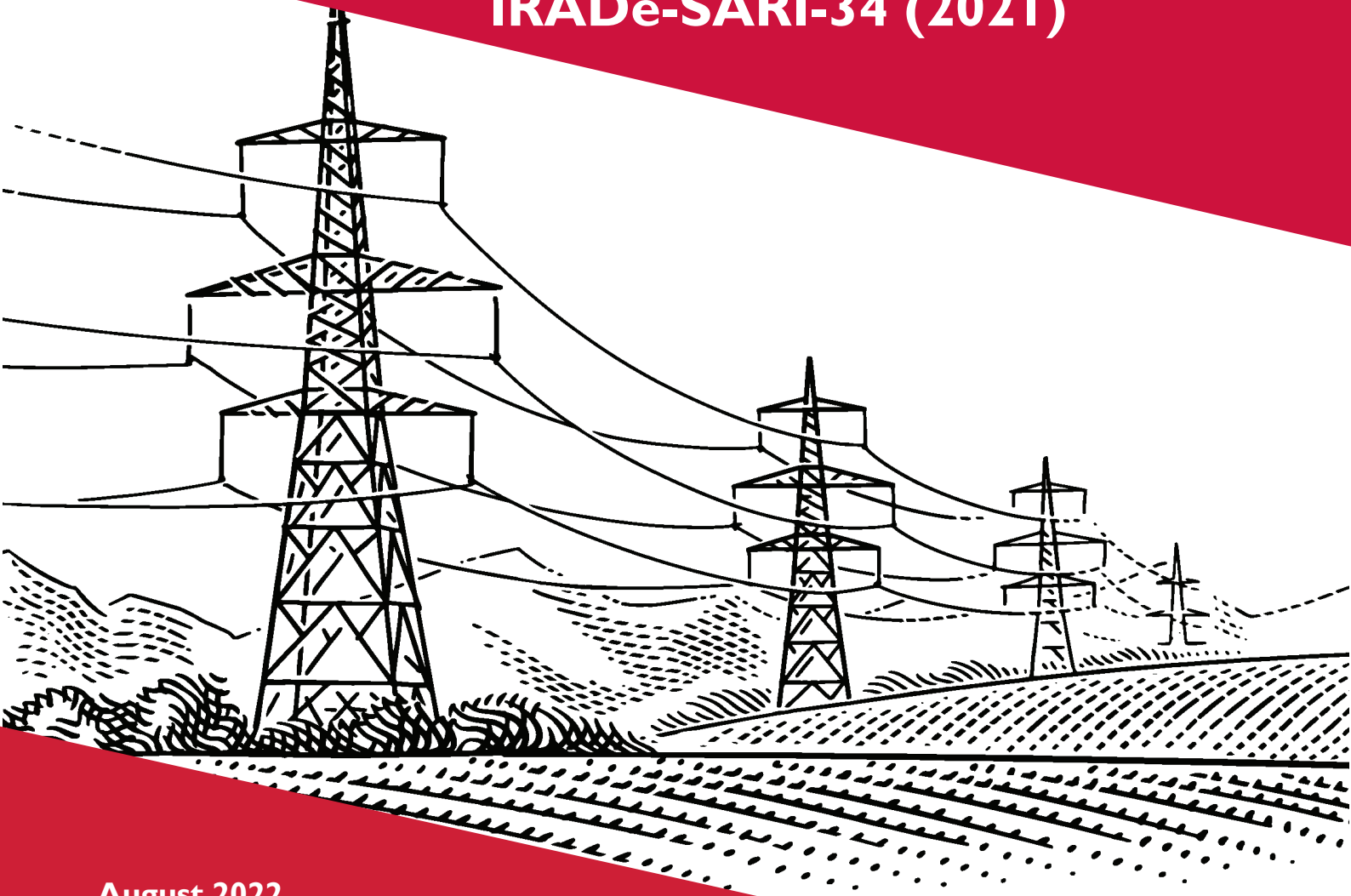
SOUTH ASIA REGIONAL INITIATIVE
FOR ENERGY INTEGRATION (SARI/EI)

Building consensus and developing a strategy paper on "Creating Regional Technical Institution/Body for cross-cutting deliberations and promoting excellence towards the development and operation of the regional transmission network in South Asia"

IRADe-SARI-34 (2021)



August 2022

SOUTH ASIA REGIONAL INITIATIVE FOR ENERGY INTEGRATION (SARI/EI)

FINAL REPORT

BUILDING CONSENSUS AND DEVELOPING A STRATEGY PAPER ON "CREATING REGIONAL TECHNICAL INSTITUTION/BODY FOR CROSS-CUTTING DELIBERATIONS AND PROMOTING EXCELLENCE TOWARDS THE DEVELOPMENT AND OPERATION OF THE REGIONAL TRANSMISSION NETWORK IN SOUTH ASIA"

IRADe-SARI-34 (2021)

INTEGRATED RESEARCH AND ACTION FOR DEVELOPMENT (IRADE)

AUGUST 2022

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The report can be considered as a base document for further analysis and it aims to stimulate further discussion and analysis for developing sustainable energy infrastructure through accelerated regional energy/electricity cooperation among South Asian countries—Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.

IRADe-SARI-34 (2021)

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Foreword

The U.S. Agency for International Development (USAID) has been working to enhance regional energy cooperation in South Asia since the year 2000, through its South Asia Regional Initiative for Energy (SARI/E) program. The first three phases of the program took place during the years 2000-2012. These initial phases focused on building trust, raising awareness, and assessing potential transmission interconnections. The current and fourth phase of the program, South Asia Regional Initiative for Energy Integration (SARI/EI), which was launched in the year 2012, focuses on three developmental outcomes. These include: the establishment of a Policy, Legal and Regulatory Framework, Advancement of Transmission Systems Interconnection, and establishment of the South Asia Regional Electricity Market. This phase is being implemented by the Integrated Research and Action for Development (IRADe).

South Asia is one of the fastest growing regions in the world. The demand for clean and renewable energy is expected to double by the year 2030. . Increased cross-border electricity trade among the different countries in the region will allow for South Asia economies to continue to grow and expand. Transmission networks play a very crucial role in enhancing power trade. It is important that the advancement of the regional transmission network for South Asia is given high priority among Governments, Development Partners and other stakeholders. A regional platform can help transmission utilities to discuss issues around transmission interconnections.

The SARI/EI program has developed a strategy paper focused on a regional transmission network in South Asia. The platform will support knowledge sharing, exchange of ideas, and best practices. The platform will also build the capacity of transmission utilities on a regular basis and help to facilitate ongoing dialogue among stakeholders.

I would like to take this opportunity to acknowledge the excellent work done by the SARI/EI team at IRADe and Deloitte India in developing this strategy paper. I hope that the findings of this paper will be useful for all of the South Asian member countries.

Sincerely,

MaryTyler Holmes

MaryTyler Holmes
Acting Director, Indo Pacific Office
USAID/India

Preface

We are pleased to present the report on "Creating Regional Technical Institution/Body for cross-cutting deliberations and promoting excellence towards the development and operation of the regional transmission network in South Asia". This report has been developed under the South Asia Regional Initiative for Energy Integration (SARI/EI) project, supported by the USAID and implemented by Integrated Research and Action for Development (IRADe).

Diverse sources of energy are available across the different countries in the region, combined with varied demand patterns and levels of electrification achieved. Such divergent conditions across different countries in South Asia not only provide the advantage of economic interchange and price advantage to the different countries, but also energy security and sustainability across the region. CBET enables integration of markets for higher economic development, promotes energy efficiency and facilitates integration of renewables in the region, due to use of hydro generating capacity as balancing source, available in plenty, in some of the countries. However, in order to achieve all these benefits, the regional transmission network also needs to be augmented to carry the power from one country to another in a seamless manner and for this development of an integrated transmission network in the region and its efficient operation and control is most essential.

The present report analyze and assess the various-operational mechanisms in South Asia related to coordinated system planning, integrated system/network development, and grid code harmonization from the perspective of CBET. Based on the in-depth review of the existing forums/institutional mechanisms, in South Asian Region and their role, responsibilities, structure, function etc. and based on the international best practices, this report suggest a suitable Regional Technical Institution in South Asia Region including its role, functions, operating structure and legal status, for coordinated transmission network development and operation in the region.

I hope that this report will be a useful reference point for facilitating discussions on regulatory measures/intervention needed for ensuring a robust and efficient transmission network in the SA region and shall also provide adequate guidance to the policymakers and utilities in South Asia towards advancement of the development of regional transmission network in the different countries in South Asia as well as help towards its operations and control in a harmonious manner.

I am grateful to USAID for their continued support in the preparation of this report. I sincerely thank the research team at SARI/ EI Secretariat /IRADe for their valuable inputs for the Report, through sustained efforts in ensuring that the report is completed with clear outcome and recommendations. I would also like to acknowledge the excellent work done by Deloitte in developing the report and adhering to the suggestions we rendered from time to time in order to make the report a reference document.

Jyoti Parikh

Dr. Jyoti Parikh

Executive Director, IRADe

1 Executive Summary

1.1 Introduction

The South Asian countries have been undertaking Cross Border Electricity Trade (CBET) through transmission interconnections for over five decades. In the eastern region, CBET is undertaken between India and the other three countries viz. Bangladesh, Bhutan and Nepal. There is also a small quantum of power supply between India and Myanmar. In the western region, Pakistan imports power from Iran and Afghanistan imports power from Central Asia. In total, the overall electricity trade is estimated to be over 20,000 million units. [1]

There are multiple cross border transmission interconnections existing between the different countries and enable the cross border electricity trade to a significant quantum. At present all such interconnections are applicable at bilateral level between the networks of two adjacent countries, though in time to come interconnections between the two distant countries, passing through the network of an intermediatory country are also likely to be there. This study is being undertaken to develop a strategy paper for creation of a regional technical institution (RTI) / body of transmission utilities in South Asian countries, which may act as a platform for cross cutting deliberations and promoting excellence in the field of integrated regional transmission network in the region. The regional technical institution shall also support and render platform for enabling harmonization of guidelines and operating codes incidental to cross border interconnections, through discussions and consensus building and rendering high quality of capacity building and training in the areas of network development and operation, RE integration and knowledge sharing etc.

The genesis of this study lies in study report published by SARI/EI Task Force-2 in 2016 – 'Harmonization of grid codes, operating procedures, and standards to facilitate/ promote Cross Border Electricity Trade (CBET) in South Asia'. This report recommended the creation of a regional institution:

"Keeping in view of the international experiences and considering the technical complexity involved with respect to grid code harmonization and integrated planning and operation of a regional power system in South Asia, it is suggested to create a Regional Technical Institution / Body such as South Asia forum of transmission system utilities of SACs or South Asia Forum of Transmission Utility (SAFTU), which shall be mandated for coordinated, reliable and secure operation of the interconnected transmission network as well as for coordinated system planning and integrated system/network development and grid code harmonization."

SARI/EI [2]

Drawing lessons from the recommendations of the previous report and further adapting the scope and objectives in line with the current situation, this study report has been prepared, to build consensus and formulate a strategy for creating a regional technical institution/body which may facilitate and render support towards regional cooperation and development and operation of integrated regional transmission network and related activities in South Asia Region.

1.2 Need for a Regional Technical Institutional (RTI) mechanism in South Asia

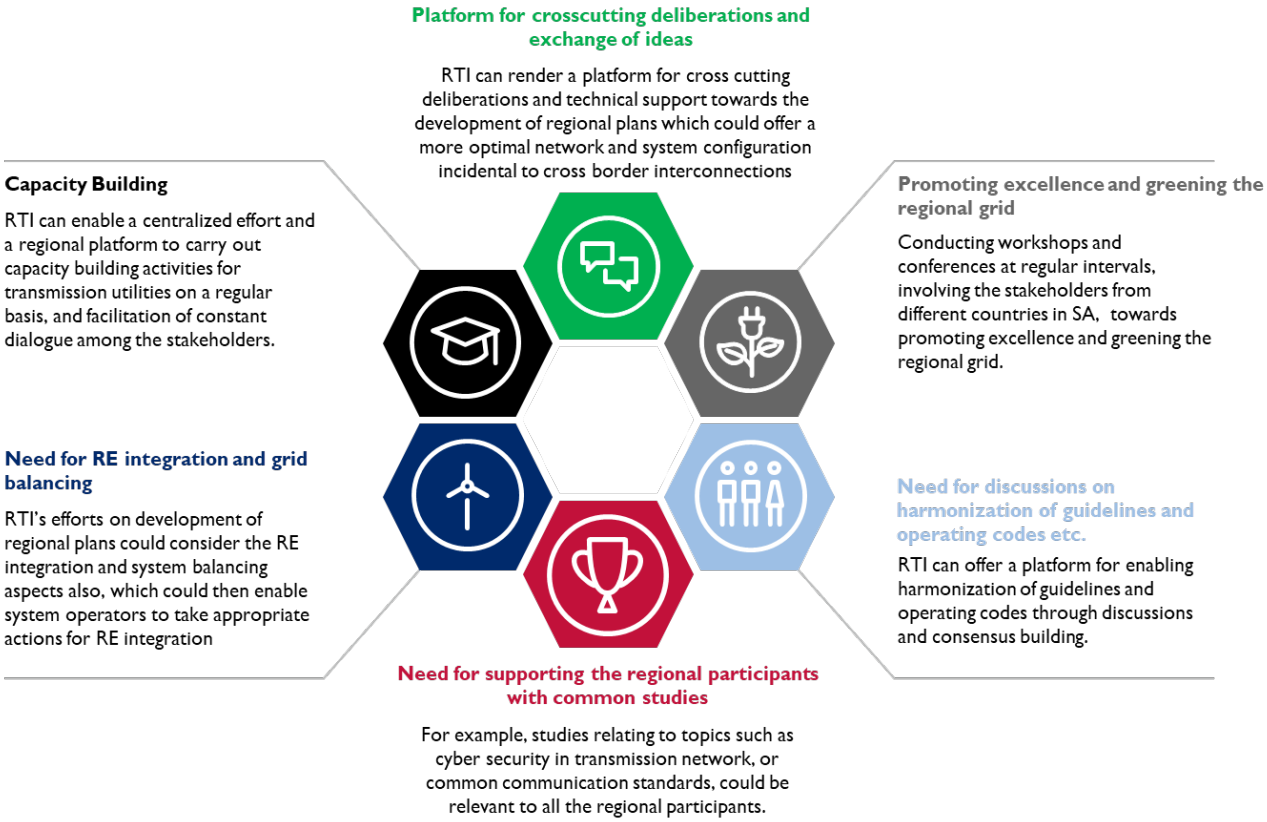
On matters relating to CBET and regional cooperation, the development and operation of the network incidental to cross border interconnections can be optimised if the plans of the different countries are in harmony and are based on an integrated regional approach. A regional level technical institution can facilitate discussions and deliberations towards such regional cooperation in a very effective manner and can play a potential role in the matters related to promotion of CBET.

The establishment of regional bodies on electricity co-operation across the globe, are believed to have facilitated the development of cross-country guidelines and codes. Considering the anticipated transition of South Asian market for electricity from bilateral to tripartite mode and the possibility of multiple countries getting access to India's power exchanges as per CERC's latest regulation on Cross Border Electricity Trade (CBET), South Asian countries also stand to benefit from having a regional technical body which may offer a platform for cross-cutting

deliberations and promoting excellence towards the development and operation of the regional transmission network in South Asia.

Some of the key areas where the need for RTI arises are described below.

Figure 1: Need for a regional technical institutional mechanism



1.3 Key learnings from international experience

Across the globe, there are examples of technical coordination institutions for electricity. While those examples may or may not be directly relatable and relevant to South Asia, in order to learn from those experiences, a study of those international examples have been undertaken. Some of the international regional technical institutions and their functions are mentioned below:

This includes the following:

Table 1: Key international bodies for regional coordination among transmission utilities

Organization	Brief introduction	Key roles and responsibilities
entsoe European Network of Transmission System Operators – Electricity (ENTSO-E)	• Established in 2008. • Have 42 electricity transmission system operators (TSOs) as its members, across 35 European countries.	• Development of network codes • Drafting of ten-year network development plan (TNYDP) • Publish summer and winter generation outlooks • Undertake studies on network safety and protection • Develop commonly agreed and compatible data exchange formats • Undertake research
pjm PJM Interconnection, USA	• Established in 1997. • Have generation owners, transmission owners and electricity suppliers in 13 states and the District of	• Development of Regional Transmission Expansion Plan (RTEP), with a 15 year outlook, in order to maintain the future reliability and economic performance of the grid. • Direct the operation and coordinate the maintenance of transmission System

Organization	Brief introduction	Key roles and responsibilities
	Columbia, in USA as its members.	• Design and manage wholesale energy market, including market for reserves
HAPUA Heads of ASEAN Power Utilities (HAPUA) and ASEAN Power Grid Coordination Committee (APGCC)	• HAPUA established in 1997. • Have national power utilities of the 10 ASEAN countries as its members • HAPUA has also established a separate ASEAN Power Grid Consultation Committee (APGCC) which coordinates on activities related to development of ASEAN Power Grid.	• HAPUA - Promote cooperation among its members to strengthen regional energy security through interconnection development, enhancing private sector participation, encouraging standardization of equipment, promoting joint project development, cooperation in human resources, research & development, and to enhance quality & reliability of electricity supply system • APGCC - Facilitate and assist the HAPUA Council in the implementation of inter-gov. MoU for establishment of ASEAN Power Grid (APG) and preparation of annual and multi-year action plans for the development of the APG
SAPP South African Power Pool (SAPP)	• Established in 1995, under the African Development Community (SADC). • Have the national power utilities of 12 countries in southern Africa as its members.	• Provide a forum for regional solutions to electric energy problems • Coordinate the planning and operation of the electric power system among member utilities • Development of SAPP pool plan • Harmonise relationships between member utilities. • Provide a Market Trading Platform
Greater Mekong Subregion Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region	• Established in 2002, with the objective of managing regional power trade in the Greater Mekong Sub region and provide recommendations on overall policy in this area.	• Prepare GMS Grid Code/Regional Power Trading Operating Agreement (RPTOA) • Preparation of a regional interconnection plan • Developing regional performance standards
EOR Central American Interconnection System (SIEPAC)	Ente Operador Regional (EOR) • Established in 2013, to operate the regional transmission line running through the member countries.	• Planning the Regional Transmission Network • Directing and coordinating the technical operation of the Regional Electricity System • Carrying out the commercial management of the Regional Electricity Market (MER) of Central America
Gulf Cooperation Council Interconnection Authority (GCCIA)	• Established in 2001, to realize more cooperation and fostering the links between GCC states in the areas of trade and services in power	• Plan and operate the GCC interconnector • Run daily/monthly/yearly explicit auctions on grid capacities rights • Facilitate and arrange energy schedules • Prepare periodic accounts and statements for energy exchanged between the member countries
Arab Union of Electricity (AUE)	• Established in 1987 to develop the generation, transmission and distribution of electrical energy in the Arab World, and Improving and coordinating the areas of interest of its members	• Planning Committee • Committee of Interconnected Arab Networks (CIAN). • Engineering and Production Committee • Renewable Energy Committee

The review of such regional institutions revealed the following key learnings:

Table 2: Summary of key learnings from international experience

Area	Key learning
Key functions	• Functions like support towards transmission planning, providing a platform towards cross cutting deliberations on the subjects of operational and protection coordination matters across the cross border links, framing and harmonization of network codes/standards and activities like capacity building etc. form the most widely undertaken functions of the regional coordination institutions.
Legal framework	• The legal framework across regional organizations vary and include the organizations formed through intergovernmental agreements/MoUs, inter utility agreements/MoUs, through separate laws, as voluntary organizations, or as a company / corporation / Joint Venture / Association. • There are historical precedents in entities traversing from loosely formed to more formal arrangements, as it matures. A case in example is PJM which evolved from an unincorporated association, to a Limited Liability Corporation. • Another example is Nordel, which was established 1963 as an advisory association of leading persons from the electricity industries of Denmark, Norway, Sweden, Finland and Iceland. Nordel changed itself from to an 'association of Transmission System Operators' in Nordic countries by adopting a new set of bylaws in 2000. • Yet another example is VLPGO (Very Large Grid Operators Association), more recently known as GO15. Though the association was created in 2004, it became an incorporate not-for-profit association only in 2009.
Funding mechanisms	• International institutions rely on a variety of options such as funding from member Governments or for example the European Commission in the case of ENTSO-E and other government's funding (for example, Norwegian government funding for SAPP). • Financing can also be through fees from the power market participants and consumers as well as by way of occasional supports from Multilateral Development Bank (MDB)/ Development Financial Institutions (DFI).

As elaborated above, in order to learn from their experiences, the study about the different international models have been carried out. Irrespective of the above learnings, it is important to note that each region has its own characteristics and peculiarities and has to choose its own pathway towards regional cooperation. Hence while developing this strategy paper, due care has been taken that for meeting the requirements of South Asia region, we have to look at its specific needs and individualities and the framework has been customised and proposed accordingly.

1.4 Options for setting up South Asia Forum of Transmission Utilities (SAFTU)

A South Asia Forum of Transmission Utilities (SAFTU) may be set up as the RTI, to facilitate and render support for crosscutting deliberations and promoting excellence towards integrated transmission network development and operation in the region. The broad framework of the proposed RTI is elaborated in the following sub-paras:

1.4.1 Membership

As SAFTU is primarily the forum of transmission utilities, the national level transmission utility and transmission planning agency in each member country can be the Member Entities, who will be part of SAFTU Executive Council. While SAFTU is for South Asia, considering the existing interconnection (though at a lower voltage) between India and Myanmar, Myanmar may be allowed to participate as an Associate Member, if the country desires so.

In addition to Member Entities as described above, the Participant Entities (facilitated through Groups) could be:

- Transmission utilities (other than national transmission utility) who operate the cross border network infrastructure;
- National Load Despatch Centre / System Operator;
- Representatives from the respective Government Department;
- Any other relevant entity, if required. *(For example, in some cases the relevant Regional Load Dispatch Centre in India will also be a key stakeholder. Another example is the invitation of experts from research institutions as observers.)*

The core activities of SAFTU will be managed by the Member Entities in the Executive Council, and in taking the key decisions and undertaking the functions of the SAFTU, they shall be supported by the Participant Entities through the respective Groups.

1.4.2 Key objectives and functions

A regional institutional mechanism such as SAFTU for technical coordination in South Asia could play a supportive role across different areas including:

1. Act as a platform for crosscutting deliberations and exchange of ideas on the subjects related to network development and operation in South Asian Grid;
2. Dissemination of knowledge towards deployment of advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing and integrating diverse sources of energy available in the South Asia region;
3. Provide a platform for enabling harmonisation of guidelines and operating codes through discussions and try to build consensus through discussions on the issues of common interest;
4. Undertake research, technical studies, and come up with white paper and discussion briefs in relevant areas of integrated system planning and network development;
5. Conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, towards promoting excellence and greening the regional grid;
6. Promote and render assistance towards knowledge sharing, capacity building & training in system planning, network development, RE integration, etc.

The role of SAFTU is not envisaged as an overarching controlling body, but as a facilitating institution, which provides support to rest of the regional stakeholders, with the ultimate objective of promoting excellence towards development and operation of regional transmission network in South Asia.

1.4.3 Legal framework

Based on the key learnings from international experiences as explained above, the following examples of legal identity have been observed in case of the regional cooperation bodies relating to electricity sector in the different regions across the globe.

1. Establish through/under Intergovernmental or inter-utility arrangements (e.g. RPTCC, International Solar Alliance, HAPUA, SAPP);

2. Incorporate as a company / corporation through Articles of Association, By Laws, etc. (e.g. PJM Interconnection, SIEPAC, GCCIA,);
3. Incorporate as a voluntary organization (like society/trust) under the laws of host country (e.g. Council of European Energy Regulators, Northeast Power Coordinating Council, Midwest Reliability Organization, International Civil Aviation Organization, Arab Union for Electricity, SAARC Chambers of Commerce and Industries); and
4. Establish as an Association (e.g. SAFIR, Forum of Load Despatchers, earlier form of PJM – PJM Interconnection Association, earlier form of GO15 – Very Large Power Grid Operators Association).

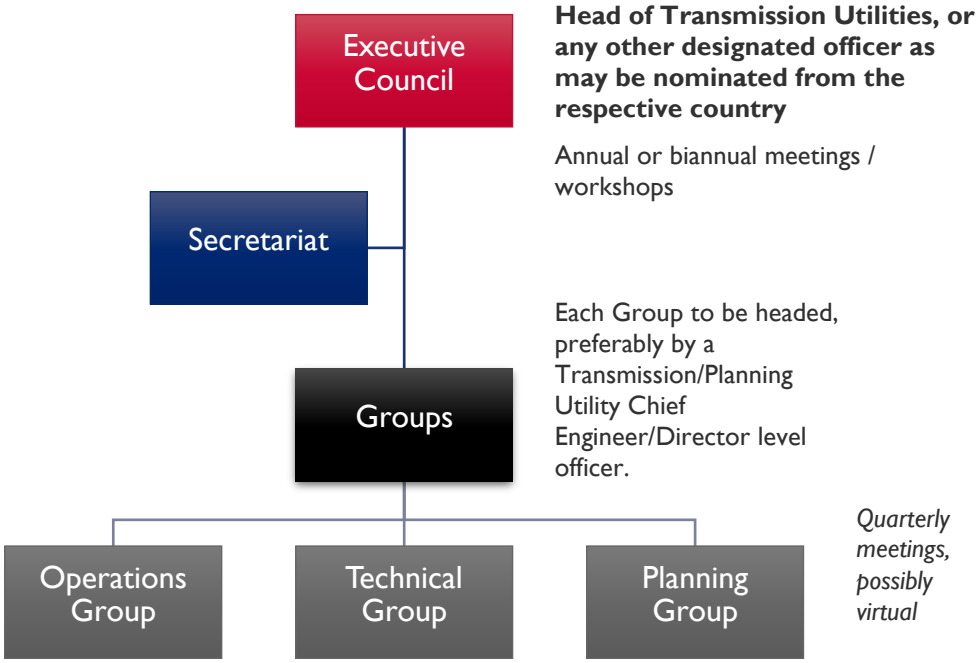
Based on the specific nature of engagements currently experienced in South Asia relating to the cross border electricity trades, during the initial phase, SAFTU can be created as a loosely formed Association and can act as an advisory and a facilitating body, with the member entities trying to reach at the decisions through discussions and consensus building and implement and comply with the recommendations on voluntary basis. During the current period such an approach is most pragmatic and is also desirable in order to set-up the association and start the activities in an expeditious manner. There is precedence for such evolution, as seen in the case of PJM, Nordel and GO15.

In the longer term, as the institution gains momentum and if need arises, based on the mutual consent of the members, switching to more formal format, can be explored.

1.4.4 Organizational structure

The proposed structure of the SAFTU is as illustrated below.

Figure 2: Proposed organizational structure for SAFTU



The SAFTU Executive Council may preferably consist of the heads of the transmission utilities or any other designated officer as may be nominated from the respective country, and representatives from transmission planning agencies.

Each Group can be headed by a Chief Engineer/Director level official from the respective field and will serve as the Chairperson for the Group.

The Secretariat and the Groups will report to the Executive Council.

1.4.5 Secretariat

Considering the international examples and implementation feasibility, a permanent secretariat in one of the member countries will be the preferred option for SAFTU. Till the time the secretariat is financially self-sustaining, the same could be housed within one of the willing member utilities.

The Secretariat will undertake coordination activities among the member entities and also among the Executive Council and Working Groups. The Member Secretary can also act as the Member Secretary for the Executive Council and all the Groups.

1.4.6 Funding

In the initial years, it can be expected that SAFTU will be financially supported by the transmission utility of host country, and time to time support from development agencies such as USAID. There will be no membership fee collection during this initial phase and this will help in implementing the initial process expeditiously.

However, in the long term, the goal shall be to move towards a self-sustainable financing mechanism, through membership funding. The member utilities may contribute towards membership funding

1.5 Way forward

Considering the discussions on various aspects detailed above, especially the legal status and institutional structure, and considering the geopolitical scenario in South Asia, the following observations can be made regarding a potential roadmap for the establishment of SAFTU:

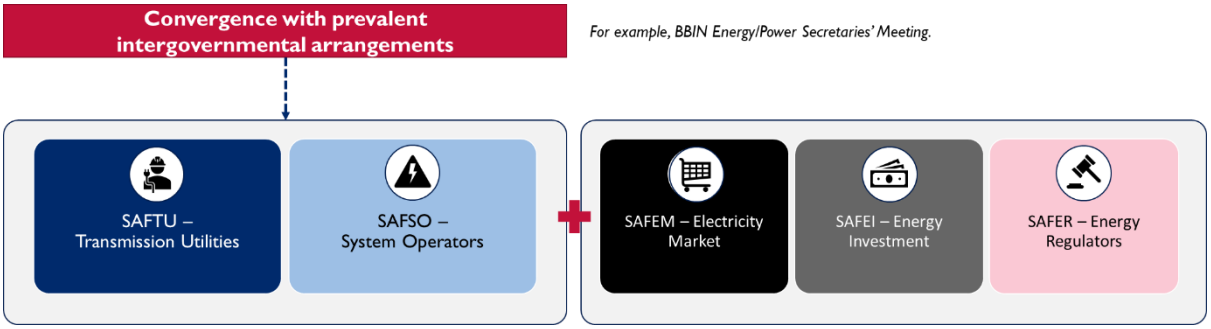
1. If there is an overall consensus among the transmission utilities of member countries, establishing SAFTU as a loosely formed association could be the quickest way to commence the operations of SAFTU, at least for the initial years.
2. In the initial years, it may be challenging to arrange a member contribution based financing structure for SAFTU. Therefore, SAFTU secretariat can be housed within the transmission utility of a willing member country, which shall support SAFTU with locating the secretariat office and the staff resources in the initial years. Time to time support of development agencies , such as providing support for carrying out any technical studies and organizing conferences could also be possible at this stage. This could also include capacity building assistance and technical handholding from entities and projects supported by development agencies such as USAID's South Asia Regional Initiative for Energy Integration (SARI/EI).
3. Notwithstanding the physical location of secretariat, the overall chairmanship of SAFTU can still be determined through a rotational basis.
4. Gradually, with the passage of time, as the SAFTU gains momentum and makes its presence visible in the different matters related to regional transmission network, SAFTU can try to move towards a more formal structure, preferably under an intergovernmental/inter-utility agreement, based on the requirement and mutual consent of the member countries.

The following key activities are important to get the plan for creation of SAFTU to be implemented:

- Preparation of charter for SAFTU
- Countries to discuss and agree on Charter
- One of the transmission utilities agree to host the Secretariat of SAFTU
- Countries to accept the Charter as part of a common meeting (which will also be the initial meeting of SAFTU)

With the passage of time, based on the requirement and mutual consent of the member countries, the proposed forums for transmission utilities (SAFTU) and system operators (SAFSO) can be made responsible to report to any intergovernmental arrangements. In the longer term, the possibility of bringing all the proposed regional platforms under a common framework can also be explored.

Figure 3: Vision for longer term integration of regional platforms



2 Introduction

2.1 Background

The regional energy cooperation offers an ideal platform to achieve sustainable growth through sharing of available natural resources. In the context of energy sector, it is applicable to South Asian countries where there is a vast diversity of available energy resources which are still under development, particularly hydropower and renewable.

Figure 4: Spread of hydro and renewable energy potential

Hydro	**India** 145 GW	**Nepal** 83 GW	**Pakistan** 42 GW	**Bhutan** 41 GW	**Afghanistan** 23 GW
Solar and Wind	**India** 1052 GW	**Pakistan** 340 GW	**Afghanistan** 68 GW	**Bhutan** 13 GW	**Sri Lanka** 12 GW

Source: Ministries of respective governments, IRENA, ADB[3]

The regional electricity trade has the potential to deliver significant economic benefits as well as improve the reliability of power in environment friendly manner. Cross Border Electricity Trade (CBET) provides the benefits of lower electricity costs, diversifying supply and, the opportunity to tap into renewable and low carbon energy resources. Estimated savings in undiscounted electricity supply costs could be around USD 9 billion each year if there is full power grid interconnection. Greenhouse gas (GHG) emissions could also be reduced by more than 9 percent annually compared to the business as usual case[4].

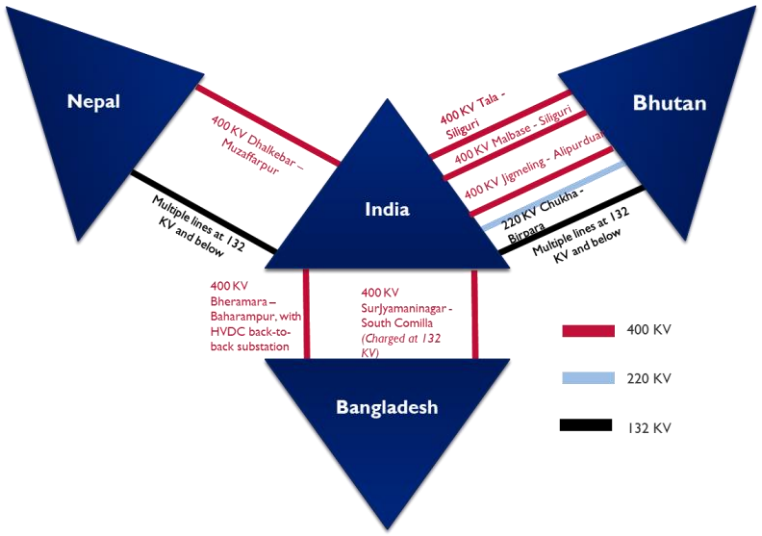
Enhanced cross border electricity trade is expected to result in direct economic benefits, both for importing and for exporting countries. The net importers will benefit through greater industrial output owing to enhanced access and continuity of electricity supply. The exporting countries will benefit through growth in national income which will accrue through export revenue. For example, recent studies of India-Nepal power trade indicate gains for both countries. Nepal, as the exporting country, is projected to gain through export earnings as well as enhanced consumption[5]. Under an accelerated bilateral power trading arrangement between both countries, Nepal's GDP is expected reach USD 85 billion by 2040 from USD 21.14 billion in 2016, which is a four-fold increase[6].

The costs imposed by non-availability of electricity are an important aspect to consider. The high rates of direct economic losses because electricity outages in South Asia is a matter of concern. Such estimated losses calculated as forgone value of sales range from 3 per cent in Sri Lanka to almost 27 per cent in Nepal (2017)[7]. This can be addressed by increase in CBET.

Each country has individual energy needs and specific resources which under an integrated regional plan can be leveraged in the most cost-effective and environmentally sustainable manner. In South Asia, power grids of select countries are interconnected, and there is a substantial amount of Cross Border Electricity Trade (CBET) that is being conducted.

The figure below illustrates the key existing interconnecting transmission lines in South Asia, showing the voltage level for each of the interconnections.

Figure 5: Key cross border interconnections in South Asia

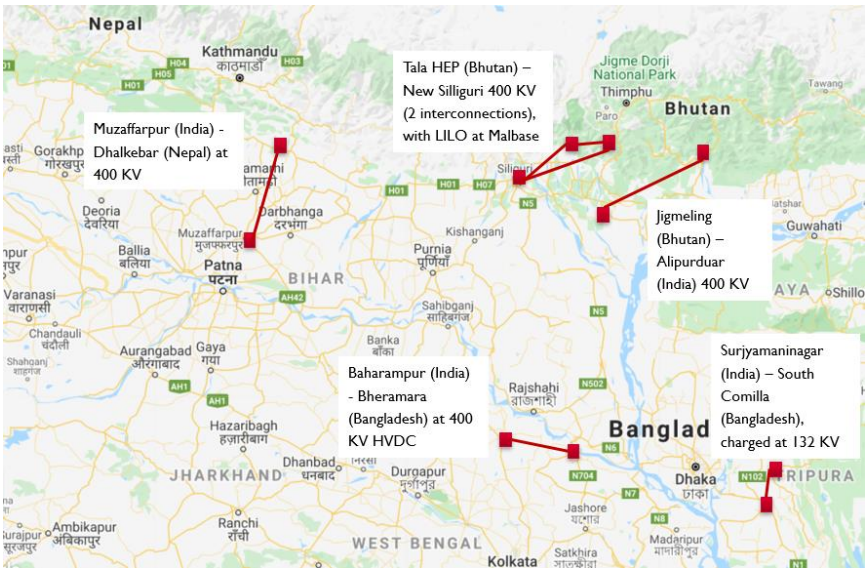


The existing cross border interconnections among the South Asian countries depicted above are:

- India and Bangladesh
  - 400 KV Bheramara – Baharampur (with HVDC back to back sub-station at Bangladesh end)
  - 400 KV Surjyamaninagar – South Comilla (charged at 132 KV)
- India and Bhutan
  - 400 KV Tala - Siliguri line
  - 400 KV Malbase – Siliguri line (LILO to one of the Tala – Siliguri circuits)
  - 400 KV Jigmeling - Alipurduar
  - 220 KV Chukha (Malbase) - Birpara
  - Multiple lines at 132 KV and below
- India and Nepal
  - 400 KV Dhalkebar – Muzaffarpur
  - Multiple lines at 132 KV and below

An approximate graphical layout of the 400 KV lines are provided below:

Figure 6: Approximate illustration of CBET lines at 400KV



Approximate estimate. Political borders are not depicted.

There are multiple cross border transmission interconnections existing between the different countries, and a significant quantum of cross border electricity trade is also taking place. The arrangements for such cross border electricity trade are present only at a bilateral level and in general any avenues which may facilitate and support such mechanism at regional level is not there. It is in such a background, that this study is being undertaken and the purpose of the study is to develop a strategy for creation of a regional technical institution (RTI) / body of transmission utilities in South Asian countries, which may act as a platform for cross cutting deliberations and as a facilitating body towards development of integrated regional transmission network in the region. The regional technical institution shall also render support towards adoption and implementation of guidelines for CBET and involved in the areas of capacity building and training in the areas of system planning, network development RE integration and knowledge sharing etc.

The genesis of this study lies in study report published by SARI/EI Task Force-2 in 2016 – 'Harmonization of Grid codes, Operating procedures, and Standards to facilitate/ promote Cross Border Electricity Trade (CBET) in South Asia1'. This report recommended the creation of a regional institution:

"Keeping in view of the international experiences and considering the technical complexity involved with respect to grid code harmonization and integrated planning and operation of a regional power system in South Asia, it is suggested to create a Regional Technical Institution / Body such as South Asia forum of transmission system utilities of SACs or South Asia Forum of Transmission Utility (SAFTU), which shall be mandated for coordinated, reliable and secure operation of the interconnected transmission network as well as for coordinated system planning and integrated system/network development and grid code harmonization."

SARI/EI [8]

The establishment of regional bodies on electricity co-operation across the globe are believed to have facilitated the development of cross country guidelines and codes. Considering the anticipated transition of South Asian market for electricity from bilateral to tripartite mode (such as Nepal-India-Bangladesh), and the possibility of multiple countries getting access to India's power exchanges as per CERC's latest regulation on Cross Border Electricity Trade (CBET)[9], South Asian countries also stand to benefit from having a regional technical body which may offer a platform for cross-cutting deliberations and promoting excellence towards the development and operation of the regional transmission network in South Asia.

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

This document provides the framework for participating entities in India to engage in cross border trade of electricity with its neighbouring countries. Cross border trade will be allowed through mutual agreements between Indian entities and entities of the neighbouring countries under the overall framework of the regulation. For tripartite agreements, the cross-border trade of electricity across India will be allowed under the overall framework of bilateral agreements signed between Government of India and the governments of the respective neighbouring countries of the participating entities. National Load Dispatch Centre (NLDC) will grant short-term open access, while the Central Transmission Utility will be responsible for granting long-term access and medium-term open access for cross border trade of electricity. Further, any electricity trading licensee of India can trade in the Indian power exchanges on behalf of any participating entity from other countries after obtaining approval from the designated authority.

The proposed RTI can deal with aspects such as:

1. Act as a platform for crosscutting deliberations and exchange of ideas on the subjects related to network development and operation in South Asian Grid;
2. Dissemination of knowledge towards deployment of advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing and integrating diverse sources of energy available in the South Asia region;
3. Provide a platform for enabling harmonisation of guidelines and operating codes through discussions and try to build consensus through discussions on the issues of common interest ;

4. Undertake research, technical studies, and come up with white paper and discussion briefs in relevant areas of integrated system planning and network development;
5. Conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, towards promoting excellence and greening the regional grid; and
6. Promote and render assistance towards knowledge sharing, capacity building & training in system planning, network development, RE integration, etc.

2.2 Scope of Work under the Study

Background and purpose: South Asian Regional Initiative for Energy Integration (SARI/EI) is a long-standing program of USAID started in the year 2000. The program covers eight countries of the region i.e. Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka. The program has consistently strived for enhancing energy security of South Asian nations. The SARI/EI program of USAID entered its fourth phase in 2012 and is being continued till 2022. The SARI/EI program aims to promote regional energy integration as well as increase cross border electricity trade in the region. The overall objective of SARI/EI is to create the right "enabling" environment to support the establishment of a South Asian electricity market, and gain consensus and support from the key decision makers and stakeholders. SARI/EI program focuses on three developmental outcomes i.e. Coordination of Policy, Legal and Regulatory Framework; Advancement of Transmission Systems Interconnection; and establishment of South Asia Regional Electricity Market. To achieve these outcomes, three dedicated Task Forces (TFs) have been constituted under the program, represented by government nominated members from South Asian Country governments (Energy/Power Ministries), Electricity Regulatory Commissions, Planning Authorities, National Power Transmission utilities, Power Market Institutions etc. Integrated Research and Action for Development (IRADe) is the implementing partner for the fourth phase (2012-2022) of the SARI/EI program.

To address various technical issues related to integrated system planning and system operation, the SARI/EI Task Force-2 which focuses on Advancement of Transmission System Interconnection, in its report 'Harmonization of Grid codes, Operating procedures, and Standards to facilitate/ promote Cross Border Electricity Trade (CBET) in South Asia', 2016, recommended the creation of a regional technical Institution/body to support coordinated, reliable, and secure operation of the interconnected transmission network; coordinated system planning; integrated system/network development for integrated grid operation and facilitating harmonization of technical standards for a Regional Power Grid. The creation of this institution was proposed, keeping in view, the international experience.

Drawing lessons from the recommendations of the above report and further adapting the scope and objectives in line with the current situation, the primary purpose under this study is to develop a strategy paper through a consultative process that draws upon the views and opinions of the key stakeholders on a proposed regional technical institutional mechanism to offer a platform for cross-cutting deliberations and promoting excellence towards the development and operation of the regional transmission network in South Asia. The proposed Regional Technical Institution/Body i.e. the South Asian Forum of Transmission Utilities (SAFTU) will be a neutral body. The strategy paper will also facilitate in building consensus among the stakeholders. The Scope of Work includes the following:

1. Give a detailed background on the creation of a Regional Technical Institution/Body/Association i.e. the South Asia Forum of Transmission System Utilities of SACs or South Asian Forum of Transmission Utility (SAFTU) in the region for promoting CBET through a consultative process with all relevant stakeholders.

2. Analyze and assess the various-operational mechanisms in South Asia related to coordinated system planning, integrated system/network development, system operation and grid code harmonization from the perspective of CBET.

3. Review and analyze the international experiences in Europe (ENTSO-e), Southern Africa (SAPP), Western Africa (WAPP), US (PJM and other markets), and Central America etc. in formation of a Regional Technical Institution/Body/Association etc. for coordinated system planning and integrated system/network development, facilitating ground level development of the transmission system, harmonization of technical standards and coordinated grid operation, from the perspective of CBET.

4. Analyze the existing forums/institutional mechanisms, if any, in South Asian Region and their role, responsibilities, structure, function etc. Analyze and explore the possibility of linkage of the proposed institution i.e. SAFTU with any of these existing institutions such as SAARC, BIMSTEC and SAFIR , particularly with specific reference of housing SAFTU within one of these existing institutions.

5. Based on the above analysis, suggest a suitable Regional Technical Institution or Body or Association in South Asia Region including its role, functions, operating structure (including working groups, expert committee etc.) and legal framework etc., in order to facilitate coordinated system planning and operation etc. in the region. The proposed draft shall also discuss in detail the pros and cons in regard to the different possible operating and legal framework, organizational structure, and financial arrangements etc. It shall also carefully evaluate and deliberate upon, that the proposed institutions should initially start with a formal or a loosely formed structure, and in case of later which institution is best suited to house SAFTU and what can be the roadmap to ultimately go in for a more formal structure.

6. Provide technical support and present the proposed structure in the South Asia Regional Transmission Utility Workshop, to be organized by SARI/EI secretariat for detailed consultation and to seek views of transmission utilities, system operators etc. on the study findings. Meetings with the concerned stakeholders in South Asian countries India, may also be required to be held.

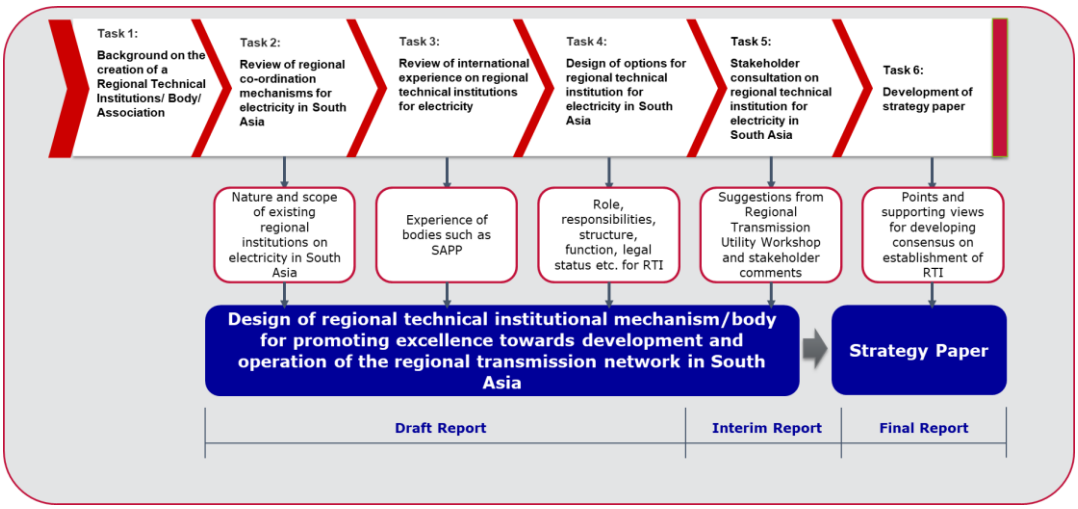
7. Develop a detailed strategy for the function, mode of operation and creation of the Regional Technical Institutions/Body/Association i.e. SAFTU.

8. Put up a strategy paper to SARI/EI Project Secretariat in the form of a report. The Strategy paper should reflect the nuances, opinions and suggestions of the concerned parties/stakeholders, along with the final recommendations, developing consensus towards addressing differences, while building upon areas of unanimity.

2.3 Approach and Methodology

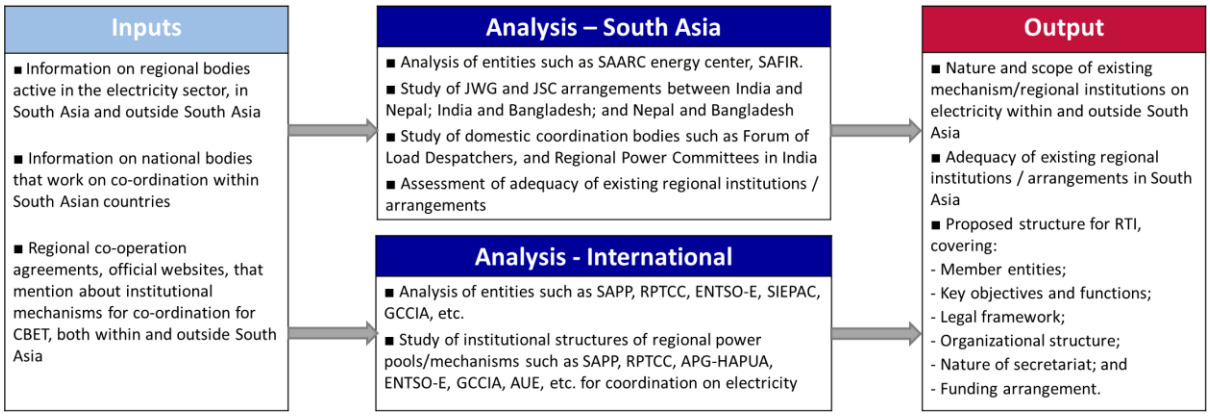
The detailed approach and the various tasks to be undertaken in line with the Scope of Work, leading to the development of the final report and strategy paper has been outlined below.

Figure 7: Overall approach and methodology



Broadly, there are three key stages covering all the tasks depicted above. The first one is the development of options for the proposed RTI. To start with, a detailed background has been provided on creation of the RTI in the region. This has been followed by the review of existing regional co-ordination mechanism/institutions for promoting CBET in South Asia. Another important element is the detailed study and evaluation of international experience on regional technical institutions for electricity. The approach followed for the review of existing mechanisms in South Asia and international experience, and identification of options for RTI has been depicted below.

Figure 8: Approach for review of existing mechanisms and identification of options for RTI



Based on the findings from the need for the RTI, existing mechanisms in South Asia and the learnings from the International experience, options have been designed for the proposed RTI for South Asia. The aspects of the RTI covered are its potential members and type of entities, objectives, functions, legal framework, organizational structure, nature and location of the secretariat and, funding arrangements.

The next stage involves extensive stakeholder consultation, first by gathering inputs through questionnaire from the key stakeholders, followed by feedback taken during the South Asia Transmission Utility Workshop and other interactions as required. This Workshop will provide a platform for interaction with transmission utilities on the need for regional coordination mechanism and the proposed design for such a regional institution.

The last stage covers the development and finalisation of the strategy paper, based on the findings and the views/suggestions of the stakeholders. The paper will provide final recommendations regarding the different aspects related to the establishment of the proposed RTI and, build consensus by considering different options and suggestions of the stakeholders.

3 Background on the need for a Regional Technical Institutional (RTI) mechanism in South Asia

3.1 Cross Border Electricity Trade (CBET) in South Asia

The South Asian region has diverse natural resources ranging from large coal reserves in India, gas reserves in Pakistan and Bangladesh, hydropower potential in Nepal and Bhutan, and non-conventional resources (solar and wind) in all countries. The power system varies from countries with peak demand of 388 MW to 177 GW. The electricity mix also varies from country to country. The following table provides a snapshot of the power sector of the South Asian countries.

Table 3: Power sector profile for South Asia

South Asian Countries	Peak electricity demand (MW)	Installed capacity of electricity (MW)	Primary source for electricity production	Electricity Availability (MU)
Afghanistan*	1150	567	Hydro	6045
Bangladesh	13,975	18,961	Gas	70,533
Bhutan	388	2343	Hydro	6960*
India	177,022	344,011	Coal	1,267,209
Maldives	-#	256	Diesel	1405$
Nepal	1320	1182	Hydro	7551
Pakistan	21,736	38,375	Gas	140,992
Sri Lanka	2833	4528	Hydro	15,374*

** 2018. $2017. Others are for 2019. # - Most of the islands are not interconnected.*
Source: NTDC, Maldives Ministry of Environment, SARI/EI, National Statistical Bureau of Bhutan, SAARC Energy Center[10]

Resource and demand complementarity, need for additional electricity at low cost and political coordination has led to the development of various CBET arrangements between South Asia countries. There is already a substantial cross border electricity trade happening between the countries.

Table 4: Cross border electricity trade volume in South Asia

Countries involved in CBET	Trading Volume (MU)
Central Asia to Afghanistan*	3905*
India to Bangladesh	6988
Bhutan to India	6311
India to Nepal	2373
India to Myanmar	9
Iran to Pakistan	486#

** 2018, # 2019, all other numbers for April 2019 – March 2020. Source: POSOCO, NTDC, SAARC Energy Center[11]*

According to a World Bank presentation, regional cooperation in South Asia can enable more than 105,000 MW of transmission capacity by 2040 which will support unlimited cross border power trade[12]. Creation and participation in a common power market will lead to more efficient utilisation of generation assets, wider benefit of efficient price discovery and, reduced counter-party search and transaction efforts for all participants. A summary of CBET in South Asia is provided below.

Table 5: Summary of CBET interconnections for South Asian countries

Trade Partners	Key Interconnections	Nature of Trade
Afghanistan – Central Asia (Iran, Tajikistan, Turkmenistan, Uzbekistan)	• Torbat-e Jam (Iran) – Herat (Afghanistan) at 132 KV[13] • Turkmenistan – Pul-e –Khumri (Afghanistan at 220 KV[14] • Turkmenistan – Herat (Afghanistan) at 110 KV[15] • Termez (Uzbekistan)– Pul-e –Khumri (Afghanistan) at 220 KV[16] • Tajikistan border – Pul-e –Khumri (Afghanistan) at 220 KV[17] • Turkmenistan–Uzbekistan–Tajikistan–Afghanistan–Pakistan (TUTAP) interconnection at 220 KV and 500 KV AC – *under progress*[18] • Turkmenistan—Afghanistan–Pakistan (TAP) Interconnection at 500 KV AC – *under progress*[19] • CASA 1000 project *(under progress)* – a 500 KV HVAC line from Kyrgyz Republic to Tajikistan, a ±500 KV HVDC line connecting a 1,300 MW terminal at the Nowshera converter station in Pakistan via Afghanistan[20]	All the existing lines are used for import of power to Afghanistan
Bangladesh – India	• Baharampur (India) - Bheramara (Bangladesh) at 400 KV HVDC • Surjyamaninagar (India) - South Comilla (Bangladesh) at 132 KV (AC)	CBET under medium and long term PPAs for import to Bangladesh
Bhutan – India	• Tala HEP (Bhutan) – New Silliguri/Binnaguri Power Pooling point at 400 KV (2 interconnections)[21] • Malbase – Siliguri line at 400 KV (LILO to one of the Tala – Siliguri circuits) • Jigmeling – Alipurduar at 400 KV • Chukha HEP / Malbase (Bhutan) – Birpara (India) at 220 KV (3 interconnections)[22] • Kurichhu HEP (Bhutan) – Salakati (India) at 132 KV[23] • Motanga (Bhutan) – Rangia (India) at 132 KV • Sibsoo/Jholung (Bhutan) - Chumarchi/Samtse (India) at 11 KV (2 interconnections)[24] • Udalguri/Assam (India) - Daifarm/Bhairab kunda (Bhutan) at 11 KV[25] • Rangia/Tamulpur (India) - Darranga/Samdrupjongkhar (Bhutan) at 33 KV (not in use) [26] • 400 KV lines for evacuation of power from Punatsangchhu-I and II HEPs and Mangdechhu HEP -– *under progress*[27]	Net export to India on an annual basis, though during dry season there is import from India
India – Myanmar	11 KV Moreh (India) –Tamu (Myanmar) at 11 KV	Limited to supply of nearly 3 MW to the

Trade Partners	Key Interconnections	Nature of Trade
		border town of Tamu in Myanmar
Nepal - India	• Muzaffarpur (India) - Dhalkebar (Nepal) at 400 KV (currently charged at 220 KV)[28] • Kusaha (Nepal) - Kataiya (India) at 132 KV[29] • Gandak (Nepal) – Ramnagar (India) at 132 KV[30] • Mahendranagar (Nepal) – Tanakpur (India) at 132 KV[31] • ~14 interconnections at 33 KV[32] • Pithoragarh (India) – Baitadi (Nepal) at 11 KV[33] • Dharchula (India) – Jaljibe (Nepal) at 11 KV[34] • Dharchula (India) – Pipli (Nepal) at 11 KV[35] • Butwal (Nepal_ Gorakhpur (India) at 400 KV - *proposed*[36]	All lines currently used for import of power to Nepal Net import from India on an annual basis, though there is export to India when surplus is available
Pakistan - Iran	• Jakigur (Iran) – Mand (Pakistan) at 132 KV[37] • Mirjaveh (Iran) – Pakistan at 20 KV[38] • Saravan (Iran) – Pakistan at 20 KV[39] • Polan (Iran) – Gwadar (Pakistan) at 230 KV – *under progress*[40]	All lines currently used for import of power to Pakistan
India – Sri Lanka	• Madurai (India) – New Habarana (Sri Lanka) - *proposed*[41]	The proposed line will be used for import of power to Sri Lanka

The existing level of interconnections in South Asia is for bilateral power trade and cross border transmission networks have to be developed considering the anticipated shift to multilateral power trade in the future.

In the future, more generation capacity is expected to come up in South Asian region which will mainly cater to cross border sales. The overall cross border trade is also expected to increase. As new lines and additional capacity comes up, including additional arrangements such as third-country sale through wheeling, the complexity of the cross border transmission arrangements are also expected to increase. Under such conditions harmonisation of guidelines and operating codes across the transmission lines incidental to cross border interconnections and to maintain the security and integrity of the advanced transmission network, across the different countries would be vital.

For example, once the 500 MW PPA for supply of hydropower from Nepal to Bangladesh from Upper Karnali HPP is made operational, the corresponding annual energy is estimated to be 2447 Million Units. [42] In comparison, the import of power by Bangladesh from India was 6786 MU in 2019.[43] Thus just the new import of power from Nepal to Bangladesh could increase the overall import of Bangladesh by 36%. This would call for enhanced efforts towards development and operation of the transmission network, incidental to cross border interconnections, including requirement of creation of new interconnection capacity between India and Bangladesh.

3.2 Support towards development and operation of the integrated regional transmission network in South Asia

At present there are multiple cross border transmission interconnections existing between the different countries and enable the cross border electricity trade to a significant quantum. However, the arrangements for such cross border electricity trade at present are only at a bilateral level. This study is being undertaken to develop a strategy paper for creation of a regional technical institution (RTI) / body of transmission utilities in South Asian countries, which may act as a platform for cross cutting deliberations and promoting excellence in the field of integrated regional transmission network in the region. The regional technical institution shall also render support towards harmonised network development and operation, incidental to cross border interconnections and rendering high quality of capacity building and training in the areas of network development and operation, RE integration and knowledge sharing etc.

Some of the key roles of RTI are described below.

1. Act as a platform for crosscutting deliberations and exchange of ideas on the subjects related to network development and operation in South Asian Grid

In order to achieve consensus amongst the member countries on various aspects related to the mandate of RTI, it should undertake activities to ensure regular communication amongst member countries, developing work plan and ensuring regular meeting. RTI should act as a platform for consensus building with the following activities:

- Act as a platform for crosscutting deliberations and technical support towards the development of regional plans which could offer a more optimal network and system configuration incidental to cross border interconnections in South Asia;
- Arrange regular interactions among the transmission utilities and other Member and Participant Entities;
- Organize annual meetings and develop annual agendas for these regional interactions; and
- Organize specific need based events/meetings to help bringing the regional stakeholders on a common platform.

2. Dissemination of knowledge towards deployment of advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing and integrating diverse sources of energy available in the South Asia region

Larger regional systems typically allow sharing of common flexible reserves for better integration of renewable energy. RTI's efforts on discussions relating to regional plans could consider the RE integration and system balancing aspects also, which could then enable system operators to take appropriate actions for RE integration,

More importantly, RTI can facilitate knowledge dissemination on advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing. Different South Asian countries had varied successes and learning related to these aspects, which can be presented for the benefit of all the Members through the RTI platform.

3. Provide a platform for enabling harmonisation of guidelines and operating codes through discussions and try to build consensus through discussions on the issues of common interest

RTI can offer a platform for discussions relating to harmonization of guidelines and operating codes through discussions and consensus building. In an interconnected network, the core network guidelines and operating codes in each country will need to be compatible with each other. RTI can offer a platform for enabling such harmonisation of guidelines and operating codes through discussions and consensus building.

Harmonization of grid code in South Asia

The SARI/EI study on 'Harmonization of grid codes, operating procedures and standards to facilitate/promote cross border electricity trade in the South Asia region' noted the following challenges and requirements for grid code harmonization:

- It is essential that while interconnecting two transmission systems, the respective grid codes have to be compared and reviewed to understand the underlying principles of individual systems and then harmonize the relevant rules to suit cross-border interconnection and trading.
- In case of a synchronous interconnection, voltage, basic insulation strength, nominal frequency and protection scheme must match. In case of asynchronous interconnection, the tripping of High Voltage Direct Current (HVDC) terminal would itself constitute a disturbance in terms of loss of load or loss of supply.
- Transmission System Operators (TSOs) of all the member countries of a planned regional grid interconnection should first establish a common framework for preparation and implementation of operating guidelines and procedures and, exchange of data etc.

Source: SARI/EI[44]

RTI can undertake an active role in providing inputs to policy makers and regulatory bodies on harmonization of technical procedures to ensure smooth implementation. Currently such initiatives are undertaken mostly on bilateral basis. RTI can play a role in the following:

- Facilitate discussions on harmonization of guidelines and operating codes such as those relating to;
  - Network operational practices and outages;
  - Measures for improving network security and reliability; and
  - Metering arrangements.
- Provide platform for discussions relating to system protection, including relay settings, islanding etc.;
- Provide platform for discussions relating to communication systems; and
- Provide platform for discussions relating to cyber security measure.

4. Undertake research, technical studies, and come up with white paper and discussion briefs in relevant areas of integrated system planning and network development

There could be many common areas where transmission utilities may prefer to undertake studies, which if undertaken at a regional level, involving experts from across the globe, could offer a better utilization of resources. For example, studies relating to topics such as integrated system planning, cyber security in transmission network, or common communication standards, could be relevant to all the regional participants. In such matters, RTI can undertake research, technical studies, and come up with white paper, discussion briefs, issue briefs, and discussion notes.

Activities under research and studies may also include maintaining information systems to record and maintain monthly cross border energy transfers, and network constraints in the region.

5. Conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, promoting excellence and greening of the regional grid

RTI will play a positive and enabling role by conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, on the aspects related to sharing of planning and operational best practices and promoting excellence and greening of the regional grid. RTI could play a facilitating role in increased integration of renewable energy and system balancing. Larger regional systems typically allow sharing of common flexible reserves for better integration of renewable energy.

RTI may also target collaborating with other similar institutions at regional level as well as at international level.

6. Promote and render assistance towards knowledge sharing, capacity building & training in system planning, network development, RE integration, etc.

The functions carried out by the transmission utilities are similar and there is huge scope for synergy and collaboration. Further the functions discharged by such utilities require a lot of pooling of technical expertise and creation of an ecosystem that adapts with increasing CBET transaction. Each transmission utility in the region is operating under different level of power market maturity and shall require regular capacity building to ensure CEBT at regional level is not impacted by the same. It will beneficial to leverage the technical expertise available at utilities in different member countries. RTI shall undertake activities to enhance capacity building in the region on issues aligned with its mandate and can cover:

- Knowledge sharing, high quality Capacity Building & Training in System planning, network development, RE integration, etc.;
- Arrange workshops for experience sharing and consultations; and
- Coordinate the training of members' staff to improve the region's knowledge of cross border trading operations.

More importantly, it may be noted that the role of RTI is not envisaged as an overarching controlling body, but a facilitating institution, which provides support to rest of the regional stakeholders, with the ultimate objective of promoting cross border electricity trade in South Asia. A detailed overview of the functions of RTI, after studying existing mechanisms in South Asia and international experience is presented in Chapter 7.

4 Analysis of existing regional coordination mechanisms for electricity in South Asia

Studying the existing institutional mechanisms in South Asia for coordination on matters related to CBET is essential to understand the present scenario in terms of their coverage.

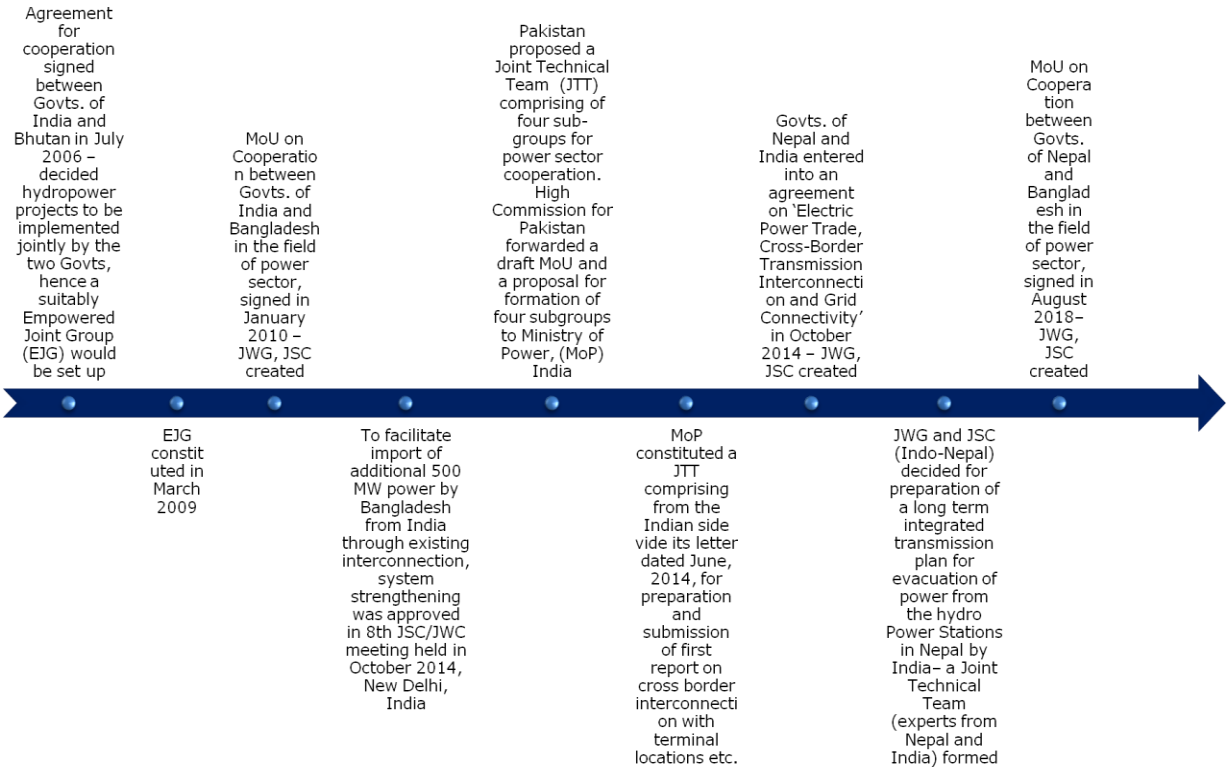
Besides regional institutions/mechanisms, similar federal level coordination bodies within India have also been covered. Further, national level institutional mechanisms related to transmission system planning and operation has been covered.

4.1 Bilateral Governmental Forums – JWG, JSC

There are various bilateral government to government mechanisms in South Asia to facilitate cross border power trade. This include those for India – Nepal, Bangladesh – India, Bangladesh – Nepal, Bhutan – India, and India – Myanmar. These arrangements evolved mostly under a government to government agreement / memorandum of understanding (MoU).

The evolution timeline of some of the key bilateral mechanisms are shown below.

Figure 9: Evolution of bilateral government-level mechanisms



Source: SARI/EI, CEA [45]

4.1.1 India - Nepal

Governments of Nepal and India signed an agreement on 'Electric Power Trade, Cross-Border Transmission Interconnection and Grid Connectivity' on October 2014.[46] As per the Agreement, a Joint Working Group (JWG) and a Joint Steering Committee (JSC) were created for inter-governmental coordination at a high level:

*"The Parties shall set up a **Joint Working Group co-chaired by Joint Secretaries of the Power/Energy Ministries of the two countries** to promote and facilitate cooperation in the areas identified under this Agreement. The Joint Working Group shall take lead role for planning and identification of cross-border interconnections, selection of transmission technologies, preparation of Detailed*

Project Reports (DPRs), and modes of investment for timely implementation of projects, and preparation and finalization of operation and maintenance guidelines.
*A **Joint Steering Committee co-chaired by the Power/Energy Secretaries of the two countries** shall be constituted to review the progress made by the Joint Working Group. The Joint Working Group and the Steering Committee will **meet at least twice a year and once a year** respectively at mutually agreed venues."*

The JWG and JSC meet and discuss on matters relating to new cross border lines, financing modalities for such lines, and related matters. The role of these committees, and their composition are listed below.

Role of Joint Working Group

Take lead role for:

- Planning and identification of cross-border interconnections;
- Selection of transmission technologies;
- Preparation of Detailed Project Reports (DPRs);
- Identify modes of investment for timely implementation of projects; and
- Preparation and finalization of operation and maintenance guidelines.

Members of Joint Working Group

Co-chairs: Joint Secretaries of the Power/Energy Ministries of the two countries

Invitees and delegate members - Nepal:

- Representatives of planning, transmission, load despatch and power trade departments of NEA (Deputy MD / Chief level)
- Representatives of Department of Electricity Development (DOED) (Deputy Director General level)
- Additional members from Ministry of Electricity, Water Resources and Irrigation (MoEWRI)

Invitees and delegate members - India:

- Representatives of Power System Planning and Appraisal wing of Central Electricity Authority (CEA) (Chief Engineer level)
- Director (Transmission) of Ministry of Power

Meeting Frequency of Joint Working Group: At least twice a year

Role of Joint Steering Committee

The role of JSC is to primarily review the progress made by the Joint Working Group in its activities.

Members of Joint Steering Committee

Co-chairs: Power/Energy Secretaries of the two countries

Invitees and delegate members - Nepal:

- Joint Secretary of the Energy Ministry

- Representatives of Ministry of Foreign Affairs / Embassy
- Representatives of Ministry of Law
- Head of Nepal Electricity Authority (NEA) and DOED
- Representatives of MoEWRI, NEA's transmission wing, Investment Board of Nepal (IBN)

Invitees and delegate members - India:

- Joint Secretary of the Power Ministry
- Representatives of Ministry of External Affairs / Embassy
- Representatives of Ministry of Law
- Head of CEA
- Representatives of Ministry of Power (India) and CEA

Meeting Frequency of Joint Steering Committee: At least once a year

It can be seen that the JSC and JWG meetings cover a large spectrum of key stake holders, at a very senior level. Some of the key aspects considered at JWG and JSC meetings between India and Nepal were:

1. Implementation of special protection scheme (SPS) for cross border lines;
2. Review of ongoing cross border transmission projects;
3. Review of study for new cross border transmission lines;
4. Augmentation of network capacity to support cross border trade;
5. Exchange of power through energy banking;
6. Procurement of power through power exchanges of India;
7. Review of study on coordinated grid operation of India and Nepal;
8. Review of progress of generation and transmission system of export oriented hydropower plants;
9. Discussions on guidelines for CBET; and
10. Discussions on trilateral power trade, involving Bangladesh.

In order to assist the activities of JWG and JSC, further joint groups are constituted at a lower level. For example, a Joint Technical Team (JTT) is constituted to develop a long term integrated transmission plan between India and Nepal, with a perspective period up to 2035. The JTT was comprised of officials from CEA, National Load Despatch Center (NLDC) and Power Grid Corporation of India (PGCIL) in the Indian side, and from NEA and DOED in the Nepal side. JTT's study on Long Term Integrated Transmission Plan was accepted by both JWG and JSC in the third JWG and JSC meetings held in June 2016. The study proposed 11 cross-border interconnections for transfer of 25 GW of power from Nepal to India in a phased manner up to 2035, with the priority lines being the existing 400 KV Muzaffarpur – Dhalkebar line and the proposed 400 KV New Butwal – Gorakhpur line. In addition, the following lines were proposed for time frame of 2025:

1. Muzaffarpur – Dhalkebar 400 KV line for 900 MW Arun-3 hydropower plant (HPP);
2. Lumki – Bareilly 400 KV line for 900 MW Upper Karnali HPP; and
3. New Duhabi – New Purnea 400 KV line for 800 MW Upper Arun HPP.[47]

A Joint Operational Committee (JOC) was also constituted to identify the operational issues and actions required for smooth operation of Indian and Nepal grids. The JOC consisted of officials from CEA, National Load Despatch Center (NLDC) and PGCIL in the Indian side, and from NEA in the Nepal side.[48]

4.1.2 Nepal – Bangladesh

JWG and JSC arrangements were established between Nepal and Bangladesh pursuant to the MoU on Cooperation in the field of Power Sector, signed between the Governments on 10 August 2018.[49] JWG will promote and facilitate cooperation in the areas covered in MoU whereas JSC will review the work of JWG.

Role of Joint Working Group

Promote and facilitate cooperation in:

- Development of projects relating to hydropower, transmission, energy efficiency and renewable energy;
- Consultancy services, capacity building and knowledge sharing;
- Encourage and support cooperation between public and private sector entities of the two countries relating to electricity;
- Support and facilitate joint venture investments in power projects;
- Facilitate and assist public and private sector entities for successful implementation of the power projects; and
- Exchange on visits by the power sector personnel of both countries.

Meeting Frequency of Joint Working Group: At least once a year

Co-chair of Joint Working Group: Joint Secretaries of Ministries of Power/Energy of both countries

In addition to co-chairs, the meetings will be attended by delegate and invitee members.

Role of Joint Steering Committee: Review the progress of Joint Working Group

Meeting Frequency of Joint Steering Committee: At least once a year

Co-chair of Joint Steering Committee: Energy/Power Secretaries of both countries

In addition to co-chairs, the meetings will be attended by delegate and invitee members.

The JSC and JWG between the countries discuss matters such as:

1. Discussions on possibility of power trade between Nepal and Bangladesh;
2. Discussions on possibility of Bangladesh investing in HPPs in Nepal;
3. Discussions on possibility of cross border interconnections between Bangladesh and Nepal; and
4. Cooperation in the field of renewable energy.

4.1.3 Other bilateral arrangements

Similar to India-Nepal and Nepal-Bangladesh, JWG and JSC arrangements operate also between other countries, such as the following:

- Between Governments of India and Bangladesh, as per MoU on Cooperation in the field of Power Sector, signed on 11 January 2010; and
- Between Governments of India and Myanmar. A MoU between the countries on cooperation in power sector was signed on 19 October 2016. The second JSC and first JWG meetings were held on 23-24 April 2018.[50]
- Between Governments of India and Sri Lanka. The third JWG meeting was held on July 2018. [51]

Another bilateral coordination mechanism in South Asia is the Empowered Joint Group (EJG) constituted between GoI and Royal Government of Bhutan (RGoB) to expedite the approval process for the implementation

modalities, funding, and contingencies plans. EJG also monitors the progress of activities such as preparation of DPRs and construction of the selected hydro power projects. EJG is headed by Minister of Economic Affairs, RGoB with four members from RGoB and three members from GoI.

However, limited information in public domain is available for the above arrangements, to understand more about the activities of these forums.

4.2 Coordination arrangements and provisions under SAARC Framework Agreement

The SAARC Inter-Governmental Framework Agreement on Energy Cooperation (Electricity) was signed by the Member States of South Asian Association for Regional Cooperation (SAARC) in November 2014[52]. The Framework Agreement lays down the guiding principles for enabling cross-border trade of electricity on voluntary basis, between 'Buying and Selling Entities' of the SAARC Member States.

The Agreement stipulated various levels of coordination on transmission and related aspects for CBET. For example, the Agreement suggests coordination on data sharing, planning of cross border interconnection, and joint development of coordinated network protection systems incidental to the cross-border interconnection, knowledge sharing and joint research. Further details of such provisions are reproduced below.

Table 6: Key provisions of SAARC Framework Agreement on Energy Cooperation (Electricity)

Articles	Description
Article 5: Data updating and sharing	Member States may share and update technical data and information on the electricity sector in an agreed template.
Article 7: Planning of Cross-border interconnections	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.
Article 10: Electricity Grid Protection System	Member States shall enable joint development of coordinated network protection systems incidental to the cross-border interconnection to ensure reliability and security of the grids of the Member States.
Article 14: Knowledge sharing and joint research in Electricity Sector	Member States may enable and encourage knowledge sharing and joint research including exchange of experts and professionals related to, inter alia power generation, transmission, distribution, energy efficiency, reduction of transmission and distribution losses, and development and grid integration of renewable energy resources.
Article 15: Regulatory mechanisms	Member States shall develop the structure, functions and institutional mechanisms to resolve regulatory issues related to electricity exchange and trade.

As per the articles of Framework Agreement, the Member States have already agreed to cooperate on data sharing, knowledge sharing, planning of cross-border interconnections and joint development of coordinated network protection. Though no institutional framework is specifically mentioned for these activities in the Framework Agreement, the fact that these activities are already mentioned and agreed by the Member States, provides a basis for discussing the possibility of setting up an institution for such activities. The proposed RTI only seeks to create an institutional framework that will enable among other things, the implementation of some of the provisions of Framework Agreement. In other words, establishment of RTI will be in line with the spirit and overall objectives of SAARC Inter-Governmental Framework Agreement on Energy Cooperation (Electricity).

4.3 Coordination arrangements for BIMSTEC grid interconnection

The BIMSTEC countries (Bangladesh, Bhutan, India, Myanmar, Nepal, Sri Lanka and Thailand) have signed a Memorandum of Understanding (MoU) for establishment of BIMSTEC grid interconnection on 31 August 2018. [53] The MoU also has various clauses in which the countries have agreed to coordinate on CBET.

Table 7: Key provisions of MoU for establishment of BIMSTEC grid interconnection

Articles	Description
2.2: Objectives of grid interconnection	a) Coordinate and cooperate in the planning, development and operation of interconnected systems to optimize costs while maintaining satisfactory reliability and security; b) Fully recover the costs and share benefits equitably, resulting from the reductions in investments on generation, transmission systems and fuel cost; c) Provide reliable, secure and economic electricity supply to the Parties; d) Develop transmission tariff framework for trading of electricity among the Parties; and e) Open up new avenues of cooperation to promote electricity trade.
2.3: Additional issues that will be considered	Harmonization of institutional, operational, legal and regulatory frameworks for implementation and operation of the grid interconnections and trade among the Parties.
3: Institutional arrangements	Creation of BIMSTEC Grid Interconnection Coordination Committee (BGICC) to actively coordinate and represent parties involved in the regional energy trade. Parties may enable their transmission planning agencies to plan the cross border grid inter-connections through bilateral/ trilateral/ multilateral mutual agreements among the Parties concerned based on the needs of the trade in future through power system studies and sharing of requisite information.

As indicated in clause 3 of the MoU for establishment of BIMSTEC grid interconnection, the BIMSTEC Grid Interconnection Coordination Committee (BGICC) is envisaged as a regional mechanism to actively coordinate and represent parties involved in the regional energy trade. This is closely related to RTI's functions, with five countries common between South Asia and BIMSTEC (Bangladesh, Bhutan, India, Nepal, and Sri Lanka).

BIMSTEC had envisaged the creation of a BIMSTEC Grid Interconnection Coordination Committee (BGICC) to actively coordinate and represent parties involved in the regional energy trade. The MoU for establishment of BGICC was signed in August 2018.[54]

The MoU recognizes the need to have an appropriate structure referred to as the BIMSTEC Grid Interconnection Coordination Committee (BGICC), to actively coordinate, for successful implementation of grid interconnections and trade in electricity. BGICC can engage BIMSTEC Energy Sector Committee of Experts/Officials, Task Force for BIMSTEC Trans-Power Exchange and Development Projects, BIMSTEC Energy Center and other institutions to provide technical support. The BGICC can determine modalities to implement BIMSTEC Grid Interconnections Master Plan and regional trade arrangements. As per the MoU, the BGICC shall report to the BIMSTEC Senior Officials' Meeting on Energy and/or Energy Ministers Meeting.

The active countries in South Asia that currently undertake CBET among themselves – India, Nepal, Bhutan and Bangladesh are also part of BIMSTEC. While BGICC will be a separate institution, it may be noted that other clauses such as an agreement among parties on harmonization of operational, legal and regulatory frameworks, coordination and cooperation in the planning, development and operation of interconnected systems etc., are equally relevant to the proposed activities of RTI.

4.4 Mechanism for approval of cross border lines and related aspects in India

The Government of India has notified Member (Power Systems) of CEA, as the Designated Authority (DA) for facilitating CBET. The Draft Conduct of Business Rules (CBR) of the Designated Authority mentions a set of institutional framework and procedures relating to cross border transmission lines.[55] This includes the following:

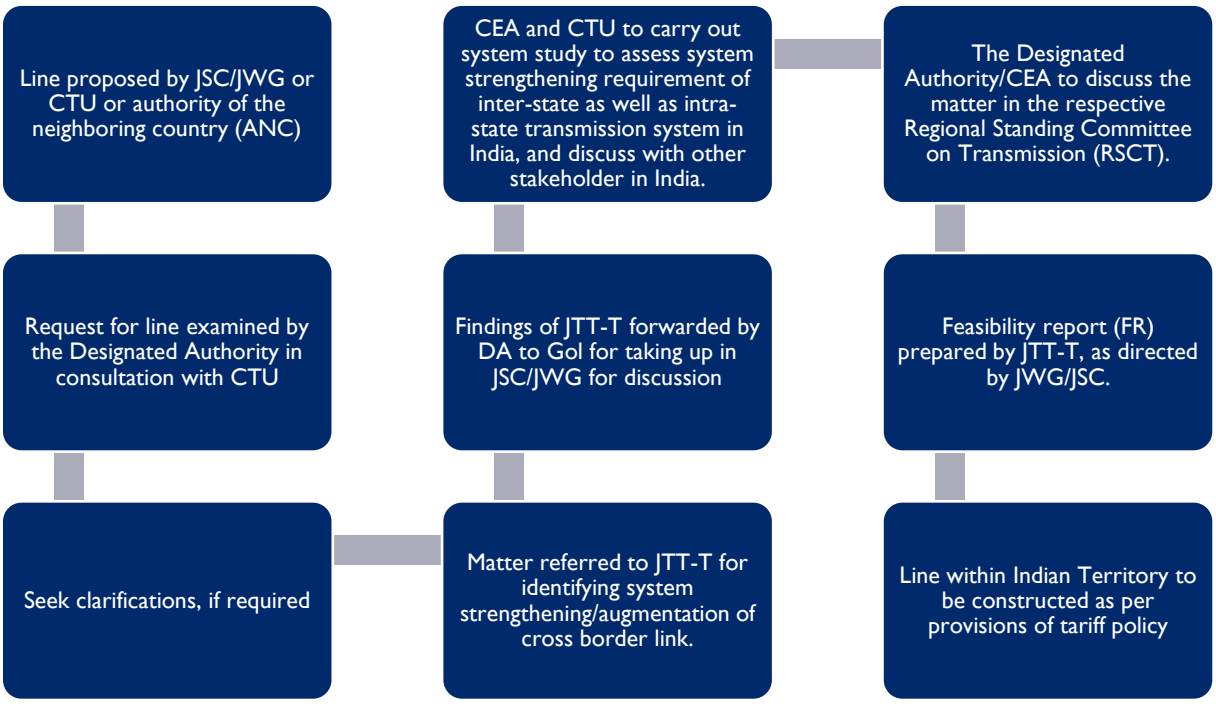
1. A Joint Technical Team - Transmission (JTT-T) for performing works related to development of cross-border links; and
2. A Joint Operation Committee (JOC) for discharging the function of coordination with neighbouring country related to grid security, safety and operation.

Indian side of JTT-T shall comprise of Nodal Officer of DA as team leader and members from CTU and POSOCO. Representative from CTU shall be convener of the team from Indian side. Broad functions of JTT-T would inter-alia include:

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

The broad steps for approval of a cross border line under these rules are illustrated below:

Figure 10: Process for construction of cross border lines with India



Indian side of the JOC shall comprise of Nodal Officer of DA as team leader and members from POSOCO and CTU. Representative from POSOCO shall be convener of the team from Indian side. JOC will have its counterpart in neighbouring country.

Broad functions of JOC would include:

- Providing power system model for joint operational studies;
- Setting up common operation philosophy, recovery procedure, information exchange between system operators;

- Protection coordination including planning and setting of Special Protection Scheme (SPS), under frequency relays and df/dt, etc.;
- Coordinate requirement of frequency response and balancing reserves;
- Annual maintenance outage plan;
- Methodology and assumptions for calculation of transmission capacity and reliability margin for cross border exchange under short term open access; and
- Operating Philosophy.

The System Operators of the respective countries shall be jointly responsible for integrated, reliable, secure and stable operation of the cross-border interconnections.

4.5 Federal level coordination bodies within India

4.5.1 Regional Power Committees (RPCs)

The Regional Power Committees in each of the five regions of India (North, East, West, South and North East) by the Ministry of Power, Government of India on 25 May 2005, through a Government resolution, notified under the provisions of Electricity Act, 2003. The Committees are required to work towards facilitating the integrated operation of the power system and agree on matters concerning the stability and smooth operation of the integrated grid and efficiency in the operation of the power system in their respective regions.

The key functions of the RPCs are as below:

- To undertake regional level operation analysis for improving grid performance;
- To facilitate inter-state/inter-regional transfer of power;
- To facilitate all functions of planning relating to inter-state/ intra-state transmission system with central transmission utility (CTU) / state transmission utility (STU);
- To coordinate planning of maintenance of generating machines of various generating companies of the region including those of inter-state generating companies supplying electricity to the Region on annual basis and also to undertake review of maintenance programme on monthly basis;
- To undertake planning of outage of transmission system on monthly basis;
- To undertake operational planning studies including protection studies for stable operation of the grid;
- To undertake planning for maintaining proper voltages through review of reactive compensation requirement through system study committee and monitoring of installed capacitors; and
- To evolve consensus on all issues relating to economy and efficiency in the operation of power system in the region.

Over the course of time, RPCs have also been entrusted additional responsibilities by the Central Electricity Regulatory Commission:

- Preparation of weekly deviation charges & reactive energy charges accounts;
- Preparation of regional energy accounts;
- Preparation of regional transmission accounts;
- Certify availability of regional AC and HVDC transmission system;
- Periodic inspection of under frequency relays; and
- Preparation and review of annual outage plans of generation.

Activities of RPC are divided among five sub-committees[56].

Functions of Technical Coordination Sub-Committee (TCC)

- Consider all issues referred by the other sub-committees concerning operation of regional grid, commercial aspects, inter-state / inter-regional transfer of power, grid stability etc. leading to economy and efficiency in the operation of power system in One region.
- TCC shall implement the decisions of the RPC and also provide guidance and assist SRPC in discharge of its functions and formulation of policy matters on regional grid operation, grid security, and commercial matters.

Functions of Operation Coordination Sub-Committee (OCC)

- Reviewing the schedule v/s actual generation of various power stations drawn up in the previous month
- Estimating the availability of power and energy from each power station and demand of each State for the current and next month
- Drawing up coordinated maintenance schedule for generating units and major transmission lines
- Reviewing of operational discipline and its norms to be observed by constituents
- Reviewing the operation of Automatic Under-Frequency Relays
- Discussing system occurrences, if any, during the previous month and
- Reviewing the status of implementation of the recommendations of the inquiry Committees and any other matter referred by the TCC/RPC.

Functions of Protection Coordination Sub-Committee (PCSC)

- Analysis of system disturbances in the region
- Review of protective relaying schemes, relay co-ordination islanding schemes, automatic under frequency load shedding schemes,
- Review of the implementation of recommendations made by the Inquiry Committee of the grid disturbance in the region

Functions of System Study Sub-Committee

- Study for need for capacitors and reactive compensation
- Load flow, short circuit and transient stability studies

Functions of Commercial Sub-Committee: Energy accounting and commercial issues

The Committee has a secretariat, with Member Secretary and Staff provided by the Central Electricity Authority (CEA). The Secretariat takes care of the following activities:

- Keep custody of records of proceedings of the Committee, Sub- Committees, Task Force and Working Groups of the RPC;
- Prepare agenda for the Committee and Sub-Committee meetings;
- Prepare minutes of Committee and Sub-Committee meetings;
- Take follow-up action on the decision taken in the Committee & Sub-Committee meetings;
- Maintain archive of data and information pertaining to operating parameters, protection system and communication -system of the regional power system; and

- Collect from constituent members or other offices, companies, firms or any other party as may be directed by Committee, such information as may be considered useful for the efficient discharge of functions of the Committee under the Resolution and place the information before the Committee and its sub- committees.

Chairperson of RPC is selected from each constituent state on alphabetic rotational basis, for a term of one year.

4.5.2 Regional Standing Committees on Transmission

While the RPCs handle most of the operation coordination, planning of interregional transmission system is undertaken at the level of Regional Standing Committees, formed in 2005. The Regional Standing Committees on Transmission consists of the following constituents:

- Chairperson – Member (Power System), CEA;
- Member Secretary – Chief Engineer (Power System), CEA;
- COO of CTU;
- Director (System Operation) of Power System Operation Corporation (POSOCO);
- Heads of STUs in the region;
- Member Secretary of relevant Regional Power Committee; and
- Heads of utilities such as NTPC, NHPC, SECI (+ DVC for East, NEEPCO for North East).

Key Functions

- Carry out a quarterly review of the Transmission System in the region.
- Draw up proposals for strengthening inter-Regional transmission system.
- Assess the transmission system requirements in the near, medium and long term and draw up transmission schemes to meet these requirements.
- Examine applications for connectivity and access and ensure that these are granted speedily, provided that the requisite fees/charges are paid.
- Review the upstream and downstream network associated with transmission schemes.
- Examine and evaluate the intra-state transmission proposals.
- Review and facilitate the construction of the inter-regional grid strengthening schemes.

4.5.3 Transmission coordination within the countries in South Asia

In rest of the South Asian countries, coordination in transmission related aspects is undertaken by the respective transmission utilities, with some consultations with Government also in case of cross border lines. However, unlike the case of India, since there is only one central transmission utility in rest of the South Asian countries, there does not seem to be any inter-agency coordination mechanisms prescribed for these countries. Details of entities undertaking transmission planning and related aspects in the South Asian countries are listed below.

Table 8: Entities undertaking transmission planning and related aspects in South Asian countries

Country	Transmission Planning	Transmission Utility	Ministry
Afghanistan	Da Afghanistan Breshna Sherkat (DABS)	Da Afghanistan Breshna Sherkat (DABS)	Ministry of Energy and Water
Bangladesh	Power Grid Company of Bangladesh (PGCB)	Power Grid Company of Bangladesh (PGCB)	Power Division, Ministry of Power, Energy and Mineral Resources (MoPEMR)

Country	Transmission Planning	Transmission Utility	Ministry
Bhutan	Department of Hydropower & Power Systems, Ministry of Economic Affairs	Bhutan Power Corporation (BPC)	Department of Hydropower & Power Systems, Ministry of Economic Affairs
India	Central Electricity Authority (CEA)	Power Grid Corporation of India Limited (PGCIL) Various private transmission licensees also operate. There are a few cross border lines at 132 KV operated by state transmission utilities also.	Ministry of Power
Nepal	Nepal Electricity Authority (NEA) There is also Rastriya Prasaran Grid Company Limited (RPGCL), which has been involved in the development of Transmission System Master Plan in the country	Nepal Electricity Authority (NEA) There is also a Rastriya Prasaran Grid Company Limited (RPGCL) though it does not currently operate any transmission lines.	Ministry of Energy, Water Resources and Irrigation (MoEWRI)
Pakistan	National Transmission and Dispatch Company (NTDC)	National Transmission and Dispatch Company (NTDC)	Ministry of Water and Power
Sri Lanka	Ceylon Electricity Board (CEB)	Ceylon Electricity Board (CEB)	Ministry of Power, Energy and Business Development

4.6 Proposed institutional mechanisms for coordination of system operators and market participants

There are linkages between objectives and focus areas of RTI with other similar regional forums (existing/proposed). For example, the BIMSTEC Grid Interconnection Coordination Committee (BGICC) is proposed to be set up, to coordinate for successful implementation of grid interconnections and trade in electricity in the BIMSTEC region.

There are also discussions that for electricity cooperation in South Asia two more institutions may be mentored under USAID's SARI/EI program – the South Asia Forum of System Operators (SAFSO) and the South Asia Forum of Market Participants (SAFEM) may also be considered.

SAFSO is envisaged as a regional forum of system operators in South Asian countries in order to provide a platform for discussions, dissemination and collaboration amongst the system operators in South Asia, to specifically deal with the aspects such as:

1. Provide a platform for deliberations on cross-cutting themes and subjects related to safe, reliable, efficient and economic system operation;
2. Promote Knowledge exchange and sharing of best practices within system operators in South Asian Countries;
3. Render support to promote technological excellence and harmonization of practices in respect of system operation and promote capacity building in power system operation;
4. Promote development of a Code of Ethics for Load Despatchers in South Asia;

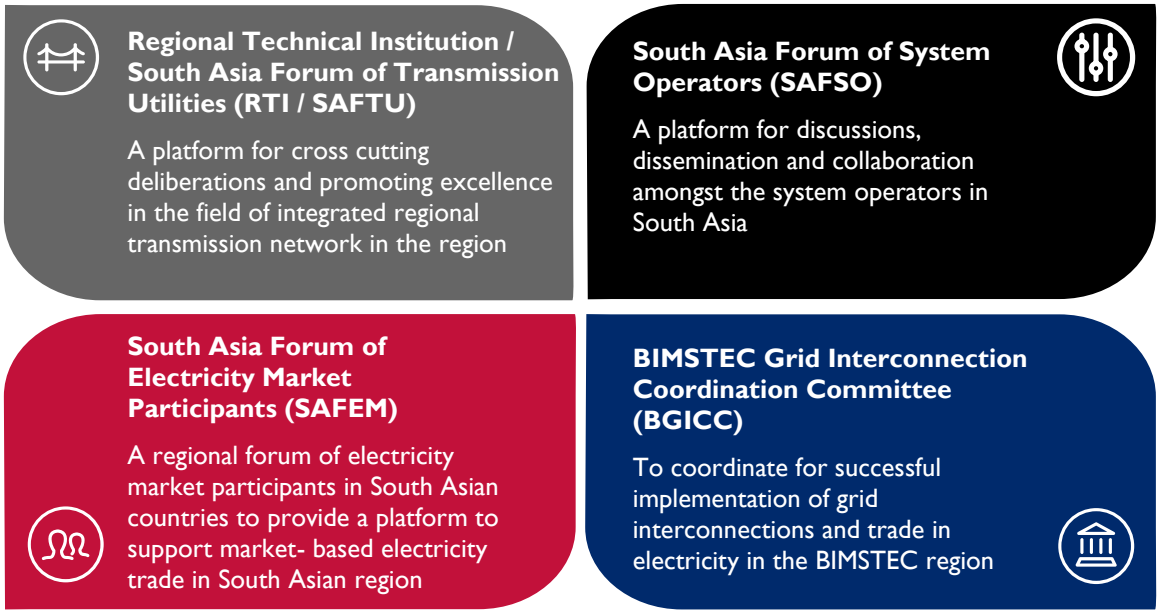
5. Provide technical inputs/advice to the national regulatory agencies and other statutory bodies on the matters related to system operation;
6. Promote technical cooperation, frequent interaction, active consultation & collaboration amongst system operator's in South Asian Countries.

SAFEM is envisaged as a regional forum of electricity market participants in South Asian countries to provide a platform to support market- based electricity trade in South Asian Region to deal with aspects such as:

1. Discuss and deliberate on products such as Day Ahead contracts, short term, medium term and long term contracts, financial derivatives, ancillary services market, capacity markets, etc
2. Assist member nations towards its implementation subject to approval by policy makers and regulators of member nations
3. Assist member nations in developing framework for multilateral/trilateral power market development in South Asian region
4. Help member countries in adoption & implementation of market rules/regulations for CBET
5. Help in addressing issues and challenges to facilitate RE trade in South Asia
6. Advise the members on upcoming energy generation sources and energy storage technologies
7. Provide advisory support on analysis the potential of regional gas market in the SA region

It is expected that all these new coordination mechanisms will co-exist with each other, and with external forums such as the BGICC.

Figure 11: A potential regional ecosystem for electricity cooperation



Thus RTI, even if established as a stand-alone entity, caters to only part of the overall regional ecosystem. The role of other existing / proposed entities are also equally important.

4.7 Other regional mechanisms

As there are only a limited number of regional mechanisms for cross border electricity trade in South Asia, a few additional institutional mechanisms related to coordination in electricity sector, but not specific to cross border trade were also analysed, so as to understand their institutional structure and related aspects.

These include the following:

- **SAARC Energy Centre**

  Under the South Asian Association for Regional Cooperation (SAARC), the SAARC Energy Centre was established on 1stMarch 2006, with the objective of serving as a regional institution of excellence for the initiation, coordination and facilitation of SAARC programs in energy. The Centre is envisaged to provide technical inputs to the SAARC Working Group meetings on Energy, and facilitate accelerating the integration of energy strategies within the region by providing relevant information and expertise.

- **Council of Experts of Energy Regulators – Electricity (CEERE)**

  CEERE serves as a regional forum to discuss, share knowledge, and achieve consensus on harmonized rules to enable bilateral and multilateral power trade in the SAARC region.

- **South Asia Forum of Infrastructure Regulators (SAFIR)**

  Established in May 1999, with the support of The World Bank, the South Asia Forum of Infrastructure Regulators (SAFIR) focuses on providing high capacity training and capacity building on Infrastructure regulation. The objectives of the forum are:

  - Provide a platform for experience sharing amongst the regulators of the region;
  - Build regulatory decision-making and response capacity in South Asia;
  - Facilitate the regulatory process;
  - Conduct training programs to serve regulatory agencies and other stakeholders;
  - Spur research on regulatory issues; and
  - Provide a databank of information relating to regulatory reform processes and experiences.

Further details of these entities is available in 'Annexure 1: Review of other regional institutions'.

5 International experience on regional coordination mechanisms for electricity

There are multiple examples of regional coordination for cross border trading across the globe. The learnings from those institutions/coordination centres trying to facilitate cross border electricity trade while ensuring reliability, could be used for setting up a regional technical institution (RTI) in South Asia.

Some of the key examples are discussed below, which highlight the nature of the institutions, their members, institutional arrangements and, roles and responsibilities among other aspects. Key learnings from each of the institutions have been identified. The institutions reviewed as a part of this analysis are:

1. Southern African Power Pool (SAPP)
2. Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region
3. Heads of ASEAN Power Utilities/Authorities (HAPUA)
4. Central American Interconnection System (SIEPAC)
5. European Network of Transmission System Operators for Electricity (ENTSO-E)
6. Gulf Cooperation Council Interconnection Authority (GCCIA)
7. Arab Union of Electricity (AUE)
8. Pennsylvania-New Jersey-Maryland Interconnection (PJM)

The above institutions were selected for analysis, considering the need to cover a variety of geographical areas, institutional arrangements, evolutionary maturity and scope of work. The institutions mentioned above cover South East Asia, Middle East, Europe, and America. Some of the entities such as ENTSO-E and PJM has a long history of evolution. For example, PJM's history can be tracked as far back as 1927. In comparison, there are newer entities such as SIEPAC which was formed only in 2013. Some of the entities such as GCCIA and SIEPAC were created to cover a specific regional transmission infrastructure, in comparison to more generic organizational groupings such as ENTSO-E and PJM.

5.1 Southern African Power Pool (SAPP)

The Southern African Power Pool was established in 1995, comprising 12 Southern African Development Community (SADC) member countries (Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe) of which nine are operating members whose interconnected grid carries about 97% of the power produced by SAPP countries. SAPP is the most advanced power pool in Africa.

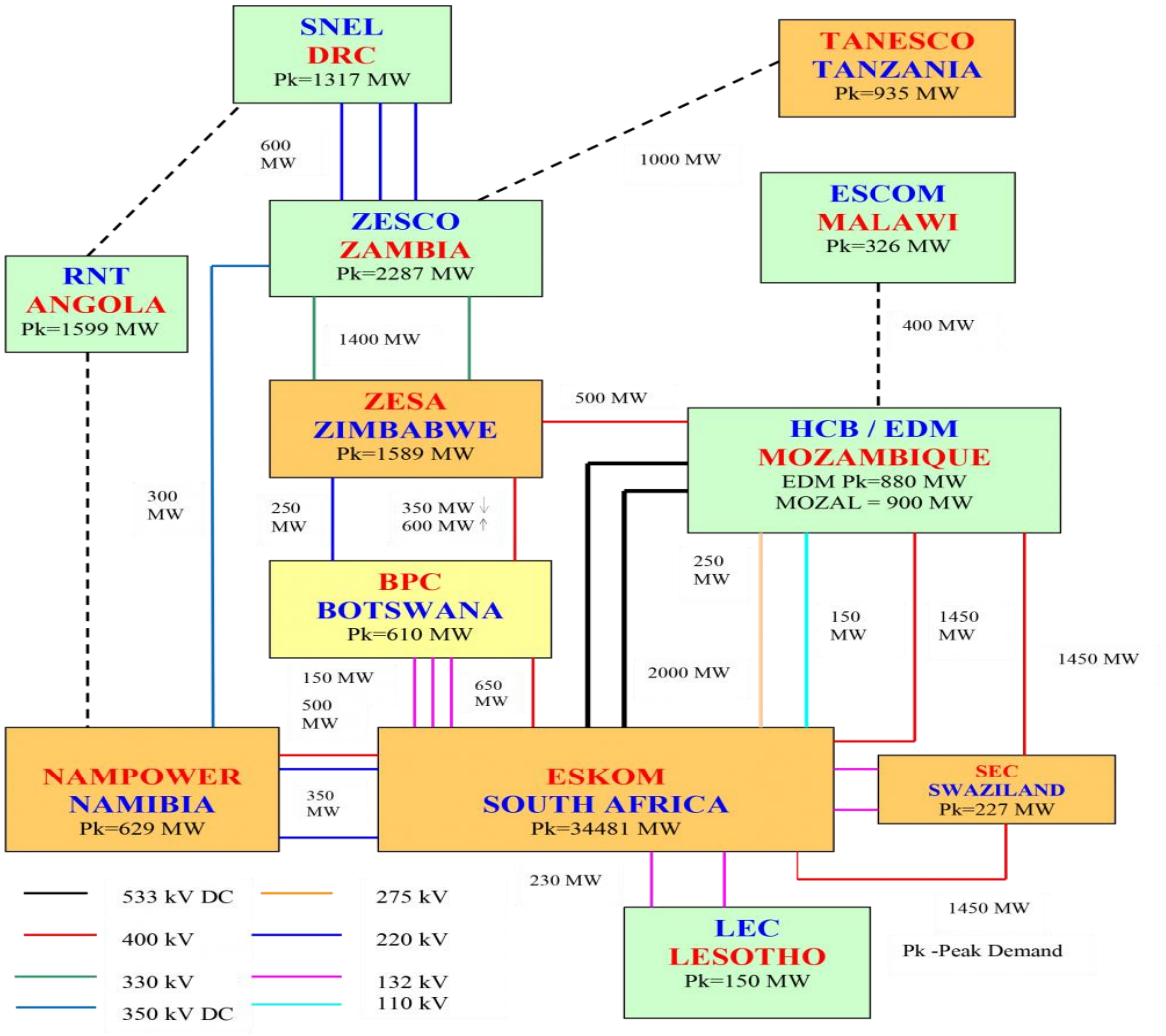
SAPP is a cooperation of seventeen[57] national electric power utilities from the member countries, of which twelve members are from the national power utilities in the SADC region, two members are independent transmission companies and the rest are independent power producers[58]. Eskom in South Africa is the largest generator in the SAPP, with the highest installed and operating capacity. SAPP ensures that among the various utilities in the SADC region, there is integrated planning and smooth operation of the interconnected transmission system.

5.1.1 Regional arrangement and technical institutional mechanism

Trading under SAPP consists of both bilaterally negotiated contracts, and competitive trade (day ahead, intraday, forward physical market - monthly and forward physical market – weekly). The competitive trade is executed through a market trading platform SAPP-MTP.

Electricity trading is facilitated through the cross border interconnectors (transmission networks) as illustrated below.

Figure 12: SAPP interconnectors



Source: SAPP official website – www. sapp.co.zw

5.1.2 Institutional structure, coordination roles and responsibilities

The primary objective of the SAPP is to create a common electricity market in the SADC region for their consumers to benefit from the advantages associated with this market. It aims to provide reliable supply of electricity at an economical rate, also ensuring efficient utilisation of the natural resources with minimum adverse effect on the environment

1. SAPP governance

The SAPP's guiding structure is based on intergovernmental memorandum of understanding (MOU) that authorises and guarantees inter-utility MOU and operating agreements. The SAPP is governed by the following five agreements:

- The inter-Governmental Memorandum of Understanding, which enabled the establishment of the SAPP
- The Inter-Utility Memorandum of Understanding, which established the SAPP's basic management and operating principles
- Agreement Between Operating Members, which established the specific rules of operations and pricing

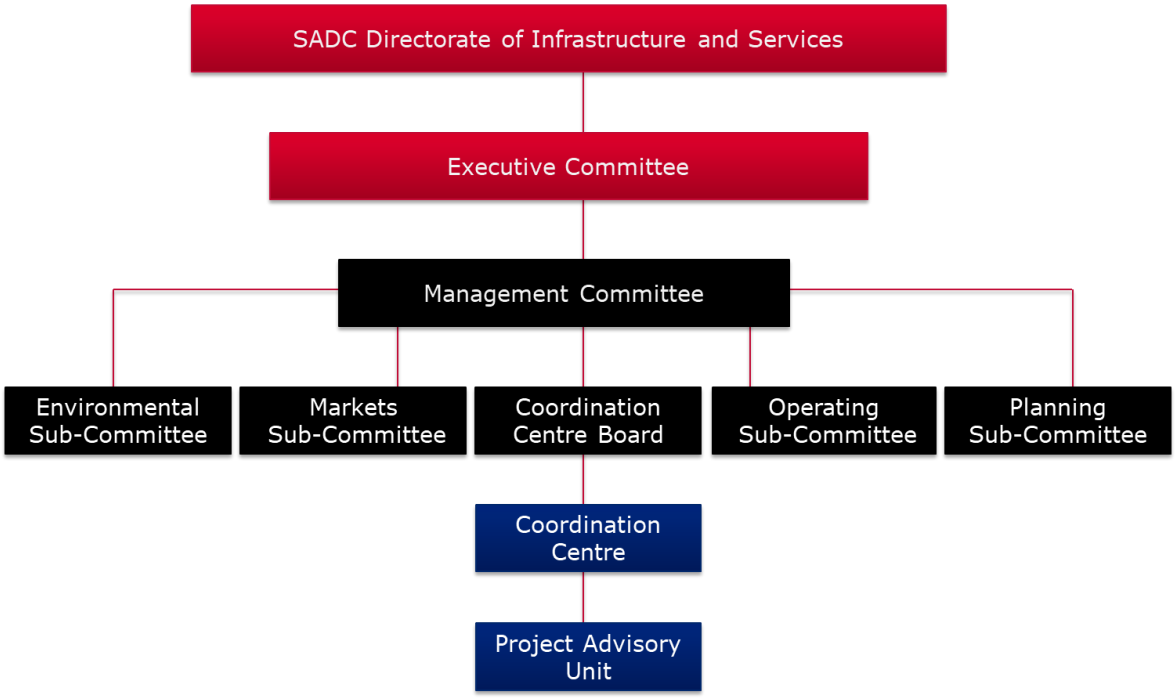
- Operating Guidelines, which provide standards and operating guidelines
- SAPP Coordination Centre (CC) Constitution

2. SAPP structure

The SAPP has four working sub-committees: Environmental Sub-Committee, Markets Sub-Committee, Operating Sub-Committee and Planning Sub-Committee under a common Management Committee. The Management Committee reports to the Executive Committee, which is under the SADC Directorate of Infrastructure and Services. Besides the four working committees/sub-committees, in April 2007 the Coordination Centre Board was created to govern the activities of the SAPP Coordination Centre.

The organisational structure of the SAPP is as illustrated below:

Figure 13: SAPP structure



3. Responsibilities of the Coordination Centre

A permanent SAPP Coordination Centre was established in Harare, Zimbabwe. The members of SAPP fund the activities of the Coordination Centre through an annual subscription. The Coordination Centre prepares a budget, which is presented to the Coordination Centre Board for approval. Initially, the board had been made up of utility representatives of the Operating Sub-Committee, but since 2008 the Coordination Centre Board has been an independent body (as shown in the SAPP structure figure above)[59].

- The key responsibilities of the Coordination Centre are as follows:
- Act as the nodal centre/body for SAPP activities
- Facilitate the operation of the energy market
- Monitor the operations of SAPP transactions between the Operating Members and between Members and Non-members
- Carry out technical studies for example, evaluation of the impact of future projects on the operation of the power pool
- Provide power pool statistics and, maintain a database for planning and development

- Coordinate the training of members' staff to improve the region's knowledge of power pool operations

The detailed functions undertaken are as explained in the table below:

Table 9: Functions of the Coordination Centre

Monitoring	Conducting studies, analysis and maintaining databases
• Monitor the inadvertent power flows and the returns in kind between members • Monitor and advise on the use of the Operating Guidelines • Monitor and report on the control performance criteria, as specified in the Operating Guidelines, to all the Operating Members • Monitor the availability of the communication links between the Control Centers of the Operating Members and between these Control Centers and the Co-ordination Center. • Monitor the calculation and implementation of the various types of Reserves. • Monitor adherence to the Agreement by the Operating Members, regarding Accredited Capacity Obligation and calculate the penalties for insufficient Accredited Capacity and their re-allocation among members	• Provide routine daily reports, data and information relevant to the operation of the Power Pool to the Operating Sub Committee and to the Members • Evaluate the impact of future projects on the operation of the pool • Perform operational planning studies to highlight possible operating problems • Perform studies to determine transfer limits on timelines and inform Operating Members accordingly • Establish and update a database containing historical and other data to be used in Planning and System Operation studies • Gather and act as the official custodian of data pertaining to transactions between Operating Members and Between Operating Members and Non-Members • Prepare and issue annually control performance summaries report for the Operating Sub-Committee
Advisory	**Miscellaneous (operational, Capacity building, etc.)**
• Advise the Operating Sub-Committee accordingly after evaluation of the impact of future projects on the operation of the power pool • Provide information and give technical advice or support to members of SAPP, in matters pertaining to parallel operation • Advise on the adjustments that are required to maintain, at all times, the contractual pool reserves and the agreed upon services, post dissemination of generation and transmission maintenance schedules • Provide advice on short-term and long-term operating problems • Advice regarding the feasibility of wheeling transactions	• Convene, following a disturbance affecting the parallel operation of the pool, a post disturbance committee • Carry out projects and assignments as directed by the Operating Sub-Committee • Disseminate the generation and transmission maintenance schedules received from the operating members • Co-ordinate the training of the members staff and if required, organize training seminars for the operation of the interconnected system • Facilitate trading in the Day Ahead Market (DAM)

4. Key activities of the four sub-committees

The primary activities of the sub-committees are as below:

Figure 14: Key activities of the Sub-Committees

Markets Sub-Committee

- Continued development of an appropriate electricity market for the SADC Region
- Design and recommendation of a suitable market structure for SAPP
- Determine criteria to authorize Members to trade
- Admit and authorise Members to trade
- Under take risk management, research and benchmarking
- Presentation of all findings and recommendations to the Management Committee
- Responsible for all market operations in SAPP

Environmental Sub-Committee

- Development of Environmental Guidelines for SAPP and reviewing such guidelines
- Presenting findings and recommendations to the Management Committee, other 3 sub-committees
- Making recommendations to harmonize regional environmental legislation relating to electricity
- Providing Key Performance Indicators for environmental impact assessment for SAPP interconnector projects and undertake risk assessment

Planning Sub-Committee

- Establishment and updating of common planning and reliability standards
- Review every 2 years an overall integrated generation and transmission plan, based on individual member's plans
- Evaluation of software and other tools for load forecasting, etc.
- Evaluation of improvement required for the proper operation oft the interconnected system and recommending the Management Committee about the members' financial contributions
- Determination of transfer capability limits between systems and assist the Operations Sub-Committee to prepare Operating Procedures
- Assess the capacities of transmission plant in the system of Operating Members for calculating wheeling rates, including annual review

Operating Sub-Committee

- Establishment of methods for testing generating units, measuring technical performance (eg. planned outage rates), operating reserves and, conducting system operational studies
- Monitor each member's compliance to the declared system peak and accredited capacity obligations
- Update approved operating procedures for the SAPP interconnected power system and monitor system performance against set criteria
- Ensure coordination of generation and transmission schedules of Operating Members
- Determine applicable penalties for non-compliance to approved procedures and enforce such penalties and upon failure to enforce refer the matter to the Management Committee

The SAPP develops the **SAPP Pool Plan**, to identify the key investments in the generation and transmission space of regional significance. Primary aim of the Pool Plan is **to facilitate enhancement of integration and power trade in the SAPP region**. *Detailed case study focusing on the Pool Plan has been included in Annexure II.*

5. Funding of the SAPP

SAPP's financing comes from Members' contributions, administration fee from Market Trading Platform and external grants. The Members' contribution has a uniform base contribution, and then varying levels of fee based on energy share, demand share etc.

The members of SAPP fund the activities of the Coordination Centre through an annual subscription. The Coordination Centre prepares a budget, which is presented to the Coordination Centre Board for approval[60].

Transmission projects are funded by SAPP cooperating members with grant funding.

SAPP has successfully secured funding from various International Cooperating Partners for capacity building, exchange visits and project preparation. Special funds are received from donor agencies such as the World Bank,

African Development Bank, Development Bank of South Africa and, can be grants such as the ZIZABONA Project Grant and Norwegian Government Grant (RNE/SAPP)[61].

SAPP's Members' funds and Special funds *(2018)*[62]

Description	Amount (USD)	Percentage of (A+B)
Members' funds (A)		
General reserve	306,000	2.06%
Members' contributions to capital expenditure	686,485	4.63%
Accumulated funds	10,706,990	72.25%
Total Member's funds (A)	***11,699, 475***	***78.94%***
Special funds (B)		
Norwegian Government Grant (RNE/SAPP)	1,965,926	13.27%
ZIZABONA Project Grant	946,763	6.39%
World Bank	207,708	1.40%
Total Special funds (B)	***3,120,397***	***21.06%***
Total (A+B)	**14,819,872**	**100.00%**

5.1.3 Key learnings

Success factors/benefits

- The Southern African Power Pool (SAPP) allows multilateral trading among multiple countries in southern Africa. It exists as a separate market arrangement that sits above (or separately from) local, in-country power market arrangements. Multilateral trading is economically beneficial because it allows more optimal utilisation of local and regional resources. This can lower operating costs.
- SAPP, as a multilateral trading platform has been successful in addressing several issues plaguing the power sector in the SADC region in the following ways:
  - Reduction in load shedding
  - Increase in reliability
  - Optimization of trade opportunities through Intra Day Market (IDM) trading
  - Improved method for determination of charge for losses from wheeling bilateral trades

- Better handling of energy imbalances

- Southern African Power Pool, provides successful examples of various forms of PPPs, as well as various levels of engagement of the private sector in generation and transmission projects of regional importance

Challenges/Areas for further development

- An area of development is to construct new interconnections so that all the SAPP members can be connected through cross border transmission lines, including the currently non-operating member countries. At present, the non-operating members are TANESCO of Tanzania, ESCOM of Malawi and ENE of Angola, which are not connected to the SAPP grid. The Mozambique-Malawi interconnector is being developed, which will link Malawi to the SAPP grid, via Mozambique through the construction of a 200 km, 400 KV line[63].

- Greater focus is required on all the SAPP objectives, especially access to electricity, including the promotion of small cross-border distribution projects in parallel with the large regional generation and transmission schemes.

- Issues related to lack of trust among the countries and willingness to liberalize markets

5.2 Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region

Energy cooperation in the Greater Mekong Sub-region started in 1992. The Greater Mekong Sub-region (GMS) comprises 8 regions in 6 countries, namely-Cambodia, the People's Republic of China (PRC) (Yunnan Province and Guangxi Zhuang Autonomous Region), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand and Vietnam. Currently, there are over 1700 MW of export oriented power plants, supplying power across the country borders within GMS[64]. There are multiple cross border transmission lines, such as Lao PDR-Thailand and Cambodia-Vietnam.

The Inter-Governmental Agreement (IGA) on Regional Power Trade in the GMS was signed in November 2002. After this, there has been two Memorandums of Understanding (MoUs), in 2005 and 2008. These two MoUs include a Regional Power Trade Operating Agreement (RPTOA) and a Road Map with milestones to achieve a regional power market. RPTCC comprises officials from the energy departments and ministries of the six countries in the sub region.

5.2.1 Regional arrangement and technical institutional mechanism

GMS model has been successful due to the emphasis that has been placed on ensuring a gradual evolution of the regional market from bilateral contracts to a more complex, centralized regional trading system. The roadmap for development of power market in the GMS has been laid out by the World Bank and ADB in four stages[65]:

- Stage 1 – Enabling country to country trading through bilateral transactions

- Stage 2 – Enabling trading between any two GMS countries using transmission lines of a third country (but limited based on available capacity of lines linked to PPAs)

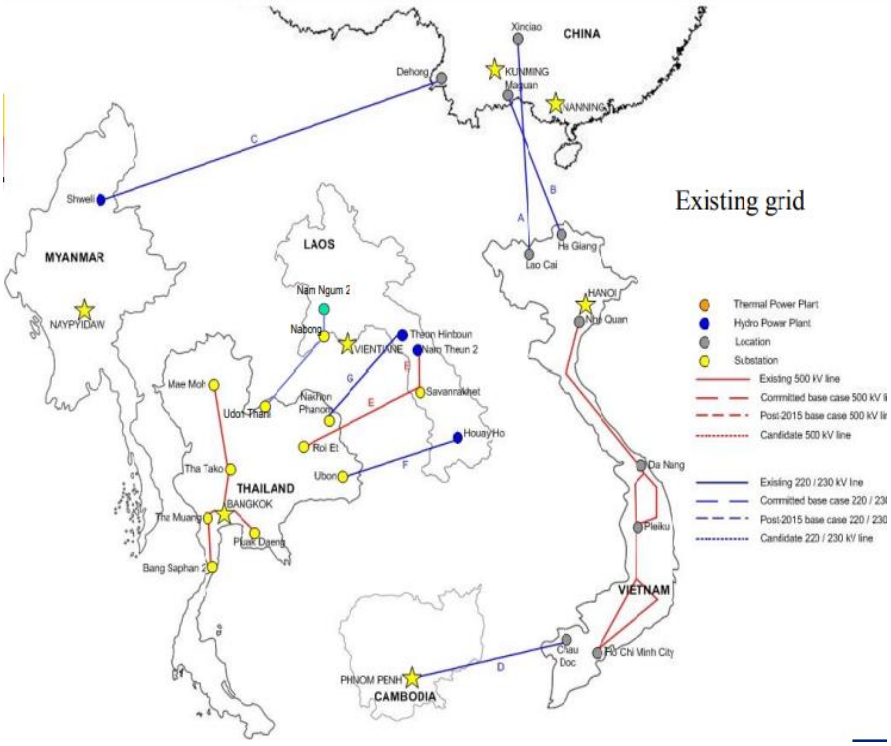
- Stage 3 – Third parties other than national power utilities are allowed to utilize regional interconnections

- Stage 4 – Establishment of multi-buyer and multi-seller regional competitive market

The GMS market is currently in transition from stage 1 to stage 2. Currently, no timeline seems to have been specified for the shift to stage 3, when third parties such as trading licensees will be allowed to participate in the regional market.

The existing cross country grid network is as illustrated below. In PRC, two regions are covered – Guangxi and Yunnan. There are 10 interconnections, with a total capacity of about 5000 MW, at 220/230 KV and 500 KV[66].

Figure 15: Existing grid network



Source: Power Trade in Greater Mekong Sub-region, Asian Development Bank, Workshop on Sustainable Development of Power Sector and Enhancement of Electricity Trade in South Asia Region: Policy, regulatory Issues/Challenges and the Way Forward, 2016

5.2.2 Institutional structure, coordination roles and responsibilities

The Regional Power Trade Coordination Committee (RPTCC) manages regional power trade in the Greater Mekong Sub-region and provides recommendations on overall policy in this area. It also facilitates the exchange of information on energy sector plans and projects of the natural resources with minimum adverse effect on the environment.

1. RTPCC governing structure and functions

The RPTCC operates through Greater Mekong Sub-region Secretariat which is supported by Asian Development Bank. The secretariat is provided by the host country for each meeting and the Asian Development Bank (ADB). RPTCC has a Chairperson and Vice Chairperson elected from among the members. The ADB manages several consultancy projects providing support to the RPTCC.

There are two working groups[67], which have the following functions respectively –

- Working group 1: primary task is to prepare and adopt –
  - common performance standards for GMS
  - transmission regulations
  - standard regional metering arrangements
- Working group 2: primary task is to prepare GMS Grid Code/Regional Power Trading Operating Agreement (RPTOA)

A MoU on the Guidelines for the Implementation of the RPTOA was signed in July 2005, which approved the draft RPTOA issued by the third RPTCC meeting (April 2005) as guidelines for Stage 1 of the regional power market. Further it set up two new institutions to support the work of the RPTCC[68]:

- The Focal Group (FG), to coordinate implementation activities in the member countries
- The Planning Working Group (PWG), to carry out the functions of the operational and system planning working groups mentioned in the draft RPTOA. The functions include –
  - preparation of a regional interconnection plan
  - developing regional performance standards
  - creating a regional database

Additionally, there is the Sub regional Electric Power Forum, which serves as an advisory body to the GMS Ministerial Meetings on sub regional power issues.

2. Funding of the RPTCC

External agencies are playing a crucial role to develop the regional power market. Asian Development Bank (ADB) is the main external agency supporting the GMS Programme. The ADB, other development financial institutions (DFIs) and bilateral donors have been active in funding consultancies to undertake several Technical Assistance (TA) studies on the regional power market[69].

The ADB and World Bank are also funding the construction of regional interconnectors. The ADB also finances the upgrading of existing MV interconnectors.

5.2.3 Key learnings

Success factors/benefits

- Strong political support
- Cooperation at technical level. The ADB, other development financial institutions (DFIs) and bilateral donors have been active in funding consultancies to undertake several Technical Assistance (TA) studies about the regional power market.
- Cooperation among GMS countries plus ADB and development partners is a key facilitating factor. The ADB and World Bank are also funding the construction of regional interconnectors. The ADB also finances the upgrading of existing MV interconnectors.
- Bilateral power trade has been achieved with private sector participation
- GMS model has been successful due to the emphasis that has been placed on ensuring a gradual evolution of the regional market from bilateral contracts to a more complex, centralized regional trading system. The roadmap for development of power market in the GMS has been laid out by the World Bank and ADB in four stages:
  - Stage 1 – Enabling country to country trading through bilateral transactions
  - Stage 2 – Enabling trading between any two GMS countries using transmission lines of a third country (but limited based on available capacity of lines linked to PPAs)
  - Stage 3 – Third parties other than national power utilities are allowed to utilize regional interconnections
  - Stage 4 – Establishment of multi-buyer and multi-seller regional competitive market

Challenges/Areas for further development

- Gaps exist among the power systems and regulatory regime
- Stronger cooperation is required to tackle technically complex issues and to gradually harmonize regulatory regimes
- Fair sharing of the benefits of power trade among the participants should take place
- Managing the social and environmental impacts of hydropower development is an issue

5.3 Heads of ASEAN Power Utilities/Authorities (HAPUA) for ASEAN Power Grid (APG)

ASEAN Power Grid cooperation was initiated in 1997 to establish cross-border electricity interconnections between 10 ASEAN member countries, namely Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam.

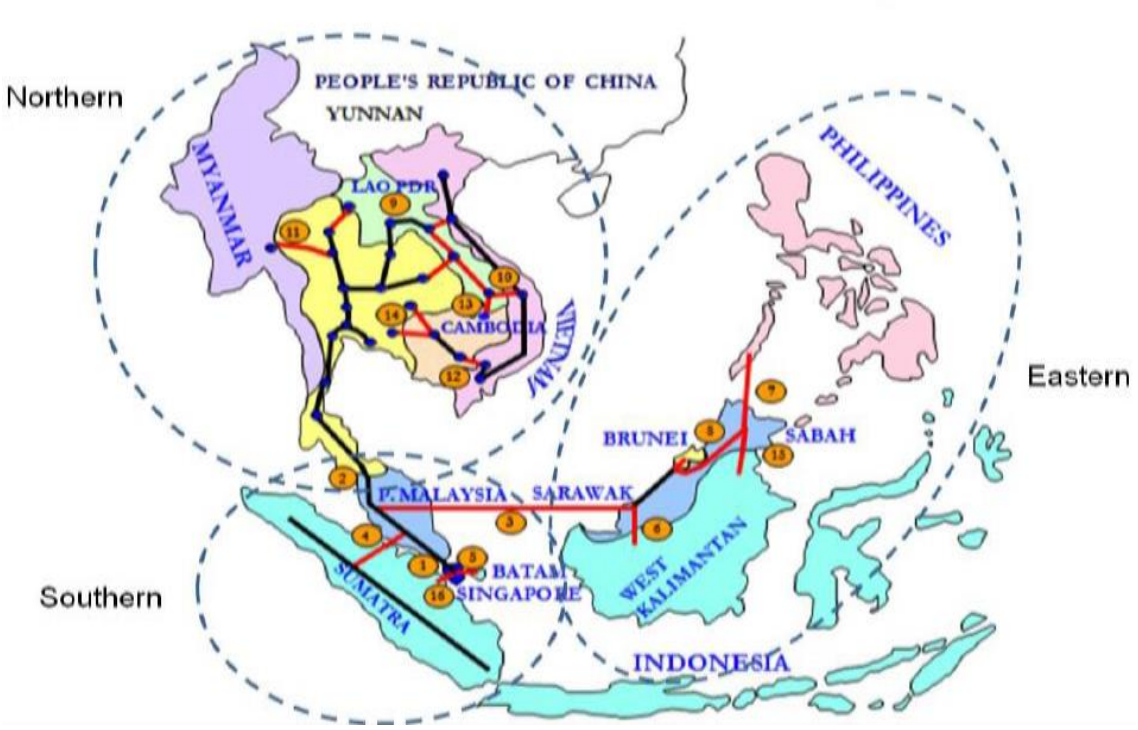
The ASEAN Power Grid (APG) is an initiative to construct a regional power interconnection to connect the ASEAN region. As one of the physical energy infrastructure projects in the Master Plan of the ASEAN Connectivity, the APG project is expected to enhance electricity trade across borders that would provide benefits to meet the rising electricity demand and improve access to energy services in the region[70].

5.3.1 Regional arrangement and technical institutional mechanism

The ASEAN Power Grid comprises 16 cross-border transmission projects that are divided into the Northern, Southern and Eastern development corridors. Electricity transfer of up to 28 GW between South-east Asia countries is enabled through the networks[71]. Power connections will first be developed on cross-border bilateral terms, then expanded to a sub-regional basis before being upgraded into an integrated regional power architecture[72].

The transmission interconnection of the three APG corridors is as illustrated below.

Figure 16: Grid interconnection



Source: ASEAN Power Grid Cooperation: Cross-Border Electricity Trade and its Influence on Carbon Emissions, Asia Pacific Energy Research Centre

The Laos-Thailand-Malaysia interconnection was the first multilateral project signed in 2017 to transfer 100 MW of electricity from hydro power in Laos to Malaysia via transmission lines in Thailand[73]. This project has been marked as a milestone for APG cooperative. However, the progress of APG infrastructure development is has been slow. The schedule of cross-border transmission projects in APG has been revised a few times since its inception in 1997.

5.3.2 Institutional structure, coordination roles and responsibilities

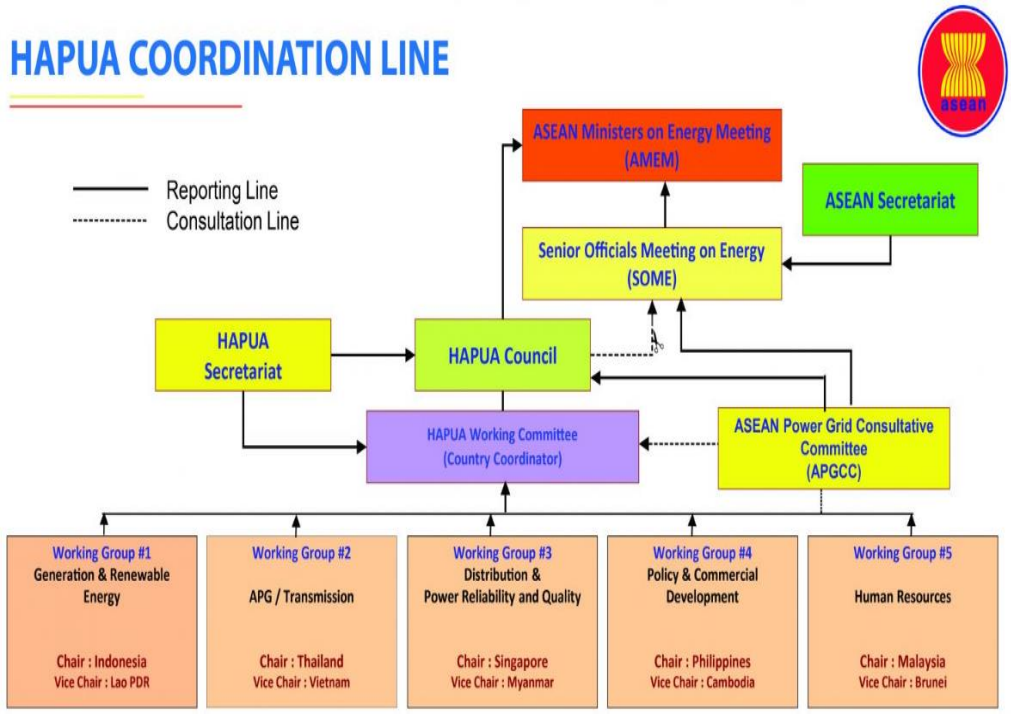
ASEAN Power Grid's lead coordination body is called as HAPUA - the Heads of ASEAN Power Utilities/Authorities. There are also coordination mechanisms such as "Ministers of Energy Meeting" organized under ASEAN.

The ASEAN Ministers of Energy Meeting of 2014 endorsed the ASEAN Plan of Action for Energy Cooperation (APAEC) 2016-2025, which is the blueprint for energy sector cooperation. This was the third such plan being adopted by ASEAN. The ASEAN Center for Energy (ACE) is another key component, which serves as a data hub and knowledge centre.

1. Structure of the Heads of ASEAN Power Utilities/Authorities (HAPUA)

The MoU of HAPUA and the new structure of HAPUA organization was signed by all member countries in the 20th Meeting of the HAPUA held in May 2004 in Cambodia. The Working Groups were restructured during the 28th HAPUA Council Meeting in June 2012 in Brunei Darussalam. The current structure is as below[74].

Figure 17: HAPUA structure



Source: HAPUA official website – www.hapua.org

HAPUA Secretariat reports to HAPUA Council and HAPUA Working Committee. HAPUA Secretariat consists of a Secretary In-charge, Assistant Secretary, Technical Officers and Administrative Officers. The HAPUA Secretariat rotates between each member country every three years. The present Secretariat is hosted by Indonesia.

HAPUA Council consists of heads of Electricity Departments / Government owned Electricity Utilities. The HAPUA Working Committee consists of VP /Director / Deputy Director level officials of Electricity

Departments / Government owned Electricity Utilities. The HAPUA Working Committee oversees each of the five Working Groups.

HAPUA collaborates with numerous dialogue partners and international organizations, including Japan, Korea, China, Australia, US, Russia, ASEAN Secretariat, ASEAN Center for Energy (ACE), International Energy Agency (IEA), Economic Research Institute for ASEAN and East Asia (ERIA), and ASEAN Energy Market Integration (AEMI).

2. ASEAN Power Grid Consultative Committee (APGCC)

ASEAN Power Grid Consultative Committee (APGCC) is an organisation under HAPUA, established in 2007. Its focus is to enhance the cooperation to execute the development of 16 interconnection projects with 27 links. Thirteen links have been operating. The role of APGCC is to facilitate and assist the HAPUA Council in the implementation of Memorandum of Understanding on the ASEAN Power Grid.

APGCC is composed of a Chairman, a Vice chairman, members (governments and utilities representative), alternate members, and chairman of HAPUA Working Group No. 1, 2, 4, and 5. All expenses to be incurred by the members of the APGCC in carrying out their tasks are to be borne by their respective countries.

3. Responsibilities of the Working Groups under HAPUA

The objectives of the five Working Groups areas are as follows:

Table 10: Functions of the Working Groups

Working Group 1: Generation and Renewable Energy
• Identify potential energy resources to ensure fuel security studies to support APGCC for each member countries • Share knowledge & experience in Generation and Renewable Energy • Set up community of Generation & Renewable Energy experts
Working Group 2: Transmission / ASEAN Power Grid (APG)
• Facilitate and expedite the implementation of the ASEAN Interconnection Power Project by working towards harmonizing technical standards and operating procedures among the ASEAN member countries • Incorporating new elements of long term power demand forecast and optimization of regional long term power development plan (with interconnection scheme) • Share strategies, best practices, challenges and experiences of member utilities on enhancement of transmission system reliability and technology development • Exchange experiences and technology in system protection and control, operation and maintenance and to establish criteria for the benchmarking of system operations performance among ASEAN countries
Working Group 3: Distribution and Power Reliability & Quality
• Share strategies, best practices, challenges and experiences of member utilities on enhancement of power reliability, quality and minimize losses in support of the implementation of the APG • Discuss the impact and smoothen the integration of Distributed Energy Resources (DER) / Renewable Energy on the power grid in support of HAPUA's target of achieving 23% of renewable energy by 2025 • Exchange experiences and practices of power reliability & quality projects, renewable energy integration processes as well as asset management

Working Group 4: Policy Studies and Commercial Development
• Propose solutions on legal and regulatory framework for bilateral and cross border power interconnection and trade, formulation of institutional and contractual arrangements for cross border electricity trade to include taxation, tariff and third party access (wheeling charge) • Identify and recommend financing modalities for realizing the APG • Project development for ASEAN resources participation to develop power generation, transmission and distribution within the region
Working Group 5: Human Resources
• Facilitate the implementation of the ASEAN Interconnection Power Project through utilization and optimization of expertise within ASEAN utilities • Share strategies, best practices, challenges and experiences of member utilities on enhancement of ASEAN human resource • Identify and coordinate training and development projects related to Human Resource and Human Capital Development which benefit members from ASEAN utilities/authorities • Facilitate short and long term development programme through the utilization of resources not only within the utilities/authorities but also external resources outside ASEAN utilities/authorities

4. Funding of HAPUA

HAPUA has been successful its cooperation with the Asian Development Bank to develop technical standards and financing models for countries to upgrade their respective power systems[75].

All expenses incurred by the members of the APGCC in carrying out their activities are borne by their respective countries[76].

5.3.3 Key learnings

Success factors/benefits

- ASEAN aims to be sharing 23,200 MW of power into 2020[77] and beyond, which is half as much as the current installed generation capacity of the Philippines, using the interconnections.
- It will result in expansion of renewable energy – for example, the tri-partisan deal highlights a key benefit of an ASEAN power grid[78]. In 2017, Malaysia inked an Energy Purchase and Wheeling Agreement (EPWA) with Lao PDR and Thailand, to purchase hydro power from Lao PDR via Thailand's existing transmission grid. Laos is a huge generator of low-carbon hydropower, yet one of the smaller regional electricity consumers. Malaysia is able to purchase 100 MW[79] of clean hydro-power to boost the share of renewables as part of its energy mix.
- HAPUA has successfully cooperated with the Asian Development Bank (ADB) to develop technical standards and financing models for countries to consider when advancing their respective power systems. However, it is important for such standards to be homogenized as interoperability would greatly improve the efficiency of cross-border electricity trade.

Challenges/Areas for further development

- HAPUA must swiftly develop a legal framework as a predominant guide towards realizing APG. Prevailing overlapping claims on territories are a hampering factor when it comes to promoting freer cross border energy trade. An adequate legal framework will also prove vital as the more developed countries within ASEAN can engage in knowledge and technical transfer with some of the lesser developed nations when it comes to APG projects.

- As the expansion of the interconnections under APG is continuing, financing investment for particularly less-developed member countries on this project remains a challenge. Private and foreign companies' involvement is thus expected to play an important role in developing the ASEAN power infrastructure.
- The APG project will also require optimization of generation fuel mix, establishment of a regional regulatory and technical framework, as well as development of a mechanism for raising capital to create market confidence for the funding and investment of the APG.

5.4 Central American Interconnection System (SIEPAC)

SIEPAC stands for Sistema de Interconexión Eléctrica para los Países de América Central, commonly translated in English as the Central American Electrical Interconnection System. The interconnection, commissioned in 2013, covers Panama, Costa Rica, Honduras, Nicaragua, El Salvador, and Guatemala.

The agencies involved are –

- Guatemala's National Electrification Institute (INDE)
- El Salvador's Río Lempa Hydroelectric Executive Commission (CEL)
- Honduras' National Electricity Company (ENEE)
- Nicaragua's National Electricity Transmission Company (ENATREL)
- Costa Rican Electricity Institute (ICE)
- Panama's Electricity Transmission Company (ETESA)

Extra-regional partners include Spain's Endesa, Colombia's Interconexión Eléctrica, S.A. (ISA) and Mexico's Federal Electricity Commission (CFE)[80].

5.4.1 Regional arrangement and technical institutional mechanism

Bulk of the cross border trade in SIEPAC is under bilateral contracts though a very small quantum (<5%) is traded in a spot market.

In the Central American Interconnection System, the Regional Commission for Electric Interconnection (CRIE) has been set-up pursuant to the Framework Treaty for regional Electricity Market in Central America. The Commission has its own legal identity and has jurisdiction over the Regional Electricity Market (MER).

Ente Operador Regional (EOR) is the regional market operator for MER. EOR has its own legal status and capacity of international public law applicable to the signatory parties to Framework Treaty of the Central American Electricity Market signed in 1996. EOR is located in the Republic of El Salvador.

The CRIE and the EOR are the governing bodies that respectively regulate and operate the MER, with support from the national entities in each of the countries.

SIEPAC consists of two interdependent projects:

- The development of a regional electricity market (MER) based on a standard set of trading rules at the regional (supranational) level. Part of the MER initiative is the creation of a regional institutional structure, including regional regulator and a regional transmission operator
- The establishment of a 1,800 km international transmission line, running from Panama in the south to Guatemala in the north, that will increase transfer capacity at all borders in the region to 300 MW[81]. These lines connect 15 substations through 28 access bays[82].

The SIEPAC cross country transmission line is as illustrated below.

Figure 18: SIEPAC international transmission line

Source: Regional Power Sector Integration: Critical Success Factors in the Central American Electricity Market, Ontario International Development Agency and University of Tokyo

5.4.2 Institutional structure, coordination roles and responsibilities

The SIEPAC and the MER are currently helping Central America to optimize its national electricity markets and are encouraging power generation schemes on a larger scale and at international level.

1. Governing institutions for the regional market

Central America created three Regional Market (MER) institutions responsible for accelerating regional electricity integration:

- The CDMER (Council of Directors of Regional Market), the lead policy body comprising national representatives of the six governments
- The Regional Commission for Electrical Interconnection (CRIE), which is the regional electricity regulator
- The Regional System Operator (EOR), which is the regional operator and system administrator

The inter-institutional coordination among the CDMER, CRIE, and EOR takes place through "Tripartite Meetings" of the three governing boards and through Meetings of the technical committee of the MER, established by the executive secretaries of the three institutions.

2. Responsibilities of CRIE and EOR

CRIE's role is to regulate the MER to market development and competition. It is required to coordinate with the national regulators. Its responsibilities include:

- Approving regulations for the market and coordinating with the country level regulators
- Setting tariffs for use of the transmission system

- Developing the market through increasing stages of competition and preventing any member country to dominate
- Imposing penalties for noncompliance with market rules
- Settling disputes among participants
- Approving extensions to the regional transmission network

CRIE is headed by a board of commissioners comprising one representative from each of the six member countries. Commissioners are appointed for a term of five years. It is based in Guatemala[83].

The functions of EOR are as follows:

- Proposing rules for MER and transmission system use for approval by CRIE
- Ensuring quality and security of supply in the electricity system
- Carrying out the market operation function in an efficient manner
- Settling market transactions among participants
- Providing information on market conditions, as well as developing and publishing generation and transmission expansion studies
- Centrally planning extensions of the Regional Transmission Network (RTR)
- EOR is in charge of the operation of the RTR and is responsible for coordinating market transactions made over the network. MER participants must send their bids and offers for day-ahead transactions in the regional market to EOR, which then verifies the technical feasibility of proposed transactions in coordination with the market operators of each country.

EOR's board of directors is made up of two representatives from each country and are appointed for a term of five years. EOR is a nonprofit organization based in El Salvador.

The administrative costs of CRIE and EOR are met through contributions from the governments, fees paid by market participants and penalties imposed for noncompliance with the rules. Both CRIE and EOR have been supported during their design, setup and capacity building stages by technical assistance from Inter-American Development Bank (IADB)[84].

3. Funding of SIEPAC and functioning of the regional market

The transmission projects are funded primarily by loans from the Inter-American Development Bank (IADB). Other Multilateral Financial Institutions (MFIs) are - the Central American Bank for Economic Integration (BCIE), Corporación Andina de Fomento or the Development Bank of Latin America (CAF) and the European Investment Bank (EIB). Some part of funding also comes from equity financing. Transmission lines are constructed through Public-Private Partnership (PPP) and hence get funding from private companies. For example, EPR is a public-private joint venture between the governments of the six countries (through their state-owned transmission utilities), one private-sector company (Endesa of Spain), and the major transmission owners from Mexico and Colombia. EPR has its head office in Costa Rica and branches in each country.

The illustration below shows the financing structure for the SIEPAC transmission line.

- IADB is the largest debt financier. The IADB loans were provided to each of the six state utilities, which then applied the borrowing toward equal contributions to EPR. EPR is the executing agency for the loans, which are backed by sovereign guarantees from each government.
- The BCIE loan is made up of USD 40 million originating from the European Investment Bank (EIB). This is extended to EPR toward the cost of substation and access bay equipment.
- La Corporación Andina de Fomento (CAF) signed a loan agreement with EPR in February 2009. In addition to construction of SIEPAC the loan will contribute to the interconnection with Mexico and Colombia.

Figure 19: Financing structure for the SIEPAC transmission line

Source	US$M	Terms
IADB soft loans (Fund for Special Operations)	50	40 years, 5yr grace period, 1% interest
IADB ordinary capital loans	120	25 years, 5yr grace period, 6% interest
Spanish Fund loan (through IADB)	70	35 years, 5yrs grace period, 2% interest
BCIE loans	100	20 years, 5yrs grace period, 6.5% interest
CAF loans	15	
EPR Equity	50	11-12% TIR
Total	405	

Source: Central American Electric Interconnection System (SIEPAC) Case Study-Regional Power Sector Integration: Lessons from Global Case Studies and a Literature Review/ ESMAP Briefing Note 004/10/June 2010

Technical assistance provided for the regional electricity market (MER) design and implementation was supported by IADB through both grants and loans. The rest of the required funding was provided by the six countries[85].

5.4.3 Key learnings

Success factors/benefits

- The SIEPAC allows multilateral trading among its member countries. Exists as separate market arrangements that sit above (or separately from) local, in-country power market arrangements.
- Since demand profiles and energy supply structures differ across the region, the production and distribution of electricity throughout the regional electricity market (MER) are organised is such a way as to site power generation projects in the most cost-effective locations, thus helping to lower energy market costs. This also increases the countries' potential to ensure security of supply for their populations, along with the creation of a mechanism to import energy if necessary.
- The SIEPAC single synchronised transmission line will physically enable a market at the regional level, and the regional market in turn provides the economic basis for the integrated transmission investment.

- Together they will allow generation projects to achieve economies of scale and to increase the use of the region's hydro resources
- The regional market is unique as a trading system that has been developed at the international level while accommodating different stages of development in the underlying national markets. It provides an example of countries with diverse national sectors finding a workable institutional solution to support trade.

Challenges/Areas for further development

- There is the challenge of linking the integration of energy with the other economic integration initiatives in the region (Colombia, for example), This harmonization process, which is one of the options for future development of the SIEPAC, requires the same negotiating and consensus-building procedures that were undertaken by the existing 6 members countries of the SIEPAC. This requires a significant amount of effort and cooperation.
- SIEPAC is facing operational and institutional difficulties, for example, one of SIEPAC's purposes was to be attractive for investment with clear and uniform regulations related to the auction of transmission rights, with fixed prices for the use of power transmission lines in a determined period of time. However, MER's authorities are constantly changing the applicable operational regulations and auctioning transmission rights that do not last longer than a year (in the energy sector a short term usually means 5 years). Longer term of transmission rights should be provided to attract investors.

5.5 European Network of Transmission System Operators for Electricity (ENTSO-E)

The European Union (EU) is an economic and political union between 27 EU countries that together cover much of the European continent. The countries together constitute a single market (also known as the 'internal' market) through a standardized legal system that applies to all member states.

The internal market of European Union also contains a single internal market for electricity. The market focuses on providing market access to third parties and on ensuring competition on wholesale and retail markets. The market hosts day ahead, intra-day, forward and balancing products. In 2018, the traded volume of electricity in the market exceeded 12, 000 Billion Units[86]. This was equivalent to 4% of total electricity generation in 2018[87].

The European internal market may be considered as a market of markets, as there are 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.) within it.

Some of the key factors behind the success of the internal market include:

- Strong overall framework on cooperation provided by the European Union
- Detailed legal framework for energy cooperation, issued as a set of directives by the European Commission
- Institutional framework for cooperation between Transmission System Operators (TSOs) and regulators

Currently, the key coordination body on transmission within the European internal market is the European network of transmission system operators for electricity (ENTSO-E). ENTSO-E was established in 2009 and was given legal mandates by the EU's Third Legislative Package for the Internal Energy Market, which aims to further liberalize the gas and electricity markets in the EU[88].

The Third Energy Package is a set of two European directives and three regulations. The Regulation that stipulates ENTSO-E's tasks and responsibilities is Regulation (EC) 714/2009 on conditions for access to the network for cross-border exchanges in electricity. The regulation sets out ENTSO-E's responsibilities in enhancing the cooperation between its member TSOs across the EU to assist in the development of a pan-European electricity transmission network in line with European Union energy policy goals. These include:

- Ensuring the secure and reliable operation of the increasingly complex network
- Facilitating cross-border network development and the integration of renewable energy sources
- Enhancing the creation of the Internal Electricity Market (IEM)

'REGULATION (EC) No 714/2009 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity' states that –

"In order to ensure optimal management of the electricity transmission network and to allow trading and supplying electricity across borders in the Community, a European Network of Transmission System Operators for Electricity (the ENTSO for Electricity), should be established. The tasks of the ENTSO for Electricity should be carried out in compliance with Community competition rules which remain applicable to the decisions of the ENTSO for Electricity. The tasks of the ENTSO for Electricity should be well-defined and its working method should ensure efficiency, transparency and the representative nature of the ENTSO for Electricity. The network codes prepared by the ENTSO for Electricity are not intended to replace the necessary national network codes for non-cross-border issues……"

ENTSO-E is an association established under the Belgian law. However, ENTSO-E's membership stretches beyond the EU member countries and comprises of 42 electricity transmission system operators (TSOs) from 35 countries across Europe.

Evolution of ENTSO-E

Cross border exchange of electricity in Europe started very early way back in 1921, when it was possible to transmit electric power from Nancy in France, via Switzerland to the area around Milan in Italy, representing a distance of roughly 700 km. The following are the key milestones in the history of the integrated European power grid, eventually leading to the establishment of ENTSO-E[89].

- The International Union of Producers and Distributors of Electrical Energy (UNIPEDE) was s established in 1925 by the electricity utilities of Italy, France and Belgium. Many more members joined soon after
- Although in earlier decades, starting roughly in the 1920s, a few Western European countries had cross-border electricity connections, there was no coordinating body. The first proposal for a Europe-wide electricity network was made in May 1929.
- After World War II, a closely intertwined process of both increased interconnection and institutionalization took place. The initiation of one of the greatest European integration projects ever was realized on in May 1951, when the Union for the Coordination of Production and Transmission of Electricity (UCPTE) was founded in Paris.
- The representatives of 8 countries (Belgium, Federal Republic of Germany, France, Italy, Luxembourg, the Netherlands, Austria and Switzerland) worked out the articles of association of the UCPTE. These articles of association were accepted at the inaugural meeting of the UCPTE, held on 23 May 1951 at the headquarters of the Organisation for European Economic Co-operation (OEEC), in Paris. The founder members were also listed in the articles of association. As the tasks of the UCPTE related primarily to operational management, the group of founder members was different from the group that had developed the articles.
- In 1954, the articles were amended slightly to ensure that extraordinary members could also be admitted
- The UCPTE's original role was to contribute to the development of economic activity through the more effective use of energy resources that was enabled by the interconnection of electricity networks. Its members were selected from the management authorities of electricity production and transmission systems in the eight countries. The main objective of the UCPTE was to ensure the optimum operation of electric power plants.

- In 1955 the supply of electric power was primarily a national task. Cross-border exchange had not been developed as a business at this time. Exchange was feasible in this period and was realized up to a capacity of 100 MW. Some countries were not involved in a regular exchange of electricity. Exchange was only possible within the UCPTE countries.
- The working method and cooperation of the regional load distributors developed continuously and the structure of the UCPTE ensured that this creative process did not stop. Through their own collaboration, the members of the UCPTE who were responsible for interconnected operation within the companies constantly enjoyed the benefits arising from cooperation within the union.
- In the mid-1980s, parallel operation of the Western European interconnected grid was not only limited to the 12 countries of the UCPTE region. It also encompassed third countries, including the grid on mainland Denmark, which was constantly in synchronisation with the UCPTE grid. From July 1985, there was a three phase-current connection with Albania. In addition, Scandinavia, the United Kingdom (from January 1986) and the bordering countries of COMECON (of former Soviet Union) were connected via direct-current connections to the UCPTE grid. In 1987, the UCPTE was extended to include four countries, namely Spain, Portugal, Greece and the former Yugoslavia.
- Following the adoption of its new articles of association, which came into effect in January 1997, the UCPTE became the operational organisation responsible for defining the technical rules required to ensure the reliable operation of the interconnected systems of its member countries
- The 1990s saw the introduction of dynamic regulatory processes, as part of the move towards a Single European Electricity Market, by means of the unbundling of generation, transmission and distribution services. Owing to this reason, the UCPTE changed its focus to the transmission grid only and changed its name to the UCTE, dropping the "P" for Production, in 1999.
- The UCPTE was defined as a free association of representatives of electricity undertakings and government officials covering the interconnected countries of Western Europe. Although during its early years it embraced working groups on the coordination of maintenance and operational problems in thermal power stations, it was the working party on improving general interconnections that was to provide the organization's main focus for the future.
- In July 1999, the UCTE was involved in the foundation of the Association of European Transmission System Operators (ETSO) in Frankfurt am Main. In addition to the UCTE, the other members were ATSOI (for Ireland), NORDEL (for Northern Europe) and the UKTSOA (for the United Kingdom). The UCTE focused on technical rules.
- In May 2001 the then existing UCTE was dissolved and a new UCTE established as an association of transmission system operators. The UCTE was now a forum of TSOs acting independently but without losing the interface with generation companies and distributors, consumers and regulators. It not only technical aspects but, increasingly, intertwined market aspects too. The technical side involved introducing planning and operational standards to achieve reliable synchronous transmission networks that were able to cope with a constantly rising demand trend, and also with regard to future extensions of the synchronously interconnected system.
- In addition to the UCTE as a technical association, the NORDEL, UKTSOA, ATSOI and BALTSO also existed with the same goals in other parts of Europe. It was becoming quite clear, specially under the rearranged market design, that a shift from a more voluntary to an enforcement-based platform would be needed if a sufficient level of compliance were to be guaranteed. In this context ENTSO-E was formed.
- This new structure was expected to enable faster and more focused development towards the needs and goals set by the European Union. In the past the UCTE developed through the initiatives of TSOs and

their dedicated individuals, without laws and rules imposed by authorities. In 2009, ENTSO-E took over all operational tasks of the 6 existing TSO associations in Europe, including UCTE.

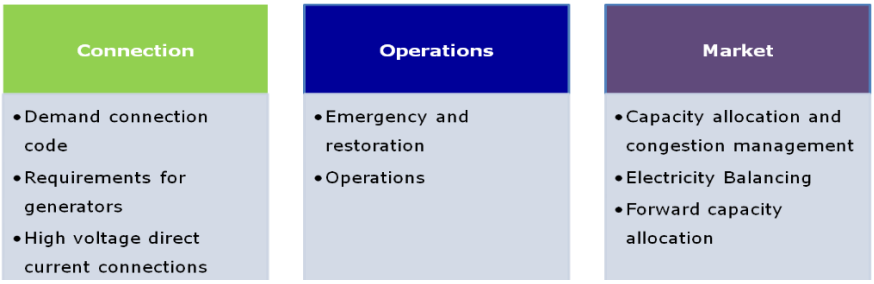
The geographical area covered by ENTSO-E's member TSOs is divided into five synchronous areas and two isolated systems (Cyprus and Iceland). Synchronous areas are groups of countries that are connected through their respective power system. The non-EU ENTSO-E member countries are Albania, Bosnia and Herzegovina, Iceland, Switzerland, Montenegro, FYR of Macedonia, Norway and Serbia.

5.5.1 Regional arrangement and technical institutional mechanism

The common set of rules for developing a secure, competitive and low-carbon European electricity sector and, the internal energy market is called network codes. The codes are a technical rulebook that complements existing legislation by defining a common 'code of conduct' for all. Generators, grid operators, traders and all other players in the sector will adopt the same practices and business processes. These rules are drafted by ENTSO-E with guidance from the Agency for the Cooperation of Energy Regulators (ACER).

Starting in 2009, eight network codes have been developed, which have been grouped into three categories as illustrated below.

Figure 20: Categories of network codes



Implementation of the codes often requires a combination of national decisions, regional agreements, and pan-European methodologies and tools. All market participants, DSOs, TSOs and regulators are involved in various ways. ENTSO-E oversees part of the implementation tasks and additionally, ENTSO-E facilitates the tasks attributed to 'all TSOs'. 'All TSOs' refers to the TSOs of all EU countries (pan-European 'all TSOs'), or to the TSOs of a specific EU region (regional 'all TSOs'). The TSOs whose countries are not member of the EU are also involved in the development phase. However, the validation of the deliverables to be submitted to National Regulatory Authorities (NRAs) is made by 'all TSOs', not by ENTSO-E.

Once submitted to all EU NRAs (or to those of the respective region), all NRAs must similarly reach a decision to formally adopt the deliverable and make it legally binding. In case they cannot reach a consensus, a safety net process involving ACER is foreseen[90]. The process has been depicted below.

Figure 21: Network codes implementation process

Source: ENTSO-E Annual Report 2017

5.5.2 Institutional structure, coordination roles and responsibilities

ENTSO-E's objectives are to promote the reliable operation, optimal management and sound technical evolution of the European electricity transmission system in order to ensure security of supply and to meet the needs of the Internal Electricity Market.

1. ENTSO-E's governance and structure

ENTSO-E is governed by an Assembly representing the 42 Transmission System Operators and by a Board consisting of 12 elected members.

Other bodies of the association are:

- the Committees
- the Legal and Regulatory Group
- the Regional Groups
- the Secretariat

The Committees are – Research Development & Innovation Committee, System Development Committee, System Operations Committee and Market Committee. ENTSO-E's operations activities are overseen by the System Operation Committee (SOC), which is currently presided by an official from Austrian Power Grid as Chairman and by an official from RTE (TSO of France) as Vice-Chairman. The Committee reports to the ENTSO-E Board and Assembly. All activities of the ENTSO-E SOC are supported by the ENTSO-E Operations Secretariat team.

The five permanent Regional Groups based on the synchronous areas (Continental Europe, Nordic, Baltic, Great Britain and Ireland/Northern Ireland, are a part of SOC.

2. Responsibilities of ENTSO-E

Its tasks include:

- Elaborating rules (network codes) for the operation of the electricity transmission networks
- Coordinating grid operation through the exchange of operational information
- Development of common safety and emergency standards and procedures
- Ensuring regional cooperation through the Regional Security Coordination Initiatives (RSCIs)
- Facilitating technical cooperation between TSOs
- Developing long-term pan-European network plans (TYNDPs)
- Drafting a 10-year network development plan every two years, which is then reviewed by the Agency for Cooperation of Energy Regulators (ACER)

The **System Development Committee (SDC)** of ENTSO-E prepares the **Ten Year Network Development Plan (TYNDP)**. This is a collective exercise and the process involves extensive stakeholder consultation via the **Network Development Stakeholder Group (NDSG)**. *Detailed case study explaining the TYNDP preparation process has been included in Annexure II.*

3. Funding of ENTSO-E

The Members contribute annually to the budget of by payment of Membership subscriptions determined by their voting power with thirty per cent of the budget financed by the Members in proportion to the First Part of their

Voting Power (one country one vote) and seventy per cent in proportion to the Second Part of their Voting Power (proportion to population).

A part of the research and innovation related activities of ENTSO-E is funded by the European Commission (EC). It also assists in financing some of the interconnector projects. For example, the EC funded the Celtic Interconnector, a high-voltage electricity cable linking Ireland and France[91].

5.5.3 Key learnings

Success factors/benefits

- Manages an internal market which is composed of several smaller markets :42 electricity transmission system operators (TSOs) from 35 countries across Europe
- Has established a common set of rules for developing a secure, competitive and low-carbon European electricity sector for the internal market - called network codes. The codes are a technical rulebook that complements existing legislation by defining a common 'code of conduct' for all. Generators, grid operators, traders and all other players in the sector will adopt the same practices and business processes. These rules are drafted by ENTSO-E with guidance from the Agency for the Cooperation of Energy Regulators (ACER).

5.6 Gulf Cooperation Council Interconnection Authority (GCCIA)

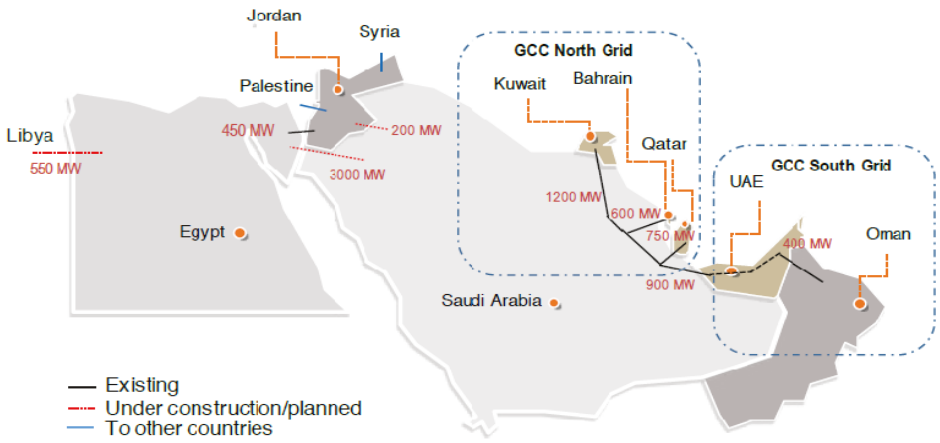
The Gulf Cooperation Council Interconnection Authority (GCCIA) is a joint stock company subscribed by the six Gulf States, whose Articles of Association and By-Laws were approved by Royal Decree in 2001. GCC countries agreed to establish the GCCIA for the purpose of interlinking the power systems of its countries. It is owned by the electricity companies in the six GCC countries of Bahrain, Kingdom of Saudi Arabia (KSA), Kuwait, Qatar, UAE and Oman.

In 2018, the energy traded under GCC interconnection was 1236 MU. GCCIA estimates the annual savings from the interconnection to be over USD 1 billion[92]. The GCC electricity scheme was envisaged primarily to allow participating countries to share reserve capacity to minimise overall investment in peaking plant, and minimize interruptions. Active trade in electricity through the interconnector was only a secondary function, however it is being encouraged now. The board of directors of GCCIA introduced schemes for 2016 to encourage power trading[93].

5.6.1 Regional arrangement and technical institutional mechanism

The GCCIA has commissioned a 400 KV grid that connects the electrical power networks of the GCC countries. The 400 KV double circuit transmission line's route length is 900 km[94]. The GCC interconnector is as illustrated below.

Figure 22: GCC interconnector



Source: Electricity Market Integration in the GCC and MENA: Imperatives and Challenges, King Abdullah Petroleum Studies and Research Center (KAPSARC), 2018

This interconnection enables electrical energy exchange and emergency support among these countries. Physical infrastructure between countries consist of 50 Hz AC interconnection between Kuwait, Bahrain, Qatar, UAE and Oman with a back-to-back High Voltage Direct Current (HVDC) interconnection to the 60 Hz Saudi Arabian system.

The Phase III of the GCC interconnection linked the networks of Kuwait, Saudi Arabia, Bahrain, Qatar (North Grid) and the United Arab Emirates and Oman (South Grid)[95].

Trading opportunities among the member countries arise owing to different timings of peak load, seasonal differences, type of fuel used, efficiency of machines, etc. Cross border power trading provides support in case of grid emergencies. GCC interconnector helped the member countries to avoid power supply interruptions in around 1,725 frequency events that occurred during 2009 to 2018 owing to sudden loss of generation in those countries. There exist both unscheduled (during emergencies) and scheduled power trade. Power trading among the GCC countries picked up in the last couple of years with bilateral contracts comprising "in-kind" and "in-cash" models. Post initiation of power trading, the member countries are now considering exchange of power for optimisation & efficiencies via day ahead markets. Currently, GCC Power Exchange operates Day Ahead Continuous and Intra-Day Continuous Market[96].

5.6.2 Institutional structure, coordination roles and responsibilities

The key objectives of the GCCIA interconnector are as follows[97].

Table 11: Key objectives of the GCCIA interconnector

Key objectives	Responsible body/committee
Share installed capacity resources	Planning Committee reporting to CEOs / MDs of GCC Utilities
Support each other during emergencies	Operations Committee reporting to CEOs / MDs of GCC Utilities
Enter into contracts for operative reserves	Operations Committee reporting to CEOs /MDs of GCC Utilities
Trade electrical energy through scheduled energy transfers	Trading Offices & Exchange Market Committee reporting to Mid/Senior Management

1. GCCIA governance

The agreements and articles which govern the GCCIA are as below.

- General Agreement - signed at the Ministerial level of the member countries, sets out the rules and regulations governing the high-level relationships among the member countries in relation to the interconnection scheme. The following issues are covered –
    - rights of interconnection
    - connection fees
    - performance
    - defaults
    - governing laws
    - termination
- Articles of Association and By-Laws - Articles of Association and By-Laws were approved by a Royal Decree on July 29, 2001.

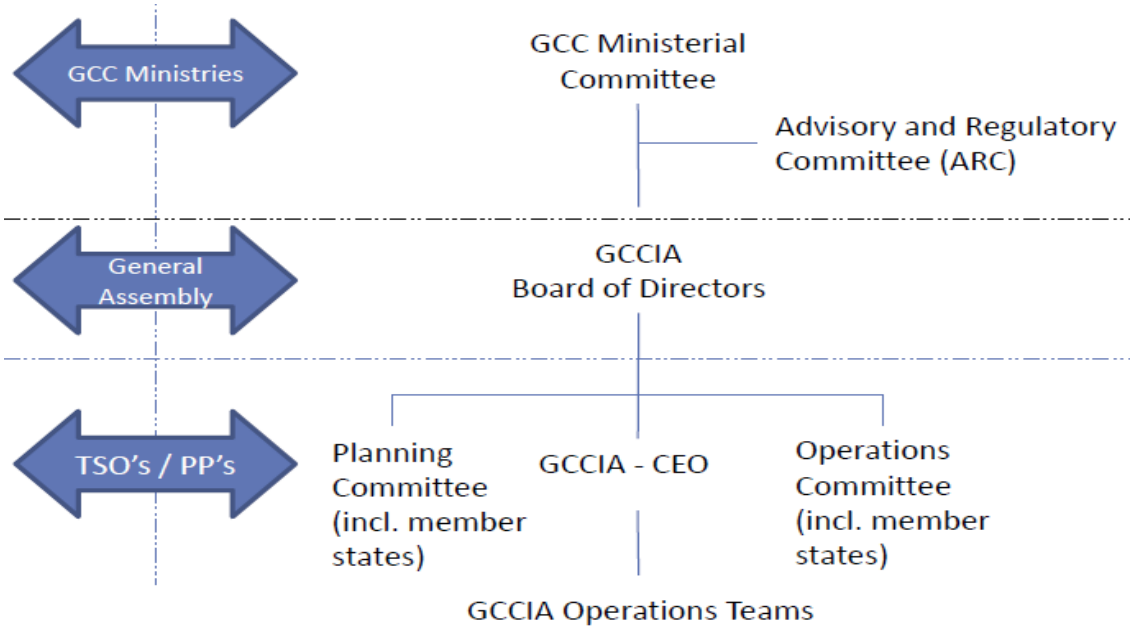
- Power Exchange and Trading Agreement (PETA) - the parties referred to in the PETA are the GCCIA, six Transmission System Operators (TSOs) and the two procurement parties (Abu Dhabi Water and Electric Company) and Oman Power and Water Procurement Company). It governs the terms & conditions, connectivity & usage, technical & commercial rules of the electricity trade. It consists of the following three main components -
    - Trading Agreement: sets out the terms on which the parties may use the interconnector for scheduling transfers of energy and power
    - Interconnection and Use of System Agreement : sets out the terms on which the parties will connect to / have access to the interconnector
    - Transmission Code : sets out the detailed technical rules that govern connection to /access to the interconnector where the interconnection and use of system agreement requires each party to comply with the Interconnector Transmission Code
- Interconnection Transmission Code (ITC) - is the members' technical code for the 400 KV interconnector and provides guidelines on how the members will conduct themselves. It indicates how the interconnector will be operated, including operating reserve allocation.

2. GCCIA structure

The GCCIA is managed by a twelve member Board of Directors, which comprises two officials from each of the six member countries. The Chairmanship is rotated among the member countries every three years98. The rules and regulations governing the GCCIA and members are issued either by the Board of Directors, or by a General Assembly comprising the Board and members of Planning Committee and Operations Committee, which are also nominated by the member countries[99].

The organisational structure of the GCCIA is as illustrated below[100]:

Figure 23: GCCIA structure



Source: Initiative for a Clean Energy Corridor Executive Strategy Workshop, IRENA, June 2013and

The frequency of the GCC Power Exchange meetings are as illustrated below.

Table 12: GCC Power Exchange meetings

Meeting type	Frequency/schedule	Participants
Roundtable meetings	Bi-Annual meetings	Management – CEOs and MDs
Exchange Market Committee	Quarterly Meetings	Mid-management
Trading Officers; Working Group	Quarterly Meetings	Working level

Source: Experience of GCCIA in developing GCC Regional Electricity Market, 2019, GCCIA presentation

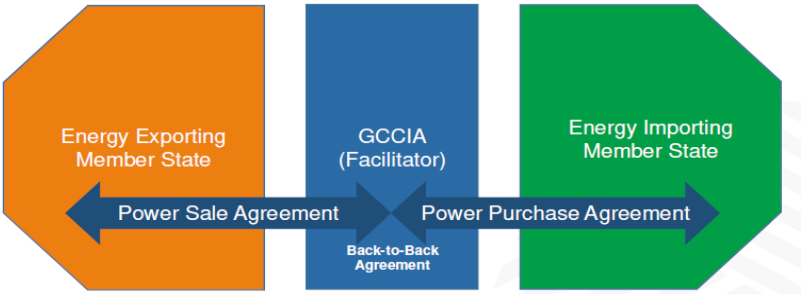
3. Functions of GCCIA

The key functions of the GCCIA for facilitating power trading, as per PETA are as below.

- Run daily/monthly/yearly explicit auctions on grid capacities rights
- Facilitate and arrange energy schedules according to received notifications of bi-lateral exchanges
- Prepare periodic accounts and statements for energy exchanged between the member countries
- Generate and send invoices to member countries for any deviations from agreed energy exchange schedules
- Implement PETA and apply any penalties or defaults on cosignee parties

The GCCIA is a neutral body which aims to mitigate the risk of power trading. It enters into back-to-back power trade agreements as shown below.

Figure 24: Power trading facilitation by the GCCIA



Source: Experience of GCCIA in developing GCC Regional Electricity Market, 2019, GCCIA presentation

At present the access to the regional network (the GCCIA network) is limited to the national electricity utilities (PETA parties). The national electricity transmission utilities have the interconnection rights and are balancing parties. The distribution utilities trade power at the regional level. The current structure of the power exchange is as illustrated below.

Figure 25: Power exchange structure

Source: Experience of GCCIA in developing GCC Regional Electricity Market, 2019, GCCIA presentation

4. Funding of GCCIA

The project is financed with funds from the member countries. The capital cost for the three phases were estimated to be – USD 1.10 billion, USD 300 million and USD 137 million respectively. GCC countries share the cost in proportion to the net present value of estimated reserve savings capacity. Each member country is responsible for arranging their share of the capital required (can be a combination of debt or equity as decided by the member country).

The table below shows the percentage sharing of capital costs among the member countries[101].

Table 13: Percentage share of capital costs among the GCCIA member countries

Member country	Capital costs sharing percentage	
	Phase I	Phases I and III
Saudi Arabia	40.00%	31.60%
Kuwait	33.80%	26.70%
Qatar	14.80%	11.70%
Bahrain	11.40%	9.00%
UAE	-	15.40%
Oman	-	5.60%
Total	100%	100%

5.6.3 Key learnings

Success factors/benefits

- The authority had the backing of GCC leaders and. the support of electricity and energy ministers
- Ensures that no single country dominates and takes undue advantage of trading. Even though the shareholdings vary, each country has equal representation on the GCCIA board, with the chairmanship rotating every three years, so that no single country drives this initiative.
- Reduced power outages through cross border power trading. GCC member countries help each other by sharing spinning reserve capacity, which reduces overall investment in peaking plants and minimises power interruptions.
- GCC member countries have incurred savings because of the interconnection
- A bilateral trading system currently gives the member countries visibility regarding capacity in other member countries and enables them to place bids using yearly, monthly or daily options
- Power is not the only commodity the interconnector carries. The network has been built to carry fibre optic cables to enable reliable telecommunications needed for core operations of the grid. GCCIA got permission of telecom regulators in the GCC to lease additional spare fibres to licensed operators for data and telecommunications – they haven't been interrupted since operations began, providing very reliable telecom network for commercial telecom operators.

Challenges/Areas for further development

- The objective of the established authority was to use the interconnector to facilitate spot market trading, however trading is still limited. The main intra-regional transfers have occurred on an emergency basis only covering unscheduled outages. (Electricity trading falls under two categories: scheduled and unscheduled exchanges.) Scheduled exchanges occur rarely and are based on bilateral agreements between members, after which members make transmission arrangements with GCCIA. More prevalent, however, are the unscheduled exchanges whereby member countries require urgent power imports from other countries through the system to cover unexpected contingencies and ensure system reliability.

5.7 Arab Union of Electricity (AUE)

The Arab Union of Electricity (AUE) was established in 1987. It comprises 19 countries - Jordan, UAE, Bahrain, Tunisia, Algeria, Kingdom of Saudi Arabia (KSA), Sudan, Syria, Qatar, Kuwait, Lebanon, Libya, Iraq, Oman, Palestine, Egypt, Morocco, Mauritania and Yemen. Almost all Arab Ministries and electricity utilities are active members in the Arab Union of Electricity. Many of the manufacturing companies of electrical equipment that support this sector as well as producing companies are associate members. The active members are currently 32 while the associate members are 20 and the observing members are 2.

The Arab Union of Electricity Secretariat is based in Amman, Jordan. It is hosted by National Electric Power Company of Jordan.

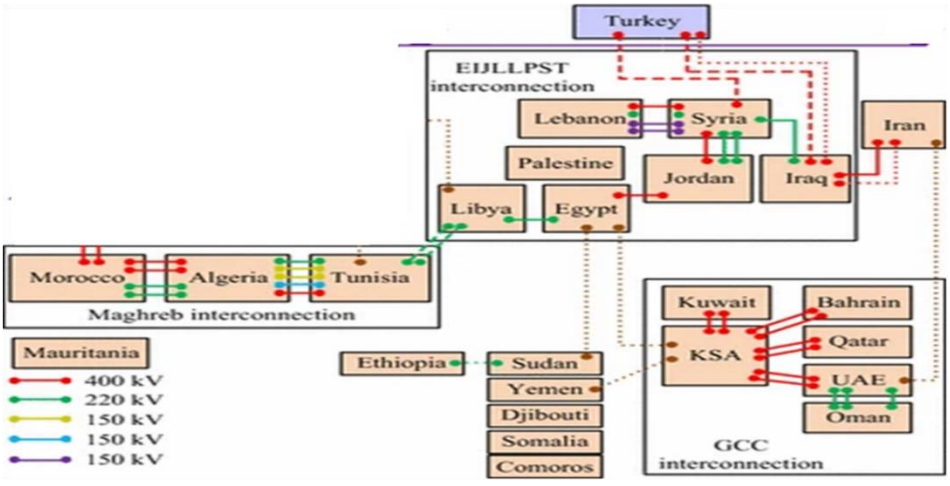
5.7.1 Regional arrangement and technical institutional mechanism

The Arab electricity interconnections include the following –

- Gulf electricity interconnection, which includes six Gulf countries namely Saudi Arabia, Kuwait, Bahrain , Qatar , UAE and Oman
- Eight countries (EIJLLPST) regional interconnection, which includes Arab Mashreq countries namely: Egypt, Iraq, Jordan, Lebanon, Libya, Palestine, Syria, in addition to Turkey
- The Maghreb interconnection, which includes the Maghreb countries, namely Tunisia , Algeria, and Morocco

The interconnections are as illustrated below.

Figure 26: Arab country interconnections



Source: Review of Middle East energy interconnection development, 2017, Journal of Modern Power Systems and Clean Energy. [The figure depicts existing and planned grid interconnection (the solid line represents "existing"; the dash line represents "not operational/island operation"; the dotted line represents "under-consideration, -study, -construction")]

In 2016, the World Bank Group and partners launched the Pan-Arab Regional Energy Trading Platform (PA-RETP) Initiative to support Arab countries to increase electricity and gas trade within the region and eventually neighboring markets, particularly Africa and Europe.

MENA countries' installed capacity is around 300 GW. However, the available cross-border transmission interconnection capacity is only 15.8 GW and a fraction of that capacity is commercially utilised. If the energy market in this region is fully integrated, it would be the world's second largest regional electricity market after the European electricity market[102],

5.7.2 Institutional structure, coordination roles and responsibilities

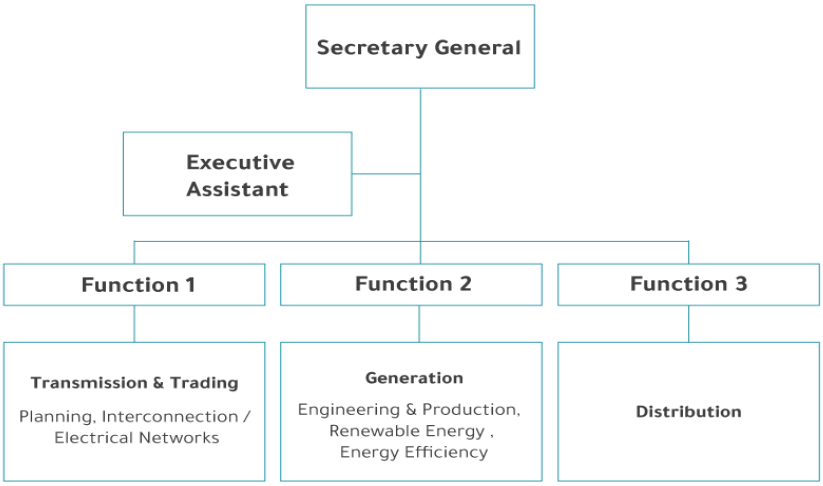
The objectives of the AUE are:

- To improve and develop the generation, transmission and distribution of electrical energy in the Arab World
- To develop, improve and coordinate the areas of interest of its members and strengthen the relationship among them

1. AUE structure and functions

The organization structure of the AUE is as illustrated below.

Figure 27: AUE structure



Source: AUE official website – www.auptde.org

All the active, associate and observing members of the AUE forms its General Assembly. The Board of Directors includes 10 members and is appointed every three years from among the active members, in order to allow participation of all the active members in the Board membership. The General Assembly is supervised by the Board of Directors. The two top posts in the Board are – Chairman General Manager and Vice Chairman – Secretary General. The General Assembly meets annually, while the Board meets at least every 6 months.

The AUE works functions the following committees:

- Planning Committee
- Committee of Interconnected Arab Networks (CIAN).
- Engineering and Production Committee
- Distribution Committee
- Renewable Energy Committee
- Human Resources Committee

The committees have representatives of various member utilities. For example, the Planning Committee is currently headed by Planning and Strategy Director of the electricity utility in Morocco. The Committee has representatives from utilities of Jordan, Syria etc.

The active members have the right to nominate members in these committees through which knowledge/experience sharing takes places and studies are undertaken. For example, a study was undertaken about electrical components industry in the Arab Countries, and to what extent it is according to the international standards. This study was conducted in cooperation with Arab League and Arab Industrial Development and Mining Organization. Training course was organized for the AUE members along with Economic and Social Commission for Western Asia (ESCWA, created by the United Nations), in the area of renewable energy.

2. Funding of the AUE

The Arab Fund for Economic and Social Development (the Arab Fund) finances power grid interconnection projects. The Arab Fund based in Kuwait, is an Arab regional financial institution focused on funding economic and social development by financing public and private investment projects and providing grants and expertise. It also provides loans at concessional rates. Supporting functions include the preparation of sectoral studies and, organizing conferences and seminars in the Arab countries. This also includes identifying cooperation opportunities and finding the factors supporting Arab development and integration, considering regional developments.

In June 2019, the AUE signed an agreement with a consulting firm to restructure the Union. The agreement was funded by the Arab Fund, which aimed to improve its performance according to best practices and increase the efficiency of electric systems[103].

Other IFIs such as the World Bank is supporting the creation of the common Arab electricity market – PAEM. The Arab Fund and other Arab Coordination Group (ACG) members will provide technical assistance to the key governing bodies of the emerging regional market, along with targeted support to infrastructure investment project preparation and financing for bilateral trade. The World Bank in partnership with the Arab Fund and other ACG members, will provide its experience to support regional integration initiatives[104].

5.7.3 Key learnings

Success factors/benefits

- There is a strong commitment at the government level
- Funding support and technical guidance has been available through the DFIs and specially the regional donor agency, the Arab Fund

Challenges/Areas for further development

- Political instability is a risk in this region and escalating geo-political tensions cause hindrance in cooperation among the member countries
- The regional power market is still at a very nascent stage and, proper regulatory and institutional mechanisms for cross border power trade are yet to be developed (for example, a regional grid code). There is limited information regarding legal, commercial and pricing issues.
- Trading has been limited. One of the key interconnections in the Arab region was established in 1988, which linked Egypt, Iraq, Jordan, Syria and Turkey. It later expanded to include Libya, Lebanon and Palestine. This was to share reserves in emergencies, as well as surplus power. However cross border power trade has been marginal owing to several impediments such as including generation capacity, different regulatory frameworks and the interconnections having small capacities. The Egypt-Jordan link is the largest, but it is only 450MW[105].

5.8 Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM)

PJM is the largest regional transmission organization (RTO) in the United States in terms of load served. It directs the operation and coordinates the maintenance of the transmission System, serving 13 states (Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia) and the District of Columbia in the United States.

Evolution of PJM

PJM started in 1927 as a mechanism to pool the generation sources of three utilities (Philadelphia Electric Company, Pennsylvania Power & Light, and Public Service Gas & Electric Company of New Jersey) through transmission interconnections. Gradually, more utilities joined. The current form – Pennsylvania-New Jersey-Maryland Interconnection LLC, is a Limited liability, non-stock company incorporated in the state of Delaware. Additional utilities joined in 1956, 1965 and 1981. Throughout this time, PJM was operated by a department of one member utility. The members entered into an agreement, originally dated 26 September 1956, called as the 'Original PJM Agreement'.

PJM began the transition to an independent, neutral organization in 1993 when the PJM Interconnection Association was formed to administer the power pool. The association was formed by the parties through a resolution dated 16 June 1993, for the purpose of implementation of the Original PJM Agreement as it then existed and as it subsequently was amended and supplemented.

In 1997, PJM became a fully independent organization. At that time, membership was opened to non-utilities, and an independent Board of Managers was elected.

The evolution of PJM and the key milestones have been depicted below.

Figure 28: Evolution of PJM and key milestone

1927	1956-1981	1993	1997
PJM started- 3 utilities realised the benefits and efficiencies possible by interconnecting to share their generating resources, formed the world's first continuing power pool	5 more utilities joined-during this period, PJM was operated by a department of one member utility	PJM Interconnection Association formed to administer the power pool - it began the transition to an independent neutral organisation	• PJM became a fully independent organisation (PJM Interconnection LLC formed) - membership was opened to non-utilities, and an independent Board of Managers was elected • The FERC approved PJM as US' first fully functioning independent system operator (ISO) • ISOs operate, but do not own, transmission systems in order to provide open access to the grid for non-utility users

2002	2002-2005	2011-2018
PJM became US' 1st fully functioning RTO – the FERC encouraged the formation RTOs to operate the transmission system in multi-state areas and to advance the development of competitive wholesale power markets	7 more utilities joined-PJM integrated a number of utility transmission systems into its operations	6 additional utilities joined during this period-these integrations expanded the number and diversity of resources available to meet consumer demand for electricity and increased the benefits of PJM's wholesale electricity market

PJM's members comprise of transmission and generation owners, electricity suppliers and end use consumers (for example industries). PJM's Operating Agreement must be signed by all organizations which want to become a member of PJM. It contains provisions that establish how PJM operates as a regional transmission organization. It defines the roles and responsibilities of the PJM Board of Managers, the Members Committee and the Office of the Interconnection (PJM management and staff.).

The **Operating Agreement** of PJM Interconnection states the following -

"WHEREAS, certain of the Members have previously entered into an agreement, originally dated September 26, 1956, as amended and supplemented up to and including December 31, 1996, stating "their respective rights and obligations

with respect to the coordinated operation of their electric supply systems and the interchange of electric capacity and energy among their systems" (such agreement as amended and supplemented being referred to as the "Original PJM Agreement"), and which coordinated operations and interchange came to be known as the PJM Interconnection; and WHEREAS, ***pursuant to a resolution of June 16, 1993, an unincorporated association comprised of the parties to the Original PJM Agreement was formed*** *for the purpose of implementation of the Original PJM Agreement as it then existed and as it subsequently has been amended and supplemented, such association being known as the "PJM Interconnection Association"; and*

…

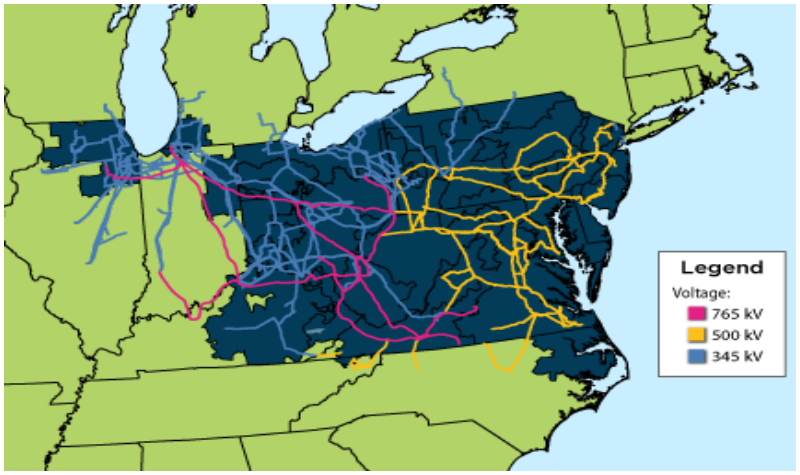
WHEREAS, so that the provisions of the Original PJM Agreement could be placed into effect consistent with a February 28, 1997 order of FERC, including those provisions related to the governance of the Interconnection, the parties to the Original PJM Agreement, along with the other interested parties, approved the conversion of the PJM Interconnection Association into the LLC pursuant to the provisions of the Delaware Limited Liability Company Act, as amended (the "Delaware LLC Act"), pursuant to a Certificate of Formation (the "Certificate of Formation") and a Certificate of Conversion (the "Certificate of Conversion"), each filed with the Delaware Secretary of State (the "Recording Office") on March 31, 1997;…."

5.8.1 Regional arrangement and technical institutional mechanism

PJM Interconnection coordinates the movement of electricity through all or parts of Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia, West Virginia and the District of Columbia.

The following figure depicts PJM's group of high—voltage transmission lines that make up the foundation of the grid in the region where PJM operates.

Figure 29: Major transmission lines of PJM forming the foundation of the grid



Source: PJM official website[106]

5.8.2 Institutional structure, coordination roles and responsibilities

PJM ensures reliable operations of the bulk electric power system, efficient wholesale markets, and infrastructure planning. It provides regional planning and operation, energy market operation, outage coordination, transactions settlement, billing and collections, risk management, ancillary services and undertakes credit risk management.

The key objectives of PJM are:

- Ensure the safety, reliability and security of the bulk electric power system
- Undertake transmission expansion planning
- Create and operate robust, competitive and non-discriminatory electric power markets

- Understand customer needs and deliver valued service to meet those needs in a cost-efficient manner
- Achieve productivity through the efficient union of superior knowledge workers and technology advances

1. PJM structure and functions

The organization structure of PJM is as illustrated below.

PJM has a two-tiered governance structure, consisting of the PJM Board and the Members. The independent PJM Board is charged with ensuring that PJM operates the grid safely and reliably and creates and operates fair energy markets. To establish neutrality, board members can have no personal affiliation or ongoing professional relationship with, or any financial stake in, any PJM market participant. The board ensures that no member or group of members has undue influence and is required to prevent the undue exercise of market power by any market participant. To support this goal, PJM employs an independent external market monitor, Monitoring Analytics, which constantly analyses market data and issues reports on compliance with the rules, standards, procedures and practices of PJM's markets.

The Members Committee, on which each member has a representative, provides advice to the board by proposing and voting on changes and new programs. The committee is made up of five sectors representing Generation Owners, Transmission Owners, Electric Distributors, Other Suppliers and End Use Customers. Only a Primary Member may vote in the committee.

Figure 30: High level organization structure of PJM

Source: PJM[107]

PJM acts as a neutral, independent party and operates a competitive wholesale electricity market and, manages the high-voltage electricity grid to ensure reliability for more than 65 million people. PJM's long-term regional planning process (which has been described in detail in Chapter 8, Annexure II) provides a broad, interstate perspective that identifies the most effective and cost-efficient improvements to the grid. An independent Board consisting of 10 members oversees PJM's activities. PJM's committees are integral to developing and refining PJM's rules, policies and processes. These provide a forum for members to share their positions and resolve difficult issues. Market committees are essential to PJM's governance structure for administering an open grid and transparent markets.

PJM's two Senior Committees are the Members Committee (MC) and the Markets and Reliability Committee (MRC). The MC provides advice and recommendations to PJM on all matters relating to the safe and reliable operation of the PJM Control Area; the creation and operation of a robust, competitive and non-discriminatory electric power market, and ensures that there is no undue influence over PJM's operations by any member or group of members. The MRC reports to the MC. There are three Standing Committees under the MRC –

- Planning Committee (PC) - has the responsibility to review and recommend system planning strategies and policies as well as planning and engineering designs for the PJM bulk power supply system to assure the continued ability of the member companies to operate reliably and economically in a competitive market environment. Additionally, the PC makes recommendations regarding generating capacity reserve requirement and demand-side valuation factors.
- Operating Committee (OC) - reviews system operations from season to season, identifying emerging demand, supply and operating issues

- Markets Implementation Committee (MIC) – initiates and develops proposals to advance and promote competitive wholesale electricity markets in the PJM region for consideration by the Markets and Reliability Committee

There are eight other Committees which are advisory in nature. One of these Committees is the Transmission Expansion Advisory Committee (has been described in detail in Chapter 8, Annexure II), which provides advice and recommendations to assist in the development of the Regional Transmission Expansion Plan (RTEP).

2. PJM's network planning process and the Transmission Expansion Advisory Committee (TEAC)

At PJM, planning includes assessing and managing the future needs of the electric grid. PJM also participates in collaborative interregional planning activities with its neighbours (other RTOs in the US). PJM's planning team consists of engineers, analysts and project managers. The planning process at PJM includes analysing and coordinating planned upgrades (such as new transmission lines), connecting new power plants to the existing system and planning PJM's connections with neighbouring transmission systems.

PJM conducts long-range planning studies and analyses future demands on the transmission system in its region. These studies identify changes and additions, such as new transmission lines or upgrades to existing equipment, needed to ensure grid reliability and to maintain the successful operation of the wholesale electricity markets. For this PJM considers:

- Expected growth in the use of electricity (for example, population growth in a specific area would drive up demand)
- Retirements (shutdowns) of existing power plants
- Public policy (state or other governmental energy initiatives)

PJM's **annual Regional Transmission Expansion Plan** determines in detail the changes needed to the transmission grid up to five years in the future, and projects the changes likely to be needed up to 15 years into the future.

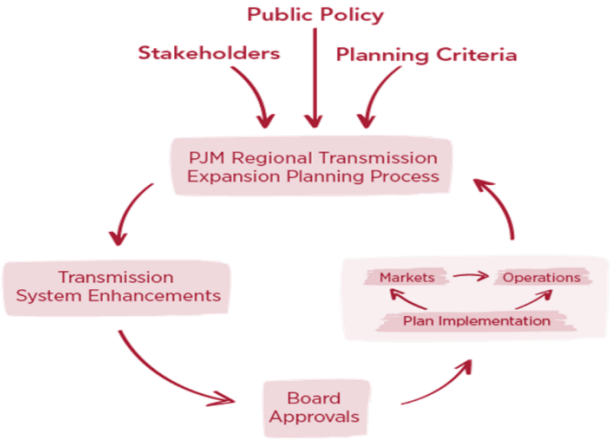
Generation interconnection studies determine whether the existing grid can handle power from a new generating plant and what changes are needed to connect the plant.

PJM works closely with neighbouring grid operators, including Midcontinent Independent System Operator and New York Independent System Operator, to coordinate upgrades around shared borders and ensure that facilities in one system do not adversely impact neighbouring systems.

Regional Transmission Expansion Planning (RTEP) process:

The following figure depicts PJM's regional transmission expansion planning process.

Figure 31: PJM's RTEP process



Source: PJM official website – www.pjm.com

PJM uses an open process to plan for changes to the electric grid in the 13-state region to maintain future reliability and economic performance of the grid. PJM participates in collaborative interregional planning activities with its neighbours. **The PJM Regional Transmission Expansion Planning process, performed annually**, looks ahead 15 years, assessing many drivers that affect grid reliability. The RTEP process begins 15 years in advance to ensure that PJM is already planning for the future of the grid. PJM studies many scenarios and analyses various grid conditions that could lead to problems in the way power flows throughout the region. These problems might include:

- Transmission lines that are carrying the maximum amount of electricity that they are able to carry
- New generators, which, when they begin operating, could cause parts of the system to be overloaded owing to the increased amount of power flowing through the lines
- Substation equipment that could be overloaded

PJM also considers public policy needs such as the impact of state renewable energy requirements or demand response/energy efficiency efforts, generator retirements and fuel shifts such as the major change from coal to natural gas generation.

After PJM identifies potential problems, it works with transmission owners and other members through a competitive planning process to determine the best fix for the problem, meeting required national standards. Examples of these solutions include:

- New transmission lines
- Replacing existing high voltage transmission lines with lines capable of carrying more power
- Installation of devices that maintain voltage levels

Therefore, PJM first identifies the transmission projects that will be needed to serve customers in the future. As part of that process, it ensures that the transmission system complies with national and regional reliability criteria to prevent overloaded facilities and potential blackouts. PJM does the following analysis to identify RTEP projects and incorporates the latest information available on:

- Load forecast
- Demand resources
- Generation resources
- Transmission topology
- Bilateral transactions

PJM incorporates deliverability tests (simulating stressed, emergency grid conditions) to ensure power can be delivered when it is most needed, such as when local generation cannot meet customer demand.

The Regional Transmission Expansion Planning process determines the need for and benefits of a transmission project, however it does not review or approve locations where transmission lines are ultimately built. That is the responsibility of individual states.

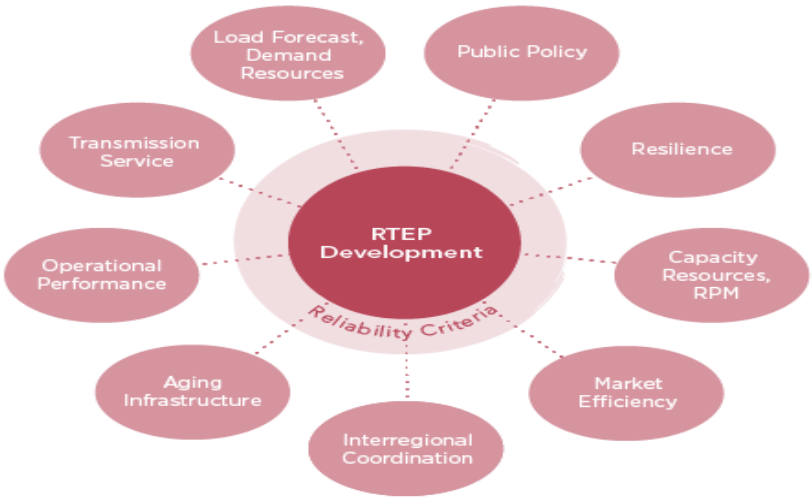
All transmission improvements identified through this process are discussed publicly in stakeholder meetings, and reviewed and approved by the PJM Board before being included in PJM's expansion plan. The cost of these upgrades is allocated to PJM transmission owners following rules in PJM's federally-approved governing documents. Under PJM agreements, transmission owners are obligated to build transmission projects approved by the PJM Board that are needed to maintain reliability standards.

Regional Transmission Expansion Planning Protocol governs the process by which the Members shall rely upon the Office of the Interconnection to prepare a plan for the enhancement and expansion of the Transmission Facilities in order to meet the demands for firm transmission service, and to support competition,

in the PJM Region. Further details are also provided in the **PJM Region Transmission Planning Process Manual**.

The various elements involved in the RTEP development process have been illustrated in the figure below.

Figure 32: Elements considered during the Regional Transmission Expansion Planning process



Source: PJM official website – https://www.pjm.com/

All transmission improvements identified through this process are discussed publicly in stakeholder meetings, and reviewed and approved by the PJM Board before being included in PJM's expansion plan. The cost of these upgrades is allocated to PJM transmission owners following rules in PJM's federally-approved governing documents. Under PJM agreements, transmission owners are obligated to build transmission projects approved by the PJM Board that

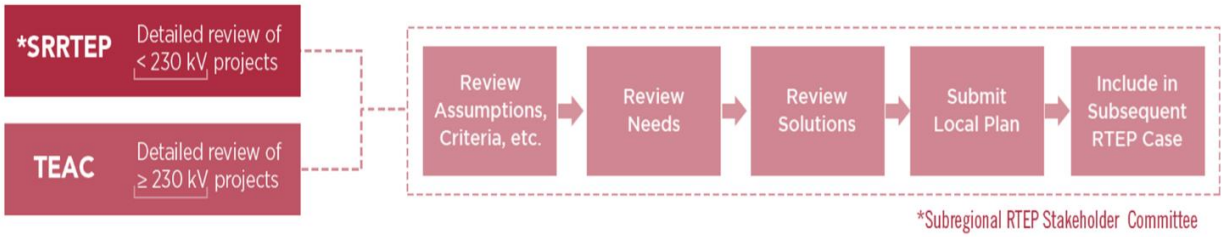
After PJM identifies a baseline transmission need, PJM may open a competitive proposal window, depending on the required in-service date, voltage level and scope of likely projects. Throughout each RTEP window, developers can submit project proposals to address one or more needs. When a window closes, PJM evaluates each proposal to determine if any meet all of our project requirements. If so, PJM then recommends a proposal to the PJM Board. Once the Board approves a proposal, the designated developer becomes responsible for project construction, ownership, operation, maintenance and financing. PJM identifies the affected parties who bear the responsibility for network system projects that permit the interconnection of new generation and other new transmission services. Supplemental projects are exceptions to this process. Transmission owners develop these projects themselves to address local reliability needs and are responsible for building them.

The different types of RTEP projects are:

- **Baseline projects** ensure compliance with national and regional reliability standards. These projects are identified to fix issues like overloads, bus voltage drops, excessive short circuit current, generator stability and congestion issues.
- **Network projects** are identified to help new generation resources connect to the grid reliably
- **Supplemental projects** are identified and developed by transmission owners to address local reliability needs, including customer service and load growth, equipment material condition, operational performance and risk, and infrastructure resilience. PJM reviews them to evaluate their impact on the regional transmission system.

The figure below shows the process for supplemental projects.

Figure 33: Supplemental project process



Source: PJM official website – https://www.pjm.com/

PJM Transmission Expansion Advisory Committee (TEAC)

The Transmission Expansion Advisory Committee (TEAC) is established under the Operating Agreement (OA) of PJM and provides advice and recommendations the PJM Office of the Interconnection on the preparation of the PJM Regional Transmission Expansion Plan for review and approval by the PJM Board of Managers. The Sub Regional RTEP Committees (SRRTEP) provide review and input of Sub regional RTEP projects and provide recommendations to the TEAC concerning Sub regional RTEP projects. There are three SRRTEPs – Mid-Atlantic, Southern, Western.

The responsibilities of the TEAC are:

- Provide comments and recommendations on the scope and assumptions for Regional Transmission Expansion Plan (RTEP) studies, including economic/market efficiency analysis
- Provide comments on the RTEP analysis for specific points throughout the RTEP process cycle
- Provide comments and recommendations on the RTEP that will be proposed to the PJM Board of Managers for consideration and approval, as necessary
- Provide comments and recommendations on RTEP matters as requested by the PJM Board of Managers

TEAC membership and participation are open to parties as described in the PJM Operating Agreement (OA) and are as follows:

- all Transmission Customers, as that term is defined in the PJM Tariff, and applicants for transmission service;
- any other entity proposing to provide Transmission Facilities to be integrated into the PJM Region;
- all Members;
- the agencies and offices of consumer advocates of the States in the PJM Region exercising regulatory authority over the rates, terms or conditions of electric service or the planning, siting, construction or operation of electric facilities; and
- any other interested entities or persons.

Communications between TEAC membership, the Office of the Interconnection and the Board of Managers comprise of a written notice-and-comment process. The Office of the Interconnection has the responsibility of compiling comments from TEAC participants. All written comments are posted to the PJM web site and provided to the PJM Board of Managers together with a PJM staff summary focuses on conveying what the issues are; who has raised the issues and why the issues are of importance to Board consideration of RTEP approval. Communication to the Board of Managers will not include results of voting.

PJM staff will be ultimately responsible for preparing and issuing all reports, running the committee meeting, , management of data, final analytical work, and compilation and publication of other relevant documentation that may be required from time to time.

The following core competencies are recommended in order for TEAC members to be able to provide advice and recommendations to the PJM Office of the Interconnection on the preparation of the PJM Regional Transmission Expansion Plan for review and approval by the PJM Board of Managers:

- Sufficient decision-making authority to support the Mission of the TEAC
- Sufficient experience, knowledge, or background to contribute effectively to TEAC discussions and recommendations
- Interpersonal, decision-making, team-working and presentation skills

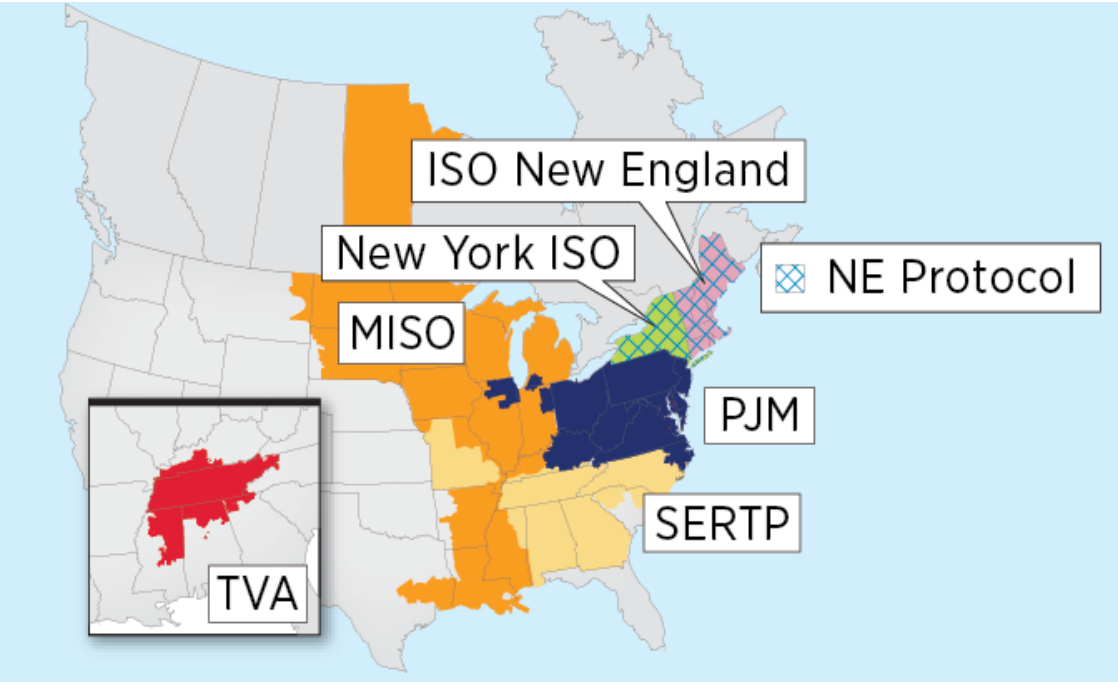
Interregional Planning:

PJM participates in collaborative interregional planning activities with its neighbors:

- **Northeast:** New York Independent System Operator (NYISO) and ISO New England
- **West:** Midcontinent Independent System Operator (MISO)
- **Southeast:** Southeastern Regional Transmission Planning (SERTP) and North Carolina Transmission Planning Collaborative (NCTPC)

The figure below depicts the regions under PJM's neighboring RTOs.

Figure 34: Regions under PJM's neighbouring RTOs



Source: PJM official website – https://www.pjm.com/

Coordination with PJM RTEP Process

Interregional planning is integrated with PJM's own Regional Transmission Expansion Planning (RTEP) process in accordance with the following guidelines as per the - Open Access Transmission Tariff; Operating Agreement and series of manuals and stakeholder activities via the PJM Transmission Expansion Advisory Committee (TEAC).

3. Funding of PJM

As per federal regulation, PJM operates as profit neutral entity, i.e. total revenues and expenses must equal each other over the long term. PJM is regulated by the Federal Energy Regulatory Commission (FERC) and is a non-stock company, which means that the company does not have the right to issue stock shares to raise equity funding. Also it does not have any debt (such as bonds) issued to the public or traded publicly.

PJM's expenses are recovered from its members primarily based on fixed, long-term rates in PJM's Open Access Transmission Tariff. It recovers its administrative costs i.e. the costs of operating the electric transmission system and the wholesale electricity markets, through fixed rates billed to members based on their activity levels.

The table below shows the percentage break-up between the two broad type of services and the respective revenue percentage break-up[108]

Table 14: Break-up of type of services and revenues

Services	**54%** - services for ensuring reliable power supply and planning for the future grid	46% - market related
Revenues from members	75% - from load serving entities	25% - from others • 20% - generation owners • 5% - financial marketers, traders

If PJM collects more revenues from the fees than its actual expenses for each calendar quarter, then it refunds the over-collections to members in the subsequent calendar quarter. Alternatively, if PJM collects lower revenues from the fees than its actual expenses for each calendar quarter, then it may use an approximately USD 14 million long term reserve previously funded by PJM's members.

5.8.3 Key learnings

Success factors/benefits

- Initially, PJM started with three utilities and gradually more utilities joined over the time. These integrations expanded the number and diversity of resources available to meet consumer demand for electricity and increased the benefits of PJM's wholesale electricity market.
- A primary driver of integration has been the desire to better utilize both local and regional resources, which is mostly hydroelectric in this case
- PJM's transparent regional transmission planning process takes into consideration proposed changes to the bulk electric grid in its region in order to maintain the future reliability and most economic performance of the grid. The Regional Transmission Expansion Plan (RTEP) process looks ahead 15 years to assess factors that may affect grid reliability. PJM studies scenarios and analyses various grid conditions that could lead to reliability problems throughout the region. It works with stakeholders to determine the best solution. As a result, the RTEP identifies needs, and the enhancements required to meet those needs, in order to maintain reliability in compliance with North American Electric Reliability Corporation (NERC) and PJM planning criteria. However PJM does not review or approve locations where transmission lines and facilities are ultimately built. That is the responsibility of individual states. All transmission improvements identified through this process are discussed publicly in stakeholder meetings and reviewed and approved by the PJM Board of Managers before inclusion in PJM's RTEP.

- Through organizational realignment, investment in report generation and automation tools, and closer coordination with transmission owners to improve on-time completion of studies, PJM reduced its interconnection queue-study backlog while managing the all-time highest annual number of incoming interconnection requests

Challenges/Areas for further development

- PJM's capacity market (for long term power requirements) is not working as desired. The grid operator's independent market monitor or IMM found the capacity market is not competitive.

5.9 Summary of international experience

The main aspects of the international regional institutions focusing on coordination for cross border electricity trade are summarized in the table below.

Table 15: Summary of international regional institutions

Parameters	South African Power Pool (SAPP)	Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region	Heads of ASEAN Power Utilities (HAPUA)	Central American Interconnection System (SIEPAC) – Ente Operador Regional (EOR)
Established	1995	2002	1997	2013
Member countries	12 SADC member countries - Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mozambique, Namibia, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe	6 Greater Mekong Sub-region countries - Cambodia, the People's Republic of China (PRC), Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Vietnam	10 ASEAN member countries - Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, Philippines, Singapore, Thailand and Vietnam	6 Central American countries - Panama, Costa Rica, Honduras, Nicaragua, El Salvador, Guatemala
Type of member entities	12 national power utilities 3 Independent Power Producers (IPP) 2 transmission companies	Energy departments and ministries, national power utilities	10 national power utilities. Energy Ministers have separate meetings.	6 national power utilities
Key activities / objectives	• Provide a forum for regional solutions to electric energy problems • Coordinate the planning and operation of the electric	• Manage regional power trade in the Greater Mekong Sub region and provide recommendations on overall policy in this area.	• Promote cooperation among its members to strengthen regional energy security through interconnection	• Planning the Regional Transmission Network • Directing and coordinating the technical operation of

Parameters	South African Power Pool (SAPP)	Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region	Heads of ASEAN Power Utilities (HAPUA)	Central American Interconnection System (SIEPAC) – Ente Operador Regional (EOR)
	power system among member utilities • Development of SAPP pool plan • Harmonise relationships between member utilities. • Provide a Market Trading Platform	• Facilitate the exchange of information on energy sector plans and projects • Prepare common criteria for coordinated system planning and technical standards for operational coordination	development, enhancing private sector participation, encouraging standardization of equipment, promoting joint project development, cooperation in human resources, research & development, and to enhance quality & reliability of electricity supply system • To facilitate and expedite the implementation of the ASEAN Interconnection Power Project • Propose solutions on legal and regulatory framework for bilateral and cross border power interconnection and trade and formulation of institutional and contractual arrangements for cross border electricity trade • Study, Identify and recommend Financing	the Regional Electricity System • Carrying out the commercial management of the Regional Electricity Market (MER) of Central America

Parameters	South African Power Pool (SAPP)	Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region	Heads of ASEAN Power Utilities (HAPUA)	Central American Interconnection System (SIEPAC) – Ente Operador Regional (EOR)
			Modalities for realizing the ASEAN Power Grid (APG)	
Legal framework	Established through a charter, agreement between operating members	Established through an Inter-Governmental Agreement (IGA) on Regional Power Trade. Regional Power Trade Operating Agreement (RPTOA) also exists	The MoU of HAPUA and the new structure of HAPUA organization has been signed by all member countries	SIEPAC is owned by Empresa Propietaria de la Red (EPR). a public-private JV between the governments of the six countries (through their state-owned transmission utilities), one private-sector company (Endesa of Spain), and the major transmission owners from Mexico and Colombia. Ente Operador Regional (EOR) is the TSO for the SIEPAC line.
Powers	SAPP has powers to impose penalties for non-compliance to its Operating Guidelines	No specific binding powers	No specific binding powers	SIEPAC institutions such as EOR (transmission operator) and CRIE (regulator) has binding jurisdiction limited to the SIEPAC regional transmission infrastructure
Secretariat location	Harare, Zimbabwe	Secretariat is under Greater Mekong Subregion Secretariat, established by Asian	HAPUA's Secretariat is currently in Indonesia. There is a provision	Costa Rica

Parameters	South African Power Pool (SAPP)	Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region	Heads of ASEAN Power Utilities (HAPUA)	Central American Interconnection System (SIEPAC) – Ente Operador Regional (EOR)
		Development Bank (ADB) in Manila, Philippines Meeting venue is provided by the host country for each meeting and the Asian Development Bank (ADB)	for rotation of secretariat for three year periods.	
Funding arrangements	Multilateral Development Bank (MDB) / Development Finance Institutions (DFI) (The World Bank), Swedish International Development Cooperation Agency), external grants from other governments (e.g. Norway), member funding, administration fee from Market Trading Platform	MDB/DFIs (ADB)	MDB/DFIs (ADB), member funding	MDB/DFIs (Inter American Development Bank), member funding, private investment

Parameters	European Network of Transmission System Operators for Electricity (ENTSO-E)	Gulf Cooperation Council Interconnection Authority (GCCIA)	Arab Union of Electricity (AUE)	Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM)
Established	2009	2001	1987	1997

Parameters	European Network of Transmission System Operators for Electricity (ENTSO-E)	Gulf Cooperation Council Interconnection Authority (GCCIA)	Arab Union of Electricity (AUE)	Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM)
Member countries	35 countries (27 EU member countries and 8 non-EU member countries- Albania, Bosnia and Herzegovina, Iceland, Switzerland, Montenegro, FYR of Macedonia, Norway and Serbia	6 GCC countries- Bahrain, Kingdom of Saudi Arabia (KSA), Kuwait, Qatar, UAE and Oman	19 Arab countries - Jordan, UAE, Bahrain, Tunisia, Algeria, Kingdom of Saudi Arabia (KSA), Sudan, Syria, Qatar, Kuwait, Lebanon, Libya, Iraq, Oman, Palestine, Egypt, Morocco, Mauritania and Yemen	13 states (Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia) and the District of Columbia in the United States of America
Type of member entities	Transmission system operators	National power utilities	Arab ministries, electric power utilities (active members); manufacturing companies of electrical equipment in power sector, producing companies (associate members)	Generation owners, Transmission Owners, Electricity Suppliers, End use consumers (e.g. industries)
Key activities / objectives	• Ensuring the secure and reliable operation of the increasingly complex network; • Facilitating cross-border network development and the integration of renewable energy; and	• Realize more cooperation and fostering the links between GCC states in the areas of trade and services in power • Operate the GCC Interconnection	Improving and developing the generation, transmission and distribution of electrical energy in the Arab World, and Improving and coordinating the areas of interest of its members and strengthening the relationship among them	• Ensure the safety, reliability and security of the bulk electric power system. • Create and operate robust, competitive and non-discriminatory electric power markets

Parameters	European Network of Transmission System Operators for Electricity (ENTSO-E)	Gulf Cooperation Council Interconnection Authority (GCCIA)	Arab Union of Electricity (AUE)	Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM)
	• Enhancing the creation of the Internal Electricity Market, IEM.			
Legal framework	Established through legal mandates by the EU's Third Legislative Package for the Internal Energy Market, It is an association established under the Belgian law	A joint stock company subscribed by the 6 GCC countries, whose Articles of Association and By-Laws were approved by Royal Decree	Established as an association with secretariat hosted by National Electric Power Company, Jordan	A Limited liability, non-stock company incorporated in the state of Delaware (United States)
Powers	ENTSO-E can undertake compliance monitoring, and recommend rectification actions.	GCCIA can demand compliance to, and impose penalties with regard to non-compliance of Power Exchange & Trading Agreement (PETA)	No specific binding powers	PJM has legal mandate as an RTO and ISO, conferred to it by FERC
Secretariat location	Brussels, Belgium	Official domicile is in Dammam, Saudi Arabia	Amman, Jordan	Valley Forge, Pennsylvania, USA
Funding arrangements	Member funding, European Commission funding	Member funding	MDB/DFIs	Revenue from services provided to its members – 75% from load serving entities and 25% - from

Parameters	European Network of Transmission System Operators for Electricity (ENTSO-E)	Gulf Cooperation Council Interconnection Authority (GCCIA)	Arab Union of Electricity (AUE)	Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM)
				generation owners, financial marketers, traders

6 Review of international and regional institutions to derive learnings for RTI

Various aspects that that need to be evaluated in order to suggest the institutional structure of the proposed RTI include: the focus areas of the institution; key functions; legal framework; secretariat and the funding arrangements.

The above mentioned parameters have been mapped against the international regional institutions and regional mechanism existing in South Asia in this section, to understand the precedents and derive learnings on treatment of these aspects in such institutions. The subsequent tables depict the mapping for each of the parameters.

6.1 Review of international institutions

6.1.1 Focus areas

While transmission is the key focus area for the identified institutions / arrangements, many of them also deal with aspects relating to system operation and market operation. Well established organizations with a long history such as ENTSO-E, PJM and SAPP can be seen to deal with all these aspects.

Table 16: Mapping of focus areas

Institution / arrangement	Focus areas		
	Transmission Planning and related aspects	System Operation	Market Operation
South African Power Pool (SAPP)	✓	✓	✓
Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region (GMS)	✓		✓
Heads of ASEAN Power Utilities / Authorities (HAPUA)	✓		
Central American Interconnection System (SIEPAC)	✓	✓	✓
European Network of Transmission System Operators – Electricity (ENTSO-E)	✓	✓	✓
Gulf Cooperation Council Interconnection Authority (GCCIA)	✓		✓
Arab Union for Electricity (AUE)	✓		

Institution / arrangement	Focus areas		
	Transmission Planning and related aspects	System Operation	Market Operation
Pennsylvania – New Jersey – Maryland (PJM) Interconnection	✓	✓	✓

From the above, the following can be inferred as learnings for RTI in South Asia:

1. Transmission planning will form the primary focus area for RTI. However, at least in the longer term, the RTI may also expand beyond transmission planning, into system and market operation, unless there are alternate institutions that handle those functions.

6.1.2 Key functions

The international institutions perform a wide variety of functions in the transmission sector starting from the preparation of the Master Plan to carrying out energy accounting calculations. SAPP performs all the key functions and can be a good example to refer to in terms of the activities the proposed RTI can undertake from the transmission perspective for cross border training. SIEPAC actually is an arrangement, where the regional power market (MER) is controlled by the two main bodies – the CRIE (the regulator) and the EOR (the market operator).

Table 17: Mapping of Key functions

Institution / arrangement	Transmission Planning	Network Codes / Standards	Operational coordination	Wheeling tariffs and commercial matters	Energy accounting	Capacity building
South African Power Pool (SAPP)	✓	✓	✓	✓	✓	✓
Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region (GMS)	✓	✓				✓
Heads of ASEAN Power Utilities / Authorities (HAPUA)	✓		✓			✓
Central American Interconnection System (SIEPAC)	✓		✓		✓	

Institution / arrangement	Transmission Planning	Network Codes / Standards	Operational coordination	Wheeling tariffs and commercial matters	Energy accounting	Capacity building
European Network of Transmission System Operators – Electricity (ENTSO-E)	✓	✓	✓			✓
Gulf Cooperation Council Interconnection Authority (GCCIA)	✓		✓		✓	
Arab Union for Electricity (AUE)						✓
Pennsylvania – New Jersey – Maryland (PJM) Interconnection	✓	✓	✓	✓	✓	✓

From the above, the following can be inferred as learnings for RTI in South Asia:

1. Transmission planning, operational coordination, framing of network codes/standards and capacity building forms the most widely undertaken functions of the regional coordination institutions.
2. Additional functions such as commercial matters and energy accounting becomes applicable in some cases, due to the specific nature of regional power pool arrangement.

6.1.3 Legal framework

The table below depicts the legal framework under which the institutions are established. Most of the international institutions are either established through agreements (between the member countries' governments or the member utilities).

Table 18: Mapping of legal status

Institution / arrangement	Entity created under Intergovernmental Agreement / MoU	Entity created under Inter utility Agreement / MoU	Entity created as an Association through law	Company / Corporation / Joint Venture	Voluntary organization (like society/trust) under the laws of the host country
South African Power Pool (SAPP)*		✓			

Institution / arrangement	Entity created under Intergovernmental Agreement / MoU	Entity created under Inter utility Agreement / MoU	Entity created as an Association through law	Company / Corporation / Joint Venture	Voluntary organization (like society/trust) under the laws of the host country
Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region (GMS)	✓				
Heads of ASEAN Power Utilities / Authorities (HAPUA)		✓			
Central American Interconnection System (SIEPAC)				✓	
European Network of Transmission System Operators – Electricity (ENTSO-E)			✓		
Gulf Cooperation Council Interconnection Authority (GCCIA)				✓	
Arab Union for Electricity (AUE)**					✓
Pennsylvania – New Jersey – Maryland (PJM) Interconnection				✓	

** In case of SAPP, there was also an Inter-Governmental Memorandum of Understanding which enabled the establishment of SAPP. The Inter-Utility Memorandum of Understanding established SAPP's basic management and operating principles.*

*** In case of Arab Union for Electricity (AUE), the genesis lies in intergovernmental discussions, facilitated through Second Arab Energy Council, held in Qatar on March 1982.*[109]

In addition to the above, there are also examples of entities that are created as voluntary organizations (such as society/trust), such as the case of North American Electricity Reliability Council (NERC), Midcontinent Independent System Operator (MISO) and New England ISO. In the US context, they are termed as non-profit entities. That does not necessarily mean other entities have a profit motive. There are examples such as PJM Interconnection, which though established as a corporation, is profit neutral, meaning total revenues and expenses must equal each other over the long term. Any excess fees collected by PJM is paid back to its members.[110] A few additional examples

of voluntary organizations include the Council of European Energy Regulators, Northeast Power Coordinating Council, Midwest Reliability Organization, International Civil Aviation Organization, SAARC Chambers of Commerce and Industries.

From the above, the following can be inferred as learnings for RTI in South Asia:

1. Regional organizations are typically formed through intergovernmental agreements / MoUs, inter utility agreements / MoUs, through separate laws, as voluntary organizations, or as a company / corporation / Joint Venture.
2. Many of the major international institutions for cooperation in electricity transmission has an underlying agreement signed by participant Governments / utilities. For example, RPTCC in GMS. However, in many cases, there are also other relevant regional agreements / grouping, and therefore institutions can be created even by signing a MoU.
3. Formation of a regional entity under an inter-utility Agreement/MoU is another common example, though it does not necessarily mean that the same has happened without some level of governmental involved. In many such cases, there are other relevant regional agreements / grouping, which facilitated the creation of such entities. For example, SAPP's formation through inter-utility MoU is supported by the overall South African Development Committee (SADC) framework and an intergovernmental MoU for its establishment. HAPUA is established within the overall ASEAN framework.
4. In many cases even the formation of the regional institution in the form of a Company also has intergovernmental agreement/support. For instance, GCCIA was formed under the overall framework of GCC, in which the GCC Charter was signed together by the member countries. The Central American Interconnection has its genesis in an intergovernmental framework agreement, known as the Marco Treaty.
5. Regional bodies directly created under a law, such as the case of ENTSO-E which is created as an Association as directed under European Commission directives, requires a regional legal framework also. For example, in European Union, the directives of European Commission and the laws of European Parliament will have to be complied by the member countries. Due to the absence of such binding regional arrangements, this model is not relevant for South Asia.
6. Entities can also be created as voluntary associations (such as societies/trusts in India). An example is the case of Arab Union for Electricity, which started as the Arab Union of Producers, Transporters and Distributors of Electricity (AUPTDE). There are also additional example such as North American Electricity Reliability Council (NERC).
7. **There are historical precedents in entities traversing from loosely formed to more formal arrangements, as it matures. A case in example was PJM which evolved from an unincorporated association, to a Limited Liability Corporation. Another example is Nordel, which was established 1963 as an advisory association of leading persons from the electricity industries of Denmark, Norway, Sweden, Finland and Iceland. Nordel changed itself from to an 'association of Transmission System Operators' in Nordic countries by adopting a new set of bylaws in 2000. Yet another example is VLPGO (Very Large Grid Operators Association), more recently known as GO15. Though the association was created in 2004, it became an incorporate not-for-profit association only in 2009.**

8. Regional entities are not necessarily exempt from the laws of the host country where the secretariat is located. However, they may choose to obtain a few exemptions, through signing of a Headquarters Agreement or similar arrangements with the host country.

6.1.4 Secretariat location

The table below shows the type of the Secretariat location, that is whether it is a permanent one or rotating. Among the international institutions only the HAPUA (the lead coordination body of the APG) has a rotating Secretariat, wherein there is a provision to rotate the secretariat every three years.

Table 19: Mapping of location of the Secretariat

Institution / arrangement	Permanent Secretariat	Rotating Secretariat
South African Power Pool (SAPP)	✓	
Regional Power Trade Coordination Committee (RPTCC) in GMS	✓	
Heads of ASEAN Power Utilities / Authorities (HAPUA)		✓*
Central American Interconnection System (SIEPAC)	✓	
European Network of Transmission System Operators – Electricity (ENTSO-E)	✓	
Gulf Cooperation Council Interconnection Authority (GCCIA)	✓	
Arab Union for Electricity (AUE)	✓	
Pennsylvania – New Jersey – Maryland (PJM) Interconnection	✓	

** Even in the case of HAPUA, even though there is an enabling provision for rotating secretariat, in practice, the secretariat seems to have continued with Indonesia.*

From the above, the following can be inferred as learnings for RTI in South Asia:

1. A permanent secretariat is the most widely utilized institutional mechanism for regional institutions for electricity.

6.1.5 Funding

International institutions rely on a variety of options such as MDB/DFI funding, funding from member Governments or for example the European Commission in the case of ENTSO-E and other government's funding (for example, Norwegian government funding for SAPP). Financing can also be through fees from the power market participants and consumers.

Table 20: Mapping of funding

Institution / arrangement	MDBs/DFIs	Member Funding	Government grants	Fee from market participants
South African Power Pool (SAPP)	✓	✓	✓	✓
Regional Power Trade Coordination Committee (RPTCC) in Greater Mekong Sub region (GMS)	✓			
Heads of ASEAN Power Utilities / Authorities (HAPUA)	✓	✓		
Central American Interconnection System (SIEPAC)	✓	✓		
European Network of Transmission System Operators – Electricity (ENTSO-E)		✓		
Gulf Cooperation Council Interconnection Authority (GCCIA)		✓		
Arab Union for Electricity (AUE)	✓			
Pennsylvania – New Jersey – Maryland (PJM) Interconnection				✓

From the above, the following can be inferred as learnings for RTI in South Asia:

1. Funding from MDB/DFIs could play a key role in the supporting the institutions, even while some form of member funding may also be present.

6.2 Review of possibility of housing RTI within an existing institution in South Asia

Within South Asia, there are various regional cooperation mechanisms on electricity, though many of them are not necessarily related to transmission. An analysis of their suitability to house SAFTU within them is provided below.

Table 21: Review of possibility of housing RTI within an existing institution in South Asia

Institution / arrangement	Advantages	Disadvantages
SAARC – Directly under SAARC, or under its existing institutions such as SAARC Energy Center or SAARC Council of Experts of Energy Regulators – Electricity (CEERE)	▪ Easier acceptance among many South Asian countries	▪ Political acceptance for SAARC is currently low, especially considered that SAARC summit has not been held since 2014
BIMSTEC – Directly under BIMSTEC, or as part of BIMSTEC Grid Interconnection Coordination Committee (BGICC)	▪ Easier acceptance among many South Asian countries	▪ BIMSTEC will have its own BIMSTEC Grid Interconnection Coordination Committee (BGICC) which will have some of the functions that are common with RTI. Therefore BIMSTEC may not be able to host two organizations with similar objectives. ▪ BIMSTEC arrangements cover Myanmar and Thailand also.
South Asia Forum of Infrastructure Regulation (SAFIR)	It may be faster to incorporate a regional cooperation entity as part of SAFIR	SAFIR's activities are very limited, mostly focusing on infrastructure regulations and knowledge sharing and capacity building in related aspects. It may not be best suited to support a technically involved organization/arrangement such as SAFTU.

The key observation is that none of existing regional coordination mechanisms for electricity in South Asia are suited well to house RTI within itself. In case of SAARC, there is political uncertainty related to it. BIMSTEC covers a separate grouping of countries, and also has its own BGICC proposed as part of it. The proposed activities of RTI will also not match with the nature and objectives of SAFIR. It is forum for infrastructure regulators, and not transmission utilities. SAFIR is also not restricted to electricity sector. It may also be noted that regulation is not a key focus area for RTI. Thus, the proposed functions of RTI cannot be brought under SAFIR.

Therefore, in the current circumstances, RTI may have to be considered as a separate entity.

7 Options for setting up a Regional Technical Institutional (RTI) mechanism in South Asia

There are multiple cross border transmission interconnections existing between the different countries and enable the cross border electricity trade to a significant quantum. At present all such interconnections are applicable at bilateral level between the networks of two adjacent countries, though in time to come interconnection between the two distant countries, passing through the network of an intermediatory country are also likely to be there. This study is being undertaken to develop a strategy for creation of a regional technical institution (RTI) / body of transmission utilities in South Asian countries, which may act as a platform for cross cutting deliberations and promoting excellence in the field of integrated regional transmission network in the region. The regional technical institution shall also support and render platform for enabling harmonization of guidelines and operating codes incidental to cross border interconnections, through discussions and consensus building and rendering capacity building and training in the areas of network development and operation, RE integration and knowledge sharing etc. While deciding the constitution of such a regional institution, it is important that it has a well-defined legal framework and operating structure and its roles and responsibilities are clearly mapped in line with the main objective of developing such a regional technical institution/body.

The key decision points for the formation of such a new entity will be:

- Who should be the members and what type of entities should it comprise?
- What should be the key objectives and functions?
- What should be the legal framework?
- What should be the organizational structure?
- What should be the nature of the Secretariat and its location?
- What should be a sustainable funding arrangement for the institution?

The subsequent sub-sections explore options to the above points, utilising the learnings from the existing regional mechanism and international experience.

7.1 Member countries and entities

7.1.1 Member countries

The region has witnessed both bilateral as well as multilateral initiatives for promotion of cross border electricity trade in the region. Relationships between countries vary across the region and continue to change over time. Participation in any regional platform is driven by political appetite, strong internal consensus to forge partnership with other countries, potential benefits to country through such regional platforms.

In the current context, it is reasonable to expect that all the willing countries in South Asia can participate in the proposed SAFTU. Considering the existing interconnection (though at a lower voltage) between India and Myanmar, Myanmar may also be allowed to participate as an Associate Member, if the country desires so.

7.1.2 Member entities

Key learnings from international experience	There is a variation in the membership of various regional bodies. Some of them consists of Transmission System Operators whereas some have electricity utilities as the member utilities which also undertake transmission as one of the functions. Representatives of ministry and regulator do not seem to be key participant in the technical bodies.

Key observations from stakeholder response	Stakeholder view the participation of transmission utilities and system planners as the most relevant for SAFTU

Member entities shall represent the level and type of entities becoming member of SAFTU. The development of connectivity infrastructure is a long term and complex initiative and involves multifaceted considerations. There are multiple entities active in power sector in each country and their level of involvement also varies. It is important to identify each of such entities and analyse the relevant role each of these entities can play from the perspective of SAFTU. In order to provide representation from right and adequate quarters, the potential stakeholders are grouped under two layers:– Executive Council Members and Participants (Members under different Groups).

1. Executive Council Members are the Member Entities that come together to set up SAFTU and provide representation in the forum as designated by the respective country.

   Associate Member is a special category of such Member Entities, which is set aside for countries such as Myanmar, wherein though they are not part of South Asia, they may still like to participate in SAFTU on a voluntary basis due to the presence of cross border interconnections.

2. Participant Entities will be involved in the activities of SAFTU through their involvement in various Groups of SAFTU under the category Group Members.

Since the primary and overall objective of the SAFTU is to serve as a platform for cross cutting deliberations and promotion of excellence for the transmission utilities, the transmission utilities will be the key stakeholders, undertaking almost all of the functions the SAFTU will focus on. Selecting transmission utilities as the Member Entities for SAFTU shall facilitate relatively quicker consensus amongst member countries for formation of SAFTU, given the technical nature and transmission focus of the institution. However as far as choice of particular person from each country is concerned, the nomination shall be by the respective government.

As SAFTU is primarily the forum of transmission utilities, the national level transmission utility in each member country, along with transmission planning agencies (if different from transmission utility) can be the Executive Council Members of SAFTU.

In addition to the Executive Council Member Entities as described above, the Participant Entities (Group Members) could be:

- **Transmission utilities (other than national transmission utility) who operate the cross border network infrastructure**
- **National Load Despatch Centre / System Operator**
- **Representation from the respective Government Department**
- **Any other relevant entity, if required** *(For example, in some cases the relevant Regional Load Dispatch Center in India will also be a key stakeholder. Another example is the invitation of experts from research institutions as observers)***.**

As stated earlier, the core activities of SAFTU will be managed by the Executive Council Member entities, and in taking the key decisions and undertaking the functions of the SAFTU, they shall be supported by the Participant entities through the respective Groups.

7.2 Key objectives and functions

With expected increase in electricity trade in South Asia, one of the focus areas shall be enhancing discussions and deliberations on technical issues related to transmission infrastructure. Lack of such regional discussions for addressing such issues can impact the timely implementation of transmission network as well as leveraging benefits of regional trade.

Review of international experience indicates that transmission remains one of the focus areas for the regional institutions. The proposed SAFTU should focus on addressing the institutional gap for resolving technical issues related to transmission development for CBET.

Key learnings from international experience	Transmission planning, operational coordination, framing of network codes/standards and capacity building forms the most widely undertaken functions of the regional coordination institutions, based on international examples. This includes framing of network development / expansion plans, short, medium and long term power scenario / outlooks, common network codes, information standards, and knowledge sharing.
Key observations from stakeholder response	The stakeholders prefer the SAFTU to focus on support and facilitation of the following activities: • Regional *harmonization of grid codes, interconnection standards and protection standards*; • *Model guidelines* for Cross Border Electricity Trade (CBET); • *Regional planning* of cross border transmission networks; • *Consensus building* amongst different participating countries towards development and advancement of cross border transmission network; and • *Consensus building* amongst different participating countries towards smooth operation of CB transmission network and enhancement of cross border trade.

7.2.1 Proposed vision and mission for SAFTU

Mission and vision statements of a few international coordination bodies in transmission are provided below.

Table 22: Mission and vision statements of other entities

Entity	Vision	Mission
ENTSO-E	ENTSO-E's vision is to become and remain the focal point for all European, technical, market and policy issues related to TSOs, interfacing with the power system users, EU institutions, regulators and national governments. ENTSO-E's work products contribute to security of supply, a seamless, pan-European electricity market, a secure integration of renewable resources and a reliable future-oriented grid, adequate to energy policy goals.	Being the body of transmission system operators of electricity at European level, ENTSO-E's mission is to promote important aspects of energy policy in the face of significant challenges: ▪ Security - it pursues coordinated, reliable and secure operations of the electricity transmission network. ▪ Adequacy - it promotes the development of the interconnected European grid and investments for a sustainable power system. ▪ Market - it offers a platform for the market by proposing and implementing standardized market integration and transparency frameworks that facilitate competitive and truly integrated continental-scale wholesale and retail markets.

Entity	Vision	Mission
		Sustainability - it facilitates secure integration of new generation sources, particularly growing amounts of renewable energy and thus the achievement of the EU's greenhouse gases reduction goals.
PJM Interconnection	▪ To be the electric industry leader – today and tomorrow – in reliable operations, efficient wholesale markets, and infrastructure planning.	▪ As the primary task, to ensure the safety, reliability and security of the bulk electric power system. ▪ Create and operate robust, competitive and non-discriminatory electric power markets. ▪ Understand customer needs and deliver valued service to meet those needs in a cost-efficient manner. Achieve productivity through the efficient union of superior knowledge workers and technology advances.
South African Power Pool (SAPP)	▪ Facilitate the development of a competitive electricity market in the SADC region. ▪ Give the end user a choice of electricity supplier. ▪ Ensure that the southern African region is the region of choice for investment by energy intensive users. Ensure sustainable energy developments through sound economic, environmental and social practices.	▪ Aim to provide the least cost, environmentally friendly and affordable energy and increase accessibility to rural communities.
Ente Operador Regional (EOR) (TSO for Central American Interconnection)	To be a world-class operating entity, recognized for its commitment to innovation, sustainability and excellence in the integration of electricity markets	Regional energy integration by facilitating the safe, economical and sustainable energy supply of the inhabitants of Central America (translation)

Due to the nature of the above organizations, and the overall regional policy objectives, the mission and vision statement can be observed as varying. For example, ENTSO-E's mission and vision statements are reflective of their priorities of market integration, and renewables. Similarly, the focus for Central American Interconnection is regional energy integration.

For SAFTU, the key priorities may be taken as facilitating and accelerating cross border electricity trade and energy integration. Considering the proposed objectives, roles and functions, the following vision and mission statements may be considered for SAFTU.

Vision

To be a regional centre of excellence for providing a platform for crosscutting deliberations, sharing of best operational practices and support towards the development and operation of the transmission system, incidental to the cross border interconnections in the South Asia region and with the nearby regions.

Mission

To act as a regional technical institution to facilitate and render support towards harmonised transmission system development and operation, incidental to cross border interconnections, leading to the development of South Asia Power Grid and also to venture towards energy integration of South Asia region with nearby regions such as South East Asia, Central Asia and Middle East.

The above can be further refined through discussions with regional stakeholders. The vision and mission of SAFTU will have to be achieved through accomplishment of the following objectives and functions of SAFTU.

7.2.2 Key Objectives

The key objectives for SAFTU can be as follows:

- Act as a platform for crosscutting deliberations and exchange of ideas on the subjects related to network development and operation in South Asian Grid;
- Dissemination of knowledge towards deployment of advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing and integrating diverse sources of energy available in the South Asia region;
- Provide a platform for enabling harmonisation of guidelines and operating codes through discussions and try to build consensus through discussions on the issues of common interest;
- Undertake research, technical studies, and come up with white paper and discussion briefs in relevant areas of integrated system planning and network development;
- Conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, towards promoting excellence and greening the regional grid;
- Promote and render assistance towards knowledge sharing, capacity building & training in system planning, network development, RE integration, etc.

7.2.3 Proposed functions

Based on the learnings from international experience, stakeholder responses, and the specific nature of South Asia, the roles and functions of the proposed SAFTU may be designed to cover elements related to sharing of ideas and best operational practices, consensus building, and capacity building. The proposed SAFTU shall focus and render support on technical issues related to development and operation of the transmission system incidental to cross border interconnections. SAFTU shall also render support to other institutions (policy makers, regulators, system operators etc.) by providing technical inputs on transmission system development and operation.

The key functions of SAFTU are described below.

1. Act as a platform for crosscutting deliberations and exchange of ideas on the subjects related to network development and operation in South Asian Grid

In order to achieve consensus amongst the member countries on various aspects related to the mandate of SAFTU, it should undertake activities to ensure regular communication amongst member countries, developing work plan and ensuring regular meeting. SAFTU should act as a platform for consensus building with the following activities:

- Act as a platform for crosscutting deliberations and technical support towards the development of regional plans to offer a more optimal network and system configuration incidental to cross border interconnections in South Asia;
- Arrange regular interactions among the transmission utilities and other Member and Participant Entities;

- Organize annual meetings and develop annual agendas for these regional interactions; and
- Organize specific need based events/meetings to help bringing the regional stakeholders on a common platform.

2. Dissemination of knowledge towards deployment of advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing and integrating diverse sources of energy available in the South Asia region

Larger regional systems typically allow sharing of common flexible reserves for better integration of renewable energy. SAFTU's efforts on discussions relating to regional plans could consider the RE integration and system balancing aspects also, which could then enable system operators to take appropriate actions for RE integration,

More importantly, SAFTU can facilitate knowledge dissemination on advanced and efficient networks in the region, particularly keeping in view the need towards renewable energy integration and grid balancing. Different South Asian countries had varied successes and learning related to these aspects, which can be presented for the benefit of all the Members through the SAFTU platform.

3. Provide a platform for enabling harmonisation of guidelines and operating codes through discussions and try to build consensus through discussions on the issues of common interest

RTI can offer a platform for discussions relating to harmonization of guidelines and operating codes through discussions and consensus building. In an interconnected network, the core network guidelines and operating codes in each country will need to be compatible with each other. SAFTU can offer a platform for enabling such harmonisation of guidelines and operating codes through discussions and consensus building.

SAFTU can undertake a leading role in providing inputs to policy makers and regulatory bodies on harmonization of technical procedures to ensure smooth implementation. Currently such initiatives are undertaken mostly on bilateral basis. SAFTU can play a role in the following:

- Facilitate discussions on harmonization of guidelines and operating codes such as those relating to;
    - Network operational practices and outages;
    - Measures for improving network security and reliability; and
    - Metering arrangements.
- Provide platform for discussions relating to system protection, including relay settings, islanding etc.;
- Provide platform for discussions relating to communication systems; and
- Provide platform for discussions relating to cyber security measure.

4. Undertake research, technical studies, and come up with white paper and discussion briefs in relevant areas of integrated system planning and network development

There could be many common areas where transmission utilities may prefer to undertake studies, which if undertaken at a regional level, involving experts from across the globe could offer a better utilization of resources. For example, studies relating to topics such as integrated system planning, cyber security in transmission network, common communication standards, environmental impact analysis, resource sharing, disaster management etc. could be relevant to all the regional participants. In such matters, SAFTU can undertake research, technical studies, and come up with white paper, discussion briefs, issue briefs, and discussion notes.

Activities under research and studies may also include maintaining information systems to record and maintain monthly cross border energy transfers, and network constraints in the region.

5. Conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, promoting excellence and greening of the regional grid

SAFTU will play a positive and enabling role by conducting workshops and conferences at regular intervals, involving the concerned stakeholders from different countries in South Asia, on the aspects related to sharing of planning and operational best practices and promoting excellence and greening of the regional grid. SAFTU could play a facilitating role in increased integration of renewable energy and system balancing. Larger regional systems typically allow sharing of common flexible reserves for better integration of renewable energy.

SAFTU may also target collaborating with other similar institutions at regional level as well as at international level.

6. Promote and render assistance towards knowledge sharing, capacity building & training in system planning, network development, RE integration, etc.

The functions carried out by the transmission utilities are similar and there is huge scope for synergy and collaboration. Further the functions discharged by such utilities require a lot of pooling of technical expertise and creation of an ecosystem that adapts with increasing CBET transaction. Each transmission utility in the region is operating under different level of power market maturity and shall require regular capacity building to ensure CEBT at regional level is not impacted by the same. It will beneficial to leverage the technical expertise available at utilities in different member countries. SAFTU shall undertake activities to enhance capacity building in the region on issues aligned with its mandate and can cover:

- Knowledge sharing, high quality Capacity Building & Training in System planning, network development, RE integration, etc.;
- Arrange workshops for experience sharing and consultations; and
- Coordinate the training of members' staff to improve the region's knowledge of cross border trading operations.

7.3 Legal framework

The legal status is an important element for consideration and shall also depend upon the level of political support available for setting up such an institution. The selection of the possible option on legal status shall require due consideration for aspects related to applicable law, ability to raise funding, operating flexibility and ability to meet its objectives.

Key learnings from international experience	Regional organizations are typically formed through intergovernmental or inter utility agreements / MoUs (SAPP, HAPUA, RPTCC), through separate laws (ENTSO-E), or as a company / corporation / Joint Venture (PJM Interconnection LLC, GCCIA, SIEPAC). There are also organizations that are established as associations. For example, NERC, New England ISO and Midcontinent ISO are established as 'Non Profit' organizations. However, this need not imply that other arrangements are 'For Profit' arrangement. Rather, the 'Non Profit' designation is equivalent to the society/trust model seen in South Asia. An underlying 'inter-governmental/inter-utility' agreement / MoU is a common way to provide a foundation for the establishment of regional institution.

	However, there are historical precedents in case of a number of entities forming from loosely formed to more formal arrangements, as it matures. A case in example was PJM which evolved from an unincorporated association, to a Limited Liability Corporation. Another example is Nordel. Nordel was established 1963 as an advisory association of leading persons from the electricity industries of Denmark, Norway, Sweden, Finland and Iceland. In 2000, it changed itself from an 'association of persons' to an 'association of Transmission System Operators' in Nordic countries by adopting a new set of bylaws. [111] Another example is VLPGO (Very Large Grid Operators Association), more recently known as GO15. Though the association was created in 2004, it became an officially incorporated not-for-profit association only in 2009.[112]
Key observations from stakeholder response	The stakeholders prefer the SAFTU to be an entity created under SAARC/BIMSTEC, or a body specifically created for this purpose under an intergovernmental agreement. However, it may be noted that the activities of SAARC have been very limited in the past years, due to geopolitical situation, resulting in even the biennial SAARC summit not being held for more than six years. BIMSTEC is supposed to constitute its own BIMSTEC Grid Interconnection Coordination Committee (BGICC). A separate intergovernmental agreement for establishment of SAFTU can be an option in the longer term, though the same may take substantial time.

Analysis about the options for legal framework

Based on the key learnings from international examples, and examples of regional cooperation bodies relating to energy sector in South Asia, and the specific nature of South Asia, the legal identity of the proposed SAFTU can be adopted from among the options shown below.

Table 23: Options for legal framework

Options	Pros	Cons	Ease of implementation
1. Establish through/under Intergovernmental or inter-utility arrangements (e.g. RPTCC, International Solar Alliance, HAPUA, SAPP)	• Full-fledged legal status • Decisions being taken in a collective manner are likely to be implemented without much difficulty • Can be self-sufficient and can devise ways & means to collect funds	• Requires high level of commitment at Government level	• Low • Significant consensus building is required for all the member countries to sign such binding agreements, which can delay the establishment of the SAFTU • Under the current situation, formation of

Options	Pros	Cons	Ease of implementation
			SAFTU on these principles may be challenging
2. Incorporate as a company / corporation through Articles of Association, By Laws, etc. (e.g. PJM Interconnection, SIEPAC, GCCIA)	• Separate legal status • Authority and scope can be defined in the articles of association and by laws • Operational flexibility for investments and funding • Flexibility in man-power hiring	▪ High level of management oversight and compliance as per laws ▪ In many cases, the formation itself is initiated through an overall intergovernmental agreement / intergovernmental political grouping. For example, GCCIA traces its genesis to a common decision of the GCC countries for its establishment.	▪ Medium ▪ More suited when there is a dedicated regional infrastructure, such as in the case of GCCIA and Central American Interconnection.
3. Incorporate as a voluntary organization (like society/trust) under the laws of host country (e.g. Council of European Energy Regulators, Northeast Power Coordinating Council, Midwest Reliability Organization, International Civil Aviation Organization, Arab Union for Electricity, SAARC Chambers of Commerce and Industries)	• Can be implemented, after completing basic legal formalities • Separate entity status • Access to grants. Some non-profits are eligible to receive public and private grants, making it easier to get operating capital.	▪ There may be legal hurdles relating to registration, foreign funding etc. ▪ Restrictions are there for activities and foreign funding. For example, in India, societies can be established only for the following purposes: "promote fields of arts, commerce, science, research, education, sports, charity, social welfare, religion, environment protection, or other similar objectives." ▪ Limited authority towards enforcing decisions.	▪ Medium ▪ Can be considered, subject to laws and processes of the host country
4. Establish as an Association (e.g. SAFIR, Forum of Load Despatchers, earlier form of PJM – PJM Interconnection Association, earlier form of GO15 – Very Large Power Grid Operators Association)	• Quick and easier to implement • Appropriate for limited mandate • Limited compliance requirement	• No separate legal status • Activities may get restricted to advisory nature with no authority	▪ High ▪ Can be considered for the initial period of setting up of SAFTU, after which the organization can transition to more formal nature under options 1-3 depending on the consensus among member utilities.

Based on the above-mentioned options, following can be inferred while deliberating upon the legal framework of SAFTU:

- Option 1 requires a high level of governmental commitment. The intergovernmental arrangement could be in the form of an agreement or a MoU. In many cases, the intergovernmental agreement is also succeeded by a 'Headquarters Agreement' signed with the host country of secretariat of the newly created institution. Example: International Solar Alliance (ISA) or International Renewable Energy Agency (IRENA). There are also cases where an Intergovernmental arrangement is succeeded by an inter-utility arrangement, as is seen in the case of SAPP. If governmental commitment can be obtained, SAFTU can be set up as an entity established under intergovernmental arrangement. Even a few binding powers can be prescribed for SAFTU under such an option. However, owing to the substantial time required for this process, the option may not be viable in the short term.
- Option 2 is more suited to regional pools with clearly identifiable regional transmission infrastructure, or when the regional body will be highly independent. This is not the case with the current role envisaged for SAFTU. Even otherwise, this option also requires substantial governmental support that would enable the member utilities to form part of the entity. For example, GCCIA traces its genesis to a common decision of the GCC countries for its establishment.
- Under Option 3, the operational flexibility in terms of activities that can be undertaken, compliance requirements, and involvement of foreign nationals may create difficulties. However, the model can be considered if the role of entity is viewed primarily as a discussion platform.
- Option 4 is quite similar to option 3, but does not adopt a formal registration as a society/trust. Instead, it remains as an 'Association of Persons'. However, if it starts collecting the funds in order to provide service to the members, the entity may still have to register with other authorities for tax, foreign exchange receipt etc. For example, SAFIR has its own income tax Permanent Account Number. However, even such registrations may not be required, if it does not collect any funds from its members and whatever secretariat support etc. is required is provided by one of the transmission utility and support from MDB/DFIs.

Table 24: Analysis of options for legal status of SAFTU

Options	Options 1 : Legal identity provided through Intergovernmental arrangements	Option 2: Incorporate as a company / corporation	Option 3: Incorporate as a voluntary organization (like society/trust) under the laws of host country	Option 4: Unincorporated association
Time taken to set-up	High	Medium	Medium	Low
Required legal commitment	High	High	Medium	Low
Ease of implementation	Low	Low	Medium	High

Therefore, the legal framework would upon depends on the kind of intergovernmental support that is available, the time period which can be allowed for its incorporation and the urgency of its incorporation.

In the context of SAFTU for South Asia, a formal structure under options 1 will allow it to cover the full extent of functions and activities. However, considering the complex process and extra-ordinarily large time which may be required to obtain consensus on an intergovernmental agreement, option 4 may be considered as a transitional option.

During the initial phase, SAFTU can be created as a loosely formed Association and can act as an advisory and a facilitating body, with the member entities trying to reach at the decisions through discussions and consensus building and implement and comply with the recommendations on voluntary basis. In the longer term, switching to more formal formats, can be explored.

During the current period such an approach is most pragmatic and is also desirable in order to set-up the association and start the activities in an expeditious manner. There is precedence for such evolution, as seen in the case of PJM, Nordel and GO15. PJM evolved from an unincorporated association, to a Limited Liability Corporation. Nordel, which was established in 1963 as an advisory association of leading persons from the electricity industries of Denmark, Norway, Sweden, Finland and Iceland, changed itself from to an 'association of Transmission System Operators' in Nordic countries by adopting a new set of bylaws in 2000. Another example is VLPGO (Very Large Grid Operators Association), more recently known as GO15. Though the association was created in 2004, it became an incorporate not-for-profit association only in 2009.

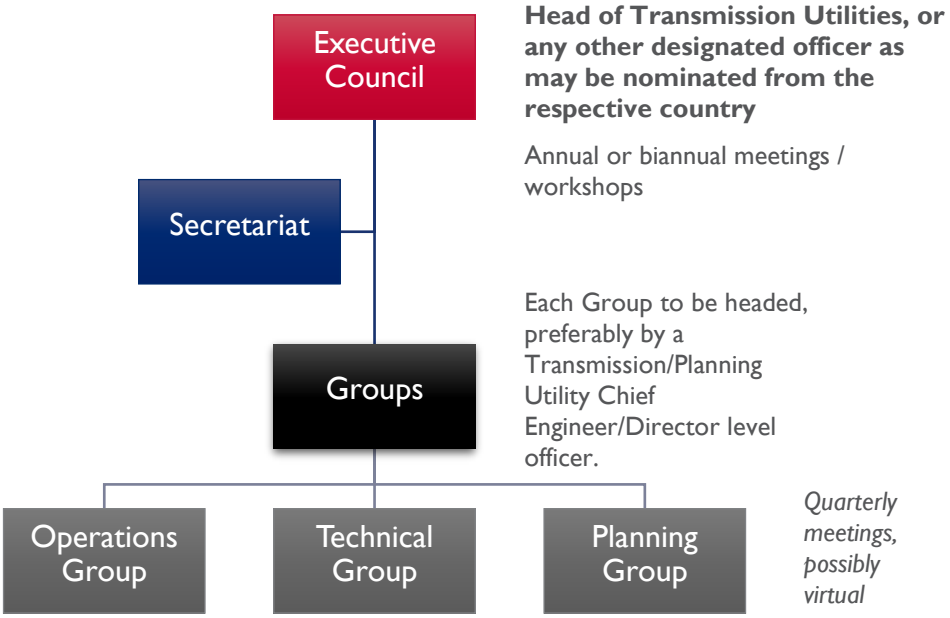
7.4 Organisational structure

7.4.1 Structure

Key learnings from international experience	There is a wide variety of organizational structure among the regional coordination bodies. PJM primarily has a board structure, whereas HAPUA is formed of councils and committees, while RPTCC has working groups. ENTSO-E has an Assembly, Board, Committees and other groupings. SAPP has a well-defined structure, with function wise sub-committees including a separate coordination centre, all reporting to the management committee.
Key observations from stakeholder response	A committee consisting of representatives from different countries, with or without a permanent secretariat, is the preferred organizational structure among regional stakeholders.

The proposed structure of the SAFTU is as illustrated below.

Figure 35: Proposed structure of the SAFTU



The SAFTU Executive Council may preferably consist of the heads of the transmission utilities or any other designated officer as may be nominated from the respective country, and also the representatives from transmission planning agency. The Executive Council will be responsible for taking the technical and executive decisions related to SAFTU and shall provide strategic directions and guidance, prioritize steps and goals that need to be taken, set timelines for such actions, and monitors their progress.

Different Groups shall render the inputs and support to the Executive Council, regarding implementation of the plan of action and shall examine and discuss the subjects in depth. The Secretariat and the Groups will report to the Executive Council. Each Group can be headed by a Chief Engineer/Director level official of the transmission/planning utilities who will serve as the Chairperson for the Group. Meanwhile the Member Secretary at the Secretariat can also act as the Member Secretary for the Groups.

7.4.2 Groups

The functions identified for SAFTU under 7.2.3 can be divided among the planning, operations, and technical Groups. The Participant Entities would also get involved in these Groups along with the Member Entities. Some of the illustrative activities to be undertaken by these Groups are described below. These will be achieved through activities such as regular discussions, undertaking research, compiling study reports and discussion papers, organizing conferences / workshops and organizing training sessions.

Planning Group

Discussions, deliberations and knowledge sharing related to the following topics:

- Development of integrated regional transmission system incidental to cross border interconnections
- Evaluation of improvement required for the proper operation of the interconnected system.
- Establishment and updating of common planning standards.
- Short term, medium term and long term forecasts / outlooks.

Operations Group

Discussions, deliberations and knowledge sharing related to the following topics:

- Operational aspects of transmission network including monitoring of its safety, security and reliability;
- Operating procedures for the interconnected power system and monitoring of system performance against set criteria.
- Regional regulatory mechanisms on matters relating to cross border electricity transmission and trade.

Technical Group

Discussions, deliberations and knowledge sharing related to the following topics:

- Development of common technical standards and network codes/grid harmonization codes in coordination with any regional regulatory mechanisms, if available. For example, HAPUA of the ASEAN Power Grid has successfully cooperated with the Asian Development Bank (ADB) to develop technical standards. In the absence of regional regulatory mechanisms, the recommendations can be suggested to the national regulators.
- Standards or guidelines for system protection, including relay settings, islanding etc.
- Communication system standards.
- Environmental impact.
- Resource sharing.

- Disaster management.
- Guidance on implementation of cyber security measures by member entities.
- Guidance on measuring operating reserves, transmission constraints etc.
- Integration of variable renewable energy on the power grid

7.4.3 Key meetings

SAFTU should have a well-defined schedule of key meetings among all the required levels of officials. This will ensure more frequent discussions among the members and resolution of issues. The follow key meetings can be suggested.

Table 25: Proposed key meetings

Meeting type	Frequency/schedule	Participants
Executive Council meetings	At least once a year	SAFTU Executive Council members
Group meetings	Quarterly (can be done through virtual platforms)	Working level – Groups and the Secretariat

7.5 Secretariat

7.5.1 Location of secretariat

Key learnings from international experience	Most of the international regional bodies have permanent secretariats. However, HAPUA's secretariat rotates between each member country every three years. The present Secretariat is hosted by Indonesia.
Key observations from stakeholder response	The stakeholders are comfortable with either of the two options - permanent and rotating secretariat.

For housing of secretariat, the following two options can be considered:

Option 1: Permanent secretariat – The proposed SAFTU can have a permanent Secretariat which can be hosted by the transmission utility of a willing country.

Option 2: Rotating secretariat – The Secretariat can be hosted by each of the member countries turn by turn.

The below illustration summarises the pros and cons of both the options.

Table 26: Pros and cons of permanent and rotating Secretariat

Options	Pros	Cons	Ease of implementation
Permanent secretariat	▪ Assists in maintaining continuity for activities and staff	▪ Host country may have to continue to bear higher efforts and costs	▪ High ▪ This is the easiest option to implement if a

Options	Pros	Cons	Ease of implementation
	▪ Only one time effort required for initial set up	to maintain the secretariat, in comparison to other countries ▪ Does not give opportunity to other countries to host the secretariat	consensus on location can be arrived at
Rotating secretariat (every 3 to 5 years)	▪ Provides a chance to all the countries to support SAFTU ▪ Provides a sense of increased ownership and responsibility ▪ More equitable sharing of costs	▪ Change in staff who manage the secretariat could affect continuity of various initiatives	▪ Low ▪ Difficult to manage the logistics for a rotating secretariat

The willingness and the financial means of the members countries will to a large extent decide the type of Secretariat, since setting it up and maintaining involves substantial cost. The decisions and agenda of meetings are to a large extent determined by the Secretarial staff.

In the case of a rotating Secretariat, the follow-up post previous meetings and other such activities related to past events might lose continuity as illustrated above. This is also a not widely used options, as almost all the regional bodies analysed in this study have permanent secretariats.

Meanwhile, setting up a dedicated independent secretariat is also a time consuming task. Aspects such as financing modalities, staff recruitment, staff rules etc. will need to be agreed between the member entities. Thus, in the initial years of establishment of SAFTU, an interim arrangement may be necessary. This can be in the form of a member entity agreeing to provide secretariat support, till a dedicated secretariat is set up. It may be noted that the secretariat of Arab Union for Electricity is hosted by the National Electric Power Company of Jordan. In South Asia, there are similar examples such as Forum of Load Despatchers being hosted within Power System Operation Corporation (POSOCO).

Therefore, in the initial years, SAFTU secretariat may be housed within a willing member entity, and in the long term, a separate and permanent secretariat may be set up.

Considering the international examples and implementation feasibility, a permanent secretariat in one of the member countries will be the preferred option for SAFTU.

Till the time the secretariat is financially self-sustaining, the same could be housed within one of the willing member utilities.

7.5.2 Structure of secretariat

In the initial years of operation of SAFTU, with the secretariat support being provided by one of the member entities, such member entity can designate one of their officers as the Member Secretary for SAFTU, and also designate a few additional staff to support the activities of Member Secretary (in addition to their existing official responsibility). Further composition of such secretariat staff will depend on the organizational processes and resource deployment by the member utility. Thus, the host member utility may decide on the structure and staffing of secretariat. Tasks of secretariat

The broad functions of the Secretariat can be as follows:

- Implementation: Implementation of tasks as directed by the Executive Council of the SAFTU.
- Monitoring and Coordination amongst member entities: Secretariat staff shall prepare the periodic work plan, monitor progress of key activities and present findings on regular basis. The role of coordination with external stakeholders (including donors) will also be led by Secretariat.
- Media/Public Relations: Inform media outlets about work performed by the organization and upcoming events.
- Funding: Undertake assessment on funding requirement in short, medium and long term. Identify possible sources of funding, regular communication with potential donors (DFIs, MDBs etc.), coordination with member entities on respective contributions.
- Provide Secretarial support to the Executive Council and Groups.

7.6 Financial arrangement

Key learnings from international experience	Funding from MDB/DFI could play a key role in the supporting the institutions, even while some form of member funding may also be present. RPTCC is supported through funds from Asian Development Bank (ADB). SAPP's financing of operating expenses comes from member's contributions and administration fee from Market Trading Platform. ENTSO-E and GCCIA are also financed through membership funding.
Key observations from stakeholder response	Regional stakeholders prefer financing through annual membership fees, paid in a mutually agreed manner

Based on the review of the regional institutions, the prevalent practices in respect of the financial arrangements are detailed in the following paras, mainly for the purpose of a broad understanding in this respect.

It has been noted that in general the expenses can be categorised into two types –

- Set up costs – office establishments including initial cost for taking up office space, furniture; recruitment cost, legal fees
- Operating costs – employees' salary (fixed and contractual), training cost, administrative costs – travel costs, cost for workshops and meetings, communication cost, cost to undertake studies, office rent

Set up costs can be potentially financed through MDB/DFI funding since that it is an initial cost and the rest through member governments' funding. The member funding can either be on equal basis, or can be determined based on other parameters such as share in cross border electricity trade, size of system or annual electricity consumption.

Costs can be optimized by taking up office space in an existing office of the respective member countries' transmission utilities. International Financial Institutions who are already funding the regional energy integration initiatives or CBET transmission corridors in the region can be targeted to support this initiative.

Operating costs can be funded through member countries governments' funding and membership fees. These costs can be optimized by using existing staff of the transmission utilities and contractual employees as well as by using the infrastructure of the member transmission utilities by paying usage charge / rent for such infrastructure, and thereby avoiding high capital expenditure. Donor agencies can be tapped for providing fixed term experts for a defined tenure to support Secretariat activities.

An alternate model is available, where the member country hosting the Secretariat bears full share, or a higher share (e.g. 40 percent) of the expenses and the remaining is recovered equally through membership fees. For example, SAARC regional institutions have been following this approach.

The specific practices followed in case of some of the typical cases are as follows:

- In case of SAPP's financing of operating expenses comes from member's contributions and administration fee from Market Trading Platform. The member's contribution has a uniform base contribution, and then varying levels of fee based on energy share, demand share etc. The members of SAPP fund the activities of the Coordination Centre through an annual subscription. The Coordination Centre prepares a budget, which is presented to the Coordination Centre Board for approval.
- In the case of the ASEAN Power Grid, all expenses incurred by the members of the ASEAN Power Grid Consultative Committee (APGCC) APGCC in carrying out their activities are borne by their respective countries. (APGCC's focus is to enhance the cooperation to execute the development of 16 interconnection projects with 27 links).
- For ENTSO-E. the members contribute annually to the budget by payment of membership subscriptions determined by their voting power with thirty per cent of the budget financed by the members in proportion to the First Part of their Voting Power (one country one vote) and seventy per cent in proportion to the Second Part of their Voting Power (proportion to population).

Therefore, the options or sources of funding include the options of funding by MDB/DFIs, member funding and host utility funding. The pros, cons and ease of implementation of the options are as illustrated below.

Table 27: Pros, cons and implementation options, for funding options

Options	Pros	Cons	Ease of implementation
Member funding	▪ Higher ownership among the member countries ▪ More sustainable in the long-run	▪ Establishment and progress can be hindered, owing to delay in securing funds ▪ Disagreement among the member countries regarding manner of sharing of funding can cause further delays	▪ Low ▪ Will need multiple deliberations to get the countries to agree on a common model ▪ Members may need to obtain the permission of their respective governments / governmental authorities
MDB/DFI funding	▪ Allows to bring in external expertise for capacity building ▪ Provides time for the member countries to arrange for funding and avoids disagreements on manner of sharing of funding contributions, thus expediting the establishment of SAFTU	▪ Member's sense of ownership and responsibility over SAFTU may seem to be lower	▪ Medium ▪ Once the challenge in identifying a willing MDB/DFI with overlapping goals in overcome, the activities can happen seamlessly
Host utility funding	▪ Quicker to implement, if the host utility is willing, and the host utility is able to obtain requisite	▪ The arrangement does not constitute a fair distribution of costs, and therefore is not advisable beyond a	▪ High ▪ Once a willing host utility is identified, rest of the financing related activities

Options	Pros	Cons	Ease of implementation
	governmental / regulatory approvals for use of their funds	transitional / development phase	may not take substantial time and effort, in comparison to the other options.

Ultimately, a decision on this matter depends heavily on the secretariat location also. If the secretariat support is provided by one of the transmission utilities of a member country, then during the initial period, the financing needs may not be substantial. Further some support in this respect from MDB/DFIs can also be of help, especially for funding of carrying out any technical studies and training/capacity building measures.

Based on the learnings from international review and taking into consideration the aspect of starting the functioning of the proposed forum in an expeditious manner, in the initial years, it can be envisaged that SAFTU will be financially supported by the transmission utility of host country, and time to time from development agencies such as USAID. There will be no membership fee collection during this initial phase, and this will help in implementing the initial process expeditiously.

However, in the long term, the goal shall be to move towards a self-sustainable financing mechanism, through membership funding, to be discussed and decided at that stage.

7.7 Basic roadmap for implementation

Considering the discussions on various aspects detailed above, especially the legal status and institutional structure, and considering the geopolitical scenario in South Asia, the following observations can be made regarding a potential roadmap for the establishment of SAFTU:

1. Establishing SAFTU as a loosely formed association could be the quickest way to commence the operations of SAFTU, at least for the initial years.
2. In the initial years, it may be challenging to arrange a member contribution based financing structure for SAFTU. Therefore, SAFTU secretariat can be housed within the transmission utility of a willing member country, which shall support SAFTU with financial and staff resources in the initial years.

   Indirect support of development agencies, such as providing physical resources for office establishment, and organizing conferences could also be possible at this stage. This could also include capacity building assistance and technical handholding from entities and projects of development agencies, including USAID's South Asia Regional Initiative for Energy Integration (SARI/EI).
3. Notwithstanding the physical location of secretariat, the overall chairmanship of SAFTU can still be determined through a rotational basis.
4. Gradually, with the passage of time, as the SAFTU gains more prominence and makes its presence visible in the different matters related to regional transmission network, based on requirement and mutual consent of the members, SAFTU can try to move towards a more formal structure, preferably under an intergovernmental/inter-utility agreement. This will enable SAFTU to obtain more operational flexibility, and a few binding powers also.

These aspects can be further detailed, or if required, can be modified, based on feedback from sector stakeholders. The analysis could also involve identification of a potential willing member transmission utility that can house SAFTU in the initial years.

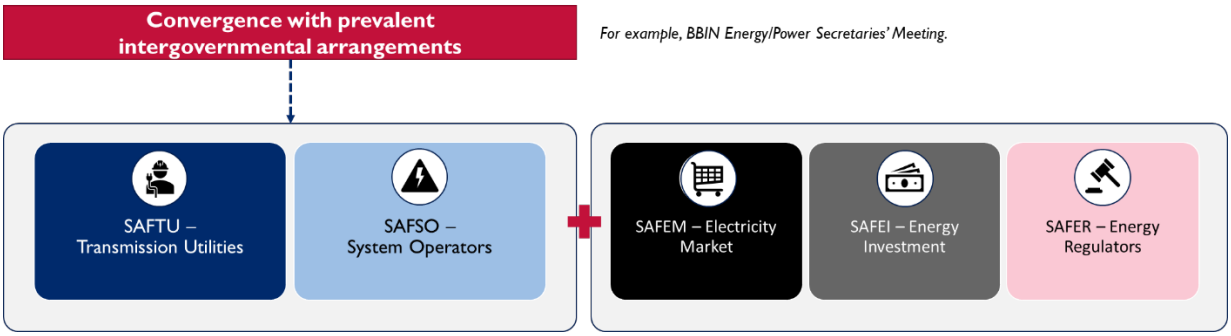
7.8 Way forward

The following key activities are important to get the plan for creation of SAFTU to be implemented:

- Preparation of charter for SAFTU
- Countries to discuss and agree on Charter
- One of the transmission utilities agree to host the Secretariat of SAFTU
- Countries to accept the Charter as part of a common meeting (which will also be the initial meeting of SAFTU)

With the passage of time, based on the requirement and mutual consent of the member countries, the proposed forums for transmission utilities (SAFTU) and system operators (SAFSO) can be made responsible to report to any intergovernmental arrangements. In the longer term, the possibility of bringing all the proposed regional platforms under a common framework can also be explored.

Figure 36: Vision for longer term integration of regional platforms



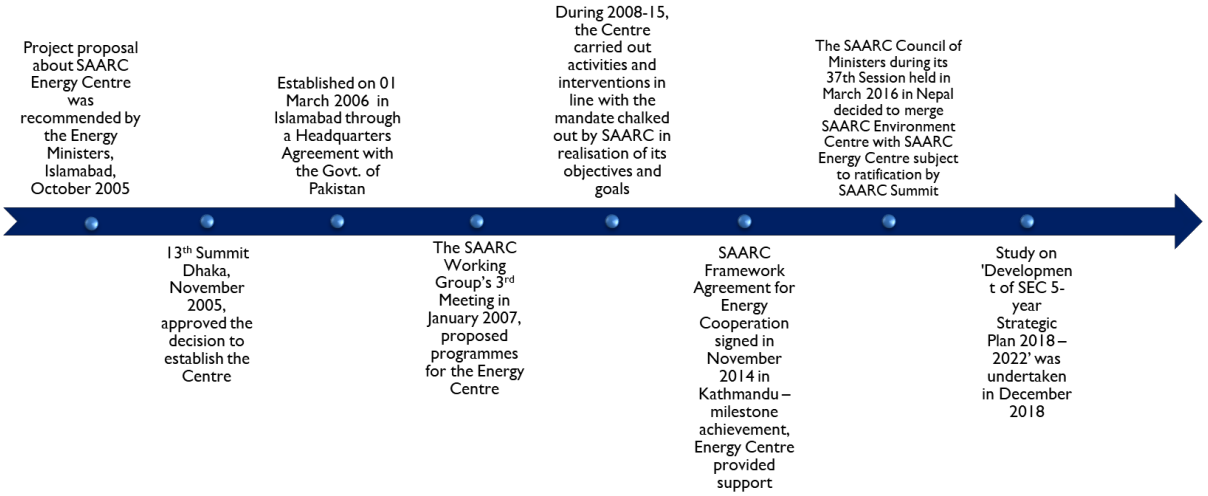
8 Annexure 1: Review of other regional institutions

8.1 Regional institutions related to electricity in South Asia

8.1.1 SAARC Energy Centre

Under the South Asian Association for Regional Cooperation (SAARC), the SAARC Energy Centre was established on 1stMarch 2006, with the objective of serving as a regional institution of excellence for the initiation, coordination and facilitation of SAARC programs in energy. The Centre is envisaged to provide technical inputs to the SAARC Working Group meetings on Energy, and facilitate accelerating the integration of energy strategies within the region by providing relevant information and expertise.

Figure 37: Evolution and key milestones of the SAARC Energy Centre

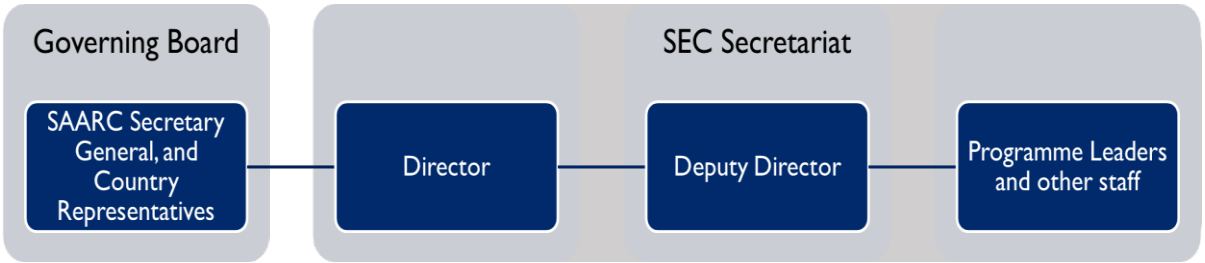


The genesis of establishment of the Centre lies in the Dhaka Declaration of 13thSAARC summit in 2005, which reaffirmed the commitment of SAARC member states to accelerate cooperation in the energy sector. The evolution and key milestones of the SAARC Energy Centre have been illustrated in the previous figure[113].

In order to allow the functioning of the Centre, a Headquarters Agreement has been entered between the Government of Pakistan and the SAARC Secretariat. The agreement allows protection to the office of Centre from unilateral entry by agents of the host Government, exemption from taxes and customs duties, power to transact in any foreign currency, and immunity to officials for actions carried out in their official capacity.[114]

The Centre has an office in Islamabad, headed by a Director, who reports to the SAARC Secretary General. The Director is assisted by a Deputy Director, Programme Leaders and other staff[115]. The governing board of the Centre has representation from Governments of all the Member States.

Figure 38: Organization structure of SAARC Energy Centre



The Governing Board of SAARC Energy Centre consists of a representative of SAARC Secretary General, representative of Ministry of Foreign Affairs of Host Country (Pakistan), Director of SEC, and the country representatives. The country representatives in the current governing board are:

- Member of Renewable Energy, Ministry of Energy & Water, Afghanistan;
- Director General (Power Cell), Power Division, Ministry of Power, Energy and Mineral Resources, Bangladesh;
- Chief Engineer, Department of Hydropower and Power System, Ministry of Economic Affairs, Bhutan;
- Member (Hydro), Central Electricity Authority, India;
- Director General, (Energy & Engineering) Ministry of Environment and Energy, Maldives;
- Superintending Engineer, Department of Electricity Development, Ministry of Energy, Nepal;
- Director General (Gas), Policy Wing, Ministry of Petroleum & Natural Resources, Pak Secretariat, Islamabad; and
- Additional Secretary, Ministry of Power & Renewable Energy, Sri Lanka.

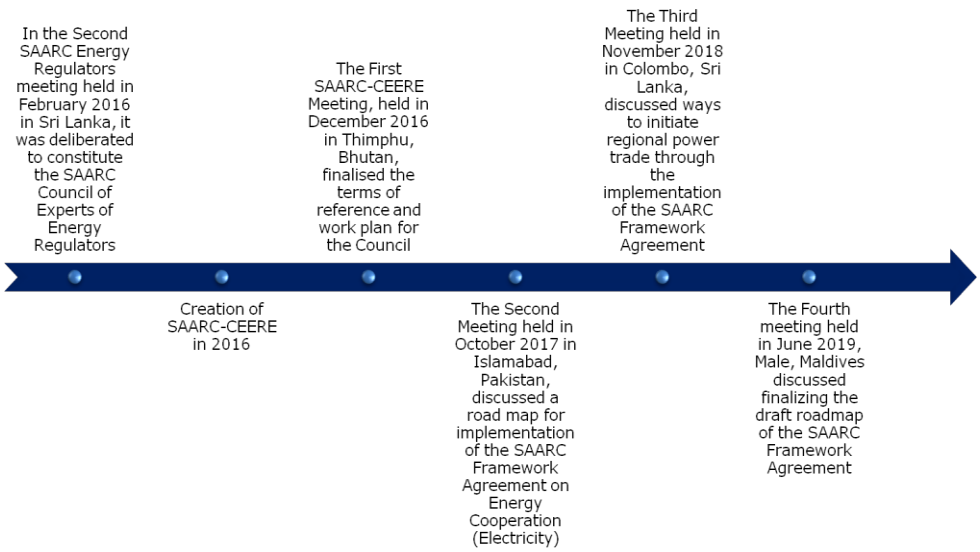
The key activities of SAARC Energy Centre are:

- Development of various study reports related to energy sector in SAARC;
- Compilation of Energy Data Books;
- Development of an Energy Data Portal;
- Organize seminars, workshops and conferences;
- Provide training; and
- Provide support to SAARC Working Group (and other) meetings on Energy.

8.1.2 SAARC Council of Experts of Energy Regulators (Electricity)

Another organization that operates for regional coordination within SAARC is the Council of Experts of Energy Regulators – Electricity (CEERE). CEERE serves as a regional forum to discuss, share knowledge, and achieve consensus on harmonized rules to enable bilateral and multilateral power trade in the SAARC region. The evolution and key milestones of SAARC Council of Experts of Energy Regulators is as shown below[116].

Figure 39: Evolution and key milestones of SAARC Council of Experts of Energy Regulators



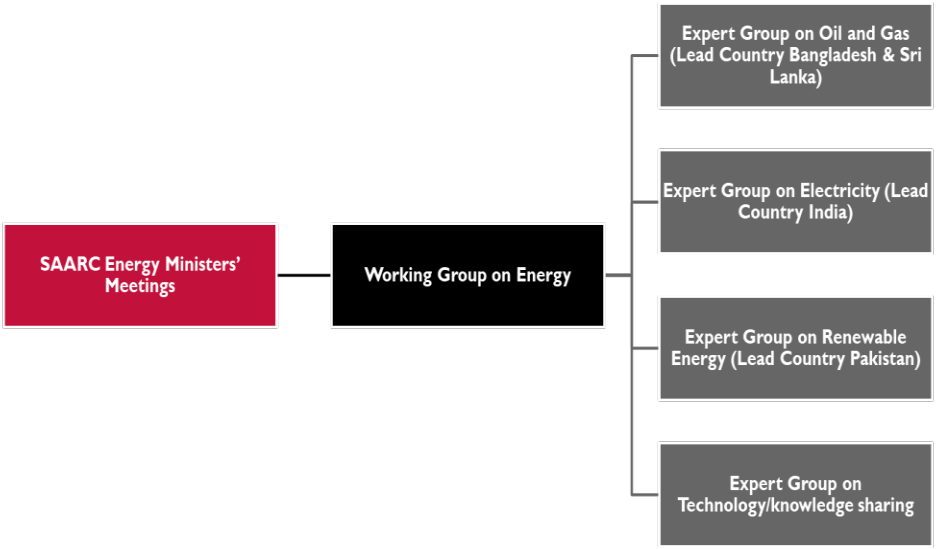
The Second Meeting also discussed issues on power trade, and harmonization of electricity laws related to implementing the SAARC Framework Agreement for Energy Cooperation (Electricity). The draft roadmap of the SAARC Framework Agreement for Energy Cooperation (Electricity), finalised during the Fourth Meeting, has laid out the following key objectives[117]:

- Enable cross-border electricity trade among countries in the SAARC region
- Facilitate assistance for projects pertaining to renewable energy

Unlike SAARC Energy Centre, CEERE does not have a clear institutional and legal identity on its own, but functions mostly as a platform for discussions.

It may also be noted that other than the SAARC Energy Centre and SAARC CEERE, there is a Working Group for energy, under the SAARC. The Working group comprises of Expert Groups on (i) Oil and Gas; (ii) Electricity; (iii) Renewable Energy; and (iv) Technology/Knowledge Sharing (including energy efficiency, coal, etc.). Key decisions are discussed and taken as part of the SAARC Energy Ministers' meetings.

Figure 40: SAARC coordination mechanisms for energy



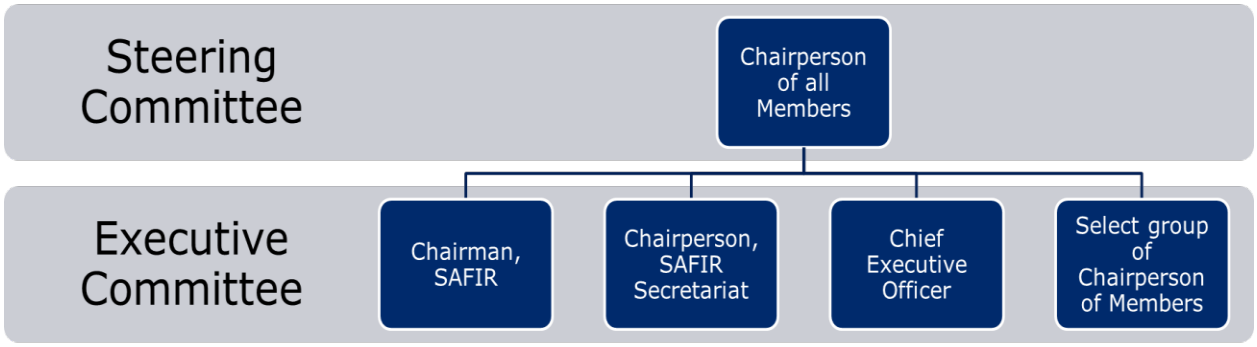
8.1.3 South Asia Forum of Infrastructure Regulators (SAFIR)

Established in May 1999, with the support of The World Bank, the South Asia Forum of Infrastructure Regulators (SAFIR) focuses on providing high capacity training and capacity building on Infrastructure regulation. The objectives of the forum are:

- Provide a platform for experience sharing amongst the regulators of the region;
- Build regulatory decision-making and response capacity in South Asia;
- Facilitate the regulatory process;
- Conduct training programs to serve regulatory agencies and other stakeholders;
- Spur research on regulatory issues; and
- Provide a databank of information relating to regulatory reform processes and experiences.

As per the Memorandum of Association of the forum, a Steering Committee is formed comprising all the members. Further an Executive Committee is formed consisting of a representative each from India, Bangladesh, Pakistan, Nepal, Bhutan and Sri Lanka.

Figure 41: SAFIR Organisational structure



Members of SAFIR include academic institutions, Consumer bodies/ NGOs, Corporate/Utilities and Regulatory bodies including Energy Regulators.

The Chairperson and Vice – Chairperson of SAFIR holds the office in their ex-officio capacity. Each Annual SAFIR Conference elects on rotation basis (among the Countries represented in SAFIR) a Chairperson and a Vice-Chairperson from its members representing regulatory bodies.

As per the Memorandum of Association of SAFIR, the steering committee is empowered to decide the location of Secretariat. Presently, the secretariat of SAFIR is in India, at the office of Central Electricity Regulatory Commission (CERC).

SAFIR manages its funds from its membership fees, training program fees and subscription fees.

In order to overcome the constraints due to time, space and organizational boundaries, SAFIR forms "Virtual Working Groups" from amongst the representatives of the Member organizations, to discuss, deliberate various issues of great importance to the infrastructure sector. The SCM (Steering Committee Meeting) and the ECM (Executive Committee Meeting) of the SAFIR are also held at regular intervals.

Some of the key activities of SAFIR include:

- Organizing a 'Core course on infrastructure regulation';
- Annual general meeting; and
- Organizing investor conferences on issues relating to regulation.

SAFIR was formed as an association of persons, created under a common MoU. Even though it is housed within CERC, it has its own accounts, and also has a separate tax registration. SAFIR was supported by the World Bank's Public Private Infrastructure Advisory Facility (PPIAF) between 1999 and 2009, through capacity building, organizing workshops, maintaining website, and development of strategic plan. SAFIR eventually transitioned to have a permanent secretariat in 2008. [118]

8.1.4 Summary

Table 28: Summary of regional institutions in South Asia

Parameters	SAARC Energy Centre	Council of Experts of Energy Regulators – Electricity (CEERE)	South Asia Forum of Infrastructure Regulators (SAFIR)
Established	2006	2016	1999

Parameters	SAARC Energy Centre	Council of Experts of Energy Regulators – Electricity (CEERE)	South Asia Forum of Infrastructure Regulators (SAFIR)
Type of organization	Association of Countries of SAARC region for energy cooperation.	Council for regular meetings of Energy Regulators	Forum of Infrastructure Regulators in South Asia
Secretariat location	Islamabad	None	New Delhi Secretariat support from Central Electricity Regulatory Commission (CERC)
Members	SAARC Member States	Energy regulators in SAARC Member States	Regulatory Commissions, Research Institutions, NGOs, Utilities etc.
Key areas of function	Development of various study reports, compilation of energy data, capacity building etc.	Discussion and knowledge sharing platform	Aims at providing high quality capacity building and training on infrastructure regulation & related topics, in South Asia and to stimulate research
Funding sources	Through SAARC, which gets funded through Member State contributions	Not known	Membership Fees Consumer bodies/NGOs - 500 USD. Academic /Research institution - 2000 USD. Regulatory Bodies - 4000 USD
Legal Status	Established under Headquarters agreement between SAARC and Government of Pakistan	Not known	Works within CERC, but with separate accounts

8.2 Intra-country Regional forums within India

8.2.1 Forum of Regulators (FOR)

The Forum of Regulators was established in 2005, under the provisions of India's Electricity Act of 2003:

Section 166(2) of the Electricity Act, 2003: "Section 166. (Coordination Forum): —
(2) The Central Government shall also constitute a forum of regulators consisting of the Chairperson of the Central Commission and Chairpersons of the State Commissions.
(3) The Chairperson of the Central Commission shall be the Chairperson of the Forum of regulators referred to in sub-section (2)."

The Forum consists of Chairperson of Central Electricity Regulatory Commission (CERC) and Chairpersons of State Electricity Regulatory Commissions (SERCs). The Chairperson of CERC is the Chairperson of the Forum.

Secretarial assistance to the Forum is provided by CERC. Secretary of CERC acts as the ex-officio Secretary to the Forum.

Functions of the Forum

- Analysis of the tariff orders and other orders of Central Commission and State Commissions and compilation of data arising out of the said orders, highlighting, especially the efficiency improvements of the utilities;
- Harmonization of regulation in power sector;
- Laying of standards of performance of licensees as required under the Act;
- Sharing of information among the members of the Forum on various issues of common interest and also of common approach;
- Undertaking research work in-house or through outsourcing on issues relevant to power sector regulation;
- Evolving measures for protection of interest of consumers and promotion of efficiency, economy and competition in power sector; and
- Such other functions as the Central Government may assign to it, from time to time.

The Forum is advisory in nature, facilitating consensus building and developing model regulations,

CERC can take necessary financial contributions from the State Commissions for carrying out the activities of the Forum. However, CERC will also have to keep separate accounts for the activities of the Forum. The Annual Financial Contribution to be made by the members shall be as decided by the Forum in the meeting to be held in the first quarter of every year. The Forum is required to meet at least twice in a year.

8.2.2 Forum of Load Despatchers (FOLD)

Forum of Load Despatchers (FOLD) is a forum of organizations carrying out System Control activities in India. FOLD was created based on a decision arrived by India's Forum of Regulators (FoR) in 2008. The charter of FOLD describes its functions as the following:

- Promoting technological excellence;
- Promoting harmonization of practices;
- Promoting compliance to Reliability Standards;
- Facilitating development of Ancillary Services in power system;
- Promoting capacity building in Power System/Market Operation;
- Facilitating information sharing with stakeholders;
- Developing Code of Ethics; and
- Development and review of suitable Performance indicators.

All the executives working in State, Regional and National Load Despatch Centres (SLDCs, RLDCs, NLDC) would be members of the General Body of FOLD. A Steering Committee comprising of the Head of State/Regional/National Load Despatch Centres or its authorized representative would be constituted to steer the activities of FOLD. Besides these the Steering Committee would constitute Working Groups to advise the Steering Committee on matters related to power system and electricity market operation. The Working Groups would have volunteers/nominated members from the General Body and invited experts.

The Secretarial assistance to the FOLD is provided by the National Load Despatch Centre located in New Delhi. There have been thirty two meetings of the FOLD, during its initial eleven years of operation. FOLD's success

has been in the area of providing a platform among the load despatch centres for knowledge sharing and discussions. In addition, there are discussions on development of Human Resources in the organization and capacity building of the team members.

8.3 Other regional institutions

8.3.1 Council of European Energy Regulators

The Council of European Energy Regulators is a voluntary organisation in which Europe's national energy regulators voluntarily cooperate to protect consumer interests and to facilitate the creation of a single, competitive and sustainable internal market for gas and electricity in Europe.

In March 2000, ten national energy regulatory authorities signed the "Memorandum of Understanding for the establishment of the Council of European Energy Regulators". They had voluntarily formed CEER to facilitate cooperation in their common interests for the promotion of the internal electricity and gas market. In order to cope with a growing number of issues and to improve cooperation at the operational level, the regulators decided in 2003 to formally establish themselves as a not-for-profit association under Belgian law and to set up a small secretariat in Brussels.

Excerpts from CEER Articles of Association[119]

ARTICLES OF ASSOCIATION OF THE COUNCIL OF EUROPEAN ELECTRICITY REGULATORS ASBL - CONSOLIDATED ON 23 October 2019

CHAPTER 1 – NAME, REGISTERED OFFICE, PURPOSE, DURATION

Article 1 - Name

A not-for-profit association is constituted under the name "Council of European Energy Regulators", abbreviated "CEER" or the "Council".

Article 2 - Registered office

The registered office of the association is established in the judicial district ("arrondissement judiciaire") of Brussels, in 1040 Bruxelles (Belgium), cours Saint-Michel 30a, box F.

Article 3 - Purpose

3.1. The association does not seek to make profits. The objectives of the association are to:

- promote the development of efficient and competitive internal markets for electricity and gas in Europe through the establishment of appropriate mechanisms;

- set up cooperation in order to achieve competitive internal markets for electricity and gas in Europe, in which the principles of transparency and non-discrimination are ensured;

- promote a broad and representative vision of Europe's energy markets;

- set up cooperation, information exchange and assistance amongst the Members and Observers, with a view to establishing expert views for discussion with the institutions of the European Union (EU) and, in particular, with the European Commission, and representative international organisations of other sectors which may be involved;

- contribute to the advancement of research on regulatory issues;

- establish coherent and expert knowledge and analysis such that the institutions with which Members wish to hold discussion naturally consult the Members at a formative stage in policy development;

- provide a framework for the discussion of regulatory issues and exchange of experience;

- provide the necessary elements for the development of regulation in the fields of electricity and gas;

- develop joint approaches vis-à-vis transnational energy companies that operate in, or can exert influence on, separated regulated utility markets;

- promote and provide training;

- cultivate relations with similar associations outside the EU area;

- with the agreement of the other members of the International Confederation of Energy Regulators (ICER), CEER will, as and where appropriate, represent ICER in the management of projects related to the dissemination of best regulatory practices, and may provide secretariat services to ICER;

- work together, where possible, to establish common policies among Members and Observers towards agreed issues; and

- share the knowledge and expertise acquired in Europe in respect of energy market regulation with authorities, organisations or associations from countries situated outside of the EU, on its own or through entities it cooperates with.

8.3.2 Northeast Power Coordinating Council

Northeast Power Coordinating Council, Inc. (NPCC) is a not-for-profit corporation in the state of New York responsible for promoting and enhancing the reliability of the international, interconnected bulk power system in Northeastern North America. NPCC is one of six Regional Entities which, together with the North American Electric Reliability Corporation (NERC), make up the Electric Reliability Organization Enterprise. NPCC Membership is a combination of Organization and Sector.

NPCC's Board of Directors consist of fourteen (14) Stakeholder Directors, two (2) Independent Directors, an Independent Board Chair and the President and CEO. There are two (2) Stakeholder Directors from each of the following Sectors:

- Sector 1: Transmission Owners
- Sector 2: Reliability Coordinators
- Sector 3: Transmission Dependent Utilities, Distribution Companies, and Load-Serving Entities
- Sector 4: Generator Owners
- Sector 5: Marketers, Brokers and Aggregators
- Sector 6: State and Provincial Regulatory and/or Governmental Authorities
- Sector 7: Sub-Regional Reliability Councils, Customers, Other Regional Entities, and Interested Entities

8.3.3 Midwest Reliability Organization

Midwest Reliability Organization (MRO) is one of six regional electric reliability councils under North American Electric Reliability Corporation (NERC) authority. It is a regional entity within the NERC structure for the purpose of preserving and enhancing electric service reliability, adequacy and security in its corporate region and other interconnected regions for the benefit of all end-users of electricity in the region. . It is operated as a Delaware non-stock, non-profit corporation and is organized pursuant to the general corporation law of the State of Delaware.

8.3.4 International Civil Aviation Organization

The International Civil Aviation Organization (ICAO) is a UN specialized agency, established by States in 1944 to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention).

ICAO works with the Convention's 193 Member States and industry groups to reach consensus on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector. These SARPs and policies are used by ICAO Member States to ensure that their local civil aviation operations and regulations conform to global norms, which in turn permits more than 100,000 daily flights in aviation's global network to operate safely and reliably in every region of the world.

8.3.5 SAARC Chambers of Commerce

The representatives of National Federations of Chambers of Commerce and Industry of SAARC countries at the second meeting of Chambers of Commerce & Industry of the developing countries (G-77) in New Delhi in December 1988, signed a memorandum of understanding, expressing their intention and desire to establish the Chamber of Commerce and Industry of SAARC countries for the promotion of trade and industry in the SAARC region and to develop and achieve common objectives in these areas. Pursuant to the directive of SAARC Secretariat, SAARC Chamber of Commerce & Industry, assisted by the National Federations, submitted its draft constitution to the SAARC Secretariat and received its approval in December 1992. This signified the official recognition of the SAARC Chamber of Commerce and Industry (SAARC CCI) by all the national governments of SAARC as the apex body of all the National Federations of Chambers of Commerce and Industry of SAARC.

The constitution of SAARC CCI designates Pakistan as the Permanent Secretariat of SAARC with a Secretary General to be the Chief Executive Officer of the Secretariat. The secretariat is established in Islamabad, with sub-offices in Colombo and Mumbai. The presidency of SCCI rotates alphabetically amongst member organizations.

The SAARC Chamber shall comprise the following organs:

1. The General Assembly (also to be known as GA) - Maximum 168 members nominated by National Bodies (Chambers of Commerce) from eight countries;
2. The Executive Committee (also to be known as EC) - Maximum 88 members nominated by National Bodies (Chambers of Commerce) from eight countries; and
3. The General Secretariat.

The membership subscription, fixed by General Assembly, will be shared in the following proportion:

1. India & Pakistan 25% each;
2. Bangladesh, Nepal & Sri Lanka 11.91% each; and
3. Afghanistan, Bhutan & Maldives 4.76% each.

8.3.6 Nordel

Nordel, is one of the predecessor organizations of ENTSO-E. Nordel was established 1963 as an advisory association of leading persons from the electricity industries of Denmark, Norway, Sweden, Finland and Iceland. In 2000, it changed itself from an 'association of persons' to an 'association of Transmission System Operators' in Nordic countries by adopting a new set of bylaws. [120]

Nordel also served as a forum for contact and co-operation between the TSOs and representatives of the market players in the Nordic countries. Nordel's tasks fell mainly into the following categories:

- System development and rules for network dimensioning;
- System operation, operational security, reliability of supply and exchange of information;
- Principles of transmission pricing and pricing of ancillary services;

- International co-operation;
- Maintaining and developing contacts with organisations and regulatory authorities in the power sector, particularly in the Nordic countries and Europe; and
- Preparing and disseminating neutral information about the Nordic electricity system and market.

Nordel's highest decision-making body was the Annual Meeting, whose participants were drawn from representatives of the TSOs. The chairmanship rotated between the Nordic countries.

Nordel's executive body was the Board, composed of one representative from each of the Nordic TSOs. The Board of Nordel makes initiatives and decisions on topical issues, and implements the decisions taken at Nordel's Annual Meeting. Most of Nordel's work is carried out by committees and working groups.

8.3.7 Very Large Grid Operators Association / GO-15

GO15. Reliable and Sustainable Power Grids brings together the world's 16 largest Power Grid Operators (PGOs, also known as Transmission System Operators – TSOs or Independent System Operators – ISOs). GO15, formerly named VLPGO (Very Large Grid Operators Association), was created in 2004 following several blackouts across the world to investigate fundamental issues of common interest to its members and to develop joint action plans addressing the improvement of power system security. The GO15 Members are: AEMO (Australia), CSG (China), ELIA Group (Belgium), ESKOM (South Africa), KPX (South Korea), MISO (USA), National Grid (United Kingdom), ONS (Brazil), PGCIL (India), PJM Interconnection (USA), REE (Spain), RTE (France), SGCC (China), SO UPS (Russia), TEPCO (Japan), TERNA (Italy).

Though the association was created in 2004, it became an officially incorporated not-for-profit association only in 2009.[121]

8 Annexure II: Case studies on International experience on regional coordination mechanisms for electricity - with focus on transmission network planning

Among the international experiences covered in this report, there are three cases where the regional organizations regularly update their regional transmission plans. These three examples are covered in detail below.

8.1 European Network of Transmission System Operators for Electricity (ENTSO-E)

One of the four ENTSO-E Committees is the **System Development Committee (SDC)**, whose key function is to cooperate for network development and planning. SDC prepares ENTSO-E's **Ten Year Network Development Plan (TYNDP)**. It is supported by ENTSO-E Secretariat.

8.1.1 System Development Committee

The SDC's key objective is to co-ordinate the development of a secure, environmentally sustainable and economic transmission system with the aim of creating a robust European grid and, from the planning point of view, a high standard of interoperability, reliability and security. Currently, the SDC is chaired by Dimitrios Chaniotis of Réseau de Transport d'Électricité (RTE), France, which is the transmission system operator of France. The SDC has bimonthly meetings (January, March and so on).

Key areas of work for the SDC include:

- Ten Year Network Development Planning and Regional Investment Plans (TYNDP)
- Mid-term Adequacy Forecast (MAF)
- Seasonal Outlooks
- Scenario Building
- Data and Models
- System Design Strategy
- Connection Network Codes
- Network Modeling and Data

At present, two adequacy forecast reports are published by ENTSO-E, each one with a specific time horizon. Mid-term Adequacy Forecast (MAF) is a 1 to 10 year ahead Pan-European assessment of power system adequacy. The Winter and Summer Outlooks focus on exploring the main risks identified within a seasonal period, highlighting the possibilities for neighbouring countries to contribute to the generation/demand balance in critical situations. These are more generation specific.

The SDC also works in the areas of market and network data and models. This concerns mainly the following areas - Demand modelling; Generation modelling, including wind and PV; Storage modelling, especially hydro storage; **Transmission capacity and Network modelling**.

The most important activity of the SDC related to transmission is the preparation of the **Ten Year Network Development Plan**, which has been explained below.

8.1.2 The Ten Year Network Development Plan (TYNDP)

The Ten Year Network Development Plan (TYNDP) is a plan which aims to address the complete requirements of the EU's electricity infrastructure for the next decades, through hundreds of projects funded by over 150 billion Euros' worth of investment[122]. This complex plan is developed by ENTSO-E as mentioned above, which is the formal representation of transmission system operators in Europe. EU legislation mandated ENTSO-E with the delivery of the biennial TYNDP, the first pilot of which was released in 2010. The TYNDP identifies gaps in infrastructure from a European perspective and informs decision-makers in member countries and other

stakeholders about projects with impacting the region. The TYNDP builds on national and regional investment plans called RIPs. ENTSO-E has formed six regional groups to identify and address network investment and development challenges reflecting regional particularities and needs.

TYNDP development process

The TYNDP is published every two year, which presents how to develop the power grid in the next 10 to 20 years and is the outcome of a two-year process, starting with the development of scenarios or visions of how the European power system might look in 2030 and 2040. Over 200 experts across Europe carry out regional exploration studies, pan-European analyses and assess projects to reinforce the grid submitted through a European-wide call for candidatures. TYNDP is a non-binding community-wide 10-year network development plan, aimed at providing a vision of the extra-high voltage grid in 10 to15 years' time.

The key elements of the TYNDP package is the result of the assessment of each transmission or storage project in Europe. The TYNDP and the economic and technical studies performed to produce it generate a great quantity of valuable information on the future of the European power system. Along with the project assessment themselves, these results form the basis of the "TYNDP package". This package is also composed of the identification of system needs reports, the regional investment plans and several insight reports which provide further regional analysis for key areas and topics.

Assessment of projects

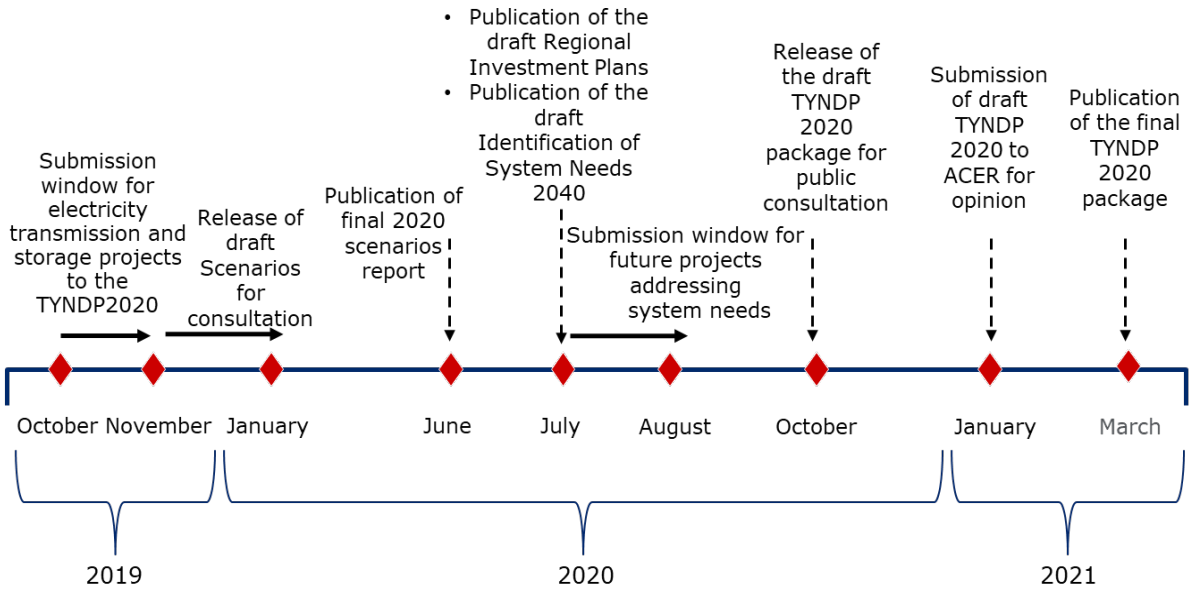
Each project included in the TYNDP is assessed using the pan-European cost-benefit analysis (CBA) methodology. The benefit of each TYNDP project is assessed against several indicators ranging from socio-economic welfare to environmental impact.

Transmission projects are multi-purpose, from ensuring the reliability of electricity supply to enabling social welfare. More recently, considering the renewable energy and CO_2 emission targets of the EU, the integration of electricity from renewable energy sources and CO_2 emission mitigation appear as new objectives for transmission projects. The majority of TYNDP projects contribute to all indicators.

Timelines for the development of the TYNDP

The figure below illustrates the timelines for the development of TYNDP 2020. As can be seen, it is a two year process, starting with the proposal submissions for the electricity transmission and storage projects and, also involves public consultation as well as consultation with ACER (which assists in performing regulatory functions).

Figure 42: TYNDP 2020 development timeline



Source: ENTSO-E official website – https://www.entsoe.eu/

Stakeholder engagement for the development of the TYNDP

The TYNDP is a collective exercise. The quality of its output very much depends on ENTSO-E's ability to engage as early and as extensively as possible with all parties that have an interest in how the power grid is designed. ENTSO-E engages regularly with the European Commission, ACER and with stakeholders via **the Network Development Stakeholder Group (NDSG).**

The Network Development Stakeholder Group is a consultative group aimed at enhancing the collaboration between ENTSO-E and key stakeholders in network development. It plays an important role in improving the quality and acceptability of the TYNDPs and Scenarios. It also contributes to the creation of a shared understanding of grid development related topics **besides facilitating consensus building**.

The purpose of the NDSG is not to replace public consultations and bilateral meetings, but to further enhance collaboration between ENTSO-E and stakeholders, exchange of ideas and streamlining of diverging opinions.

Purpose of the Group:

The Group aims to:

- Enhance communication between ENTSO-E and stakeholders in order to improve the quality and robustness of the TYNDP and related issues
- Contribute to more productive information exchanges and the creation of a shared understanding of different views on relevant development, research and assessment topics
- Facilitate greater stakeholder involvement in the TYNDP process and enable the stakeholders to play an active role in the TYNDP deliverables
- Increase acceptability of ENTSO-E's TYNDP

Structure and Membership:

The structure of the group is as follows:

- Chairman from ENTSO-E
- Permanent stakeholders - in order for the group to be able to work actively ENTSO-E limits the participants to around of 15 members. Participating associations are allowed to nominate one representative as main contact. It is upon the stakeholders to nominate different persons for the different meetings, upon the discussed topics. The membership of the group should be balanced and roughly at least following type of organisations should be represented:
    - Generating utilities, distribution utilities and electricity traders organisations
    - Consumers' representative such as NGOs (industrial consumers, households)
    - Environmental NGOs
    - Electrical equipment manufacturers/suppliers organisations
    - Local authorities
    - Trade unions
- Invited speakers/participants (specialists, University professors, etc.) depending on the agenda. The proposal should be sent 2 weeks prior to a meeting date and approved by the Chairman.
- Members of the ENTSO-E Working Groups which relate to the concerned topic
- EC and ACER may be invited as permanent observers
- ENTSO-E Secretariat permanent support

Role of the participants:

The responsibilities of the participants are:

- Consistently attend meetings (with a stable membership)
- Actively participate in meetings

- Liaise with their own members and stakeholders to update on the process of TYNDP and represent their views and concerns
- Highlight issues and concerns of their organisation
- Actively participate in the common agreed tasks

The responsibilities of ENTSO-E are:

- Act in an open and transparent manner to inform stakeholders
- Provide information to facilitate participant's understanding
- Initiate and provide information on aspects where participants input is expected
- Provide agenda's or objective of the meeting at least 2 weeks prior to a meeting date and working documents at least 1 week before

Functions of the Group:

The functions are:

- Discuss and give suggestions and/or early feedback on methodologies and scenarios on the TYNDP process Discuss, comment and give input on future TYNDPs, elements to improve, i.e. not only the data but the presentation such as outcomes and presentation format
- Discuss and give suggestions and/or feedback for useful project cost-benefit analysis metrics
- Investigate and propose solutions to enhance power system development issues, social acceptance of grid and transmission grid projects
- Investigate and propose solutions to improve citizens' involvement and quicken permitting procedures regarding the new transmission infrastructure at local/regional/national/European level
- Investigate and propose solution to improve scenarios development and uncertainties mitigation, especially with respect to sharing generation development perspectives
- Discuss and/or give input and recommendations with respect to novel and unconventional technologies and write position papers on the above topics
- Make presentations in conferences and write articles to disseminate common views

ENTSO-E is not be legally bound to accept any suggestion provided by any stakeholder, as ENTSO-E remains the sole party legally responsible for the development of the TNYDP. ENTSOE however indicates how the observations received by the stakeholders have been taken into consideration and the reasons for it.

Frequency of the meetings:

As a general rule, the group meets 3-4 times per year. This frequency of meetings depends on the amount and complexity of topics to discuss. Date of meetings are agreed among members. The meetings take place at the ENTSO-E premises in Brussels for a full day.

Time:

The duration of the Group is generally till the time ENTSO-E plans to submit the TYNDP to ACER. By that time ENTSO-E assesses the working of the group and proposes any continuation of the process/redefining the scope for the next TYNDPs

8.2 Southern African Power Pool (SAPP)

The SAPP was established to coordinate and cooperate in the planning, development and operation of regional generation and transmission facilities for mutual benefit of the member countries. The SAPP coordinates the power systems of its twelve SADC member countries. In order to fulfil its objectives and original mandate, SAPP carries out large-scale system planning for the region. To meet this objective, the SAPP Planning Subcommittee commissioned the first SAPP Regional Generation and Transmission Expansion Plan in 2001 (2001 Pool Plan).

This Pool Plan identified a detailed list of priority generation and transmission projects to accommodate for rapidly rising electricity demand in the region over the period from 2006 to 2025. In 2009, the SAPP Coordination Centre commissioned a revision of the 2001 Pool Plan. In order to provide a longer-term roadmap to regional investment decisions and, with the World Bank's support under the SAPP Program for Accelerating Regional Energy Transformational Projects (SAPP AREP Program), the SAPP commissioned development of the 2017 SAPP Pool Plan (the Pool Plan).

8.2.1 The SAPP Pool Plan

This 2017 SAPP Pool Plan is the first Pool Plan adopted by SADC/ SAPP and represents a significant milestone for SAPP in fulfilling its original mandate of coordinating and cooperating in the planning, development and operation of regional generation and transmission facilities. Going forward, the SAPP has committed resources to continue updating the planning assumptions in the Pool Plan to ensure the Pool Plan remains is dynamic in nature, reflecting the rapidly changing regional environment. In particular, the Pool Plan is based on 2015 planning data and therefore would need to be updated regularly as assumptions on technologies, prices, demand, economic growth and other macroeconomic factors change. Moreover, the process of developing the Pool Plan highlighted some key challenges regarding existing data availability and consistency at the utility level that will need to be addressed in future plans.

Objectives of the Pool Plan:

The objective of the SAPP Pool Plan is to identify the key investments in the generation and transmission space of regional significance, which will provide adequate electricity supply to the region under different scenarios. Supply of electricity should be carried out in an efficient and economically, environmentally and socially sustainable manner. Overall aim is to facilitate enhancement of integration and power trade in the SAPP region.

Methodology adopted:

The general approach in a regional power sector master plan is to compare a no-regional integration scenario (benchmark case) to a scenario where the interconnected region is considered as though it were a single country (full integration case), to derive the least cost generation and transmission investment sequencing. The Pool Plan, considers an additional unconventional third scenario - the 'Realistic Integration Case'. This scenario brings in factors of importance from individual country perspectives (e.g. each country fulfilling SAPP security and reliability planning criteria). Furthermore, an important and innovative feature of the Pool Plan is the introduction of spatial mapping using a Geographic Information Systems (GIS) approach. There is the provision of a database of spatial and non-spatial data for use by the member countries within the Rapid Impact Assessment Matrix Tool (RIAM) for Environmental and Social (E&S) Sustainability analysis.

Key highlights of the Pool Plan 2017:

The key issues covered in the Pool Plan 2017 are[123]:

- Benefits of regional integration in this region - full regional integration results in overall savings of over USD 42 billion (NPV) in investment and O&M costs. The intermediate third scenario ('Realistic Integration Case') results in over USD 37 billion savings (over the planning period of 2040).
- Case for prioritising investments for the development of regional interconnectors - investments in transmission have a quick and significant pay back. The costs of the regional interconnectors are a small proportion (about 3%) of total capital costs, but the bulk of the significant reductions in overall NPV are realized through these interconnectors, primarily through reducing generation investment costs but also through lower operational costs. There is therefore a strong case to prioritise regional interconnector investments.
- Inclusion of domestic and national transmission grids as a part of the regional integration plan - there is a clear case for considering domestic, national transmission grids as an integral part of regional integration effort as the benefits these investments bring are shared among a wider regional community.

The SAPP needs to consider developing a standardized methodology to properly reflect the regional benefit element in the national grid strengthening projects' economic rationale.

- Increase in the share of renewable energy power - renewables (and, specifically, hydro) and gas generation is expected to substantially increase at the cost of coal and other thermal generation.
- Cost efficient power supply - low electricity prices have, in the past, given the SAPP region a comparative advantage in the costs of production, particularly for energy-intensive metals and minerals. In the regional integration case, the short-run costs will be an important element in keeping the average prices of traded electricity low into the future.

Key lessons from the development of the Pool Plan:

The key lessons that emerged from the process of formulating the Pool Plan are:

- Improved and systematic data collection is required. The data must be maintained by the utilities and SAPP Coordination Centre is necessary to ensure that there are functional and updated databases that can form the start of future planning studies.
- More frequent and detailed reviews of demand forecasts are necessary, followed by updates of the generation expansion plans to meet the demand. This will aid transmission planning too.
- Methodologies used for demand forecasting should be harmonised across the region, with realistic assumptions on the key demand drivers.
- Continuous training of staff is needed in areas such as demand forecasting, collection and management of data; use of GIS and other planning tools.

The SAPP has recommended the Pool Plan perspectives to be incorporated into national power development planning and also to expedite the implementation of the priority transmission and generation projects. The Pool Plan 2017 was adopted by SADC on the Energy Ministerial Meeting in June 2018. The SADC adopted SAPP Pool Plan of 2017 as a guiding document to guide development of power generation and transmission in this region.

8.3 Pennsylvania-New Jersey-Maryland Interconnection LLC (PJM)

PJM is a regional transmission organization (RTO) that coordinates the movement of electricity in all or parts of 13 states (Delaware, Illinois, Indiana, Kentucky, Maryland, Michigan, New Jersey, North Carolina, Ohio, Pennsylvania, Tennessee, Virginia and West Virginia) and the District of Columbia in the United States. The table below provides a brief summary of key statistics on the portion of the US bulk electric grid under PJM's operating control[124]. PJM is the largest regional transmission organisation in the United States in terms of load served.

Table 29: Key statistics related to the PJM interconnection

Population (number of customers served)	65 million
Number of states served	13 + District of Columbia
Electricity consumption (2017)	773.5 TWh
Peak load	165.5 GW
Installed capacity	180 GW
Length of transmission network	135,252 km
Number of generation sources	1,379
Geographic area	630,447 sq. km

The PJM is an advanced regional pool where the default mode of trade is multilateral and regional in nature. Other options (for example, bilateral) still exist, but these are utilised on a secondary basis.

8.3.1 PJM's network planning process

At PJM, planning includes assessing and managing the future needs of the electric grid. PJM also participates in collaborative interregional planning activities with its neighbours (other RTOs in the US). PJM's planning team consists of engineers, analysts and project managers. The planning process at PJM includes analysing and coordinating planned upgrades (such as new transmission lines), connecting new power plants to the existing system and planning PJM's connections with neighbouring transmission systems.

PJM conducts long-range planning studies and analyses future demands on the transmission system in its region. These studies identify changes and additions, such as new transmission lines or upgrades to existing equipment, needed to ensure grid reliability and to maintain the successful operation of the wholesale electricity markets. For this PJM considers:

- Expected growth in the use of electricity (for example, population growth in a specific area would drive up demand)
- Retirements (shutdowns) of existing power plants
- Public policy (state or other governmental energy initiatives)

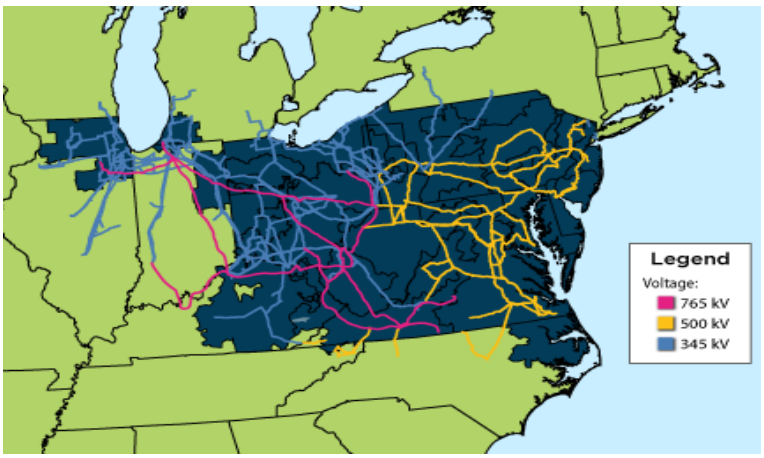
PJM's **annual Regional Transmission Expansion Plan** determines in detail the changes needed to the transmission grid up to five years in the future, and projects the changes likely to be needed up to 15 years into the future.

Generation interconnection studies determine whether the existing grid can handle power from a new generating plant and what changes are needed to connect the plant.

PJM works closely with neighbouring grid operators, including Midcontinent Independent System Operator and New York Independent System Operator, to coordinate upgrades around shared borders and ensure that facilities in one system do not adversely impact neighbouring systems.

The following figure depicts PJM's group of high—voltage transmission lines that make up the foundation of the grid in the region where PJM operates.

Figure 43: Major transmission lines of PJM forming the foundation of the grid



Source: PJM official website – https://www.pjm.com/

Regional Transmission Expansion Planning (RTEP) process:

PJM uses an open process to plan for changes to the electric grid in the 13-state region to maintain future reliability and economic performance of the grid. PJM participates in collaborative interregional planning activities

with its neighbours. **The PJM Regional Transmission Expansion Planning process, performed annually**, looks ahead 15 years, assessing many drivers that affect grid reliability. PJM studies many scenarios and analyses various grid conditions that could lead to problems in the way power flows throughout the region. These problems might include:

- Transmission lines that are carrying the maximum amount of electricity that they are able to carry
- New generators, which, when they begin operating, could cause parts of the system to be overloaded owing to the increased amount of power flowing through the lines
- Substation equipment that could be overloaded

PJM also considers public policy needs such as the impact of state renewable energy requirements or demand response/energy efficiency efforts, generator retirements and fuel shifts such as the major change from coal to natural gas generation.

After PJM identifies potential problems, it works with transmission owners and other members through a competitive planning process to determine the best fix for the problem, meeting required national standards. Examples of these solutions include:

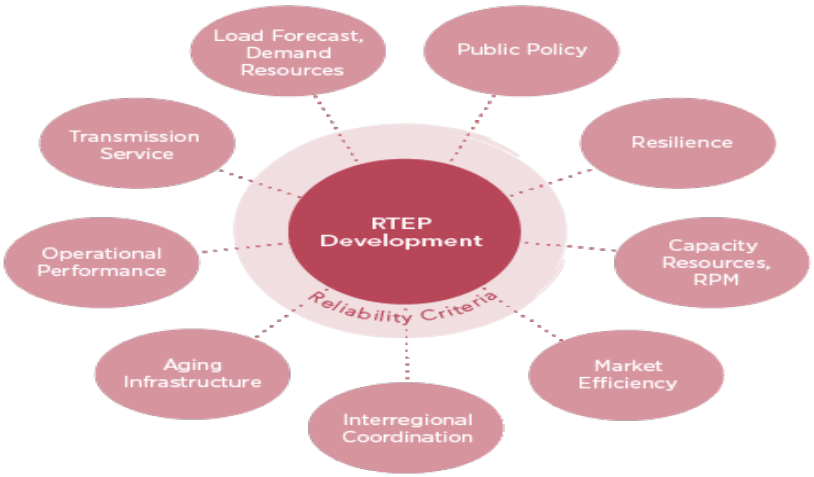
- New transmission lines
- Replacing existing high voltage transmission lines with lines capable of carrying more power
- Installation of devices that maintain voltage levels

The Regional Transmission Expansion Planning process determines the need for and benefits of a transmission project, however it does not review or approve locations where transmission lines are ultimately built. That is the responsibility of individual states.

All transmission improvements identified through this process are discussed publicly in stakeholder meetings, and reviewed and approved by the PJM Board before being included in PJM's expansion plan. The cost of these upgrades is allocated to PJM transmission owners following rules in PJM's federally-approved governing documents. Under PJM agreements, transmission owners are obligated to build transmission projects approved by the PJM Board that are needed to maintain reliability standards.

The various elements involved in the RTEP development process have been illustrated in the figure below.

Figure 44: Elements considered during the Regional Transmission Expansion Planning process



Source: PJM official website – https://www.pjm.com/

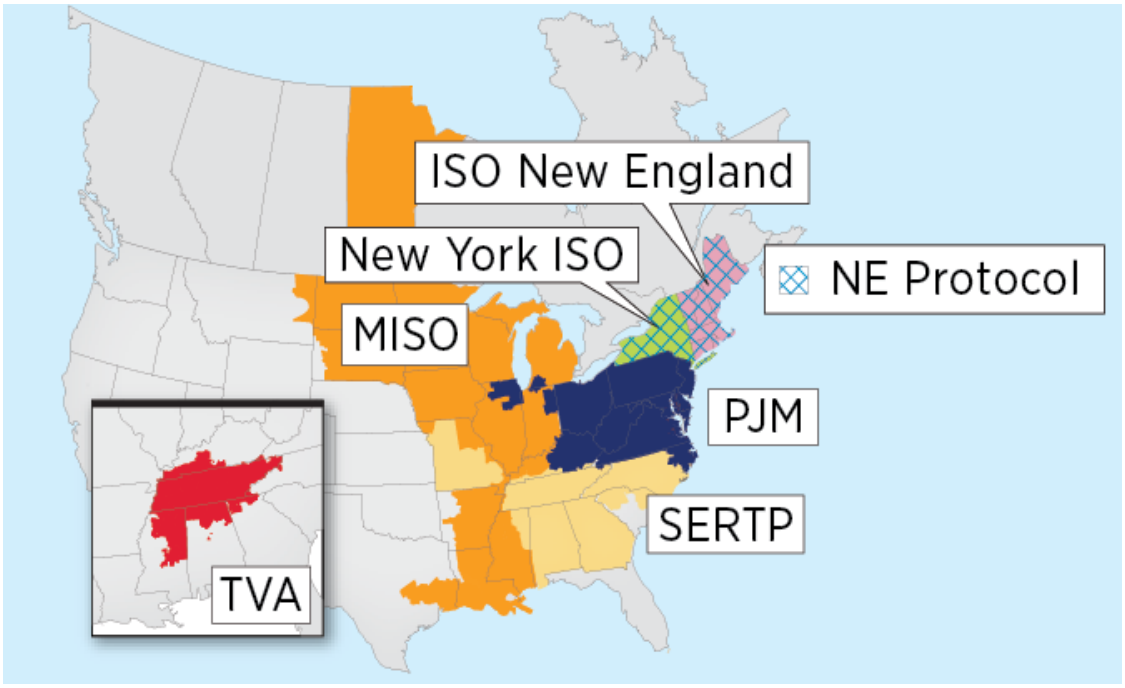
Interregional Planning:

PJM participates in collaborative interregional planning activities with its neighbors:

- **Northeast:** New York Independent System Operator (NYISO) and ISO New England
- **West:** Midcontinent Independent System Operator (MISO)
- **Southeast:** Southeastern Regional Transmission Planning (SERTP) and North Carolina Transmission Planning Collaborative (NCTPC)

The figure below depicts the regions under PJM's neighboring RTOs.

Figure 45: Regions under PJM's neighbouring RTOs



Source: PJM official website – https://www.pjm.com/

Coordination with PJM RTEP Process

Interregional planning is integrated with PJM's own Regional Transmission Expansion Planning (RTEP) process in accordance with the following guidelines as per the - Open Access Transmission Tariff; Operating Agreement and series of manuals and stakeholder activities via the PJM Transmission Expansion Advisory Committee (TEAC).

PJM Transmission Expansion Advisory Committee (TEAC)

The Transmission Expansion Advisory Committee (TEAC) is established under the Operating Agreement (OA) of PJM and provides advice and recommendations the PJM Office of the Interconnection on the preparation of the PJM Regional Transmission Expansion Plan for review and approval by the PJM Board of Managers. The Sub Regional RTEP Committees (SRRTEP) provide review and input of Sub regional RTEP projects and provide recommendations to the TEAC concerning Sub regional RTEP projects. There are three SRRTEPs – Mid-Atlantic, Southern, Western.

The responsibilities of the TEAC are:

- Provide comments and recommendations on the scope and assumptions for Regional Transmission Expansion Plan (RTEP) studies, including economic/market efficiency analysis
- Provide comments on the RTEP analysis for specific points throughout the RTEP process cycle
- Provide comments and recommendations on the RTEP that will be proposed to the PJM Board of Managers for consideration and approval, as necessary

- Provide comments and recommendations on RTEP matters as requested by the PJM Board of Managers

TEAC membership and participation are open to parties as described in the PJM Operating Agreement (OA) and are as follows:

- all Transmission Customers, as that term is defined in the PJM Tariff, and applicants for transmission service
- any other entity proposing to provide Transmission Facilities to be integrated into the PJM Region
- all Members
- the agencies and offices of consumer advocates of the States in the PJM Region exercising regulatory authority over the rates, terms or conditions of electric service or the planning, siting, construction or operation of electric facilities
- any other interested entities or persons
- Communications between TEAC membership, the Office of the Interconnection and the Board of Managers comprise of a written notice-and-comment process. The Office of the Interconnection has the responsibility of compiling comments from TEAC participants. All written comments are posted to the PJM web site and provided to the PJM Board of Managers together with a PJM staff summary focuses on conveying what the issues are; who has raised the issues and why the issues are of importance to Board consideration of RTEP approval. Communication to the Board of Managers will not include results of voting.

PJM staff will be ultimately responsible for preparing and issuing all reports, running the committee meeting, , management of data, final analytical work, and compilation and publication of other relevant documentation that may be required from time to time.

The following core competencies are recommended in order for TEAC members to be able to provide advice and recommendations to the PJM Office of the Interconnection on the preparation of the PJM Regional Transmission Expansion Plan for review and approval by the PJM Board of Managers:

- Sufficient decision-making authority to support the Mission of the TEAC
- Sufficient experience, knowledge, or background to contribute effectively to TEAC discussions and recommendations
- Interpersonal, decision-making, team-working and presentation skills

9 Annexure III: Preliminary views of stakeholders on regional technical institutional mechanism for promoting Cross Border Electricity Trade (CBET) in South Asia

9.1 Context

A web based questionnaire was shared with various regional power sector stakeholders, to understand their opinion and views on establishing a robust regional technical institutional mechanism for CBET in South Asia. This document describes the results of the questionnaire based interaction.

9.2 Summary of responses

A summary of responses is provided below:

- All the stakeholders view the creation of a South Asia Forum of Transmission Utilities (SAFTU) as a positive step.
- The stakeholders view the proposed institutional mechanism as a facilitating body to bring about better co-ordination and consensus for all the cross border lines.
- The stakeholder prefer the SAFTU to focus on the following activities:
    - Regional harmonization of grid codes, interconnection standards and protection standards;
    - Guidelines for Cross Border Electricity Trade (CBET);
    - Regional planning of cross border transmission networks;
    - Consensus building amongst different participating countries towards development and advancement of cross border transmission network; and
    - Consensus building amongst different participating countries towards smooth operation of CB transmission network and enhancement of cross border trade.
- The stakeholders prefer the following attributes related to institutional structure for SAFTU:
    - **Legal status:** An entity created under SAARC/BIMSTEC, or an intergovernmental body specifically created for this purpose;
    - **Institutional structure:** A committee consisting of representatives from different countries, with or without a permanent secretariat;
    - **Financing:** Annual membership fees paid in a mutually agreed manner; and
    - **Selection of Chairperson:** On rotational basis from the different partner countries.

Detailed listing of the questions that were asked, and responses are provided in the following sub section.

The response illustrations are provided based on the following legend, to highlight the preference of various options among the respondents:

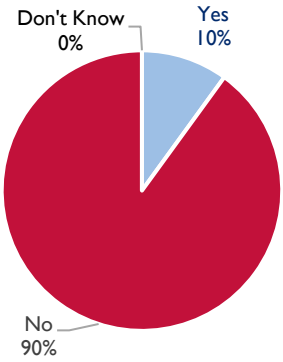
Color Legend:	Most favored by respondents	Moderately favored by respondents	Least favored by respondents

9.3 Questions and responses

Section 1: Nature of SAFTU

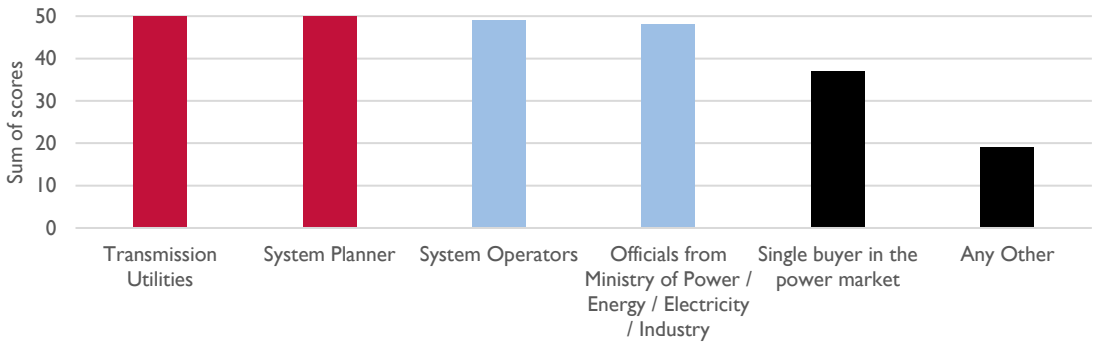
1. The USAID funded South Asia Regional Initiative for Energy Integration (SARI/EI) is planning to facilitate the creation of a South Asia Forum of Transmission Utilities (SAFTU) to coordinate on matters relating to Cross Border Electricity Trade. The creation of forum will be subject to the consent of respective Governments / utilities. What is your preliminary view about the usefulness of such a regional forum?

2. Is your organization part of any other similar forum of transmission utilities at Central / Regional / International level?

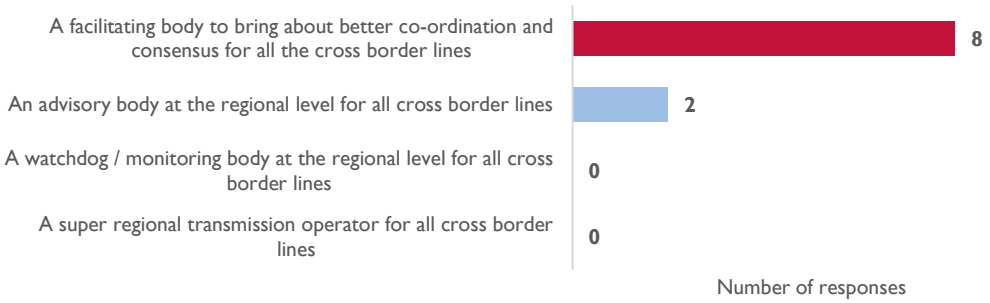


3. If answer to previous question is yes, please list the name of forum in which your organization is a part of.
   - BIMSTEC
   - SAFIR

4. Who all shall be the participants of the proposed forum?
   [Respondents were requested to select one or more of the available options on a scale of 1-6, with 1 having least priority, and 6 having highest priority]

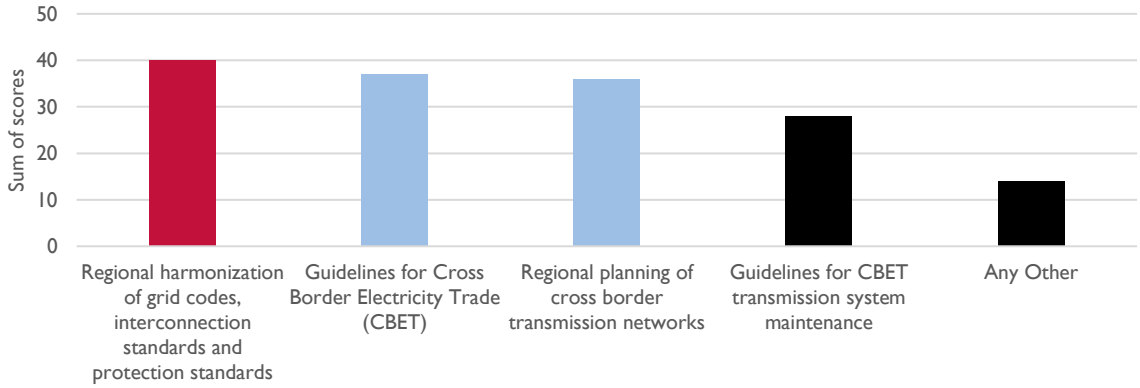


5. How can SAFTU be best described as?
[Respondents were requested to select the best out of available options]



Section II: Functions and duties of SAFTU

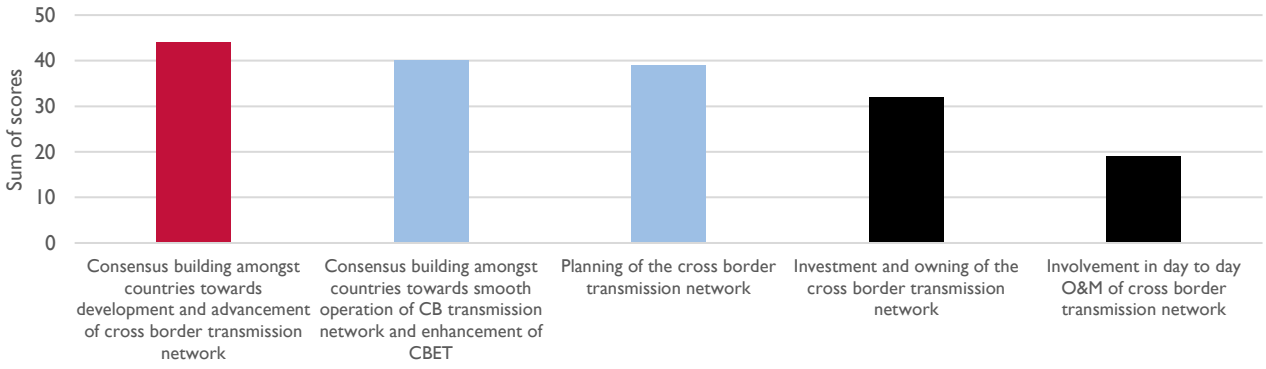
6. What should be the functions of the proposed forum?
[Respondents were requested to select one or more of the available options on a scale of 1-5, with 1 having least priority, and 5 having highest priority]



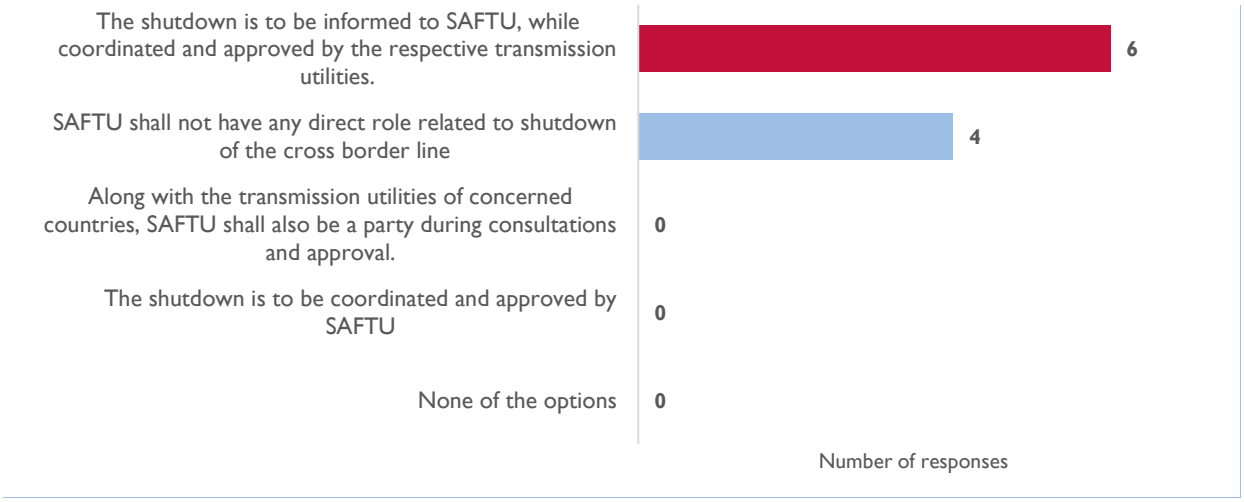
7. If you selected "Any other function" as part of response for the previous question, can you please state that function.

- Awareness and capacity building
- Capacity building of those involved in transmission planning, operation and power trading relating to cross border transmission
- Investment modality of the cross border transmission line

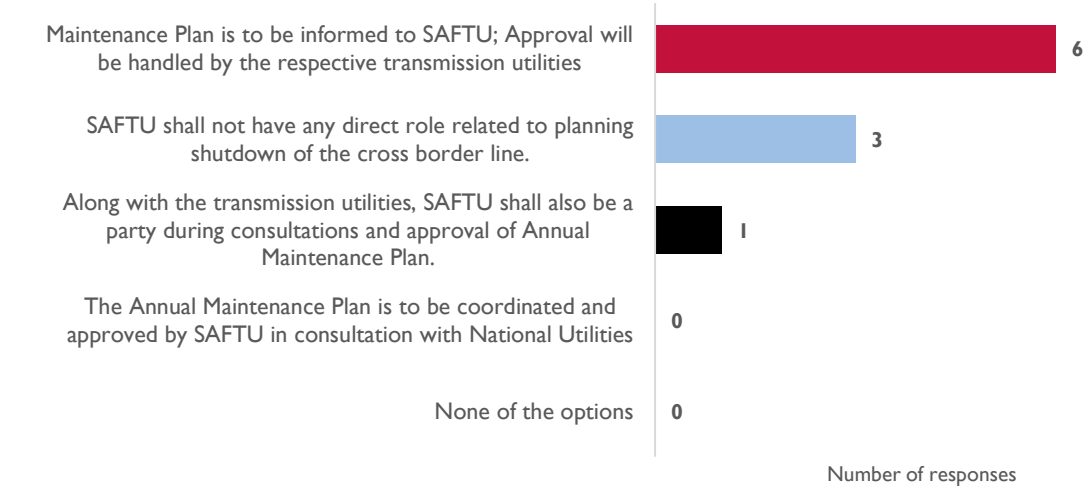
8. How can SAFTU help to supplement the efforts of transmission utilities of different countries?
[Respondents were requested to select one or more of the available options on a scale of 1-5, with 1 having least priority, and 5 having highest priority]



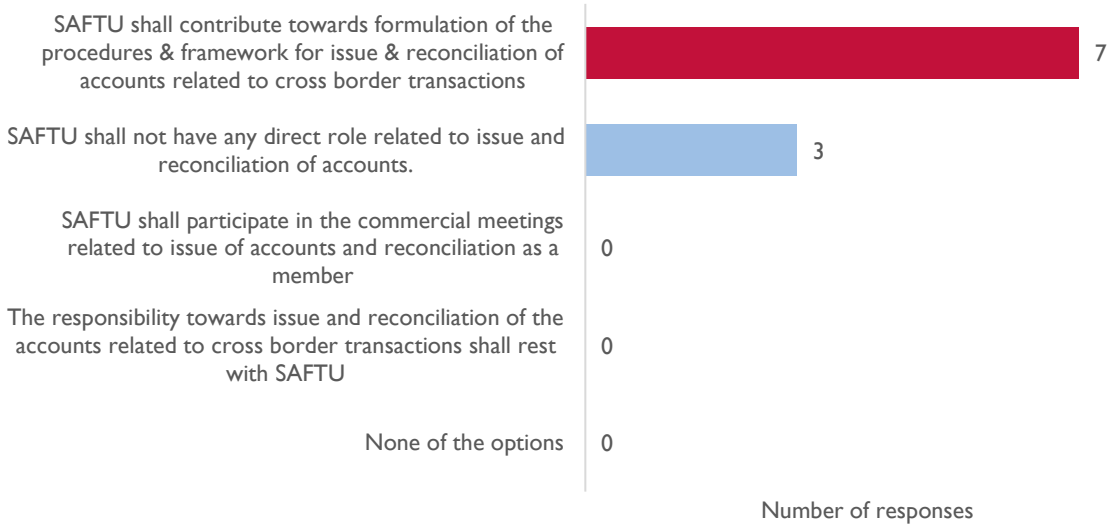
9. While taking a cross border line under shutdown during day to day operation, what can be the role of the SAFTU? *[Respondents were requested to select the best out of available options]*



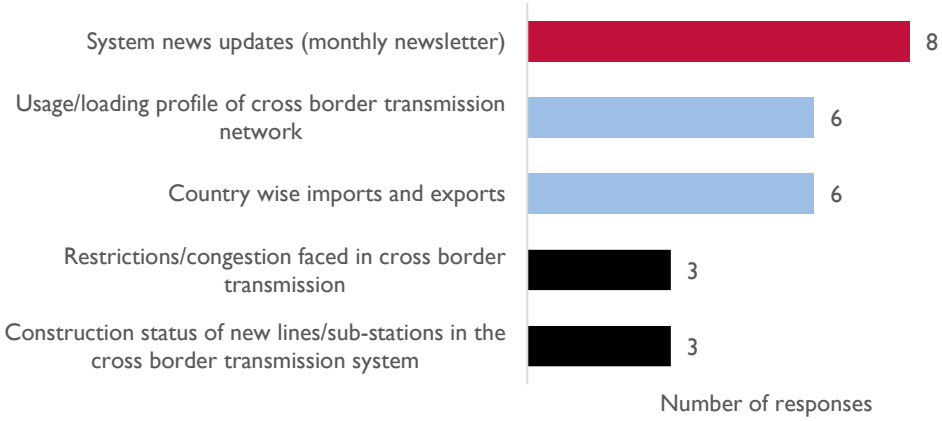
10. While carrying out the Annual Maintenance Planning of the cross border lines, what can be the role of SAFTU? *[Respondents were requested to select the best out of available options]*



11. What can be the role of SAFTU towards issue and reconciliation of accounts related to cross border transactions? *[Respondents were requested to select the best out of available options]*

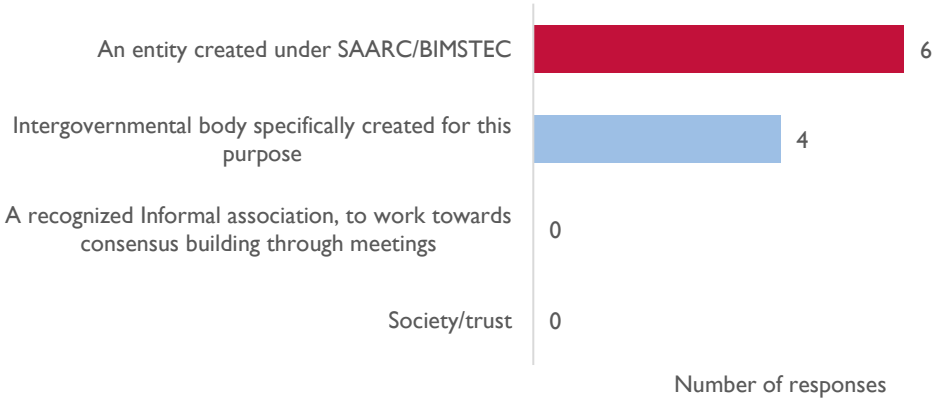


12. What type of information collection and dissemination shall the SAFTU focus on?
[Respondents were requested to select one or more of the available options]

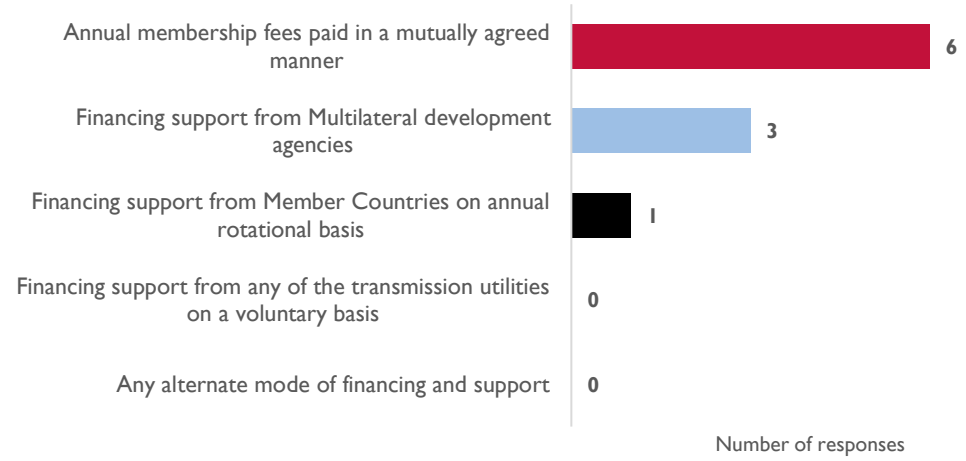


Section III: Institutional structure and financing

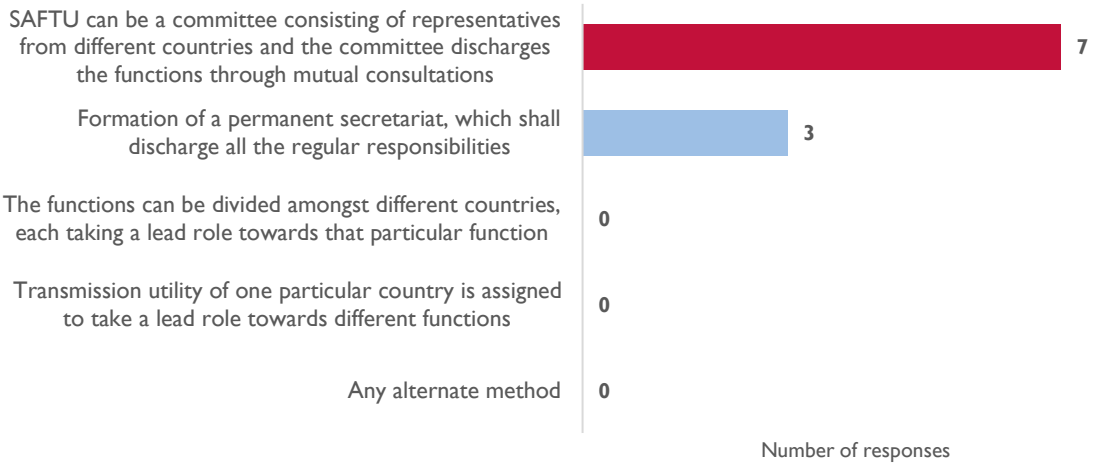
13. If a South Asia Forum of Transmission Utilities (SAFTU) is to be created, what kind of institutional structure should it try to adopt, so that it is easier for your organization to participate in the same?
[Respondents were requested to select the best out of available options]



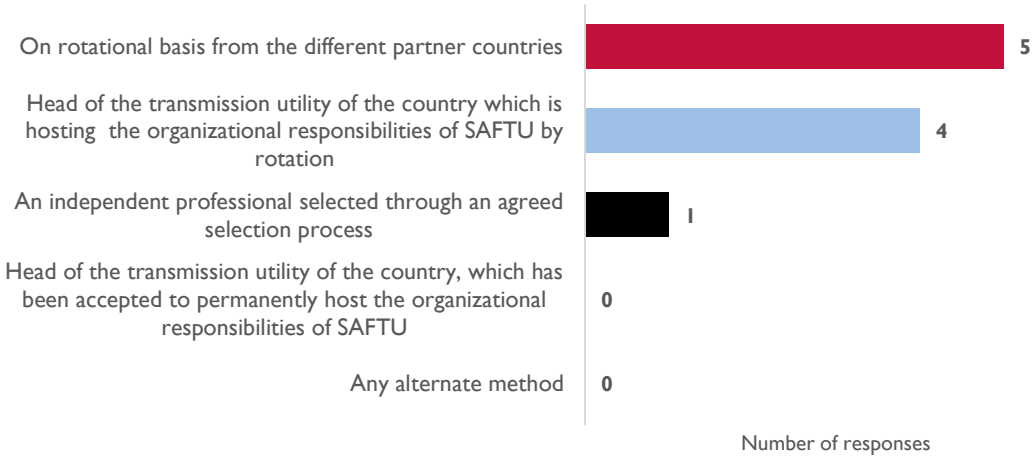
14. How can the operations of SAFTU be financed?
[Respondents were requested to select the best out of available options]



15. What kind of organization structure may the SAFTU adopt?
[Respondents were requested to select the best out of available options]

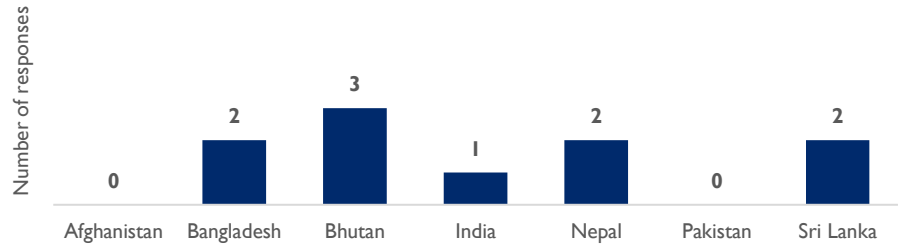


16. How can the SAFTU chairperson be selected?
[Respondents were requested to select the best out of available options]

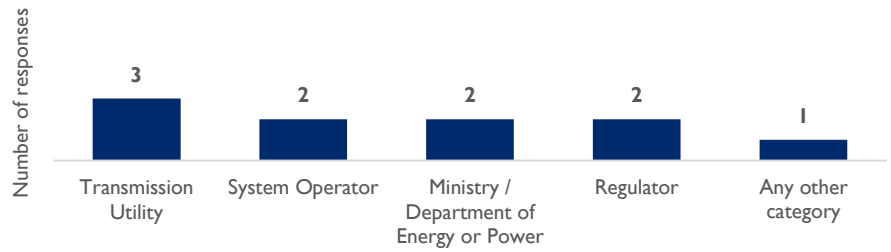


9.4 Response demographics

Country of response



Type of organization



10 Abbreviations

AC	Alternating Current
ACE	ASEAN Centre for Energy
ACER	Cooperation of Energy Regulators
ACG	Arab Coordination Group
ADB	Asian Development Bank
AEMI	ASEAN Energy Market Integration
AFESD	Arab Fund for Economic and Social Development
AMCE	Arab Ministerial Council for Electricity
APAEC	Action for Energy Cooperation
APG	ASEAN Power Grid
APGCC	ASEAN Power Grid Consultative Committee
ASEAN	Association of Southeast Asian Nations
AUE	Arab Union of Electricity
BA	Balancing Authority
BES	Bulk Electric System
BIMSTEC	Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation
BoR	Board of Regulators
BP&B	Business plan and budget
BPS	Bulk Power System
CAF	Corporación Andina de Fomento (or Development Bank of Latin America)
CB	Cross Border
CBET	Cross Border Electricity Trade
CC	Coordination Centre
CDMER	Council of Directors of Regional Market
CEA	Central Electricity Authority
CEERE	Council of Experts of Energy Regulators – Electricity
CERC	Central Electricity Regulatory Commission
CIAN	Committee of Interconnected Arab Networks
CII	Confederation of Indian Industry
CRE	Comísion Reguladora de Energía
CRIE	Regional Commission for Electric Interconnection
CTU	Central Transmission Utility
DAM	Day Ahead Market
DER	Distributed Energy Resources
DFI	Development Finance Institution
DOE	U.S. Department of Energy
DSO	Distribution System Operator
DVC	Damodar Valley Corporation
EIB	European Investment Bank

EJG	Empowered Joint Group
ENTSO-E	European Network of Transmission System Operators for Electricity
EOR	Ente Operador Regional
ERIA	Economic Research Institute for ASEAN and East Asia
ERO	Electric Reliability Organization
ESCWA	Economic and Social Commission for Western Asia
EU	European Union
FDI	Foreign Direct Investment
FERC	Federal Energy Regulatory Commission
FG	Focal Group
FICCI	Federation of Indian Chambers of Commerce & Industry
FOLD	Forum of Load Despatchers
FoR	Forum of Regulators
FPA	Federal Power Act
GCCIA	Gulf Cooperation Council Interconnection Authority
GMS	Greater Mekong Sub-region
GoI	Government of India
G, T, D	Generation, Transmission, Distribution
HAPUA	Heads of ASEAN Power Utilities/Authorities
HEP	Hydro Electric Power
HVDC	High Voltage Direct Current
IADB	Inter-American Development Bank
ICT	Interconnecting Transformer
IDM	Intra Day Market
IEA	International Energy Agency
IFI	International Financial Institution
IGA	Inter-Governmental Agreement
IRENA	International Renewable Energy Agency
ITC	Interconnection Transmission Code
JSC	Joint Steering Committee
JWG	Joint Working Group
MDB	Multilateral Development Bank
MENA	Middle East and North Africa
MER	regional electricity market
MFI	Multilateral Financial Institution
MoU	Memorandum of Understanding
MRC	Member Representatives Committee
NEEPCO	North Eastern Electric Power Corporation Limited
NEL	net-energy-for-load
NERC	North American Electric Reliability Corporation
NGO	Non-Governmental Organisation

NHPC	National Hydroelectric Power Corporation
NLDC	National Load Despatch Centre
NRA	National Regulatory Authorities
NTPC	National Thermal Power Corporation Limited
OCC	Operation Coordination Sub-Committee
PAEM	Pan-Arab Regional Electricity Market
PA-RETP	Pan-Arab Regional Energy Trading Platform
PETA	Power Exchange and Trading Agreement
POSOCO	Power System Operation Corporation Limited
PPA	Power Purchase Agreement
PRC	People's Republic of China
PWG	Planning Working Group
RC	Reliability Coordinator
RLDC	Regional Load Despatch Centre
RPC	Regional Power Committee
RPTCC	Regional Power Trade Coordination Committee
RPTOA	Regional Power Trade Operating Agreement
RSCI	Regional Security Coordination Initiative
RTI	Regional Technical Institution
RTR	Regional Transmission Network
SAARC	South Asian Association for Regional Cooperation
SAC	South Asian Countries
SADC	Southern African Development Community
SAFEM	South Asia Forum for Electricity Market
SAFIR	South Asia Forum of Infrastructure Regulators
SAFSO	South Asian Forum of System Operators
SAFTU	South Asia Forum of Transmission Utilities
SAPP	Southern African Power Pool
SAPP-MTP	Southern African Power Pool-Market Trading Platform
SARI/EI	South Asia Regional Initiative For Energy Integration
SECI	Solar Energy Corporation of India
SERC	State Electricity Regulatory Commission
SIEPAC	Central American Interconnection System
SLDC	State Load Despatch Centre
SOC	System Operations Committee
STU	State Transmission Utility
TA	Technical Assistance
TCC	Technical Coordination Sub-Committee
TOP	Transmission Operator
TSO	Transmission System Operator
ZIZABONA	Zambia-Zimbabwe-Botswana-Namibia

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About SARI/EI

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

About USAID

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

About IRADe

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

For more information, please visit the SARI/EI project website:
https://sari-energy.org/