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Developing a Strategy/White Paper on

# Creating Regional Network for sharing operational best practices and promoting harmonization & excellence in Power System Operation across South Asia Region

## IRADe-SARI-35 (2021)

August 2022

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# Creating Regional Network for sharing operational best practices and promoting harmonization & excellence in Power System Operation across South Asia Region

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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-35 (2021)

# Preface

We are pleased to present this strategy paper on "Creating Regional Network for sharing operational best practices and promoting harmonization & excellence in Power System Operation across South Asia Region". It 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).

The South Asia Regional Initiative for Energy Integration (SARI/EI) program has been advocating the need of a regional institutional mechanism in South Asia for enhancing the level of cooperation in the field of system operation and safe and secure operation of the regional grid. In this paper, a critical review has been carried out to analyse the different regional institutions and power pools in the different parts of the world, as well as regional multilateral forums in South Asia, such as SAARC, BIMSTEC and SAFIR. Based on the learning from these, the recommendations towards formation of such an institution in South Asia has been provided, including the proposed legal framework, governance mechanism, operating structure, and funding mechanism etc., towards its autonomous and self-sustained operations. Under the conclusion, the action plan towards achieving this goal and the ensuing specific gains have also been deliberated, including the optimization details in power system operation.

It has been envisaged that the proposed regional network shall also give an opportunity to the power system operators and practitioners in the different countries to share knowledge, exchange ideas, discuss operational best practices, collaborate and form consensus on the issues of common interest and build capabilities in this area. The proposed network would be advisory in nature and would aspire to collectively leverage the experience and technical know-how of power system operators in South Asian Countries (SACs).

During the course of preparation of this document, the draft Report was circulated to the key officials and decision makers in South Asian Country governments (Energy/Power Ministries), Electricity Regulatory Commissions, Planning Authorities etc. Their feedback and thoughts have helped make this report more robust and relevant to all the stakeholders. I hope that this report will be a useful reference point for facilitating enriching discussions on regulatory measures/intervention needed for ensuring grid discipline and grid reliability in the SA region.

I am grateful to the USAID for their continued support in the preparation of this report. I would like to acknowledge the excellent work done by KPMG in developing the report. I sincerely thank the research team at SARI/ EI Secretariat /IRADe for their valuable inputs, through sustained efforts in ensuring that the report is completed despite the restrictions posed by the lockdown due to Covid pandemic.

Jyoti Parikh

Dr. Jyoti Parikh

Executive Director, IRADe

# 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), was launched in 2012. It focuses on three developmental outcomes. These include: the establishment of a Policy, Legal and Regulatory Framework, the advancement of Transmission Systems Interconnection and the establishment of the South Asia Regional Electricity Market. This phase is being implemented by the Integrated Research and Action for Development (IRADe).

A key focus of the SARI/EI program is institutional strengthening and engagement of regional institutions in South Asia. For the power system in each country, the System Operator is responsible for safe, secure and reliable operation of the power grid. When the grids of two or more countries are integrated, the System Operators of these countries have to work in close coordination with each other to maintain the security of the integrated grid, especially with power markets playing a role. As cross-border electricity trade (CBET) increases with a greater number of interconnections and advancement of market operations, it is desirable to have an institutional platform that can help the system operators to discuss the technical issues related to the regional grid integration.

As a part of the SARI/EI program, a White Paper has been prepared with the aim to develop a detailed strategy for creating a regional network for power system operators and practitioners to share knowledge, exchange ideas, and discuss best practices. Based on this White Paper, the proposed network would be advisory in nature and would aspire to collectively leverage the experience and technical know-how of power system operators in South Asian Countries.

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

Sincerely,

MaryTyler Holmes

**MaryTyler Holmes**
**Acting Director, Indo Pacific Office,**
**USAID/India**

# Executive Summary

South Asia is amongst the fastest growing regions in the World driving forward the global economic growth. With rapid economic growth, the energy demand in South Asia is expected to more than double by 2030 against 2018[1] levels. Expanding and improving electricity services are imperative for the region—not only for economic growth but also to meet growing energy security and access concerns. Regional and sub-regional institutional mechanisms have been pivotal in nurturing inter-country relationships and regional cooperation in South Asia. Energy, being a key driver of socio-economic growth, has been at the core of such regional cooperation.

South Asia has strong potential for Cross Border Electricity Trade (CBET). Fulfilling regional energy requirements through CBET provides for regional energy security by diversifying energy forms and supply sources and lowering the cost of energy supply. Further, CBET enables integration of markets for higher economic development, and promotes energy efficiency.

The USAID initiated program, South Asian Regional Initiative for Energy Integration (SARI/EI), has a long history of working on CBET and facilitating regional cooperation amongst stakeholders in South Asia and has undertaken various initiatives to support this endeavor. The present study titled ***"Creating Regional Network for sharing operational best practices and promoting harmonization & excellence in Power System Operation across South Asia Region"*** has been developed under the Task Force 2 of SARI/EI[2].

The study aims to develop a detailed strategy for **creating a regional network for power system operators and practitioners to share knowledge, exchange ideas, discuss best practices, collaborate and form consensus on the issues of common interest and build capabilities in this area. The proposed network would be advisory in nature and would aspire to collectively leverage the experience and technical know-how of power system operators in South Asian Countries (SACs). It is envisaged to be an association of the entities dealing with the subject of power system operation and control, with voluntary participation by member countries.**

The following sections provides the context and rationale for creating this network.

## *I. Context*

In view of the resource and demand complementarities that exist in South Asia, CBET provides a sensible option for countries in the region. However, despite having strong potential, CBET in South Asia is yet to be fully harnessed and the enhancement of energy trade amongst the different countries in SA can bring significant changes in overall economy and optimization in the use of resources in the region.

Currently, CBET in the South Asia region has been predominantly unidirectional in the form of bilateral arrangements between India-Nepal, Bhutan-India and India-Bangladesh; with an aggregate trade of ~3700 MW in terms of Peak MW and around 18 TWh in terms of cross border energy during the FY 2020-21. The exchange of power has been facilitated mostly by Government-to-Government arrangement amongst Bangladesh, Bhutan, India and Nepal; by deliberating the issues in the Joint Steering Committees (JSC) and Joint Working Groups (JWG) at the bilateral level. Further, the recently notified Procedure for Approval and Facilitating Import/Export (Cross Border) of Electricity by the CEA (India) also specifies formation of Joint Operation Committee (JOC) and Joint Technical Team - Transmission (JTT-T) for bilateral engagement.

Going forward, CBET in South Asia is set to increase with strengthening of internal transmission & sub-transmission systems and development of new cross border links in the region (including the proposed link between India and Sri Lanka). Further, recent developments in the legal, policy & regulatory framework in India, w.r.t CBET and increased

[1] https://www.saarcenergy.org/wp-content/uploads/2019/05/SAARC-Energy-Outlook-2030-Final-Report-Draft.pdf
[2] Details of Task Forces can be found at: https://sari-energy.org/about-sariei/sariei-phase-iv/task-forces/

consensus towards tripartite contracts and market based (participation in Indian power exchanges) trading arrangements shall also enable greater regional integration. All this shall entail cooperation amongst stakeholders in a collective manner.

## *II. System Operation in South Asia*

System Operator (SO) plays an important role in the power system operation, ensuring the operational security of the power system, maintaining the balance between demand and supply, ensuring adequacy of the transmission system and contributing towards efficient functioning of the electricity grid. **As trade arrangements progress through integration as well as through other modes, the system operators of SACs would have to work in close association with each other to maintain seamless operation of the integrated system. Such association amongst SOs is useful, given the power systems of SACs are at various stages of development and vary substantially in terms of size and complexity**. **Such association will provide an opportunity to SOs in the region to engage, collaborate, and learn from each other's system characteristics and evolutionary journeys**. An in-depth analysis of the organizational structures, resource mix, key mechanisms and institutions governing the system operations, and operating frameworks and practices of power system operation in South Asia have revealed similarities and divergences across the countries (refer Box E.1), which provides strong basis for association amongst the SOs.

**Box E.1: Similarities and divergences across the SACs**

- **Power systems in South Asia vary in size and operation-** While India has a large integrated grid with regional and national level system operation, most of the other countries have mid-size and small power systems with primarily centralized system operation. Maldives has a small system with integrated utilities servings numerous islands.
- **Distribution of resource is uneven across South Asia**- The region possesses significant indigenous energy resources, however owing to its uneven distribution across the region, the South Asian countries differ in terms of their primary fuel usage. The generation supply mix in Afghanistan, Nepal and Bhutan is hydro dominated, Maldives has high dependence on diesel, Bangladesh and Pakistan depend on gas, whereas Sri Lanka is oil based. In India, coal is the dominant source, but the country has made significant progress in the development of renewable energy over the past few years. More recently, other SACs (e.g. Maldives) have also committed to expand their renewable energy capacity and move towards cleaner power generation options.
- **Different types of organizational structure exist with varying models of system operation**- There exist four models of system operation, with varying size of the grid, complexity of operations and degree of power sector unbundling. While Nepal, Sri Lanka, Afghanistan and Maldives have Vertically Integrated Utilities (VIU) undertaking system operation, Bangladesh and Bhutan have Legally Unbundled Transmission System Operator (LTSO). Pakistan has Independent Transmission System Operator (ITSO), which owns and operates the grid. India has a fully Independent System Operator (ISO) with clear distinction from the entity owning and maintaining the grid.
- **Key mechanisms and institutions to govern power system operation-** There exist adequate mechanisms (electricity law, regulation, policy) and institutions (system planning agency, system operator) to govern power system operation in respective countries. However, there are also variations that exist with distinct characteristics of each country. For example, in India, system planning is undertaken by CEA (which is a separate technical body under Ministry of Power, Govt. of India), however, in other countries system planning is undertaken by specific planning departments/wings in key entities. Similarly, India has an independent system operator, while in other countries, different models of system operation (like VIU, LTSO and ITSO) are being followed.
- **Power system operating frameworks and practices vary across South Asia**- There is variation in the system operating frameworks of South Asian countries. While grid code exists in most of the countries, the operating standards and practices differ. For instance, though all the countries in the region operate at the frequency of 50Hz, the tolerance band varies from as high as +/- 1.25 Hz in case of Nepal to as low as +/- 0.05 Hz in case of India. Deviations are also observed in case of other critical aspects, such as voltage levels, system security mechanisms and control mechanisms.

The similarities and divergences as elaborated above gives an opportunity to learn from the experiences of one another as well as to quickly leapfrog the good customs and practices established in one system to the others. Further, as far as the integrated system operation of cross-border interconnections is concerned, currently these are being managed with system operator level interactions at the bilateral level. However, **going forward with emergence of newer and enhanced cross border power trading opportunities; harmonization and convergence amongst SOs would be needed. This can be achieved through deeper and sustained engagement, knowledge exchange and collaboration amongst SOs in the region.**

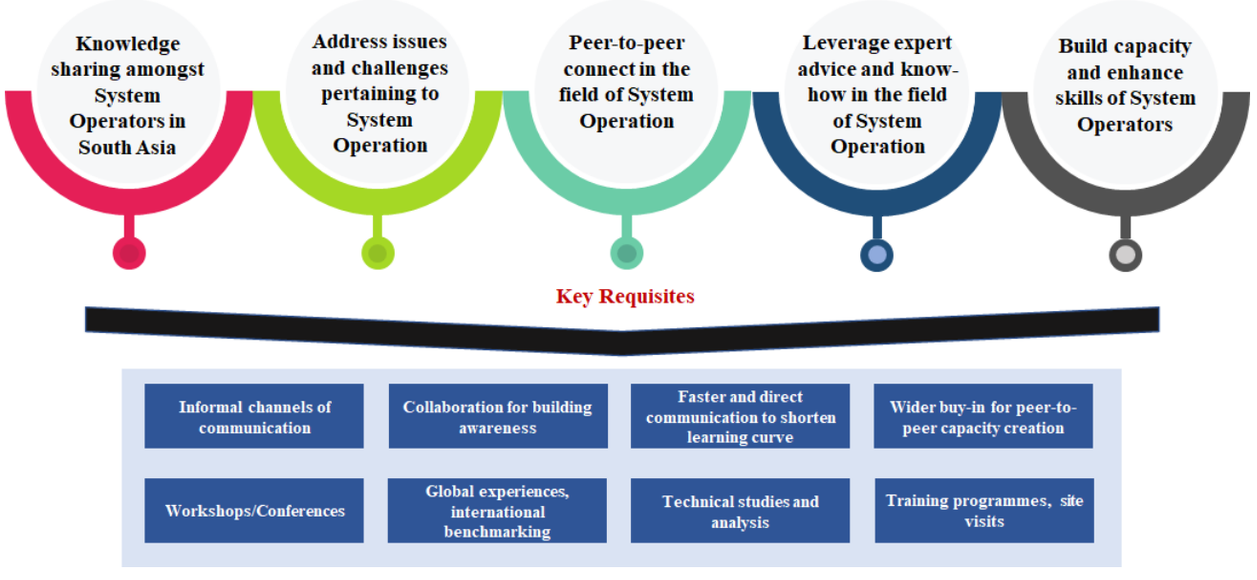
## *III. Need and Role of a Regional Network*

SARI/EI, along with other bodies such as South Asian Association for Regional Cooperation (SAARC) and South Asia Forum for Infrastructure Regulation (SAFIR), serve as stages for policymakers, regulators and other stakeholders to meet on a regular basis and share their experiences and work towards improvements at regional level. **System Operation being a specialized technical function; closer collaboration and knowledge sharing on such subjects would require relevant participants (i.e. System operators in SACs) to come together in exclusive forums to discuss and deliberate on topics linked to their role.** Most of the existing regional collaborative forums and platforms do not have avenues for such exclusive coverage within their mandate. Till date, any regional network for collaboration in South Asia to enable system operators across the region to engage and share knowledge/ideas at the field level in a collective manner, is generally not there**. The existing mode of engagement amongst SOs is more formal and focused on bilateral coordination between select countries. While these addresses the immediate and project specific coordination requirements, the need for a deeper and informal connect amongst SOs at a regional level is much needed**. Consultations and discussions with country governments as well as system operators in SAC have also indicated the need for the following:

- Sharing of good practices and knowledge amongst system operators
- Capacity Building and skill enhancement of system operators
- Avenues for more informal peer to peer connect (SO in one country with SO in other country)
- Collectively leveraging expert advice and know-how for benefit of the region

In this context, the overall rationale/need for creating a regional network of system operators has been indicated in Figure E.1.

Figure E.1: Need for creating a regional network of system operators



There has been a consensus amongst the stakeholders that the above can be fulfilled through creation of regional network of SOs. **The proposed network shall supplement[3] the present level of bilateral cooperation amongst SOs by providing an opportunity to SOs to meet, collaborate, share knowledge, exchange ideas, discuss best practices, try to build consensus on the issues of common interest and build capabilities in the field of power system operation. The proposed network would be advisory in nature. It would be formally established with flexible and voluntary participation by member countries**.

With the above backdrop, this study has been undertaken to develop a detailed strategy for "***Creating Regional Network for sharing operational best practices and promoting harmonization & excellence in Power System Operation in South Asia Region*".** The study involves (i) '**As Is' review of South Asia** w.r.t System Operations (ii) **Analysis of International regional system operators and forums** and (iii) Study of **Regional Multilateral Forums in South Asia.** Based on the analysis, the **overall institutional structure of the network has been recommended for consideration. The same has been highlighted in subsequent sections.**

The following sections provides the Vision, Mission and Key Objectives/Functions of the proposed Regional Network.

## *IV. Vision & Key Objectives/Functions*

Box E.1 indicates the Vision and Mission of the proposed network.

**Vision**: To be a regional network for cross cutting deliberations, exchange of ideas, sharing of operational best practices and capacity building in the matters related to safety, security, reliability, sustainability and economy of the Power System Operation in South Asia Region, as well as endeavor to collaborate with the neighboring regions on the issues of common interest.

**Mission:** To facilitate seamless exchange of knowledge, expertise and best practices in the domain of Power System Operation, by establishing an advisory network for enabling collaboration among Power System Operators in the South Asia and the neighboring regions.

### *Key Objectives and Functions:*

The proposed network aims to be a neutral entity set up as an Association, that will function in a spirit of cooperation and collaboration, with the following main objectives/functions:

i) **Exchange of Ideas**: Act as a platform for crosscutting deliberations and exchange of ideas towards promoting safe, secure, reliable and efficient power system operation in South Asia. This shall include documentation and sharing of experiences related to system operation, discussions on standard operating procedures/guidelines and harmonization of practices including international benchmarking in the matters related to system operation;

ii) **Knowledge Dissemination**: Sharing of technical know-how on advanced/sustainable energy systems, their impact (economic, social, environmental etc.), particularly in the areas of renewable energy integration and grid balancing, taking into view the diverse sources of energy available in South Asia region;

iii) **Technical Support/Expert Advice:** Carry out technical studies/assessment in the area of power system operation for the purpose of knowledge creation and creating evidence to support CBET. This shall include leveraging expert advice and know-how including global experiences in power system operation;

[3] The proposed regional network can also undertake technical studies and capacity building activities on demand by the existing bilateral governmental forums (Joint Working Groups, Joint Steering Committees) and bilateral mechanisms (Joint Operation Committee, and Joint Technical Team – Transmission) in the region.

iv) **Skill Development**: Facilitate and render assistance towards skill development and capability enhancement of human resource employed at the Load Despatch Centres. This shall be done with the intent to use the latest technologies and tools, in order to further enhance the level of system operation;

v) **Workshops/Conferences**: Conduct workshops for different stakeholders in SAC on matters related to system operation. These shall include the different aspects related to sharing operational practices, promoting harmonization and excellence in system operation and matters related to greening the regional grid;

vi) **Deliberation on Best Practices/Issues**: Discuss the best practices and technical issues related to system operation in the different parts of the region and across the globe in an effort to build consensus through discussions on the issues of common interest and goal.

The following section provides the key learning from the analysis undertaken in this study.

## *V. Learning from Global Organizations*

The analysis of various international organizations undertaken in the study indicates that globally these organizations have varying structures, governance mechanisms and operating frameworks. **The different organizations have charted their own path during evolution of system and to begin with, many of them started functioning as associations based on loosely formed structures, and later on as they gained momentum, transitioned into more formal structures and legal framework. The experience of these organizations not only provides useful learning for the network, but also puts forth different options across the key elements** of the organization's structure to choose from. These elements include (i) **Legal Framework (ii) Membership (iii) Organizational membership (iv) Headquarter and Handholding (v) Governance Mechanism (vi) Operating Structure and (vi) Funding Mechanism.** Table E.1 compares various global organizations across the above elements.

Table E.1: Comparison of global organizations across the key elements of an organization's structure.

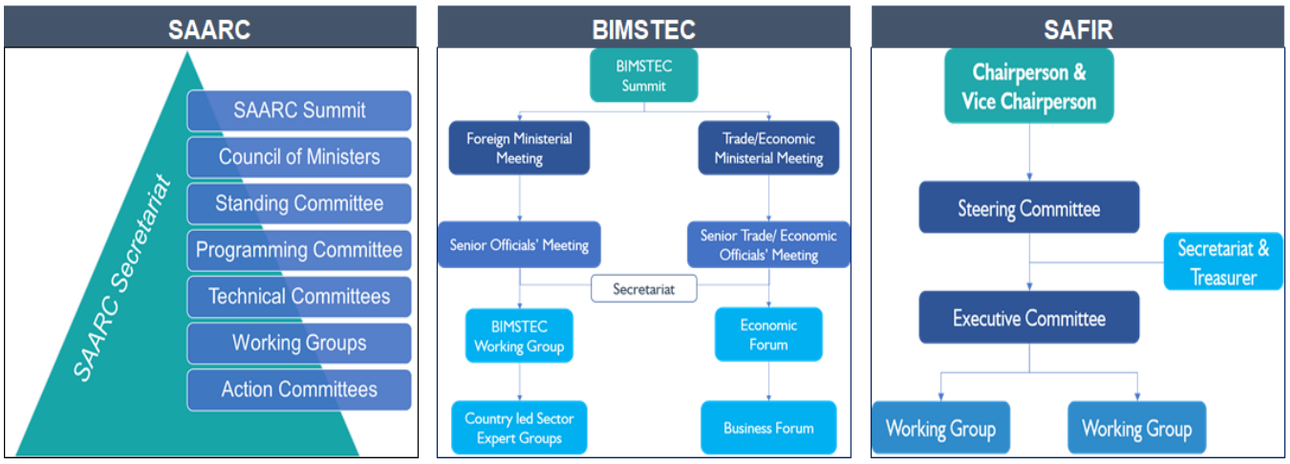
| | ENTSO-E | PJM | SPP | SAPP | WAPP | GCCIA | GMS | FOLD |
|---|---|---|---|---|---|---|---|---|
| **Legal Framework** | Society/Asso - ciation formed in line with EU mandate and registered under Belgian Law | Limited Liability Company | Association incorporated of diverse group of utilities and transmission entities | Inter-government and inter-utility agreements/ MoUs | Inter-governmental agreements | Joint Stock Company | Inter-Government Agreement/MoU | Association |
| **Member Countries** | 35 EU countries | Parts of 13 states in USA and District of Columbia | Parts of 14 states in USA | 12 Southern African Countries | 15 West African Countries | 6 Gulf Countries | 6 Member Countries (only 2 provinces of China are members of GMS) | States and regions of India |
| **Organizational Membership** | 42 TSOs of member countries | 1040 members across gencos, transcos, discoms, end-consumers and other suppliers | 98 members across municipal systems, govt. agencies, IPPs, and other power entities | 17 national electric companies from member countries | 29 national electric companies from member countries | Ministries of Energy and Water of member countries | Governments of member countries | 29 State, 5 regional and one national load dispatcher |
| **Headquarter Location** | Brussels, Belgium | Valley Forge, Pennsylvania, USA | Little Rock, Arkansas, USA | Emerald Hill, Harare, Zimbabwe | Cotonou, Benin | Al Khobar, Saudi Arabia | ADB, Manila - Philippines | NLDC, Delhi, India |
| **Governance Mechanism** | Assembly, Board, Committees and Secretariat | Board, Members, User Groups, Market Reliability and other committees | Membership, Board/Members Committee, Regional State Committee and other committees | SADC Direct. of Infra. and Services; Ex. Committee, Board & other committees | General Assembly, Executive Board, general secretariat and committees | Ministerial Committee , Advisory & Regulatory Committee (ARC), Board and other committees | GMS Summit, Ministerial Meeting, Senior Officials' Meeting and sector working groups | General Body, Steering Group and working groups |

| | ENTSO-E | PJM | SPP | SAPP | WAPP | GCCIA | GMS | FOLD |
|---|---|---|---|---|---|---|---|---|
| **Operating Structure** | System Operation, Development ,Market, and R&D committee | Planning Operating Markets and Implementation committees and other temporary subcommittees / task forces | Strategic Planning, Oversight, Markets Operations, HR Finance committees and other subcommittees/ groups | Environmental Markets Operations, planning subcommittee, Coordination Centre and Project Advisory Unit | Engineering Operations Planning Environmental Distribution Commercial Finance and HR & Governance Committees | Planning committee and Operation committee | Regional Power Trade Coord. Com. (RPTCC), Working Group on Planning Operations. (WGPO) and Working Group on Regulatory Issues (WGRI) | WGs to advise the Steering Committee on matters related to PS and electricity market operations |
| **Funding Mechanism** | Membership Fee | Fee for operating transmission system and market | Transmission Fee, Member-ship Fee, Contract Service charges and other miscellaneous revenue | Member contributions, Donor grants and Market Administration Fee | Primary revenue from fee on exchange transaction | Funded by contributions from member countries and interconnect usage charges. Project funding distributed on basis of NPV of benefits | Primarily funded by ADB Additional financial support from other multilateral donor/ funding agencies like WB, AFD, AusAID | Financially supported by NLDC (no Membership Fee collected) |

## *VI. Learning from Regional Multilateral Forums*

The regional multilateral forums offer key learning in terms of the legal frameworks adopted by organizations, their membership profile, governance, and organizational structure including head quarter location. Figure E.1 indicates the structure of key regional multilateral forums in South Asia.

Figure E.1: Structure of regional multilateral forums in South Asia




Key observations from the review of regional forums are as follows:

- **SAARC:** Created through signing of an intergovernmental agreement namely the SAARC Charter with all countries in South Asia as members of the organization. Permanent secretariat located in Nepal. SAARC has a broader mandate (electricity being one of the components in the overall agenda) with multiple layers of governance and oversight. Activities of SAARC are funded by member countries.
- **BIMSTEC**: Created through an intergovernmental agreement in the form of Bangkok Declaration. Membership includes seven (7) countries in the Bay of Bengal Region with permanent secretariat located in Bangladesh. Different priority sectors and subsectors of BIMSTEC are led by different member countries of the organization. BIMSTEC has a 4-tiered organization structure.

- **SAFIR**: A specialized technical forum of infrastructure sector regulators created as an 'Association of Persons'. Secretariat services for SAFIR are provided by CERC, which is an existing member institution. SAFIR operates through a hybrid structure involving permanent steering and executive committees as well as ad hoc working groups. Initially sponsored through multi-donor funds, SAFIR has eventually adopted a financial mechanism, wherein annual membership fee is also collected from its member organisations.

- **BBIN**: A voluntary sub-regional organization comprised of members having existing bilateral connections. An informal organization created with the objective to move beyond bilateral agreements for regional connectivity. BBIN is informally operated through a system of Joint Working Groups to ensure minimal complexity and quick action.

The study also assessed the suitability of these regional forums to host/handhold the proposed network for system operators. However, the assessment found none of these to be suitable for hosting such a network since: (i) most of these organizations have a diverse and cross-sectoral mandate, hence cannot dive deep into one specific aspect i.e. system operation of the electricity sector hence may not suit the operating structure of such organizations; and/or (ii) coverage of forums that either did not represent all South Asian countries or had mandate beyond the South Asia region.

System Operation being a specialized technical function; closer collaboration and knowledge sharing on such subjects would require relevant participants (i.e. System operators in SACs) to come together in exclusive forums to discuss and deliberate on topics linked to their domain and role. With the overall mandate being knowledge sharing and capacity building, an organization with similar mandate would be more suitable to host and operate such a network.

In view of the above, various options across the key elements of an organization's structure have been studied in this report to identify the best suited option for the proposed network. The following section provides the key options based on different parameters and eventually recommends the most suitable course of action for the proposed network.

## *VII. Key Options and Recommendations for the Proposed Network*

The experience of international organizations and regional forums not only provides useful learning about these institutions, but also puts forth different options across the following key elements of an organization's structure for consideration. Figure E.2 indicates the key options.

Figure E.2: Options across key elements for the proposed organization

| Key elements | Options | | | | |
|---|---|---|---|---|---|
| Legal framework | *Inter-Governmental Agreement/MoU* | *Inter-Utility Agreement/MoU* | *Registered Society* | *Company* | *Association* |
| Member countries | *All countries in South Asia* | *Initial members comprising countries already engaged in power trade* | | | |
| Organization membership | *Core members: National Power System Operators in member countries. Additionally, representatives from System Planning Organizations (where different from system operators); Operational, Technical, Commercial, Regulatory Bodies and Govt. Depts. etc. associated with system related functions can participate as honorary members in various committees*<br>*Associate Member: Member from adjacent region (such as Southeast Asia) on voluntary as observers* | | | | |
| Governance mechanism | *1. Executive Council 2. Working Groups* | | | | |
| Headquarter & Handholding | *Permanent Independent Headquarters in a member country* | *Headquarters co-located with the handholding organization (one of the member power system operator)* | *Headquarter rotating after every two/three years, coinciding with the country of the elected chairman* | | |
| Operating structure | • *Decision making philosophy: Consensus based*<br>• *Execution through Working Groups: Operational, Technical, Planning Groups*<br>• *Reporting framework: Executive Council to provide strategic guidance; Working Groups to report to the Executive Council and provide regular updates on tasks*<br>• *Secretariat: Handholding organization to provide administrative and coordination support* | | | | |
| Funding mechanism | *Voluntary funding support by the handholding organization* | *Donor/Grant Support for occasional and substantial expenditure* | *Membership Fee/contribution* | | |

**The above options across the key elements of an organization's structure have been studied in this report and their merits and demerits have been analyzed for applicability to the proposed network. The choices have been made keeping in perspective the objectives of the network, its functions and expectations from the proposed network. Further, options have also been weighed against various stages of network's evolution in order to identify the best suited option in the initial stage as well as in the long run**.

Based on above, this report recommends the most appropriate structure for the proposed network as follows:

- **Legal Framework/Type of Entity**- It can be set up as **an association,** to be **established with flexible and voluntary participation by member countries. The decisions shall be through consensus building and operationally flexible, ensuring greater acceptability amongst the participant countries.** It will undertake the activities which are **advisory in nature** and focused on **capacity building, knowledge sharing, expert inputs and promoting harmonization and excellence** in the field of system operation across the region. *FOLD and SAFIR with similar mandate, have also been established as associations.*

  ***Advantage:*** The mechanism can be setup quickly, easy to implement and is appropriate for engagement & collaboration based on discussions. Further, it provides flexibility to the network by quickly operationalizing its activities, making it effective during early stages.

- **Members**- **Country participation can be on voluntary and open to all South Asian Countries.** Additionally, other neighboring countries such as Myanmar can also be invited to participate, depending on the interest of the country.

  ***Advantage:*** Membership remains open and inclusive. BBIN countries can build upon their existing bilateral engagements, to kick start the operation, with other countries joining in due course based on their interest. Invited members like Myanmar can also derive benefit by participation.

- **Governance/Representation-** A simple 2-tier governance structure, including the following:

  **(i) Executive Council**: The Executive Council can provide overall **guidance and oversee the activities** of the network. It can comprise **heads of national power system operators (**or any other designated officer as may be nominated from the respective country) and representatives **from transmission planning agencies.** The **Chairpersonship** of the council can be on a **revolving basis** with each country getting the **chairpersonship for a period of 2 year.**

  (ii) **Working Groups**: This can include three (3) working groups- Operational, Technical and Planning. The participation can include **representation from SOs, planning agencies, transmission utilities, government departments and regulating agencies and invitee from academia and other relevant organizations**. Each working 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 network can be managed by a handholding organization (acting as the Secretariat) for overall administration and coordination support.

  ***Advantage:*** The structure has been derived from experience of similar international organization, and provides light handed governance for network to operate and engage in a meaningful manner.

- **Handholding/Secretariat-** It can be explored that the **national power system operator of a member country provides handholding to the network, in terms of location as well as providing the secretariat support, on voluntary basis**. This leads to the fact that the headquarters of the network to be co-located with the handholding organization[4] i.e. the premises of one of the member national power system operator.

  ***Advantage:*** The mechanism can be effective in early stages of organization to quickly operationalize it and can provide benefits of shared infrastructure and resources.

  It is important that in the early stages, the handholding of the proposed network is done by a **national power system operator which is willing to take up the role of handholding** to support the fulfillment of the network's mandate. The secretariat and headquarters of the network in its early stages may be **co-located with the handholding national system operator** where the existing frameworks, infrastructure and resources can be leveraged for operationalizing the network**.**

- **Funding Mechanism-** As stated earlier**,** on the pattern of FOLD, it can be explored that the **national power system operator of a member country provides handholding to the network,** including the **support for locating the headquarters as well as for providing the secretariat services as the host country, on a voluntary basis and also taking care of the associated expenditure.**

  - Further, looking at the operational structure and philosophy, during the operational phase also, the **expenditure towards operating the secretariat may not be substantial** and that can also be met on voluntary basis by the handholding member country. Any country specific expenditure towards travelling etc., can be borne by the respective countries. However, in case of any occasional and substantial expenditure, like for carrying out any **special technical studies or promotional activities or arranging any developmental/capacity building programs etc.** additional support from **regional multilateral forums and developmental organizations** can be sought as grants, on case-to-case basis.
  - Such an arrangement shall provide**, self-sustained solution during the starting as well as operational phase, averting the need for collection of funds/membership fees from different members**

[4] The Indian National Load Dispatch Centre (NLDC) provides the Secretariat as well as other necessary infrastructure for FOLD. By utilizing existing resources and national level experience of NLDC, FOLD has been able to effectively carry out its mandate.

towards establishment and operation of the proposed network and therefore keeping the funding mechanism simple.

**Advantage:** On the above approach, a simple and self-sustained funding mechanism can be pursued in the initial years of the organization.

### *Future options/possibilities for the Regional Network*

1. **Transition into more formal Structure**- In addition to the above recommendations, the report also touches upon a futuristic possibility about changes in the Legal Framework and Funding Mechanism etc. of the proposed network, as it may gain momentum and its activities become more profound in long run.
   - The initial **legal framework** i.e. an Association, recommended for the network to change to a **more formal structure,** say, in the form of an **Inter-Governmental Agreements / Inter- Utility MoU**, or similar nature. This may ensure association amongst the system operators of member countries in a more formal manner.
   - The concept of **membership fee/contribution** by the different member countries can also be brought-in, in order ensure self- sustainability with limited handholding/external support requirement.

   The above is however only suggestive in nature and any such action, in this direction would be need based, depending on the consensus of the participating members, at that point of time.

2. **Convergence with other similar regional networks and intergovernmental arrangements-** Going forward, based on consensus amongst the member countries, the proposed regional network can also collaborate with other similar networks to ensure synergy on the common issues as well as to avoid working in silos. Further, in the longer term, they can also be made to operate and report to any of the prevailing or new intergovernmental regional arrangements.

Based on the above recommendations and inputs received from relevant stakeholders, a Charter for institutionalization the proposed Network has been developed and included in Chapter 7 of this report.

# Contents

# 1. Introduction

## 1.1 Background and Context

Cross Border Electricity Trade (CBET) in South Asia as of 2019-20 stands at 3.7 GW per annum. As per various estimates, CBET is likely to be in the range of 35-45 GW by 2036[5]. Currently, CBET in the region is being undertaken mostly through government driven bilateral contracts. Going forward with creation of newer cross border power trading opportunities, the region is likely to graduate to other advanced modes of trade including trilateral/multilateral and regional market-based transactions. However, irrespective of the mode of CBET, harmonization of legal, policy and regulatory aspects, and operational procedures will be critical to facilitate CBET and build confidence among the stakeholders involved. The USAID sponsored South Asian Regional Initiative for Energy Integration (SARI/EI)[6], has already undertaken various initiatives to support this endeavor. Some of the key outcomes of work done towards harmonization under SARI/EI are given below.

- Development of Regional Regulatory Guidelines for promoting CBET in South Asia
- Suggested Changes/Amendments in the Electricity Laws, Regulations and Policies of South Asian Countries for promoting CBET in South Asia
- Harmonization of Grid Codes, Operating Procedures and Standards to Facilitate CBET in South Asia Region

System operations are critical areas where coordination is essential to ensure system security and reliability; avoid system risks and undue investments and facilitate dispute free scheduling, dispatch and settlement. In this regard, the role of a System Operator (SO) becomes paramount. When the power grid transcends national boundaries and electricity starts to flow across countries under CBET, system operation as an activity becomes even more critical

**Box 1.1: Overview of SARI/EI Program**

The SARI/EI program covers eight South Asian countries namely Afghanistan, Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka. The program is currently in its fourth phase which began in 2012 and aims to promote regional energy integration through increased Cross Border Electricity Trade (CBET) in South Asia. In its current fourth phase, SARI/EI has instituted three task forces focusing on three key outcomes namely:

- Coordination of policy, legal and regulatory framework (Task Force 1)
- Advancement of transmission systems interconnections (Task Force 2)
- Development of South Asian regional electricity markets (Task Force 3)

The Task Forces have representations from nominated members from South Asian governments, Electricity Regulatory Commissions (ERCs), planning authorities, national power transmission utilities, power market institutions etc. These Task Forces are working towards development of harmonized frameworks (such as aligned regulations, common minimum grid code, etc.), advancement of transmission network, development of markets and establishment institutional mechanisms/forums which can facilitate and enhance CBET in the South Asian region. The overall objective of SARI/EI is to create the right "enabling" environment to support the establishment of a South Asian electricity market.

[5] CEA, Perspective Transmission Plan; and South Asian Power Sector & CBET High Level Panel Discussion: Policy & Regulatory Aspects and Reforms – IRADe (Aggressive effort case)
[6] South Asian Regional Initiative for Energy Integration (SARI/EI), is a USAID supported program that commenced in the year 2000 and has been working towards harmonization of frameworks in South Asia

and complex as it requires coordination between system operators of participating countries to varying degrees and extent.

## 1.2 Objective of this Report

This report, developed under the Task Force 2 of SARI/EI, aims to build upon the work that has been already done towards developing harmonized codes, procedure and standards. The report aims to develop a detailed strategy for '***Creating a Regional Network for sharing operational best practices and promoting harmonization & excellence in Power System Operation across South Asia Region'***. This report delineates the structure of the proposed network and defines its objectives which revolve around **knowledge sharing, exchange of ideas, discussion on best practices, collaboration, consensus building on the issues of common interest and capacity building in the field of Power System Operations.**

As part of the study, the key functions of the proposed network have been defined and its overall structure has been recommended for consideration. The same has been undertaken through detailed background analysis as follows:

- 'As Is' review of South Asia w.r.t System Operations- This includes comparative analysis of the countries in South Asia, viz. Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka.
- Analysis of International regional system operators and forums- This includes detailed analysis of the following:
    1. European Network of Transmission System Operators – Electricity (ENTSO-E)
    2. PJM Interconnection
    3. Southwest Power Pool (SPP)
    4. Southern African Power Pool (SAPP)
    5. West African Power Pool
    6. Gulf Cooperation Council Interconnection Authority (GCCIA)
    7. Greater Mekong Sub region (GMS)
    8. Forum of Load Despatchers (FOLD)
- Study of Regional Multilateral Forums in South Asia- This includes study of the following:
    1. South Asian Association for Regional Cooperation (SAARC)
    2. Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)
    3. South Asian Forum for Infrastructure Regulation (SAFIR)
    4. Bangladesh, Bhutan, India and Nepal (BBIN)

The above analysis provides useful lessons in context of the proposed network as a regional institution, its functions as a facilitating body, range of options/ recommendations across various elements of the organizational structure and roadmap for creating the proposed network. The same has been detailed out in different chapters in the report.

## 1.3 Need for a Regional Network for System Operators in South Asia

**A System Operator (SO) plays an important role in the power system operation, ensuring the operational security of the power system, maintaining the balance between demand and supply, ensuring adequacy of the transmission system and contributing towards efficient functioning of the electricity grid.** Power system operation entails critical decision-making to generate, transmit, and deliver energy in a reliable and secure manner, through a continuous process of system monitoring and control. The decision horizons (the time between the moment the decision must be made and the time in which it takes effect) for power system operation vary significantly. They range from real time - voltage and frequency control (milliseconds to seconds) to short term - scheduling and dispatch (hours-day) to medium and long-term activities like capacity planning, bottleneck removal and outage planning. A system operator is required to perform a host of functions to enable the power grid to operate economically and efficiently.

**Box 1.2: Key functions of a system operator:**

- Monitoring and control of system parameters
- Maintaining system safety, security and reliability
- Keeping transmission elements loading within permissible limits
- Keeping tie-line power flows under check
- Scheduling and dispatch
- Balancing and settlement
- Congestion management
- Optimum utilization of hydro resources and grid balancing and environmental and social benefits derived out of those
- Coordinating ancillary services
- Interregional coordination
- Outage planning and recovery procedures
- Total Transmission Capability (TTC) and Available Transmission Capability (ATC)
- Market monitoring
- Planning and expansion
- Reporting and information exchange
- Operational liaisoning & information exchange

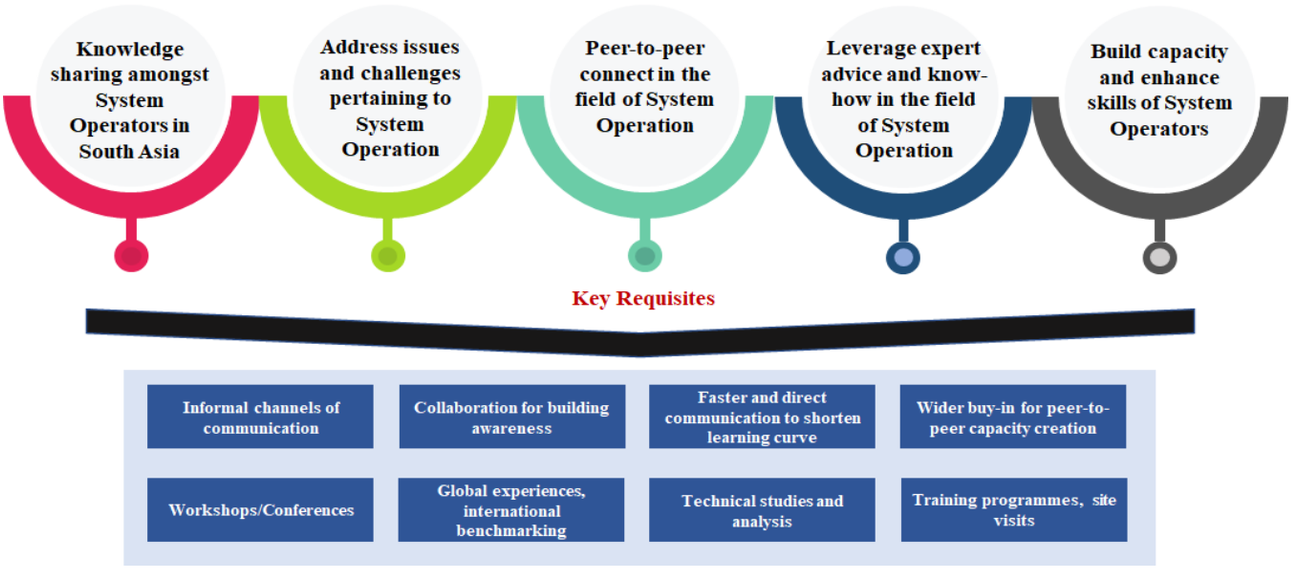
**With the evolving technological and operational environments, it is critical for system operators to stay abreast with the knowledge about latest developments, operating best practices and experiences of other system operators when dealing with similar challenges. This knowledge can be shared amongst system operators of the South Asian region who face similar socio-economic pressures.**

System Operation is **a highly specialized technical function, which needs a dedicated forum for close coordination and knowledge sharing, where the relevant participants (i.e. System operators in SACs) can come together to discuss and deliberate on topics linked to their role.** Although, SARI/EI, along with other bodies such as South Asian Association for Regional Cooperation (SAARC) and South Asia Forum for Infrastructure Regulation (SAFIR), serve as stages for policymakers, regulators, and other stakeholders to meet on a regular basis and share their experiences, but they do not have avenues for such exclusive coverage, particularly on system opeartion within their mandate. **Due to this, currently there is no regional network for the system operators from across the South Asian region to connect, engage, collaborate, and share knowledge/ideas. Presently, the system operators engage in a more formal manner and focused on bilateral coordination between select countries. While these addresses the immediate and project specific coordination requirements, the need for a deeper and informal connect amongst SOs at a regional level is much needed**. Consultations and discussions with the governments of respective countries as well as system operators in SAC has also indicated the need for the following:

- Sharing of good practices and knowledge amongst system operators
- Capacity Building and skill enhancement of system operators
- Avenues for more informal peer to peer connect (SO in one country with SO in other country)
- Collectively leveraging expert advice and know-how for benefit of the region

In this context, the overall rationale/need for creating a regional network of system operators has been indicated in Figure 1.1.

Figure 1.1: Need for creating a regional network of system operators




There has been a consensus amongst the stakeholders that the above can be fulfilled through creation of regional network of SOs. **The proposed network shall supplement[7] the present level of bilateral cooperation amongst SOs by providing an opportunity to SOs to meet, collaborate, share knowledge, exchange ideas, discuss best practices and build capabilities in the field of power system operation. The proposed network would be advisory in nature. It would be formally established with flexible and voluntary participation by member countries**

**The need for association amongst SOs is further accentuated by the fact that power systems of SACs are at various stages of development and vary substantially in terms of size and complexity**. **Such association will provide an opportunity to SOs in the region to engage, collaborate, and learn from each other's system characteristics and evolution journeys**. The following sections reinforces the need for a regional network of SOs in South Asia.

### 1.3.1 Variation in System Operation Models in SA necessitates sharing of experience and know-how

In terms of structure, System Operation can be structured as a vertically integrated utility, unbundled transmission system operator, independent transmission system operator and independent system operator. Each of the structures has its own set of characteristics, advantages, and disadvantages. As each of these models are in existence in South Asia, experiences from them can offer valuable learnings for SOs in these countries, who can collaborate as part of the proposed regional network. The different models of System Operation that currently exist are highlighted in Table 1.1.

Table 1.1 Different Models of System Operators[8,9]

| Type | Characteristics | Strengths | Weaknesses |
|---|---|---|---|
| **Vertically Integrated Utilities (VIU)** (***Afghanistan, Maldives,*** | The traditional energy-market model, where the same entity is in charge of generation, | Scope for reduction in general costs of labor, | Challenges over transparency in costs allocation; as the model has |

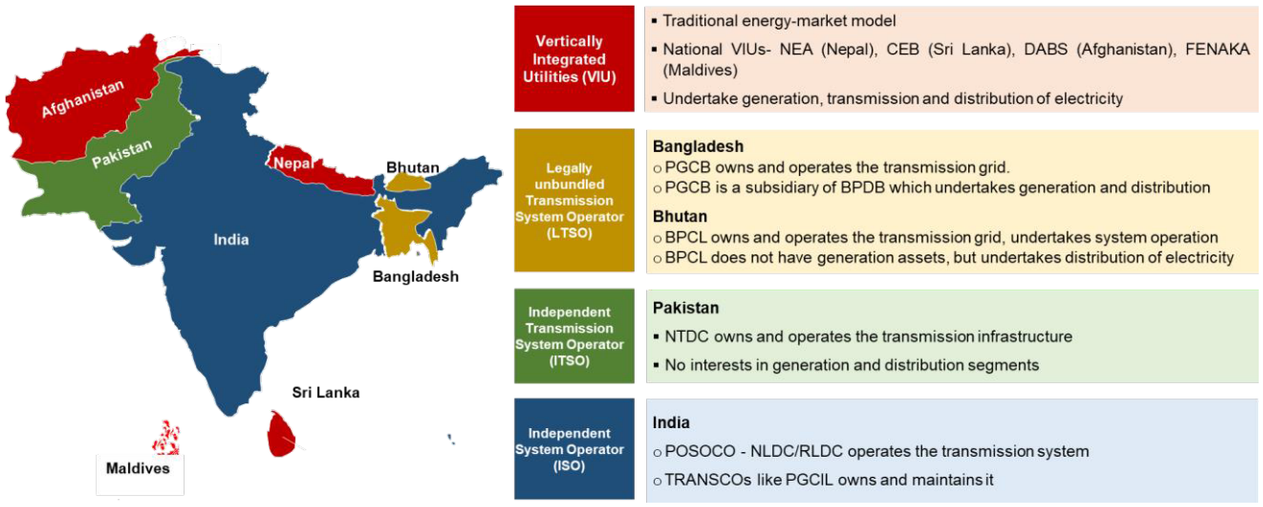
[7] The proposed regional network can also undertake technical studies and capacity building activities on demand by the existing bilateral governmental forums (Joint Working Groups, Joint Steering Committees) and bilateral mechanisms (Joint Operation Committee, and Joint Technical Team – Transmission) in the region.

8 Global Experience of Unbundling National Power Utilities, Michael Boulle, 2019

9 Global Trends in Electricity Transmission System Operation: Where does the future lie?, Mallika Chawla and Michael G. Pollitt, 2013

| Type | Characteristics | Strengths | Weaknesses |
|---|---|---|---|
| ***Nepal, Sri Lanka,*** *South Africa, Belarus etc.)* | transmission, distribution and retailing. This often works as a monopoly model (may have limited competition in some parts of the business-like generation). | management, O&M, and planning | inherent bias towards self-owned gencos in case where IPP also exist. |
| **Legally unbundled Transmission System Operator (LTSO)**<br>*(**Bangladesh, Bhutan**, Latvia, Hungary, UAE, Croatia, Oman, Ireland, Poland, Estonia etc.)* | A separate company which is responsible for both ownership and operation of the transmission grid and the power system. However, this company is a subsidiary of a parent company that also holds subsidiaries involved in generation, distribution and/or retail segments | Appropriate allocation of transmission costs (SO + TO (Transmission Operator) from the other segments of the ESI | Since LTSO and other subsidiaries involved in generation are part of the same parent company, it may influence competitive access to the transmission grid |
| **Independent Transmission System Operator (ITSO)**<br>*(**Pakistan,** Ghana, China, Thailand, Iceland, Czech Republic, Serbia, Turkey, Lithuania, etc.)* | A separate company solely responsible for both ownership and operation of the transmission grid and the power system. This company is also independent of any form of influence from other electricity-market players | This arrangement allows for fair competition among gencos to access the transmission grid<br>Synergized efforts and sharing of technical skills between transmission grid and the system operation<br>Coordination in planning and investment decisions between the TO and SO segments of the business | Risk of bias if there are multiple transmission agencies and system operation is vested with one of those agencies<br>Possible conflict of interest between transmission operator and system operator functions |
| **Independent System Operator (ISO)**<br>*(**India,** U.S., Chile, Spain, Argentina, Australia, Peru, Sweden, Canada, Romania, Russia, Mongolia etc.)* | A scenario where there is a clear distinction between organizations that are responsible for operating the transmission grid and the power system in real-time and those that own and maintain it | This arrangement allows for fair competition amongst gencos to access the transmission grid without dealing with the economic and political challenges of ownership unbundling of the transmission assets | Coordination problems in terms of information exchange (reliability), and allocation of investments costs (for building new transmission assets) between the ISO and the ITO |

Figure 1.2: Different types of operating models exist w.r.t to power system operation in South Asia




### 1.3.2 Differences in Operating Norms necessitates closer association amongst SOs across South Asia

Power system operating frameworks and practices vary across South Asia. Some of these practices where differences exist include the following:

- **Operating Codes -** Currently, each country in South Asia follows its own set of operating codes. Sharing of learnings and experience amongst the countries is invaluable to ensure efficient system operations and seamless power flow.
- **Security and Reliability Standards -** The variation in security and reliability standards amongst the countries can lead to challenges in the interconnection of the national grids and require setting up of dedicated bilateral agreements for each cross-border connection. Sharing of best practices on security and reliability standards across the region would support seamless system security during power trade.
- **Scheduling and Dispatch Practices -** The scheduling and dispatch practices vary across the region leading to a challenge in cross border scheduling of power. Sharing of best practices and learnings on scheduling and dispatch on harmonious principle could help boost coordination.
- **Metering and Settlement Mechanisms -** The procedures for metering, accounting and settlement vary across the regions, some of these practices may lead to discrepancies and disputes. Knowledge sharing and alignment on the accepted mechanisms for measurement, accounting and settlement can help harmonize system operation in the region.
- **Information Sharing -** Currently the number of interconnections is limited and sharing of data related to the cross- border links and exchange of information on critical aspects such as outage planning and other key events is on bilateral basis. But a network for knowledge sharing for system operators in the region through institutionalized process can help in sharing of valuable lessons as well as data for better coordination.

## 1.4 Objectives/Functions of the Regional Network

The proposed network is envisioned to be a neutral entity, that will function in a spirit of cooperation and collaboration, with the following main objectives/functions:

i. **Exchange of Ideas**: Act as a platform for crosscutting deliberations and exchange of ideas towards promoting safe, secure, reliable and efficient power system operation in South Asia. This shall include documentation and

sharing of experiences related to system operation, discussions on standard operating procedures/guidelines and harmonization of practices including international benchmarking in the matters related to system operation;

ii. **Knowledge Dissemination**: Sharing of know-how on advanced/sustainable energy systems, their impact (economic, social, environmental etc.), particularly in the areas of renewable energy integration and grid balancing, taking into view the diverse sources of energy available in South Asia region;

iii. **Technical Support/Expert Advice:** Carry out technical studies/assessment in the area of power system operation for the purpose of knowledge creation and creating evidence to support CBET. This shall include leveraging expert advice and know-how including global experiences in power system operation;

iv. **Skill Development**: Facilitate and render assistance towards skill development and capability enhancement of human resource employed at the Load Despatch Centres. This shall be done with the intent to use the latest technologies and tools, in order to further enhance the level of system operation;

v. **Workshops/Conferences**: Conduct workshops for different stakeholders in SAC on matters related to system operation. These shall include the different aspects related to sharing operational practices, promoting harmonization & excellence in system operation and matters related to greening the regional grid;

vi. **Deliberation on Best Practices/Issues**: Discuss the best practices and technical issues related to system operation in the different parts of the region and across the globe and try to build consensus through discussions on the issues of common interest and goal.

This report has been structured into the following chapters:

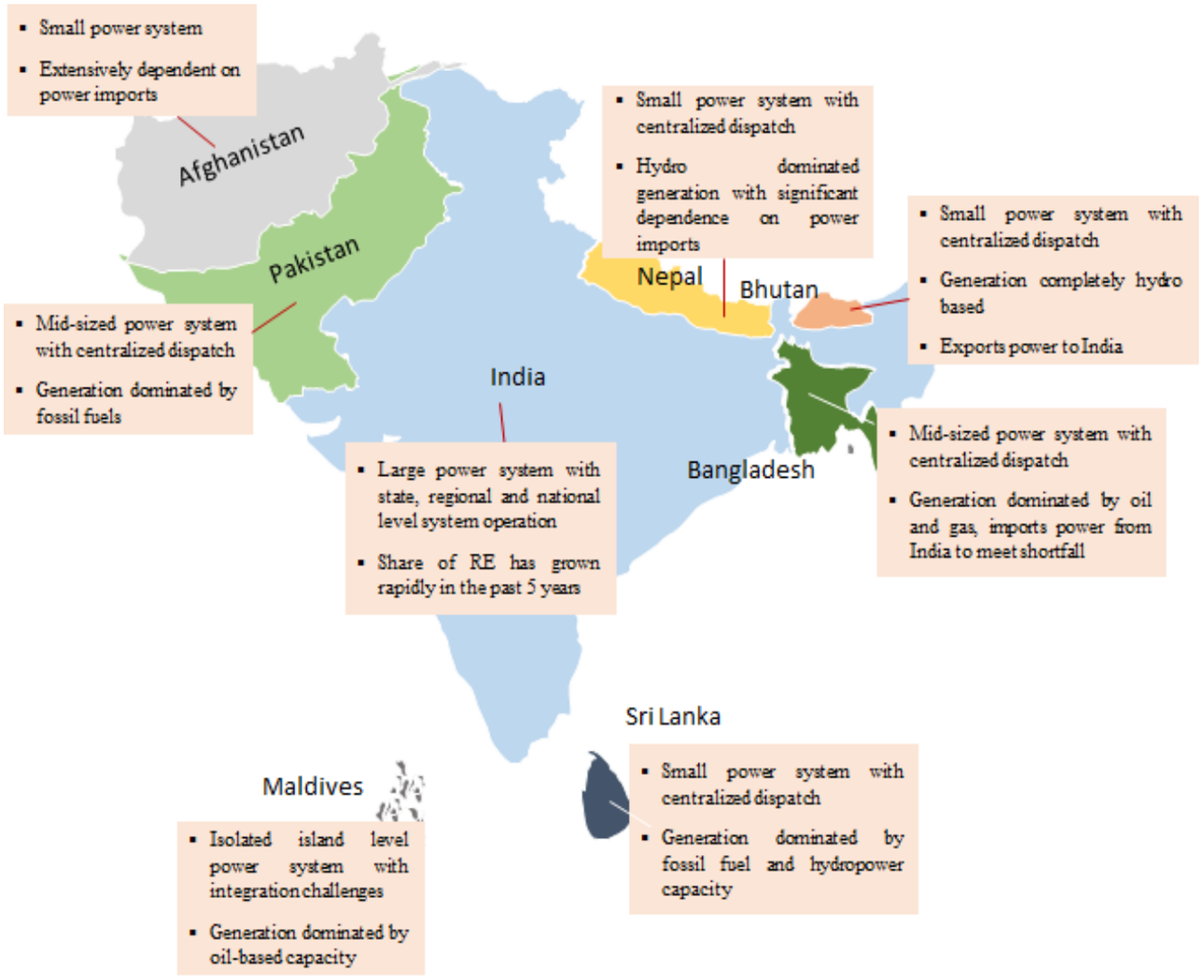
- **Chapter 2: Review of South Asia w.r.t System Operation:** This chapter covers an 'As Is' review of the hierarchical structures, organizational set ups and practices related to system operations in different South Asian countries. It also covers generation mix, load pattern and existing agreements and settlement mechanisms in the South Asian countries.
- **Chapter 3: International experiences of regional system operators and forums:** This chapter presents and analysis of relevant experiences from international power pools as well as forum of LDCs of India in terms of how coordinated system operations run and how SOs collaborate and engage for efficient operation of the larger regional grid.
- **Chapter 4: Experiences from regional multilateral forums in South Asia:** The focus of this chapter is on the analysis of the role, responsibility structure and function of various regional forums and institutional mechanisms.
- **Chapter 5: Summary of options for creation of the proposed network and proposed structure:** This chapter looks at developing a suite of options (with pros and cons of each option) on various aspects of the organizational framework to help design a suitable structure for the network
- **Chapter 6: Recommendations on creation of the regional network:** This chapter defines the development of an implementation recommendations for the network. This is done through consolidation of learnings from the analysis of the South Asian countries, study of similar international institutions and multilateral institutional frameworks in the South Asian Region.
- **Chapter 7: Proposed Charter for the regional network:** This chapter outlines the Charter of the regional network including the overall objective, functions and organizational structure.

This report as a strategy paper takes into consideration not just the learnings from regional and international analysis but also reflects on the nuances, opinions and suggestions of the relevant stakeholders. It offers detailed recommendations towards the establishment and rollout of the network so that it meets its objectives as a regional network with the aim of facilitating knowledge sharing, exchange of ideas, discussion on best practices, collaboration and consensus building on the issues of common interest in the field of Power System Operation.

# 2. 'As Is' Review of South Asia w.r.t System Operations

This chapter analyses and compares the organizational structures, hierarchy and prevailing practices of system operations amongst the South Asian countries. It also looks at how the power demand has grown over the years leading to the growth in generation resources as well as the type of agreements and settlements in South Asia. The study, through its different sections, identifies and contrasts the key mechanisms and institutions governing the system operations; their hierarchical structures; operating frameworks and practices as well as the demand-supply scenario and the associated contracting structures. Figure 2.1 denotes the broad features of power systems in South Asian countries.

Figure 2.1: Broad features of power systems in South Asia



As shown above, there exists significant variation in the power systems of South Asian countries. The following section provides country-wise overview of the organizational structure and key power system parameters of countries in South Asia.

## 2.1 Country-wise Overview of Organizational Structure of the Power Systems in SA

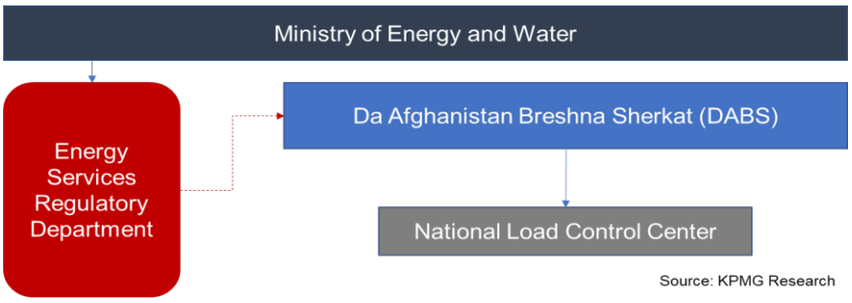
This section highlights the organizational structure of the power system (indicating key entities related to power system operation) in the South Asian countries. It also highlights the evolution of the demand and supply patterns in the South Asian countries thereby identifying the resource mix, demand growth, key areas driving demand.

### 2.1.1 Afghanistan

The organizational structure in Afghanistan for power system operation is currently under evolution. Da Afghanistan Breshna Sherkat (DABS) undertakes the role of system operation in the country along with other power sector activities[10]. A National Load Control Center (NLCC) under DABS has been established with limited coverage currently. There are proposals to greatly enhance the coverage of NLCC - DABS. Figure 2.3 and table 2.1 shows the organizational structure and power system summary sheet for Afghanistan respectively.

Figure 2.2: Afghanistan on the map of South Asia


Figure 2.3*: Organizational structure- Afghanistan




Source: KPMG Research

Table 2.1: Power system in Afghanistan- Summary sheet

| Afghanistan Summary Sheet[11,12,13,14,15,16] | |
|---|---|
| Installed Capacity | Installed capacity grew from 474 MW in 2011-12 to 519 MW in 2016-17 |
| Generation Mix | Generation mix (2016-17) comprised of 17% Hydro; 13% Thermal; 4% DG sets; 29% Import Tajikistan; 21% Import Uzbekistan; 11% Import Iran; 5%<br>Afghanistan imports nearly two thirds of its electricity from neighboring countries |
| Demand Growth | 6-9% annual demand growth between 2012 to 2032 as per power sector master plan |
| Annual Energy | N.A. |
| Electricity Access | 30% grid access (access through off grid system expected to be 90%) |

[10] https://main.dabs.af/Historyen
*Electricity sector structure in Afghanistan is currently under review for revision
[11] https://www.unece.org/fileadmin/DAM/energy/se/pp/eneff/7th_IFESD_Baku_Oct.2016/ESCAP_Elec_CIS/1_W.Aria_AVG.pdf
[12] https://policy.asiapacificenergy.org/sites/default/files/Power%20Sector%20Master%20Plan%20%28PSMP%29%20%28Final%20Report%29.pdf
[13] https://www.energycharter.org/fileadmin/DocumentsMedia/Events/Afghanistan_-_Mahmoody_Ahmad_Farhad.pdf
[14] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[15] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[16] https://www.adb.org/sites/default/files/linked-documents/47282-001-ssa.pdf

| | |
|---|---|
| Per Capita Usage | 100kWh/yr |
| Key Consumers | Domestic |

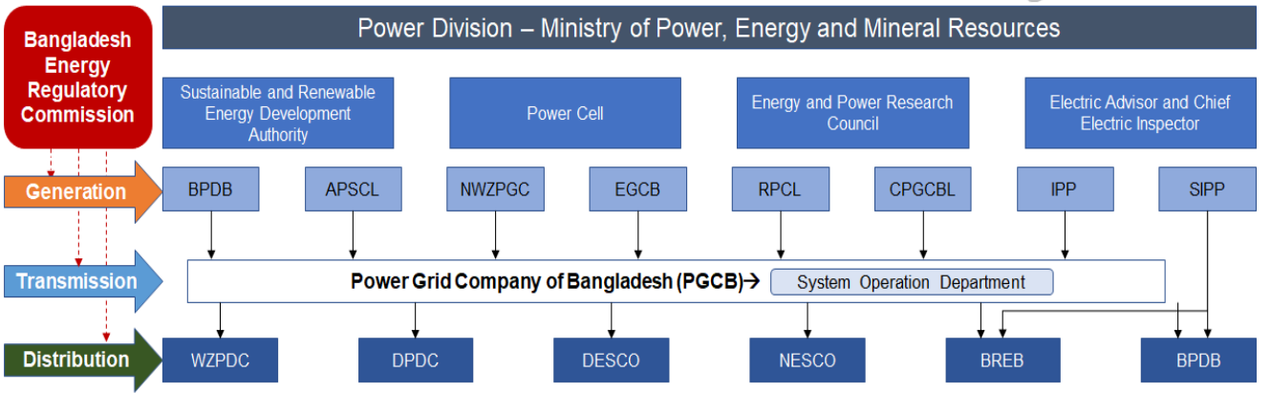
### 2.1.2 Bangladesh

In terms of the organizational structure governing power system in Bangladesh, Power Grid Company of Bangladesh (PGCB), is the key entity responsible for power system operation. It is the national transmission utility and a subsidiary of Bangladesh Power Development Board (BPDB). It owns the transmission network in Bangladesh. The regulatory oversight in the sector is maintained by Bangladesh Energy Regulatory Commission (BERC).

Figure 2.4: Bangladesh on the map of South Asia


Figure 2.5 and table 2.2 shows the organizational structure and power system summary sheet for Bangladesh respectively.

Figure 2.5: Organizational structure- Bangladesh




Source: Power Cell, Bangladesh

The key entities part of the structure, include the following:

- BPDB: Bangladesh Power Development Board
- PGCB: Power Grid Company of Bangladesh

Other generation utilities

- APSCL: Ashuganj Power Station Company Ltd.
- NWZPGC: North West Zone Power Generation Company Ltd.
- EGCB: Electricity Generation Company of Bangladesh
- RPCL: Rural Power Company Ltd.
- CPGCBL: Coal Power Generation Company Bangladesh Ltd.
- IPP: Independent Power Producers
- SIPP: Small Independent Power Producers

Other distribution utilities

- WZPDC: West Zone Power Distribution Company
- DPDC: Dhaka Power Distribution Company

- DESCO: Dhaka Electric Supply Company Ltd.
- NESCO: Northern Electric Company Ltd.
- BREB: Bangladesh Rural Electrification board

Table 2.2: Power system in Bangladesh- Summary sheet

| **Bangladesh Summary Sheet**[17,18,19,20] | |
|---|---|
| Installed Capacity | Installed capacity grew from 7GW in 2011 to over 20 GW in 2020<br>Nearly half of the installed capacity is under public sector dominated by BPDB |
| Generation Mix | Generation mix (2019-20) comprised of 54% gas; 27% furnace oil; 6% diesel based; 6% coal-based; 1% RE-Hydro; 6% imports<br>***Despite limited capacity, hydropower in Bangladesh plays a critical role in maintaining the reliability and security of the power system through system balancing and thus occupies a critical role in system operation.*** |
| Demand Growth | ~10% p.a. over the past decade with the peak demand rising from over 6 GW in 2009 to 14.7 GW currently |
| Annual Energy | Sales: 66.5 TWh<br>Generation: 70.5 TWh |
| Electricity Access | 95% of the population has access to electricity |
| Per Capita Usage | 378 kWh/yr |
| Key Consumers | Industry (44%) and Domestic (43%) |

[17] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[18] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[19] https://www.bpdb.gov.bd/bpdb_new/index.php/site/new_annual_reports
[20] https://www.bpdb.gov.bd/bpdb_new/resourcefile/annualreports/annualreport_1574325376_Annual_Report_2018-19.pdf

### 2.1.3 Bhutan

The Power Support Operation Division (PSOD) under the Bhutan Power System Operator (arm of the T&D company) is responsible for power system operation. The Bhutan Electricity Authority is the regulatory body responsible for maintaining oversight on the sector.[21] Figure 2.7 and table 2.3 shows the organizational structure and power system summary sheet for Bhutan respectively.

Figure 2.6: Bhutan on the map of South Asia

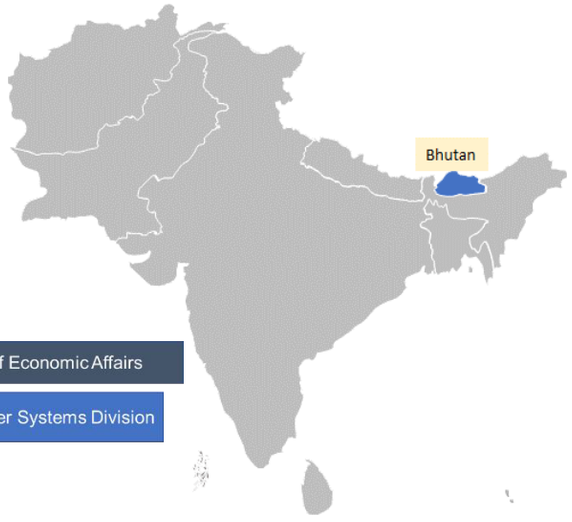
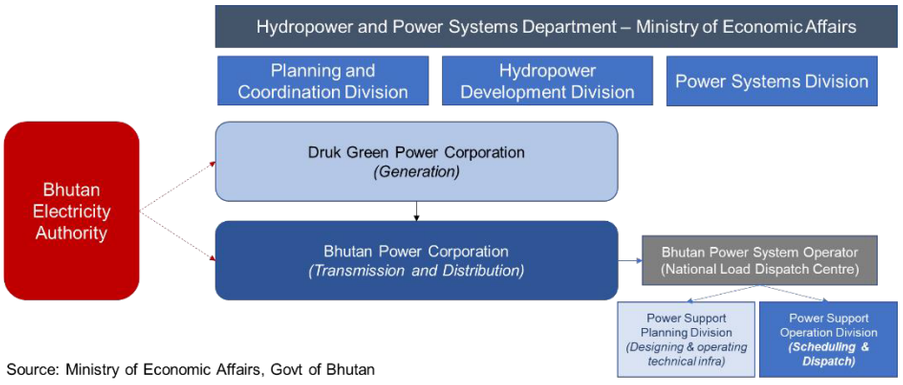



Figure 2.7 Organizational structure- Bhutan




Source: Ministry of Economic Affairs, Govt of Bhutan

Table 2.3: Power system in Bhutan- Summary sheet

| **Bhutan Summary Sheet**[22,23,24,25,26] | |
|---|---|
| Installed Capacity | Installed capacity grew from 1440 MW in 2010 to 2326 MW in 2019 |
| Generation Mix | Entire generation is hydropower based and is owned either fully by the DGPC or through subsidiaries and JVs |
| Demand Growth | 10% p.a. in the last 5 years reaching ~400 MW currently |
| Annual Energy | N.A. |
| Electricity Access | 100% of the population has access to electricity |
| Per Capita Usage | 3400 kWh/yr |
| Key Consumers | Dominated by domestic consumers with peak demand occurring in winter low flow season when some import needed to meet the peak demand |

[21] http://bpso.bpc.bt/roles-and-responsibilities/
[22] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[23] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[24] https://www.drukgreen.bt/wp-content/uploads/2020/06/Annual-Report-2018-1.pdf
[25] https://www.bpc.bt/wp-content/themes/2020/assets/downloads/BPC-Annual-Report-2018.pdf
[26] https://www.gnhc.gov.bt/en/wp-content/uploads/2020/03/SHDP-Submitted-to-GNHC-March-16-2020.pdf

### 2.1.4 India

Figure 2.8: India on the map of South Asia


Power sector in India is a concurrent subject thereby allowing it to be governed at the central and state level. At the central level it is governed by Ministry of Power as well as Ministry of New and Renewable Energy, while at the state level it is governed by the respective state governments. Central Electricity Authority (CEA) is the central planning body of the country and Central Electricity Regulatory Commission (CERC) makes the regulatory framework and adjudicates at the interstate level and also regulates power trading and power exchanges. State Electricity Regulator Commissions regulate the sector at the intrastate level. In India concept of Independent System Operator (ISO) is followed and Power System Operation Corporation (POSOCO) is the System Operator in India at the Central Level. The National Load Dispatch Centre (NLDC) and Regional Load Dispatch Centers (RLDCs) are the parts of POSOCO meant for operating the grids at National and Regional level respectively. The state load dispatch centers are typically an arm of state transco and regulated by the State Electricity Regulatory Commissions (SERC). Figure 2.9 and table 2.4 shows the organizational structure and power system summary sheet for India respectively.

Figure 2.9: Organizational structure- India

| Key Functions | Responsible Institutions: Centre | Responsible Institutions: State/ Private |
|---|---|---|
| Policy | MoP, MNRE | State Government |
| Plan | CEA | |
| Regulations | CERC | SERC |
| Generation | CGS, UMPP, IPP | State Gencos, IPP, CPP |
| Transmission | CTU, Pvt. Trans. Co. | STU, Pvt. Trans. Co. |
| System Operators | NLDC, RLDC | SLDC |
| Distribution | | Distribution Licensees |
| Trading | Power Exchange , Trading Licensee | |
| Appeal | Appellate Tribunal | |

The key entities part of the structure, include the following:

- MoP: Ministry of Power
- MNRE: Ministry of New & Renewable Energy
- CEA: Central Electricity Authority
- CERC: Central Electricity Regulatory Commission
- SERC: State Electricity Regulatory Commission
- CGS: Central Generating Stations

- IPP: Independent Power Producer
- UMPP: Ultra Mega Power Plants
- CPP: Captive Power Producer
- CTU: Central Transmission Utility
- PGCIL: Power Grid Corporation of India Limited
- STU: State Transmission Utility
- Pvt. Tans. Co: Private Transmission Companies
- NLDC: National Load Dispatch Center)
- RLDC: Regional Load Dispatch Center
- SLDC: State Load Dispatch Center (Generally, SLDCs are part of the STUs in states)

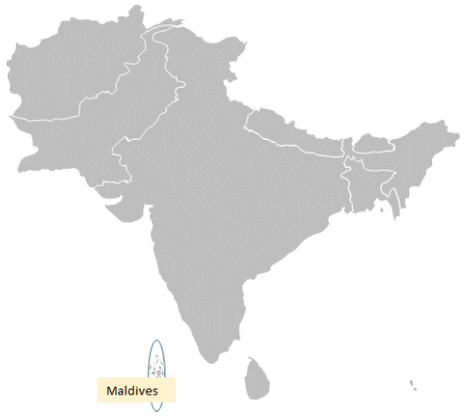
Table 2.4: Power system in India- Summary sheet

| **India Summary Sheet**[27,28,29] | |
|---|---|
| Installed Capacity | Installed capacity grew from 174 GW in 2011 to 370 GW in 2020<br>47% installed capacity is owned by private sector, 28% by state sector and 25% by central sector |
| Generation Mix | Generation capacity mix (2019-20) was 54% coal based, 24% RE, 12% hydro, 7% gas, 2% nuclear<br>RE share growth from 10% in 2011 to 24% currently |
| Demand Growth | CAGR of 5% p.a. over the past decade with peak demand rising from 104 GW in 2009-10 to 183 GW currently |
| Annual Energy | Sales: 1284 TWh<br>Availability: 1391 TWh |
| Electricity Access | 100% of the population has access to electricity |
| Per Capita Usage | 1181 kWh/yr |
| Key Consumers | Industry (41%) Households (25%) Agriculture (18%) |

[27] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[28] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[29] http://www.cea.nic.in/monthlyexesummary.html

### 2.1.5 Maldives

Figure 2.10: Maldives on the map of South Asia

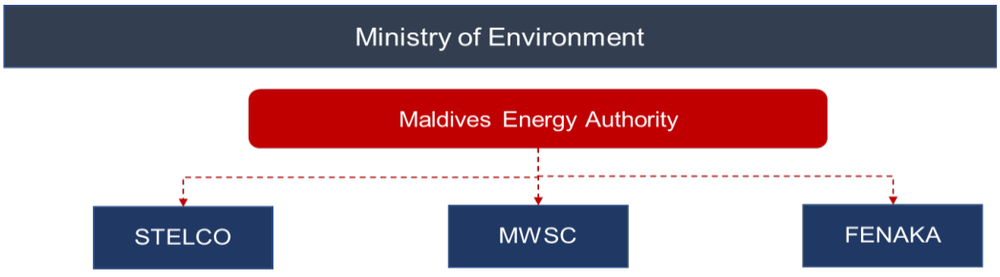



STELCO and FENAKA operate 35 and 148 power houses respectively. Male' Water and Sewerage Company Pvt. Ltd. (MWSC) operates 1 powerhouse at V.Rakeedhoo. Oversight is maintained by Maldives Energy Authority. The utilities involved in the power sector are:

- STELCO: State Electric Company Limited
- MWSC: Male' Water & Sewerage Company Pvt. Ltd.
- FENAKA

Figure 2.11 and table 2.5 shows the organizational structure and power system summary sheet for Maldives respectively.

Figure 2.11: Organizational structure- Maldives




Source: Ministry of Environment, Govt of Maldives

Table 2.5: Power system in Maldives- Summary sheet

| **Maldives Summary Sheet**[30,31,32,33,34] | |
|---|---|
| Installed Capacity | Installed capacity grew from 106 MW in in 2007 to 251 MW in 2018<br>Generation for Greater Male accounts for 57% of the country's total generation |
| Generation Mix | Generation Capacity Mix (2017) was 96% Oil; 4% Renewables<br>RE capacity has almost doubled from 6MW in 2016 to 11 MW in 2018 |
| Demand Growth | Electricity consumption has grown over 25% between 2015 (550 GWh) and 2017 (703 GWh) |
| Annual Energy | N.A. |
| Electricity Access | 100% of the population has access to electricity |
| Per Capita Usage | 1400 kWh/yr |
| Key Consumers | Island Resorts and Male Region |

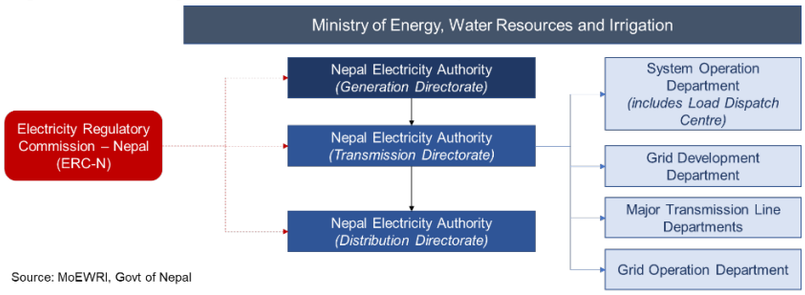
[30] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[31] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[32] https://sari-energy.org/oldsite/PageFiles/Countries/Maldives_Energy_detail.html
[33] https://www.environment.gov.mv/v2/wp-content/files/publications/20171217-pub-island-electricity-data-book-2017-17dec2017.pdf
[34] https://www.environment.gov.mv/v2/wp-content/files/publications/20181105-pub-island-electricity-data-book-2018.pdf

### 2.1.6 Nepal

The load dispatch center which is responsible for scheduling and dispatch is a part of the system operation department in the transmission directorate of the NEA. The newly formed Nepal Electricity Regulatory Commission maintains regulatory oversight over NEA and other entities in the sector. Nepal's new Electricity Bill has been tabled in the Upper House of Nepal's parliament and is due to be tabled in the lower house. The new Electricity Bill provides for unbundling of electrical utilities and is therefore expected to lead to restructuring of the activities of system operator of Nepal. New Electricity Bill is also expected to pave way for the operationalization of power trading activities and the provision of open access in Nepal. Figure 2.13 and table 2.6 shows the current organizational structure and power system summary sheet for Nepal respectively.

Figure 2.12: Nepal on the map of South Asia


Figure 2.13: Organizational structure- Nepal




Source: MoEWRI, Govt of Nepal

Table 2.6: Power system in Nepal- Summary sheet

| Nepal Summary Sheet[35,36,37] | |
|---|---|
| Installed Capacity | Installed capacity grew from 782 MW in 2013 to 1333 MW in 2020 of which 686 MW owned by IPPs |
| Generation Mix | Generation capacity mix (2020) was 96% Hydro, balance from fossil fuels and RE<br>Nepal saw electricity imports of upto 653 MW from India in 2019 |
| Demand Growth | Over 5% p.a. in the last decade, and peak demand rose from 946 MW in 2010-11 to 1320 MW currently |
| Annual Energy | Sales: 6.4 TWh<br>Availability: 7.7 TWh (including imports) |
| Electricity Access | 95% of the population has access to electricity |
| Per Capita Usage | 270 kWh/yr |
| Key Consumers | Households (42%) Industry (38%) |

[35] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[36] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[37] https://www.nea.org.np/admin/assets/uploads/supportive_docs/Annual_book_2077.pdf

### 2.1.7 Pakistan

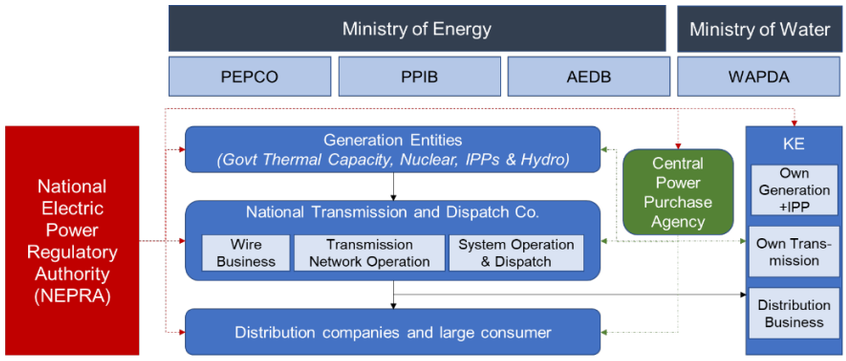
The system operation and dispatch division of the NTDC is responsible for the scheduling and dispatch of power plants. NEPRA maintains regulatory oversight over the power sector in the country including the market operator, CPPA. Figure 2.15 and table 2.7 shows the organizational structure and power system summary sheet for Pakistan respectively.

The key entities are:

- KE (erstwhile Karachi Electric)
- PEPCO: Pakistan Electric Power Company
- PPIB: Private Power and Infrastructure Board
- AEDB: Alternative Energy Development Board
- WAPDA: Pakistan Water and Power Development Authority

Figure 2.14: Pakistan on the map of South Asia


Figure 2.15: Organizational structure- Pakistan




Source: KPMG Research

Table 2.7: Power system in Pakistan- Summary sheet

| **Pakistan Summary Sheet**[38,39,40,41,42,43] | |
|---|---|
| Installed Capacity | Installed capacity grew from 23 GW in 2014 to 39 GW in 2020 with substantial generation capacity owned by IPPs |
| Generation Mix | Generation capacity mix (2020) was 64% thermal; 25% hydro; 6% RE; 4% nuclear |
| Demand Growth | Peak power demand grew from under 20GW in 2013-14 to over 27 GW currently |
| Annual Energy | Sales: 112 TWh<br>Generation: 135 TWh |
| Electricity Access | 71% of the population has access to electricity |
| Per Capita Usage | 570 kWh/yr |
| Key Consumers | Households (50%) Industry (25%) Agriculture (11%) |

[38] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[39] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[40] Pakistan's Power Future, IEEFA 2018
[41] Learning from Power Sector Reform, The Case of Pakistan, World Bank Group, 2019
[42] https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202020.pdf
[43] https://nepra.org.pk/publications/State%20of%20Industry%20Reports/State%20of%20Industry%20Report%202020.pdf

### 2.1.8 Sri Lanka

System operator is a part of the Transmission Division of the CEB. Public Utilities Commission of Sri Lanka (PUCSL) regulates the power sector in the country including all arms of the CEB. Lanka Electricity Company Pvt. Limited (LECO) is a distribution company in the western part of the country. Figure 2.17 and table 2.8 shows the organizational structure and power system summary sheet for Sri Lanka respectively.

Figure 2.16: Sri Lanka on the map of South Asia

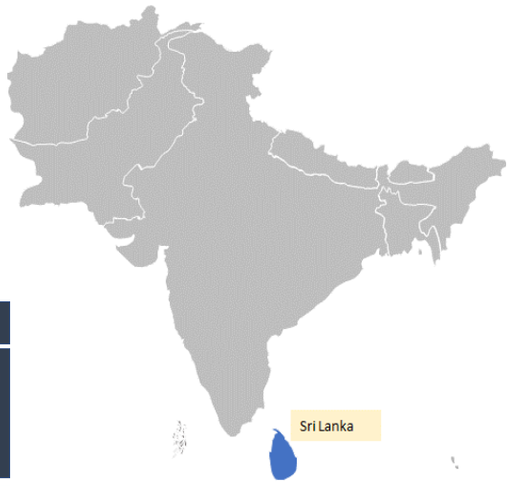



Figure 2.17: Organizational structure- Sri Lanka

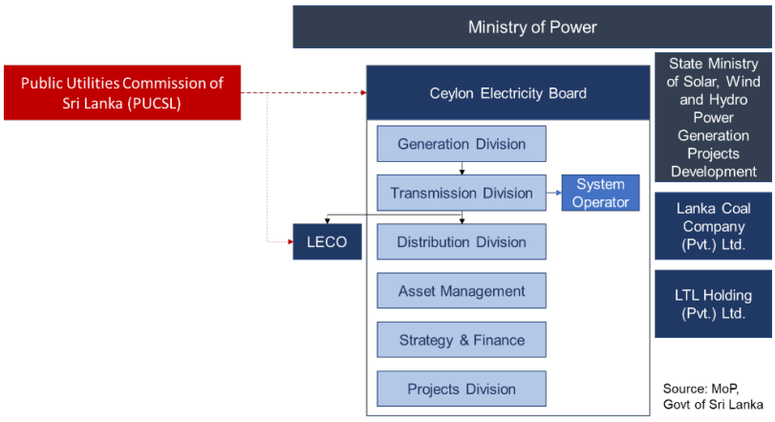



Table 2.8: Power system in Sri Lanka- Summary sheet

| **Pakistan Summary Sheet**[44,45,46,47] | |
|---|---|
| Installed Capacity | 4.1 GW of installed capacity in 2018 of which 1.2 GW owned by IPPs (oil and small hydro) |
| Generation Mix | Generation capacity mix (2018) was 50% thermal; 44% hydro; 5% RE |
| Demand Growth | Peak demand grew from 1955 MW in 2010-11 to 2453 MW in 2016-17 |
| Annual Energy | N.A. |
| Electricity Access | 100% of the population has access to electricity |
| Per Capita Usage | 603 kWh/yr |
| Key Consumers | New infrastructure projects expected to drive demand such as Western Region Megapolis Planning Project |

[44] https://data.worldbank.org/indicator/EG.USE.ELEC.KH.PC
[45] https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS
[46] Sri Lanka's Power Generation Expansion Planning, CEB, May 2019
[47] https://ceb.lk/front_img/img_reports/1595829840CEB_Annual_Report_2018.pdf

### 2.1.9 Key findings from review of organizational structures w.r.t power system operation

The study of the South Asian context has revealed similarities and divergences in the system operation structures. The separation of the role of system operator from the transmission utility stands at different stages in these countries. In terms **of entity performing the role of system operation, there are four models that exist in South Asia**. These are highlighted in the table 2.9 below.

Table 2.9: Different models of system operators in South Asian countries

| Country | Type | Characteristic |
|---|---|---|
| **Nepal, Sri Lanka, Afghanistan and Maldives** | Vertically Integrated Utilities (VIU) | In the said countries, traditional electricity system model exists, where national VIUs like NEA, CEB, DABS, FENAKA are involved in generation, transmission and distribution segments |
| **Bangladesh and Bhutan** | Legally unbundled Transmission System Operator (LTSO) | The Power Grid Company of Bangladesh is a separate company responsible for both ownership and operation of the transmission grid. However, PGCB is a subsidiary of BPDB that is also involved in generation, distribution segments<br><br>In Bhutan the transmission grid is owned and operated by BPCL which also manages system operation. It does not have generation assets but does undertake the distribution of power |
| **Pakistan** | Independent Transmission System Operator (ITSO) | The NTDC in Pakistan owns and operates the transmission infrastructure and does not have interests in the generation and distribution segments |
| **India** | Independent System Operator (ISO) | In India at the national level, there is a clear distinction between organizations that are responsible for operating the transmission grid in real-time (POSOCO - NLDC/RLDC) and those that own and maintain it (transcos like PGCIL) |

Having seen the broad organizational structure of power system operation in South Asia, it is important to analyze the key mechanisms, institutions/agencies governing system operations in South Asia. The following section provides a comparative assessment of the above across the South Asian countries.

## 2.2 Key Mechanisms, Institutions/Agencies Governing System Operations in SACs

This section focuses on the institutional structure w.r.t system operations in South Asian countries. It includes identification and a broad description of functions of key entities/agencies governing system and their inter-relationships. These include Regulatory Commissions, System Operators, technical bodies etc.

### 2.2.1 Comparative assessment across South Asian countries

The following table (2.10) highlights the key mechanisms in South Asian Countries which help in governing the system operation of their respective power sector.

Table 2.10: Comparative picture of key mechanisms governing system operations in South Asian Countries

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| **Key Mechanism I *(Laws, Acts & Regulations)***<br><br>*Responsible for governing and regulating the power sector* | ▪ **Afghanistan Electricity Law, 2015** sets the reform agenda proposing the institution-alization of electricity regulator[48]<br>▪ Afghanistan's **Power Services Regulation Act of 2016** implemented by the | ▪ Power sector in the country is governed by **Electricity Act, 2018**[52]<br>▪ **Chapter 2** of the Act talks about creation of ISO for scheduling and dispatch<br>▪ **Bangladesh Energy Regulatory Commission Act, 2003** led to creation of independent | ▪ **Electricity Act of Bhutan, 2001** governs the power sector in the country[54]<br>▪ **Bhutan Electricity Authority** established as per Section 7 of the Act<br>▪ **Section 11** addresses roles of the Authority including those involving creation of rules/codes for | ▪ **The Electricity Act, 2003** governs the power sector in the country[55]<br>▪ **Part X** of the Act deals with the creation and working of **regulatory commissions**<br>▪ **Part V** of the Act addresses transmission of power including creation and roles of **load** | ▪ Electricity sector in Maldives is regulated through the **Generation, Distribution and Supply Licensing Regulations** issued in 2019[57]<br>▪ Maldives Electricity Authority (MEA) is the delegated authority under the **Public** | ▪ Electricity sector in the country is governed by **Electricity Act, 1992**[58]<br>▪ **Nepal Electricity Regulatory Commission Act, 2017** led to the creation of a regulatory body in the country[59]<br>▪ A **Draft Electricity Bill 2076** (2019) has | ▪ **Regulation of Generation, Transmissio n and Distribution of Electric Power Act, 1997** governs the power sector<br>▪ The Act led to the creation of the regulatory body **National Electric** | ▪ Power sector in the country is governed by **Sri Lanka Electricity Act, No. 20 of 2009**[64]<br>▪ Section 17 of the Act covers development of transparent generation dispatch model by transmission licensee[65] |

[48] Afghanistan Electricity Sector Governance and Management Assessment – Afghanistan (RfP), USAID, Feb 2019
[52] https://www.bpdb.gov.bd/bpdb_new/d3pbs_uploads/files/11%20March%2019/Electricity%20Act%20(Gazette).pdf
[54] https://www.nab.gov.bt/assets/uploads/docs/acts/2014/Electricity_act_2001_Eng.pdf
[55] http://www.cercind.gov.in/Act-with-amendment.pdf
[57] http://www.energy.gov.mv/v1/download-page/laws-regulations/
[58] http://www.lawcommission.gov.np/en/archives/category/documents/prevailing-law/statutes-acts/electricity-act-2049-1992
[59] http://www.erc.gov.np/storage/listies/April2020/erc-act-2017-english.pdf
[64] https://www.ceb.lk/front_img/img_reports/1532497620Act_No._20_(E)_of_2009_.pdf
[65] https://www.ceb.lk/front_img/img_reports/1532497620Act_No._20_(E)_of_2009_.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | Ministry of Energy and Water mandates creation of Energy Services Regulatory Department for regulatory oversight of the sector. [49,50,51] | regulator[53] | scheduling and dispatch | **dispatch centers**<br>▪ An **amendment to the Act** proposed to address some recurring issues and to provide impetus on greater RE implementation [56] | **Utilities Law 4/96**<br>▪ There is no separate law/act governing the electricity sector | been proposed [60]<br>▪ **Chapter 6 of the ERC-N Act** highlights setting of codes and obligations of the system operator (like scheduling and dispatch)[61] | **Power Regulatory Authority** [62]<br>▪ **Chapter 3 of the Act** talks about dispatch from generators and roles of the National Grid Company[63] | ▪ Regulatory body Public Utilities Commission created under the **Public Utilities Commission of Sri Lanka Act, No. 35 of 2002**[66] |
| **Key Mechanism 2 *(National Policy)***<br><br>*Responsible for setting direction and goals for the power sector* | ▪ As per the **Energy Sector Strategy**[67] (2008-2013), the overall energy sector goals include the following: | The objectives of revised **National Energy Policy 2005**[68] are:<br>▪ Remove energy deficit constraints for sustained economic growth<br>▪ Ensure optimum development of | Objectives of **Bhutan Sustainable Hydropower Development Policy 2021**[69] are:<br>▪ Universal access to sustainable energy to alleviate poverty | The **National Electricity Policy 2003**[71]was issued with the aim of:<br>▪ Universal power access by 2008<br>▪ Fully meet power demand by 2012 | The key statements of **Maldives Energy Policy and Strategy 2016**[72] are:<br>▪ Strengthen the institutional and regulatory framework of | The strategic objectives of National Energy Policy Principles under **National Energy Strategy of Nepal 2013**[73] are:<br>▪ Ensure sustainability in | **National Power Policy 2013**[74] was issued with the following goals:<br>▪ Build generation capacity to sustainably | The key pillars of **National Energy Policy 2009**[75] are:<br>▪ Assuring energy security<br>▪ Providing access to |

[49] Afghanistan's Energy Grid: Planned And Existing Infrastructure, as of September 2018 -Special Inspector General for Afghanistan Reconstruction, Quarterly Report to the United States Congress, October 30, 2018
[50] Energy Supply Improvement Investment Program (RRP AFG 47282-001)
[51] Afghanistan Electricity Sector Governance and Management Assessment – Afghanistan (RfP), USAID, Feb 2019
[53] http://www.sreda.gov.bd/d3pbs_uploads/files/acts_2_bangladesh_energy_regulatory_commission_act_2003.pdf
[56] https://pib.gov.in/PressReleasePage.aspx?PRID=1615781
[60] http://www.edcnepal.org/interaction-program-on-draft-electricity-bill-2076/
[61] http://www.erc.gov.np/storage/listies/April2020/erc-act-2017-english.pdf
[62]https://www.nepra.org.pk/Legislation/Act/Regulation%20of%20Generation%20Transmission%20and%20Distribution%20of%20Electric%20Power%20Act%201997%20along%20with%20all%20amendments.pdf
[63] https://www.nepra.org.pk/Legislation/Act/Regulation%20of%20Generation%20Transmission%20and%20Distribution%20of%20Electric%20Power%20Act%201997%20along%20with%20all%20amendments.pdf
[66] https://www.pucsl.gov.lk/wp-content/uploads/2017/12/35-2002_E.pdf
[67] http://extwprlegs1.fao.org/docs/pdf/afg190065.pdf
[68] http://www.bd.undp.org/content/dam/bangladesh/docs/Projects/ncd-for-rio-convention/UNFCCC/National_Policies/National%20Energy%20Policy%20(Updated%20in%202005).pdf
[69] https://www.moea.gov.bt/wp-content/uploads/2017/07/Bhutan-Sustainable-Hydropower-Development-Policy-2021.pdf
[71] https://powermin.nic.in/en/content/national-electricity-policy#:~:text=The%20National%20Electricity%20Policy%20aims%20at%20achieving%20the%20following%20objectives,spinning%20reserve%20to%20be%20available.
[72] https://www.environment.gov.mv/v2/wp-content/files/publications/20161220-pub-mv-energy-policy-strategy-2016-20dec2016.pdf
[73] https://www.wecs.gov.np/uploaded/National-Energy-Strategy-of-Nepal-2013.pdf
[74] https://nepra.org.pk/Policies/National%20Power%20Policy%202013.pdf
[75] http://www.energy.gov.lk/images/resources/downloads/national-energy-policy-2019-en.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | ▪ Restructured sector governance and cost recoverable operations<br>▪ Rehabilitation and expansion of the public power grid<br>▪ The attraction of private investment in the energy sector<br>▪ Improved rural energy access<br>▪ Development of indigenous resources for power and energy use | indigenous energy sources<br>▪ Meet energy needs of different zones and socio-economic groups<br>▪ Ensure sustain-able operation of utilities<br>▪ Ensure rational use of total energy<br>▪ Ensure environ-mentally sound sustainable energy development<br>▪ Encourage public and private sector participation<br>▪ Integrate energy with rural development<br>▪ National electri-fication by 2020<br>▪ Ensure reliable supply at afford-able prices<br>▪ Develop regional energy market | ▪ Ensure energy security for national economic development<br>▪ Enhance CBET by participating in innovative market mechanisms<br>▪ Securitize/mobiliz e funds for sustainable hydro development<br>▪ Regionally equitable develop-ment of hydro<br>▪ Optimal water resource use by integrating with other end use and alternative energy<br>▪ Clean energy development to mitigate climate change<br>▪ Strengthen insti-tutional arrange-ments & national capacities in hydropower<br>▪ Promote "water to wire" and energy storage businesses<br>▪ Create enabling ecosystem for Bhutanese | ▪ Reliable & quality power supply at reasonable rates<br>▪ Per capita electricity availability of 1000kWh by 2012<br>▪ Minimum lifeline usage of 1 unit/ household/day<br>▪ Financial turnaround and commercial viability of power sector<br>▪ Protection of consumer interest<br>Revision of the policy is currently under discussion | the energy sector<br>▪ Promote energy conservation and efficiency<br>▪ Increase the share of renewable energy in the national energy mix<br>▪ Improve the reliability and sustainability of electricity service and maintain universal access to electricity<br>▪ Increase national energy security | the consumption of biomass energy resources<br>▪ Develop hydropower resources as the lead energy resources<br>▪ Reduce foreign dependency on imported fossil fuels<br>▪ Provide an adequate supply of energy at reasonable and affordable price<br>▪ Promote renewable energy technologies and energy efficiency<br>▪ Minimize detrimental environmental effects resulting from energy supply and use | meet power needs<br>▪ Create a culture of conserving power<br>▪ Use of indigenous resources for affordable power generation<br>▪ Minimize fuel pilferage and adulteration<br>▪ Promote world class efficiency in power generation<br>▪ Create cutting edge transmission network<br>▪ Minimize inefficiencies in the distribution<br>▪ Minimize financial losses<br>▪ Align sectoral ministries to improve governance at all levels | energy services<br>▪ Providing energy services at the optimum cost<br>▪ Improving energy efficiency and conservation<br>▪ Enhancing self -reliance<br>▪ Caring for environment<br>▪ Enhancing share of renewables<br>▪ Strengthening good sectoral governance<br>▪ Securing land for future energy infrastructure<br>▪ Providing opportunities for innovation and entrepreneurs hip<br>The energy policy has a three-pronged focus on energy security, energy |

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | | participation in construction of hydro projects<br>▪ Promote R&D, CoE and knowledge hubs in the region<br>Bhutan also released a National Energy Efficiency and Conservation Policy in 2019[70] | | | | A Draft National Electricity Policy 2020 has been created by the Power Division | sustainability and energy equity |

All countries in the South Asian region have defined laws and regulations governing the power sector as well as national policy/strategy for the sector highlighting the key goals that the country aims to achieve in stipulated time frames.

The following table (2.11) compares the key institutions in South Asian Countries which play a critical role in facilitating the system as well as the operation in their respective power sector.



[70] https://www.moea.gov.bt/wp-content/uploads/2017/07/Final-EEC-Policy-1.pdf

Table 2.11: Comparative picture of key institutions enabling system operation in SACs

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| **Key Institution I *(Regulatory Commissions and other designated institutions)***<br><br>*Responsible for the development of grid codes, operating standards and compliance & safety regulations* | **Da Afghanistan Breshna Sherkat (DABS)** [76,77]<br>▪ It was incorporated in 2009, as the key power sector entity that operates and controls all power sector functions in the country. | **Bangladesh Energy Regulatory Commission (BERC)**[78]<br>▪ Frame system related codes & standards<br>▪ Ensure compliance of above codes through development of rules and regulations | **Bhutan Electricity Authority (BEA)**<br><br>▪ Develop & implement regulations and codes<br>○ Grid code<br>○ Safety codes and regulations | **Central & State Electricity Regulatory Commission, Forum of Regulators (CERC/SERC, FoR)**[79]<br>▪ Specify grid code with regard to grid standards<br>▪ Specify and enforce the standards with respect to quality, continuity and reliability of service by licensees<br>▪ Promote competition, efficiency and development of power market through regulations<br>▪ FoR promotes transparency in the working of regulatory bodies, develop human and institutional | **Maldives Energy Authority (MEA)**<br>▪ The Authority under the Ministry of Environment and Energy is responsible for licensing and setting of tariffs in the country[80] | **Nepal Electricity Regulatory Commission (ERC-N)**[81]<br>▪ Approve grid code<br>▪ Approve distribution code<br>▪ Approve quality and safety standards for national grid<br>▪ Define obligations of system operators<br>▪ Issue directives for electricity trade | **National Electric Power Regulatory Authority (NEPRA)**[82]<br>▪ Issue guidelines and standard operating procedures<br>▪ Approve and enforce codes & standards<br>▪ Promote the development of a market, including trading | **Public Utilities Commission of Sri Lanka (PUCSL)**[83]<br>▪ Issue transmission performance standards regulations<br>▪ Approve technical standards and grid code |

[76] Energy Supply Improvement Investment Program (RRP AFG 47282-001)
[77] Afghanistan Electricity Sector Governance and Management Assessment – Afghanistan (RfP), USAID, Feb 2019
[78] http://www.berc.org.bd/site/page/36c5ee50-6ddc-4439-b66f-32445a1b7378/-
[79] http://www.cercind.gov.in/Function.html
[80] Island Electricity Data Book 2018
[81] http://www.erc.gov.np/pages/functions
[82] https://nepra.org.pk/About.php
[83] https://www.pucsl.gov.lk/electricity/

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | | | capacities in regulatory bodies etc.<br>▪ FoR has undertaken a detailed study and recommended institutional development of LDCs in the form of a detailed report '*Capacity Building of Indian Load Dispatch Centers (CABIL)'. Refer Box 2.1.* | | | | |
| **Key Institution 2 *(System Planning Agencies)***<br><br>*Focused on development of primarily medium-long term plans through dedicated agencies or additional roles to other institutions* | **Da Afghanistan Breshna Sherkat (DABS)** [84,85]<br><br>▪ Over the years, the role of DABS has also expanded into planning and investment in system infrastructure<br>▪ Last **Power Sector Masterplan** was prepared | **Power Division - Ministry of Power, Energy and Mineral Resources**<br><br>▪ Power division leads the development of **Power System Master Plan**<br>▪ Most recent power system | **Power System Division-DHPS, MoEA**<br><br>▪ Power System Division leads the development of **National Transmission Grid Master Plan**<br>▪ The most recent version of the plan was developed in 2018 with estimates upto 2040 | **Central Electricity Authority (CEA)**<br><br>▪ CEA is the designated body for the formulation of **National Electricity Plans (NEP)**<br>▪ NEP documents for generation, transmission and distribution were last issued in 2018 with forecasts upto 2027 | **STELCO & FENAKA**<br><br>▪ There is no centralized national level electricity plan and system planning is handled by STELCO and FENAKA | **System Planning Department - NEA**<br><br>▪ NEA undertakes planning through the System Planning Department under the Planning, Monitoring, and Information Technology Directorate[88]<br>▪ Water and Energy | **Power Division - MoE**<br><br>▪ The Power Division under the newly created Ministry of Energy is responsible for the strategic plan and also providing inputs for five- year plans and ADPs[90,91] | **CEB Transmission and Generation Planning Branch**<br><br>▪ The Transmission and Generation Planning Branch of the Transmission Division of CEB is tasked with development of long-term plans<br>▪ The long- term generation expansion plan |

[84] Energy Supply Improvement Investment Program (RRP AFG 47282-001)
[85] Afghanistan Electricity Sector Governance and Management Assessment – Afghanistan (RfP), USAID, Feb 2019
[88] https://www.nea.org.np/organizational_structure
[90] https://www.mowp.gov.pk/frmDetails.aspx
[91] http://cms.mowp.gov.pk:9080/userfiles1/file/Year%20book%202018-2019.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
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| | in 2013 by Ministry of Energy and Water[86] | master plan was developed in 2016 with targets upto 2041[87] | | | | Commission Secretariat also publishes energy growth forecasts with the 2015-40 forecast published in 2017 [89] | ▪ The energy department of the Ministry of Planning Development and Reform is focused on planning and execution of CPEC projects[92] | for the period 2018-2037 was published in June 2018[93] |
| **Key Institution 3 *(System Operators)***<br><br>*Primarily responsible for monitoring and coordination of system operation to ensure safety and reliability of grid. Additional functions include maintenance and operation of* | **The National Load Control Centre (NLCC - DABS)**<br>▪ It performs the function of system operation and control.<br>▪ However, currently the operation is over a limited area, wherein it coordinates and manages | **Power Grid Company of Bangladesh (PGCB)[94]**<br>▪ Owns the transmission network of the country<br>▪ Responsible for the economic dispatch of electricity throughout the country | **Bhutan Power System Operator (National Load Dispatch Centre)[95]**<br>▪ Balance demand and supply by dispatch of generation<br>▪ Coordinate transmission outage<br>▪ Monitor power import and export<br>▪ Develop load forecasts and | **National Load Dispatch Center (NLDC) and Regional Load Dispatch Centers (RLDCs) [96]**<br>▪ Ensure integrated power system operation<br>▪ Coordinate scheduling and dispatch<br>▪ Monitor grid operations and account keeping<br>▪ Ensure deviation settlement | The electricity sector operations including system operations in the country are managed by the **State Electricity Company Limited (STELCO**) and **FENAKA Corporation Limited (FENAKA)** [97] | **System Operation Department, Transmission Directorate, NEA[98]**<br>▪ Maintain security, stability and quality of power supply<br>▪ Economic scheduling and dispatch<br>▪ Ensure high network | **System Operation Division, National Transmission and Dispatch Company (NTDC) [99]**<br>▪ Control transmission and dispatch of power from generating stations | **Transmission Division, Ceylon Electricity Board (CEB)**<br>▪ Schedules and dispatches generation capacity<br>▪ System operation ensuring reliability, security and stability<br>▪ Power shortage management and load shedding |

86 https://www.adb.org/sites/default/files/project-document/76570/43497-012-afg-tacr.pdf
87 https://powerdivision.portal.gov.bd/sites/default/files/files/powerdivision.portal.gov.bd/page/4f81bf4d_1180_4c53_b27c_8fa0eb11e2c1/(E)_FR_PSMP2016_Summary_revised.pdf
89 https://www.wecs.gov.np/reports-and-publications.php
92 https://pc.gov.pk/web/energy
93 https://www.ceb.lk/front_img/img_reports/1532407706CEB_LONG_TERM_GENERATION_EXPANSION_PLAN_2018-2037.pdf
94 http://pgcb.gov.bd/sites/default/files/files/pgcb.portal.gov.bd/download/3a4d0aec_111c_49b2_9370_03a1df1f304f/2df4de53d95700233f2c3c35e8a95e9b.pdf
95 http://bpso.bpc.bt/roles-and-responsibilities/
96 http://www.cercind.gov.in/Act-with-amendment.pdf
97 Island Electricity Data Book 2018
98 https://www.nea.org.np/transDirectorate
99 http://ntdc.gov.pk/about

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| *transmission network* | the HV and MV substations (currently 17 HV and 1 MV in-service substations). | | generation requirements | ▪ Levy and collect fees from system users<br>▪ Facilitate open access<br>▪ Supervise and coordinate cross border electricity trade | | availability and reliability<br>▪ Short term system planning | ▪ Undertakes O&M of the transmission system<br>▪ Formulates grid and system operation codes and standards | ▪ Outage planning<br>▪ Collect and record system operation data<br>▪ Failure analysis, improvement in system operation and recovery protocols |
| **Key Institution 4 *(Market Operator)***<br><br>*Responsible for facilitating the power purchase transactions over different time frames and procurement mechanisms* | **No market operator** | **No market operator**<br>▪ Limited market structure<br>▪ Bangladesh Power Development Board (BPDB) main buyer<br>▪ BPDB procures power from self-owned capacity, state gencos and IPPs [100] | **No market operator**<br>▪ Market structures not present<br>▪ Bhutan Power Corporation Limited (BPCL) responsible for wheeling and sale of power in Bhutan<br>▪ Procures power from Druk Green Power Corp. (DGPC)[101] | **CERC is market regulator**<br>▪ Purchase possible for short medium & long term<br>▪ Procurement mechanism:<br>— Bilateral PPA<br>— Through trader<br>— Power exchanges<br>▪ Exchanges offer intraday, day ahead contingency, daily and weekly & real time contracts | **No market operator** | **No market operator**<br>▪ Limited market structure<br>▪ Integrated utility NEA handles T&D nationally<br>▪ Procures power from self-owned generation and IPPs | **CPPA - Central Power Purchase Agency[102]**<br>▪ Acts as national market operator (except Karachi)<br>▪ Procures power from gencos on behalf of the discoms<br>▪ Plans eventual transition to a competitive market | **No market operator**<br>▪ Limited market structure<br>▪ Vertically integrated utility CEB procures power from self-owned generation and IPPs [103] |
| **Key Institution 5 *(Load Entities)*** | ▪ Vertically Integrated Utility (DABS) | ▪ Vertically Integrated utility (BPDB) | ▪ National T&D entity (BPCL) | ▪ State and private discoms<br>▪ Large open access consumers | ▪ Vertically integrated Utility - STELCO | ▪ Vertically integrated utility (NEA) | ▪ Discoms<br>▪ KE - Vertically integrated utility | ▪ Vertically integrated utility (CEB)<br>▪ Discom (LECO) |

[100] http://www.bpdb.gov.bd/bpdb_new/resourcefile/annualreports/annualreport_1542104191_Annual_Report_2017-18_2.pdf
[101] https://www.bpc.bt/wp-content/themes/2020/assets/downloads/BPC-Annual-report-2015.pdf
[102] http://www.cppa.gov.pk/Home/CompanyProfile
[103] https://www.ceb.lk/front_img/img_reports/1563529030Annual_Report_2016.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| *Responsible for offtake of significant portion of the power generated in the country* | | ▪ Discoms (Dhaka, rural, north and west region) | ▪ Large consumers connected to the grid | ▪ Integrated entities (DVC) | ▪ Vertically integrated Utility - FENAKA | ▪ Large consumers connected to the grid | ▪ Externally connected consumers | |
| **Key Institutions 6 *(Contract Structures)***<br><br>*Mechanisms employed for contracting generation capacity and the procedures for settlement* | ▪ Import contracts have been typically short duration (1 year) with negotiated prices<br>▪ 10- year PPA signed with Uzbekistan in 2019 at fixed subsidized price | ▪ Dominated by long term PPAs (>20 years)<br>▪ Imports power from India through PTC under 15-year PPA and long term govt. to govt. agreement<br>▪ *PPAs settled bilaterally* | ▪ Single seller - single buyer bilateral procurement<br>▪ Power exports to India through long term PPAs with PTC and Tata Power Trading Company<br>▪ *PPAs settled bilaterally* | ▪ Dominated by long term PPAs with few medium/short term *(Bilateral settlement)*<br>▪ Trader negotiated contract/ agreement using open access *(Settlement via trader paying trading margin)*<br>▪ Power procurement through exchanges *(Exchange based settlement paying exchange commission)*<br>▪ Deviation Settlement option (albeit limited) to procure grid power *(LDC managed settlement)* | ▪ VIU so no separate power contracts<br>▪ Diesel based generation tariffs of 1-50 cents (USD) | ▪ Long term PPAs between NEA - IPPs<br>▪ Imports from India under govt. to govt. power sale agreements<br>▪ Power sharing agreement for Tanakpur HEP<br>▪ *PPAs settled bilaterally* | ▪ CPPA procures power on behalf of discoms<br>▪ Dominated by long term PPAs<br>▪ *Discoms settle PPAs with CPPA and CPPA settles with gencos* | ▪ Long term PPAs between CEB - IPPs<br>▪ *PPAs settled bilaterally* |
| **Other Key Observations** | The power sector in the country is aiming to transition towards a regulated environment from the current government controlled structure | BPDB procures power from its own generating stations, IPPs, SIPPs and other government owned generating companies as the single | BPCL procures nearly all of its power from DGPC and therefore the market structure is limited to a single seller - single buyer model. | India has completely unbundled its electricity sector with the separation of generation, transmission, distribution and system/market operation. | The retail tariffs determined by the MEA include significant subsidies paid for by the government.[104] | Currently the private sector participation is limited to the generation sector and all power is procured by NEA limiting the market structure. But the proposed Act (2076) aims to bring more private | With the full unbundling of the power sector completed, CPPA aims to transition to a competitive market structure in the future. | Although the Act governing the sector allows for separate licensees for generation, transmission and distribution, the roles are currently handled predominantly by CEB |

[104] Island Electricity Data Book 2018

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | buyer of power and sells power in its distribution areas and to other distribution utilities | | | | investment and competition. [105] | | |

The presence of institutions varies across the countries in South Asia depending on the maturity of the power sector in the respective countries, for instance market operators are currently present only in India and Pakistan in the South Asian region where the power sector has reached greater maturity. India has a power sector which is the largest as well as the most mature in the region, therefore it is home to a comparatively more developed power market as highlighted in Box 2.2.



[105] https://www.nea.org.np/admin/assets/uploads/supportive_docs/annual_report_2076.pdf

**Box 2.1: Capacity Building of Indian Load Despatch Centers (CABIL)**

The Technical Committee of the Forum of Regulators (FOR) for implementation of Framework on Renewables at the State level, in its 18th meeting held at New Delhi on 23rd February 2018, opined that in view of the fast changing energy landscape, the institutional capacity building of Load Dispatch Centers in India should be stimulated to improve the operational structure at the national (NLDC), regional (RLDCs) and state level (SLDCs). Consequently, sub-group was constituted to survey and identify the best practices in all LDCs in India and recommend suitable measures and roadmap for institution building and strengthening of the LDCs. A detailed report was prepared by the sub-group basis the interaction with various stakeholders, outcomes of surveys and best practices in all LDCs. The report includes suggestions with respect to infrastructure; decision support system; information and communication technology; human resource adequacy and capacity building; revenue model, performance evaluation framework for LDCs. To evaluate the performance, a balance scorecard includes four dimensions parameters - Stakeholder satisfaction, Learning and Growth, Adequacy and Efficiency of Internal Process and Financial prudence. The LDC incentives to be linked to the target score in the balance scorecard. Likewise, for individuals, the performance related pay to be linked with LDC performance and managerial appraisal as per individual KPIs.

The report provides recommendations across the following elements:

1. **Institutional capacity building:** This includes- (i) Tangibles (hard capabilities)- physical assets such as infrastructure, machinery, natural resources, organizational structure and systems etc. (ii) and Non-tangibles (soft capabilities)- social skills, experience, creativity, social cohesion, social capital, values, institutional culture etc.,
2. **Change management:** Factors impacting the overall performance of a LDCs are: business model, business environment, human resource adequacy, skill & knowledge, operating aids, goal setting & performance evaluation criteria etc. which need to be duly recognized by both internal & external stakeholders, policy makers and regulators while framing policies & regulations governing the working of LDCs.
3. **Diversity of LDCs:** LDCs varies with respect to system size, complexity, state of markets etc. Basis criteria such as Installed Generating Capacity, Installed RE capacity, peak MW, energy consumption etc., the LDCs can be categorized into emerging(small), medium and large with staffing requirements worked out accordingly.
4. **Decision support systems for LDCs**: There is need for proper Decision Support Systems at LDCs for a heightened Situational Awareness (SA). The Decision Support Systems to vary from the conventional Supervisory Control and Data Acquisition Systems (SCADA), Energy Management System (EMS) to advanced tools like Wide Area Measurement Systems (WAMS) and Dynamic Security Assessment.
5. **Distribution System Operators (DSOs)**: In view of the decentralized distributed generation leading to bidirectional flow of power, Distribution System Operators (DSOs) are recommended to interact with SLDCs to keep the system secure.
6. **Information and Communication Technology**: The ICT functions to be made a full-fledged functional division. High obsolescence rates, cyber security, third party software vs in-house capability besides vendor development must be suitably factored by the ICT teams at LDCs.
7. **Civil infrastructure & Ergonomics**: The LDCs need to be housed in a separate independent building with the right ergonomics for a control center environment.
8. **Real time operation desks:** The sub-group recommends that the Human Resource budget for real time operation should duly factor training, business travel, special assignments, leave entitlements etc.,
9. **Multidisciplinary aspect of LDCs:** The head of LDC to have the authority in matters related to transfers, posting, training, certification and professional engagement and career progression of the staff working in the LDCs.
10. **Human resource diversity:** LDCs being an executive oriented organization should have Executive and non-Executive ratio in the order of 95: 5. The typical number of executives for an emerging/small, medium and large LDCs are also determined
11. **Human-ware vs IT-ware:** A combination of both 'human ware' and 'IT ware' is recommended depending on the size of the organization.
12. **Governance of data:** It is essential that the regulation should take care of the issues & challenges associated with managing & sharing of various type & nature of data by the LDCs.
13. **Human Resource Development in LDCs:** Minimum 7 days training per person per year must be ensured. HRD expenses to be treated as part of HR expenses rather than Administrative and General (A & G) expenses and should be at least 5% of the HR expenses as HRD expenses are really an investment.

14. **Certification of LDC personnel:** It is recommended that at least 75% of the executives in a LDC are certified for basic level and 10-15% are certified specialist level with this number going up progressively.
15. **Model fees & charges regulations:** A methodology is recommended for computation of the Annual Revenue Requirement (ARR) across all LDCs and recovery thereof from all the users in line with the draft Model Regulations.
16. **HR Expense as separate head:** The LDCs are considered HR intensive, CAPEX-lite and profit-neutral units. It is suggested that HR expense be made a distinct accounting head & be separated from O&M expenses.
17. **Performance Evaluation:** The sub-group recommends that there should be appropriate incentive schemes for LDC personnel linked to these KPIs which is recovered from the users.
18. **Benchmarking:** LDCs must be benchmarked on several performance evaluation parameters under the aegis of forum of load despatchers (FOLD) related to system operation, market operation, usage of technology, adopting best utility practices, implementation of various task force/committee recommendations etc.,
19. **Reward programs:** For bringing in efficiency and building collaboration amongst members of the fraternity, it is required to conduct periodic reward & recognition programs under the aegis of FOLD

A roadmap has also been suggested for implementation of the above recommendations with specific timelines to achieve various milestones.

*Source: http://www.forumofregulators.gov.in/Data/Reports/FOR%20Report%20CABIL.pdf*

**Box 2.2: Power Market in India**

India has a far more advanced power market than other countries in South Asia. The Electricity Act 2003 laid down the provisions of competition in the India power market. Further, introduction of non-discriminatory open access in electricity sector provided further impetus for enhancing competition in the market. System Operators played a critical role in the enablement of power markets by developing the requisite operational frameworks (including for scheduling and dispatch) that helped in passing of accurate price signals to the markets. Development of power market was supported by creation of institutions to enhance efficiency through markets via bilateral trading and later in 2008 through trading on power exchanges.

Indian power market is segregated into long term (upto 25 year), medium term (3 months- 3 years) and short-term markets (less than 3 months), depending on the period of delivery for which a contract is executed. Transmission access is permitted through open- access for different timelines. Long term contracts are entered through Power Purchase Agreements (PPA). Long term and medium-term contracts generally take place through competitive bidding according to standard procedures laid down by Central Government. These contracts may be bilateral or multilateral, in many cases involving traders. Short term contracts takes place mainly through traders/power exchanges, and considerable quantum is traded directly between buyers and sellers. Since the last decade there has been a considerable rise in short-term markets i.e. from 6.1% in 2009 to 10% in 2019, whereas there has been a decline in long term markets from ~93% in 2009 to ~88% in 2019[106]. Power exchanges offer various market segments (refer table B2.1). Deviations from schedule are settled through a deviation settlement mechanism and charged as per the average frequency for a particular time block.

Table B2.1: Different Products on India Energy Exchange (IEX)

| Market Segments | Features |
|---|---|
| Day-Ahead Market | • Delivery for next day<br>• Price discovery: Closed, Double-sided Auction |
| Intraday Market & Day-Ahead Contingency Round the clock | • Intraday: For Delivery within the same day<br>• Day Ahead Contingency: Another window for next day, Gate closure: 2.5 hours |
| Term-Ahead Contracts | • For delivery up to 11 days<br>• Daily Contracts, Weekly Contracts |
| Renewable Energy Certificates | • Green Attributes as Certificates<br>• 1MWh equivalent to 1 REC |
| Energy Saving Certificates | • 1 Escert= 1 Mtoe (Metric Tonne Oil Equivalent)<br>• Trading Session on every Tuesday of the Week<br>• Trading time 1300 hrs to 1500 hrs |
| Real-Time Market (Since 1 Jun'20) | • Delivery within an hour<br>• Price discovery: Closed, Double-sided Auction |

*Source: IEX*

Recently, Government of India has also allowed trading of electricity like any other commodity through the use of derivative contracts.

[106] https://www.iexindia.com/Uploads/Presentation/30_09_2020Electricity-Market-Presentation-Sept-2020.pdf

### 2.2.2 Key findings from the comparative assessment of mechanisms, institutions/agencies governing system operations in South Asian countries

The role of governing mechanism and institutions, maturity of market structure and the type of system operation in different countries varies depending upon the size of the grid, complexity of operations and degree of power sector unbundling. Table 2.12, provides country wise summary of the key points identified in section 2.2

Table 2.12: Comparison of South Asia countries across key mechanisms, institutions and agencies

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka | |
|---|---|---|---|---|---|---|---|---|---|
| Laws, Acts & Regulations | | | | | | | | | ***Exist in all countries**, however the coverage varies depending upon the state of the power sector* |
| National Policy/ Strategy | | | | | | | | | ***Exist in all countries**, however the coverage varies depending upon the state of the power sector* |
| Regulatory Commission | | | | | | | | | ***Exist in most countries**, except in Afghanistan, where DABS is the key governing body* |
| System Planning Agency | | | | | | | | | ***Independent entity exist only in India**. In other countries, the function is undertaken by the Ministry or power utilities through internal departments* |
| System Operator | | | | | | | | | ***Independent entity exist only in India**. In other countries, the function is undertaken by the transmission utility or a department in the vertically integrated utility* |
| Market Operator | | | | | | | | | ***A market operator exist only in India and Pakistan** (limited market mechanisms in Pakistan)* |


As shown in table 2.12, all countries have adequate mechanisms and institutions to govern power system operation in respective countries. The differences are mostly to the extent that in some countries the above key points are of distinct nature, while in others they exist as part of other broader mechanisms/institutions (except market operator which only exist in India and to a limited extent in Pakistan). For example, In India, system planning is undertaken by CEA (which is a separate body under MoP, GoI), however, in other countries system planning is undertaken by specific planning departments/wings in key entities. Similarly, India has an independent system operator, while in other countries, different models of system operation (like VIU, LTSO and ISO) are being followed. However, such difference in system operation across countries in SA does not provide any hindrance to the objective of regional coordination of system operation in South Asia. On the contrary, diversities and similarities that exist provide useful learnings and offer areas of collaboration. In India, the FoR study 'CABIL' is an important reference that highlights best practices across various LDCs in India and provides suggestions on suitable measures and roadmap for institution building and strengthening of the LDCs.

Having analyzed the key mechanisms, institutions/agencies governing power system operations in South Asian countries, it is important to further delve into the operating frameworks and practices governing power system operation in South Asian countries.

The following section provides a comparative assessment of the above across the South Asian countries.

## 2.3 Operating Frameworks and Practices Governing System Operation in SACs

This section analyses different system operation codes, parameters, practices and procedures that are employed by different countries in the South Asian region. The aim to highlight the existing mismatches which would need alignment for achieving the goals of enhanced CBET in the region.

### 2.3.1 Comparative assessment across South Asian countries

Table 2.13 compares the critical system operation parameters and frameworks to identify possible deviations that may exist amongst the countries of the South Asia region.

Table 2.13: Operating frameworks governing system operation in SACs[107]

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| **Grid Code**[108, 109, 110, 111, 112, 113] *(Covers aspects like planning, connection, operation, metering, scheduling and dispatch)* | ▪ N.A. | ▪ Approved by BERC in 2012<br>▪ Managed and serviced by PGCB | ▪ Issued by Bhutan Electricity Authority (BEA) in July 2008 | ▪ Notified by CERC and came into force in April 2010<br>▪ SERCs ensure state grid codes are consistent with IEGC<br>▪ Governs all aspects of system planning and operation | ▪ N.A. | ▪ Formulated by NEA but not enacted by law or regulation, so not mandated for non-NEA entities<br>▪ Grid Code Management Committee (NEA) to implement and review<br>▪ ERC-Nepal drafting a new Grid Code | ▪ Prepared by NTDC and approved by NEPRA<br>▪ NTDC based Review Panel is a standing body for review of grid code | ▪ Formulated by CEB<br>▪ Public Utilities Commission of Sri Lanka (PUCSL) tasked with approving and amending the grid code |
| **Frequency Band**[114], [115,116,117] | ▪ 4 regional grids of the country not synchronized but are | ▪ Frequency Band: 49 Hz to 51 Hz | ▪ Normal Frequency Band: 49.5 Hz to 50.5 Hz | ▪ Frequency Band: 49.95 Hz to 50.05 Hz | ▪ Frequency Band: 49.5 Hz to 50.5 Hz | ▪ Frequency Band: 48.75 Hz to 51.25 Hz | ▪ Sensitive Mode Frequency | ▪ Frequency Band: 49.5 Hz to 50.5 Hz |

[107] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf
[108] http://berc.portal.gov.bd/sites/default/files/files/berc.portal.gov.bd/notices/82138506_08a5_4f09_a28a_b0c57ca9b367/Grid%20Code%202018%20-%2011.11.2018%20-%20Corrected%20Version.pdf
[109] http://www.bea.gov.bt/wp-content/uploads/2013/12/Grid-Code-Regulation.pdf
[110] http://www.cercind.gov.in/2016/regulation/9.pdf
[111] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf
[112] https://nepra.org.pk/Legislation/6-Codes/6.2%20NTDC%20The%20Grid%20Code%20June%202005%20with%20Grid%20Code%20Addendum%20No.%20I%20&%20II/Grid%20Code%202005.pdf
[113] https://ceb.lk/front_img/img_reports/1532500179Grid_Code_of_Transmission_Division.pdf
[114] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf
[115] https://usea.org/sites/default/files/event-/DABS%20Overview.pdf
[116] https://www.sigar.mil/pdf/quarterlyreports/2018-10-30qr-power-infrastructure.pdf
[117] https://sari-energy.org/program-activities/cross-border-electricity-trade/country-energy-data/

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | synchronized to the grids of its neighboring nations (all at 50Hz) for importing power and following their parameters [118,119,120] | ▪ Emergency State Voltage Deviation: +/- 10% | ▪ Alert State Frequency Band: 49 Hz to 51 Hz | | | | Band: 49.8 Hz to 50.2 Hz<br>▪ Tolerance Mode Frequency Band: 49.5 Hz to 50.5 Hz | |
| **Trans-mission Voltage Levels[121] and Variation Limits** | ▪ 220kV and 110kV | ▪ 400kV and 230kV<br>▪ Normal Condition Voltage Deviation: +/- 5% for 400 kV; +/- 6% for 230 kV and 132 kV Bus<br>▪ Emergency State Voltage Deviation: +/- 10% for 400 kV; +10/-15% for 230 kV and 132 kV Bus | ▪ 400kV, 220kV, 132kV and 66kV<br>▪ Normal Condition Voltage Deviation: +/- 5%<br>▪ Alert State Voltage Deviation: +/- 10% | ▪ 765kV, 400kV and 220kV<br>▪ Normal Condition Voltage Deviation: +/- 5% (400,765 kV)<br>+/- 10% (<=220kV)<br>▪ Emergency State Voltage Deviation: +/- 10% (<=220kV) | ▪ 33kV and 11kV<br>▪ Permissible Voltage Deviation: +/- 10% | ▪ 400kV, 220kV and 132kV<br>▪ Normal Condition Voltage Deviation: +/- 5%<br>▪ Emergency State Voltage Deviation: +/- 10% | ▪ 500kV and 220kV<br>▪ Normal Condition Voltage Deviation: +8% & -5%<br>▪ Emergency State Voltage Deviation: +/- 10% | ▪ 220kV and 132kV<br>▪ Normal Condition Voltage Deviation: +/- 5% (132kV)<br>+/- 10% (220kV)<br>▪ Emergency State Voltage Deviation: +/- 10% |
| **System Security Measures[122]** | NA | ▪ Contingency criteria for line outage: Single contingency of a permanent three-phase outage of any one circuit element or transformer | ▪ The security and reliability of the Transmission System shall be based on the single outage contingency (N-1)<br>▪ Except under an emergency, no | ▪ Outage of single circuit at 400 kV and 765 kV levels and outage of double circuit at 132 kV and 220 kV levels is considered as 'N-1' outage. Further, India has also introduced | NA | NA | ▪ Control of power system voltages have been specified under N-0 and N-1 conditions. | ▪ The performance of the transmission system under contingency situation (N-1) is taken into consideration |

118 https://usea.org/sites/default/files/event-/DABS%20Overview.pdf
119 https://www.sigar.mil/pdf/quarterlyreports/2018-10-30qr-power-infrastructure.pdf
120 https://sari-energy.org/program-activities/cross-border-electricity-trade/country-energy-data/
121 https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf
122 https://policy.asiapacificenergy.org/sites/default/files/Electricity%20Grid%20Code%202018.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | ▪ To be maintained stability during a fault clearance by three-phase trip within 5 cycles and followed by successful reclosure within 15 cycles | generator shall suddenly reduce his generation output by more than 5 MW and no large consumer shall cause a sudden increase in his load by more than 5 MW without prior communication to, and consent of the System Operator | N-1-1 stability criterion for critical elements of the grid<br>▪ No part of the grid shall be deliberately isolated from the rest of the National/ Regional grid except under emergency, serious damage to costly equipment and isolation is instructed by RLDC | | | ▪ All power consuming utilities are responsible for reactive power management<br>▪ System operator shall establish a base operating case and also have a emergency operating case for scheduling and dispatch | in the security criteria. i.e. outage of any one element of the transmission system at a time<br>▪ Stability criteria should ensure the system remains stable during and after a system disturbance in case of<br>- Loss of any one generation unit<br>- Large load rejection<br>- Three-phase fault at any one overhead line terminal |
| **Frequency and Voltage Control**[123, 124] | N.A. | ▪ Frequency seeing generators (designated on ramp rate basis) alter output for maintaining the frequency range<br>▪ Grid Code specifies that no cross boundary circuits or | ▪ Frequency variation controlled by ramping partially loaded stations and load shedding by discoms if needed<br>▪ Hydro units of over 10 MW are required to have governors operating at all times | ▪ RLDC can direct for isolation of parts of the grid during emergencies<br>▪ All generating stations are required to have Automatic Voltage Regulator and Power System Stabilizer in service | N.A. | ▪ All hydro units of over 10MW are required to have governors switched on at all times<br>▪ Grid code mandates that frequency seeing stations ramp up and down their generation when | ▪ Hydro stations (>100MW) capacity required to provide free governor control to help maintain grid frequency | ▪ All generating units are required to have automatic voltage regulators in service<br>▪ Droop settings in the range of 3% to 6% and |

[123] https://www.saarcenergy.org/wp-content/uploads/2018/09/Defining-Minimum-Set-of-Standardized-Technical-Data-Required-for-Regional-Power-Interconnections-and-Regional-Power-Trading.pdf
[124] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | Generating Unit of a Generator be removed from service without specific release from the NLDC<br>■ Generators with requisite ramp rates are designated as frequency seeing for altering output to keep frequency in range | ■ Isolation of any part of the grid from National/Regional grid is not permitted, except under an emergency or when such isolation is specifically instructed by system operator | ■ Regulation reserve ancillary services are utilized as per grid requirements<br>■ Creation of Ancillary services market has been proposed | | frequency crosses +/- 0.5 Hz band<br>■ Grid owner (NEA) required to install under frequency relays coving 50% of system peak demand across the grid | ■ All distribution licensees are required to provide automatic under-frequency relays for load shedding when frequency dips below threshold | governor dead band of ±0.05 Hz are specified |

Significant deviations amongst the South Asian countries are observed regarding critical system operation parameters and frameworks. Alignment of such critical parameters would be essential for enabling enhanced cross border electricity trade across the region.

Aligned system operating practices are critical for ensuring reliability of the interconnected system that enables CBET. Table 2.14 compares the practices pertaining to system operation across the region to highlight the differences that exist in the operating and control practices of South Asian countries

Table 2.14: Comparative analysis of system operation & control practices in South Asian countries

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| ▪ **Scheduling and Dispatch** [125] | ▪ N.A. | ▪ Scheduling done over 60-min blocks<br>▪ Generators provide schedule of capability on day ahead basis<br>▪ Day ahead schedule for generation published 7 hours before start of day | ▪ Scheduling done over 60-min blocks<br>▪ Distribution licensee undertakes demand estimation on daily/ weekly/monthly basis<br>▪ Generators inform system operator about day ahead capability by 9 AM<br>▪ Day ahead schedule sent to generators by 6 PM considering demand and all constraints which SO communicates to NLDC | ▪ The scheduling and dispatch are decentralized at state and regional level<br>▪ Scheduling is done on 15 min blocks<br>▪ Day ahead avail- ability is declared by gencos to their LDC by 8 AM<br>▪ Merit order dispatch of contracted capacities created with RE must run<br>▪ Schedule for each time block sent to gencos by 6 PM<br>▪ Procurement from power exchange done over STOA. Scheduling of collective transaction undertaken through coordination between Power exchange, NLDC and concerned LDCs | ▪ Scheduling and dispatch managed by the VIUs at island level | ▪ Scheduling done over 60-min blocks<br>▪ SO schedules and dispatches over inter regional links<br>▪ Day ahead generation capability estimated by 12 PM and generation schedules intimated to the generators by 4 PM | ▪ Scheduling done over 30-min blocks<br>▪ Scheduling done on day ahead basis with schedule revisions allowed on the current day<br>▪ System operator can ask generators to increase outputs during a settlement period based on demand<br>▪ The system operator is tasked with scheduling and dispatch of electricity for inter-regional links & international power transfer | ▪ Scheduling done over 60-min blocks<br>▪ Transmission licensee is tasked with scheduling and dispatch over inter regional links<br>▪ Gencos give day ahead capability schedule by 12 PM and finalized schedules sent to gencos by 3 PM<br>▪ Daily dispatch plan submitted by the SO to the PUCSL daily by 10 PM<br>▪ SO notifies the schedule, (including ancillary services) and other results of the dispatch process |
| **Deviation Settlement** [126] | NA | ▪ No deviation settlement mechanism | ▪ No deviation settlement mechanism. | ▪ Deviation Settlement Mechanism regulation issued by CERC | NA | NA | ▪ Currently no deviation | ▪ Deviations from the programmed values beyond the |

[125] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf
[126] https://nepra.org.pk/tariff/Tariff/CPPAG/2019/LAM-01%20Determination%20CTBCM%2005-12-2019%2026389-398.PDF

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | ▪ NLDC to ensure that the licensee is kept informed and up to date with all operation changes and deviations from the planned schedule | ▪ Deviations are recorded to refine the future demand estimation and issue correct schedules | ▪ Establishes a mechanism for charging the control areas (at specified rates) for deviating from the scheduled drawl/injection<br>▪ The FoR has recommended SAMAST, which is a robust, scalable and transparent framework of scheduling, metering, accounting and settlement of energy transactions at intra-state as well as interstate level in India. *Refer Box 2.3* | | | settlement mechanism<br>▪ The Competitive Trading Bilateral Contract Market (CTBCM) approved by NEPRA in 2019, has proposed development of deviation settlement mechanism | defined tolerance are considered a breach of the generator's obligations and subject to penalties as decided by PUCSL<br>▪ Monthly report includes deviations that occurred from the Year Ahead Plan, as well as their causes |
| **Outage Planning**[127, 128] | N.A. | ▪ Demand estimation and outage planning undertaken by PGCB<br>▪ The transmission licensee (PGCB) is tasked with producing a yearly transmission outage program for the period July to June.<br>▪ Outage plan is reviewed monthly in consultation with users, who are informed by the | ▪ The SO is responsible for analysis of outage plans of all licensees, and finalization of the outage plan<br>▪ The Outage plan is reviewed by the SO on a quarterly and monthly basis in coordination with all concerned licensees for any adjustments | ▪ RPC Secretariat in consultation with NLDC and RLDC undertakes annual outage planning and outages may be deferred during grid disturbances, system isolation, partial blackout etc.<br>▪ The Outage plan is reviewed by the RPC secretariat during the year on quarterly and monthly basis in coordination with all parties and concerned | N.A. | ▪ Outage planning is done in close consultation with SO<br>▪ SO may defer outage plans during grid disturbances, system isolation, partial blackout etc. | ▪ SO in consultation with the system entities also formulates the outage plan for short term (Yr 0), medium term (Yr 1-2) and long term (3-5 Yr)<br>▪ The Outage plans are reviewed by the SO, basis discussions with | ▪ Outage planning done by the transmission licensee for 3 years<br>▪ Year 3 is indicative with tentative dates, year 2 rolls over to the following year plan and year 1 is the committed plan<br>▪ The plan is updated monthly |

[127] https://www.saarcenergy.org/wp-content/uploads/2018/09/Defining-Minimum-Set-of-Standardized-Technical-Data-Required-for-Regional-Power-Interconnections-and-Regional-Power-Trading.pdf
[128] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | licensee of any proposed changes | | and adjustments made wherever found necessary | | | stakeholders and adjustments are made | |
| **System Protection and Other Steps for System Protection** [129, 130] | N.A. | ▪ For system protection, NLDC orders discoms to reduce load during periods of insufficient generation<br>▪ NLDC tasked with ensuring operating reserve for high demand period and factor the same in day ahead scheduling | ▪ Transmission licensee prepares and implements the system protection schemes<br>▪ SO and distribution entity make provisions to reduce demand in the event of insufficient generation | ▪ Users, STU, CTU, SLDC, RLDC and NLDC are required to facilitate the identification, installation and operationalization of Protection Schemes<br>▪ SLDCs are required to undertake demand estimation and reducing of demand in times of under generation | N.A. | ▪ The grid code requires splitting of demand to discrete MW blocks for HV consumers & discoms for automatic load dropping when needed<br>▪ The load blocks are categorized into group A and group B based on priority and with under frequency relays for group A at 49Hz and group B at 48Hz | ▪ Transmission licensee does demand estimation on daily/weekly/ monthly & yearly basis<br>▪ SO and discoms make provisions for demand reduction in case of under generation | ▪ Transmission licensee undertakes demand estimation on daily/weekly/ monthly and yearly basis<br>▪ Transmission licensee makes provision to reduce demand during low generation and implement automatic underfrequency load shedding program<br>▪ Load shedding done by identifying essential and non-essential load with priority rating |
| **Black Start and System Restoration Practices** [131, 132] | N.A. | ▪ *BERC Electricity Grid code, 2018 (Contingency planning)* provides guidelines of the recovery process and responsibilities of | ▪ *As per Grid Code Regulation, 2008 (Recovery procedures),* SO to develop detailed plans and procedures for | ▪ *As per Indian Electricity Grid Code, 2010*, detailed plans and procedures for restoration of the regional grid under | N.A. | ▪ Hydroassets of the country are prioritized for providing black start service | ▪ *NTDC Grid code 2005, OC 8*, specifies procedures for the restoration of power | ▪ *As per the Grid code 2015*, the transmission licensee to develop and maintain |

[129] https://www.saarcenergy.org/wp-content/uploads/2018/09/Defining-Minimum-Set-of-Standardized-Technical-Data-Required-for-Regional-Power-Interconnections-and-Regional-Power-Trading.pdf
[130] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf
[131] https://www.saarcenergy.org/wp-content/uploads/2018/09/Defining-Minimum-Set-of-Standardized-Technical-Data-Required-for-Regional-Power-Interconnections-and-Regional-Power-Trading.pdf
[132] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | all users to achieve the fastest recovery in the event of a partial or total system blackout, taking into account essential loads, generating units capabilities and system constraints.<br>▪ The SO to instruct all relevant Generators having power stations with Black Start capability, to commence their pre-planned Black Start procedure | restoration of the transmission system under partial or total blackout in consultation with all licensees and shall be reviewed and updated annually<br>▪ The SO may operate with reduced security standards during black out restoration | partial/total blackout to developed by RLDC in consultation with NLDC, all users, STU, SLDC, CTU and RPC Secretariat and reviewed/updated annually<br>▪ During black start, RLDC is authorized to operate with reduced security standards for voltage and frequency as necessary to achieve fastest possible recovery of grid | | | supplies following a total or a partial shutdown of the system<br>▪ The code requires for effective channels of communication b/w senior mgmt. of NTDC and the SO, Generators, Discoms, externally connected consumers<br>▪ During black start periods, SO is authorized to operate at reduced voltage and frequency security standards | restoration plans to manage contingencies that arise in the transmission System<br>▪ During restoration from backout, transmission licensee is allowed to operate with reduced security standards |
| **Reporting Practices**[133, 134] | NA | The Grid code defines the incidents to be reported, reporting route to be followed and information to be supplied<br>**<u>Reportable incidents</u>** | As per the Grid code, any event on the other user's system having an operational effect on transmission system to be reported by the concerned user to the SO. The code defines a | The Grid code defines the incidents to be reported, reporting route to be followed and information to be supplied<br>▪ RLDC/SLDC to be responsible for | NA | NA | The Grid code (Operation code no. 7) defines the procedure for formal exchange of written reports relating to events that have already | ▪ The SO to record events and incidents that take place or may affect the Transmission System. |

[133] https://www.saarcenergy.org/wp-content/uploads/2018/09/Defining-Minimum-Set-of-Standardized-Technical-Data-Required-for-Regional-Power-Interconnections-and-Regional-Power-Trading.pdf
[134] https://sari-energy.org/wp-content/uploads/2016/07/Study-on-Harmonization-of-grid-codes-Rajiv-07-12-2015-1.pdf

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| | | ○ Exceptionally high/ low system voltage or frequency.<br>○ Serious equipment problem.<br>○ Loss of major Generating Unit.<br>○ Falling of Transmission line/ Tower due to natural calamity<br>○ System split, Transmission System breakaway or black out.<br>○ Others | reporting procedure to be followed.<br><br>**<u>Reportable incidents</u>**<br>○ Tripping of any ICT, transmission line or capacitor bank;<br>○ Tripping of any generating units;<br>○ Major protection failure;<br>○ Exceptionally high/low voltage frequency;<br>○ Serious equipment problem<br>○ Others | reporting events to the users, SLDC/STU, CTU/NLDC/RLDC/RPC Sec.<br><br>■ All users, STU, CTU and SLDC to be responsible for collection and reporting<br><br>**<u>Reportable incidents</u>**<br>○ Violation security standards<br>○ Grid indiscipline<br>○ Non-compliance of RLDC's instructions<br>○ System islanding/system split<br>○ Others | | | occurred on the system formally reported b/w the SO, discoms, plant operators and other users of the system | ■ Information so collected to be documented in the form of daily report, outage report and monthly report |

**Box 2.3: SAMAST - Scheduling, Metering, Accounting and Settlement of Transactions in Electricity**

*SAMAST is a robust, scalable and transparent framework of scheduling, metering, accounting and settlement of energy transactions at intra-state as well as interstate level in India.*

The Indian power system has grown over the years and is subject to new developments and challenges. There has been a significant increase in intra-state, inter- state, interregional and transnational energy transactions. Further, the growth in penetration of RE and DERs has introduced additional complexities in the system. In order to streamline trade/exchange of power across states/regional boundaries a comprehensive and robust energy accounting and settlement system is essential. In view of this, a technical committee formed under the Forum of Regulators (FoR) has adopted a framework on Scheduling, Accounting, Metering and Settlement of Transactions in Electricity (SAMAST) in 2016.

The framework is based on a report prepared by a sub-committee formed by the FoR. The report is the outcome of key developments that were undertaken on the regulatory front. This included the notification of the 'Framework on Forecasting, Scheduling and Imbalance Handling for Variable Renewable Energy Sources (Wind and Solar)', 'Model Forecasting and Scheduling and Deviation Settlement framework at State level in 2015 and 'Model intra-State Deviation Settlement Mechanism for States in March, 2017.

The sub-committee interacted with State/Regional/National Load Despatch Centers and conducted a survey to study the prevailing set-up of energy accounting and settlement system in the States. The sub-committee conducted a survey of SLDC activities in energy metering, scheduling, accounting and settlement at the intra state and interstate level. 28 SLDCs and 5 RLDCs responded to the survey. The experience of SLDCs/RLDCs at the interstate/intrastate level was assimilated to evolve a uniform procedure for SAMAST across all the states and regions in India whether renewable-rich or otherwise. The report also provides a roadmap for the implementation of settlement system in states. Further, the report lays down the basic framework and governance structure of SAMAST including Information Technology (IT) infrastructure and human resources required for market operations function discharged by the SLDCs. The implementation of SAMAST is to be done by all SLDCs/STUs in a time bound manner under the oversight of the respective SERCs. The report recommends the following key elements as part of SAMAST framework:

**Key elements of SAMAST framework**

| | | | |
|---|---|---|---|
| Demarcation of interface boundary & identification of pool members | Adequate interface energy meters with AMR infrastructure | Ex-Ante Scheduling | Uniform Energy Accounting System |
| Simple, robust, scalable but dispute-free settlement system | Administration of transmission losses | Transmission Charges | Reactive Energy Pricing |
| STOA Registry and Clearing Agency | Transparency | Integrity and Probity of Accounts | Disbursal and Clearing |
| Statutory Compliances | Payment Security Mechanism and Risk Mitigation | Archival and Utilization of Energy Meter Data | Logistics for SAMAST |
| Adequacy of Human Resource | Governance Structure | Facilitating enhanced Grid Security and Economic Despatch | Implementation of Dispatch with Ancillary Services |

The success of the electricity market relies on the available systems, procedures, logistics and human resources for book-keeping of energy scheduled and actual energy exchanges between the market players through the common network. Enabling mechanisms, infrastructure and resources are critical to facilitate the SLDC in discharging the statutory and regulatory provisions. SAMAST aims to fulfill the above through the given framework.

*Source: http://www.forumofregulators.gov.in/Data/WhatsNew/SAMAST.pdf*

### 2.3.2 Key findings from the assessment of operating frameworks and practices governing system operation in SACs

Significant variation is observed in the system operating frameworks of South Asian countries. This is highlighted by the fact that although grid code exists in most of the South Asian countries, but the operating parameters defined in the grid codes vary significantly. For instance, all the countries in the region operate at the frequency of 50Hz, the tolerance band varies from as high as +/- 1.25 Hz in case of Nepal to as low as +/- 0.05 Hz in case of India. Deviations are also observed in case of other critical aspects such as voltage levels, system security mechanisms, control mechanisms etc. Table 2.15 provides country wise summary of the key points identified in section 2.3.

Table 2.15: Comparison of South Asian countries across system operation frameworks and practices

| | Afghanistan | Bangladesh | Bhutan | India | Maldives | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|---|---|
| **Frequency Band** | 50 Hz | 49 Hz to 51 Hz | 49.5 Hz to 50.5 Hz | 49.95 Hz to 50.05 Hz | 49.5 Hz to 50.5 Hz | 48.75 Hz to 51.25 Hz | 49.8 Hz to 50.2 Hz | 49.5 Hz to 50.5 Hz |
| **Transmission Voltage Levels** | 220kV and 110kV | 400 kV and 230 kV | 400kV and 220kV | 765kV, 400kV and 220kV | 33kV and 11kV | 220kV and 132kV | 500kV and 220kV | 220kV and 132kV |
| **System security criteria under contingency** | NA | N-1 | N-1 | N-1 and N-2 (for critical elements) | NA | N-1 (for select lines) | N-1 | N-1 |
| **Scheduling time blocks** | NA | 60 Mins | 60 Mins | 15 Mins | NA | 60 Mins | 30 Mins | 60 Mins |

In order to ensure seamless power flow, mutually agreed frameworks are required for cross border power trade amongst countries. Implementation of the codes related to cross border trade based on a common mutually acceptable and aligned framework can enable more synchronized operation and seamless power flow amongst the power grids of countries in South Asia, thereby facilitating CBET. Further, given that system operation is the responsibility of national power system operators in each country; their current mandate is also to be assessed to identify the variations across countries. Table 2.16 compares the mandate of system operators across South Asia.

Table 2.16: Mandate of system operators across the SACs[135][136][137][138][139][140]

| Roles of Organization | Bangladesh | Bhutan | India | Nepal | Pakistan | Sri Lanka |
|---|---|---|---|---|---|---|
| Scheduling & Dispatch | | | | | | |
| Deviation Reporting/Settlement | | | | | | |
| Market competition facilitation | | | | | | |
| System Protection | | | | | | |
| Reporting of events/incidents | | | | | | |
| System restoration services including black start services | | | | | | |
| Outage planning | | | | | | |


As shown above, the mandate and role of system operators varies and depends on factors such as size and complexity of the power system, degree of unbundling and maturity of the power markets. Alignment may also be needed on the above roles for better coordination and facilitation of CBET in the region.

The next section provides an overview of existing power trade arrangement in South Asia and further brings out the need to supplement the same through establishment of a regional network for coordination amongst power system operators.

## 2.4 Existing bilateral trading in South Asia

In South Asia, CBET is primarily taking place bilaterally between India on one side and Nepal, Bangladesh and Bhutan on the other side. The direction of trade also is predominantly unidirectional with power imports from Bhutan into India and power export from India to Nepal and Bangladesh. The following table (2.17) highlights the existing cross border connections and transaction amongst the South Asian Countries.

Table 2.17: Existing Cross Border Transactions amongst South Asian Countries

| Trade Direction | Power Purchase | Transmission Infra | Other Details |
|---|---|---|---|
| **Bhutan to India (~2200 MW)** | Tala HEP (1,020 MW) *[LT G2G contract with PTC]*<br><br>Chukha HEP (336 MW) *[LT G2G contract with PTC]*<br><br>Kurichhu HEP (60 MW) *[LT G2G contract with PTC]*<br><br>Dagachhu HEP (126 MW) *[LT Commercial PPA with Tata Power Trading Company]*<br><br>Mangdechu HPP (720 MW) *[LT G2G contract with Assam, Bihar, Odisha and WB)* | Tala (Bhutan) – Siliguri (India) 400kV D/C line<br><br>Chukha (Bhutan) – Birpara (India) 220 kV line<br><br>Geylegphug (Bhutan) – Salakati (India) 132 kV line<br><br>Malbase(Bhutan)-Silliguri(India)-400kV line<br><br>Jigmeling(Bhutan)-Alipurduar-400kV D/C line<br><br>Malbase(Bhutan)-Birpara(India)-220kV line | Bhutan's hydro exports are not covered under ABT/DSM mechanism<br><br>Scheduling done by ERLDC at India-Bhutan border point. DSM charges as per prevailing mechanism in India are computed are borne by beneficiaries<br><br>Delivery point for Dagachhu hydro is same as Tala. TPTCL (which has become ER-DSM pool member) is responsible for scheduling and imbalance settlement |

[135] In Bangladesh, the accounting is done by PGCB and the BERC formulates the operating codes.
[136] In Bhutan, the operating codes are defined by BEA and accounting is done by other arms of BPCL.
[137] In India, operating codes are defined by CERC, planning is done by CEA and transmission network is owned by transcos (govt. & private)
[138] In Nepal, the accounting is done by other arms of the NEA.
[139] In Pakistan, CPPA is responsible for developing market competition
[140] In Sri Lanka, Accounting is managed by other arms of CEB.

| Trade Direction | Power Purchase | Transmission Infra | Other Details |
|---|---|---|---|
| | | Motanga(Bhutan)-Rangia(India)-132kV line | |
| **India to Nepal**<br><br>**(~650 MW)** | 120 MW *[G2G agreements from Tanakpur HEP]*<br><br>260 MW *[LT G2G sale Muzaffarpur to Dhalkebar]*<br><br>100MW *[G2G sale from Kataiya - Kushaha and Raxaul-Parwanipur]*<br><br>Additional peaking power supply as per need (2019 planned import was 500 MW but 653 MW was imported to meet the demand) | Dhalkebar(Nepal) - Muzaffarpur(India) 400 kV D/C line (operating at 220 kV)<br><br>Kataiya to Kushaha 132kV S/C line on D/C towers<br><br>Raxaul-Parwanipur 132kV S/C line on D/C towers<br><br>Tanakpur – Mahendarnagar 132kV S/C line associated with Tanakpur HEP<br><br>Ramnagar – Gandak 132kV S/C line<br><br>14 nos. of cross border radial interconnection at 11kV, 33kV between Bihar (NBPDCL), UP (UPPCL) and Uttaranchal (UPCL) on the Indian side | Billing on actual energy with no scheduling or DSM settlement in bilateral-treaty trade<br><br>For PTC driven trade NEA provides daily schedules which are coordinated with NRLDC. Any DSM liability is passed to NEA |
| **India to Bangladesh**<br><br>**(1,340 MW)** | NTPC to BPDB (250+50 MW) *[LT G2G sale via NVVN]*<br><br>PTC India to BPDB (250+40 MW) *[MT Commercial PPA with PTC]*<br><br>Tripura - India to Commilla - Bangladesh (160 MW) *[LT G2G sale]*<br><br>PTC India to BPDB (200 MW) *[ST sale by PTC - to be supplied from power pool of WBSEDCL]*<br><br>PTC India to BPDB (200 MW) *[LT commercial sale by PTC - to be supplied from Meenakshi Energy Limited]*<br><br>Sembcorp Gayatri Power Limited (250 MW) *[LT Commercial sale from its 2,640 MW imported coal plant]* | Baharampur (India) – Bheramara (Bangladesh) 400kV D/C line with HVDC back- to back terminal at Bheramara (500 + 500 MW capacity operational and another 500 MW expected by 2021)<br><br>Tripura (India) – Comilla (Bangladesh) 400kV D/c line (presently operating at 132kV) with up to 160MW power transfer capacity | NVVNL is the designated Nodal Agency (including PTC trades) and coordinates with NLDC India and NLDC Bangladesh for scheduling<br><br>NVVNL has joined ER-DSM pool as a member and DSM liability of NVVNL get passed on to BPDB<br><br>Scheduling is done at 400 kV Baharampur S/S |

*Source: KPMG Research*

As the region progresses towards greater CBET and trilateral and multilateral trade in the coming years, the following needs to be emphasized to ensure further streamline cross border exchange of power amongst countries in South Asia.

- Adequate assessment of mode of interconnection (synchronous AC and asynchronous HVDC) to identify the suitable technology for individual cases
- Injection pattern of cross border assets needs to be further aligned with the load patterns of the receiving country to ensure efficient use of hydro resources in the region

- With data and information sharing, coordination functions may be streamlined further

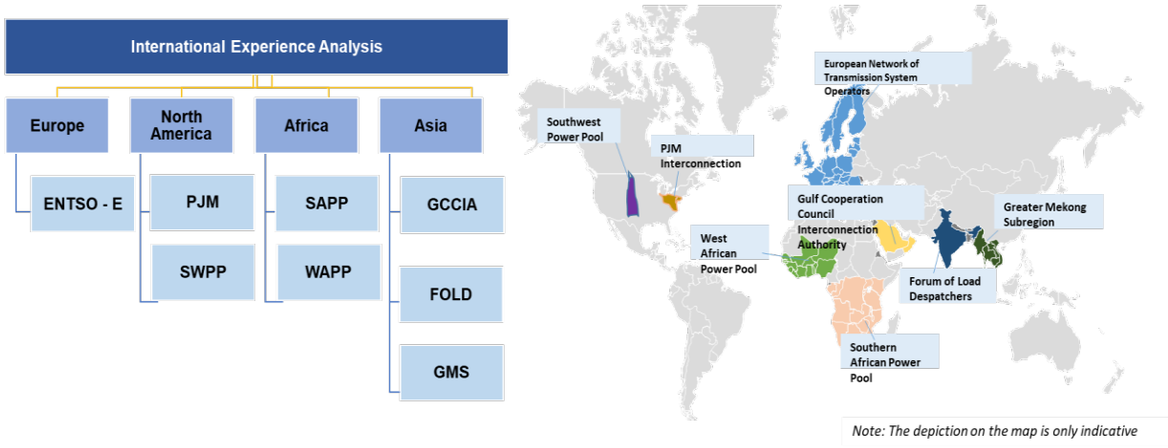
The CBET potential in the region currently remains underutilized (with only ~3.7 GW of power trade). Trade exists only in the form of bilateral arrangements, which is facilitated through mechanisms such as joint working groups and joint steering committees. In recent years, progress has been made for trilateral trade between Nepal and Bangladesh via India which would increase the need for greater harmonization amongst the countries' operating codes, practices and procedures. This shall entail cooperation amongst national power system operators of member countries in a collective manner.

Therefore, there is strong need to develop an institutional mechanism which can act as a platform for crosscutting deliberations and exchange of ideas; facilitate development and implementation of common procedures/guidelines and provide technological support as well as assistance towards harmonization of system operation practices. The institutional framework would be critical to support requisite cooperation, knowledge sharing and capacity building as well as offer support to regional regulatory institutional mechanisms. Such a framework would help in reducing complexity and costs as well as fully utilize the regional resources potential. The understanding of the divergences in the region would help in defining the functions and recommending the institutional framework of the proposed network.

# 3. International Experiences of Regional System Operators and Forums

There are multiple regional system operators and market operators' collaboration forums across the world. They offer significant insights on the key aspects of governance, organizational setup, operating structures, financing mechanisms and other CBET enabling mechanisms. This chapter analyses the experiences of regional system operators and collaboration forums to identify critical learnings that can be incorporated for creation of an effective network. The global organizations analyzed in this chapter are highlighted in Figure 3.1.

Figure 3.1: International Regional System Operators and Forums Studied.

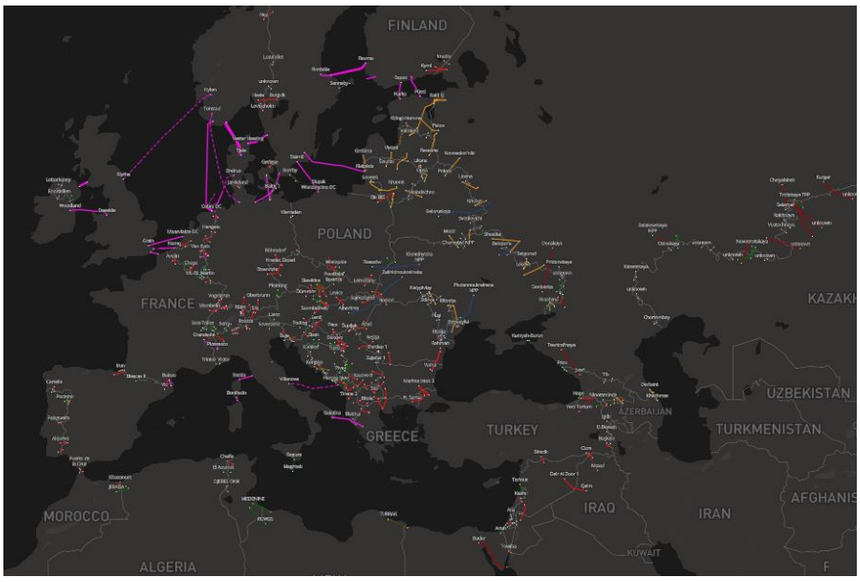



*Note: The depiction on the map is only indicative*

## 3.1 Europe

### 3.1.1 ENTSO–E (European Network of Transmission System Operators – Electricity)

Figure 3.1.1.1 ENTSO-E Member Entities*




Regional electricity interconnection started in Europe in 1921 when it became possible to transmit power 700 Kms from Nancy, France to Milan, Italy via Switzerland. The international trade of electricity highlighted hurdles that mandated inter-country coordination. Therefore, International Union of Producers and Distributors of Electrical Energy (UNIPEDE) was formed in 1925 with entities of Italy, France and Belgium as its initial members. A Europe-wide electricity network was first proposed in 1929. Post-World War II, cross country interconnections and institutionalization grew and the Union for the Coordination of

Production and Transmission of Electricity (UCPTE) was created with 8 Western European founding countries. UCPTE helped in ensuring mutual coordination and capacity utilization, better protection systems and reliability as well as more cost-effective power through optimal resource utilization. Similar organizations also rose and grew in other parts of Europe such as Integrated Power System/United Power System (IPS/UPS) in Eastern Europe, NORDEL in Nordic Countries, Baltic TSO association (BALTSO) in Baltic states, UK TSO Association (UKTSOA) in UK and Association of TSOs of Ireland (ATSOI) in Ireland. UCPTE was later renamed as UCTE dropping 'P for Production' in 1999. In anticipation of the European Commission's third package, all TSO associations intensified collaboration commitments taking initial steps towards creation of continental TSO body.[141]

Europe had a number of regional associations of Transmission System Operators (TSO), across the continent. The European Commission in 2003 instituted a study on the electricity market competition in six countries that discovered that there were issues regarding market effectiveness that needed to be resolved[142]. It was identified in the study that there were issues regarding easy and equitable availability of transparent market information and the integration amongst the markets of the member countries was limited. European TSOs had proactively started working on the envisioned tasks of forming pan European network codes, ten-year development plans, network tools and adequacy forecasts. In 2007, to formally address the identified issues, the European Commission brought in the third legislative package[143]. It was given the legal mandates by the European Commission's third legislative package in 2009. The deadline for adoption of the package by member states was March 2011 when it was finally adopted by all EU members making the provisions, directives and regulations formally applicable across Europe and thereby ensuring the requisite mandate for ENTSO-E. The Prague declaration was signed by 36 TSOs. Through this, six regional association of TSOs namely European Transmission System Operator (ETSO), ATSOI, UKTSOA, NORDEL, UCTE, BALTSO (comprising of 42 TSOs) in Europe merged in 2008-09 to form a single large continent-wide system operator association named European Network of Transmission System Operators - Electricity (ENTSO-E). Currently, ENTSO-E represents 42 TSOs across 35 countries covering five synchronous areas and two isolated systems (Figure 3.1.1.1). Country level energy flow details listed in Annexure 1.[144,145]

Further, ENTSOE-E Articles of Association (AoA) were finalized in June 2011 after consultations and deliberations with European Union Agency for the Cooperation of Energy Regulations (ACER) and European Commission. The AoA covered critical aspects such as establishment of the organization, its key roles, membership and bodies, voting powers of members and financial arrangements. The bodies described in the AoA are the Assembly, the Board, the Committees, Legal and Regulatory Group, Regional Groups and the Secretariat. The financial arrangements under AoA specify that the association is established without capital contributions and all its members are required to contribute annual membership subscription. The member ship subscription of each member is dependent of their voting rights in the body. Observers are also required to pay an observer's fee to help financially sustain the organization.[146]

ENTSO-E TSOs manage over 3 lakh kms of transmission lines supporting consumption of 3329 TWh of electricity across Europe in 2017, of which ~14% came through cross border flows. The peak load handled by the European TSOs in the year 2017 was over 542 GW.[147] The overall installed capacity of the region in 2017 was 1,060GW comprising of hydro (20%), nuclear (12%), Fossil Fuels (39%) and RE (29%).

The main objectives of ENTSO-E as per the third energy package are as follows:

- Ensure security of supply and system reliability in the connected complex network
- Facilitate cross border network development

[141] https://eepublicdownloads.azureedge.net/clean-documents/pre2015/publications/ce/110422_UCPTE-UCTE_The50yearSuccessStory.pdf
[142] https://eur-lex.europa.eu/legal-content/EN/ALL/?uri=CELEX:52006DC0851
[ii]https://www.entsoe.eu/data/map/
[143] https://ec.europa.eu/energy/topics/markets-and-consumers/market-legislation/third-energy-package_en#documents
[144] https://www.entsoe.eu/about/inside-entsoe/objectives/
[145] https://eepublicdownloads.azureedge.net/clean-documents/pre2015/publications/entsoe/Annual_Report/120326_ENTSO-E_Annual_Report_2011.pdf

[146] https://eepublicdownloads.azureedge.net/clean-documents/pre2015/Association/110628_ENTSO-E_Article_of_Association__EN.pdf
[147] https://eepublicdownloads.entsoe.eu/clean-documents/Publications/Statistics/electricity_in_europe/entso-e_electricity_in_europe_2017_web.pdf

- Integration of Renewable Energy Sources (RES) into the power system
- Optimal functioning and enhancement of the internal energy market

The organizational set up, operating framework, governance and financing mechanism of ENTSO-E is provided below:

### a) *Organizational Setup* [148]

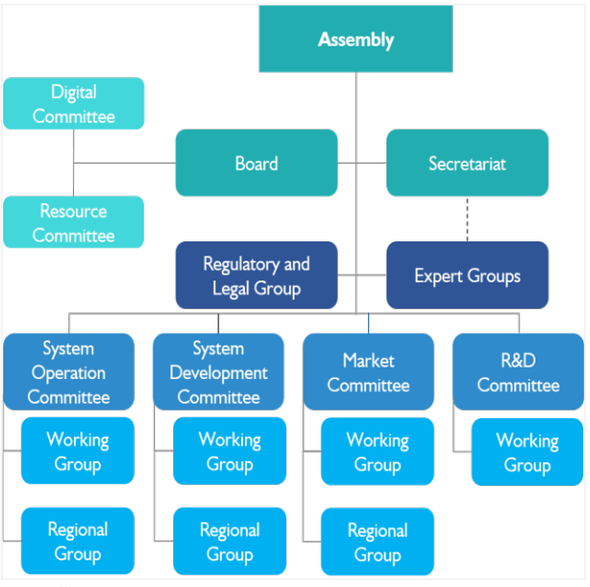
- ENTSO-E was given a legal mandate by the EU's Third Legislative Package for the Internal Energy Market in 2009 and is recognized as a formal legal advisory body as per European Commission (EC).
- ENTSO-E was registered as a non-profit association (Association internationale sans but lucratif - AISBL) at Brussels, established according to Belgian law in 2009 and is headquartered at Rue de Spa 8, 1000 Brussels, Belgium.
- ENTSO-E employs its own staff at the secretariat which is led by its management team and headed by a secretary general who is appointed for a 4-year term by the assembly. The staff strength at the end of 2019 was 103 employees.

ENTSO-E's organizational structure consists of an assembly at the top followed by a board which oversees management roles. The organization's tasks are accomplished primarily through four key committees reporting to the board supported by secretariat, regulatory and legal and expert groups. A digital committee and a resource committee report to the ENTSO-E board.[149]

### b) *Governance Model* [150,151]

ENTSO-E has a **multilayered governance** structure (Figure 3.1.1.2):

Figure 3.1.1.2 Structure of ENTSO-E




***The Assembly***

- The Assembly represents the 43 Transmission System Operators and is comprised of the members of the Association
- The Assembly is the general leading body of the Association and has full powers to enable the achievement of the Association's purpose. All powers not specifically attributed to the other bodies of the Association, belong to the Assembly
- The Assembly is responsible for admission of members, rights of members and suspension, the appointment and dismissal of President, VP, Chairpersons of committees, of members of Board and Secretary General

***The Board***

- ENTSO-E is governed by a board of 12 elected members (including chairperson and vice-chairperson)

[148] https://www.entsoe.eu/about/inside-entsoe/objectives/
[149] https://www.entsoe.eu/about/
[150] https://www.entsoe.eu/about/inside-entsoe/governance/
[151] https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/General%20ENTSO-E%20documents/General%20ENTSO-E%20documents/140930_Articles_of_Association.pdf

- Candidates are proposed for appointment to the board by the members of ENTSO-E
- The board as well as its chairperson and vice chairperson are appointed for a two-year term through a two-step voting process of the Assembly

***The Committees***

- The Assembly can create more committees or dissolve the existing committee as needed
- The chairperson and vice chairperson of the committee are appointed by the Assembly
- Each member has the right to appoint one representative to every committee

Distribution of voting rights between the members is determined by the **Articles of Association**. The Articles of Association govern operations, membership, roles and relationships of ENTSO-E and its bodies. Internal regulation documents complement the Articles of Association in governance by defining the practical and technical rules and procedures driving the operations of the entity

**Representation structure at ENTSO-E is defined in its Articles of Association[152]:**

- The Assembly comprises of representatives of all member TSOs, comprising typically of top leadership of the respective member TSOs
- A president and vice president are elected for presiding over the Assembly through a two-step voting process
- The members are required to notify ENTSO-E in writing about their representative to the Assembly
- A member can also give its Assembly representation proxy to the representative of another member (one member cannot hold more than three proxies)
- Members can send an additional representative, but they do not get voting rights
- Annual assembly meetings are held in the second quarter of each calendar year
- The Members of a given country are collectively attributed a voting power proportionate to the number of votes that that country has as EU Member State in the Council of the European Union under the voting mechanism defined by the Lisbon Treaty
- For non-EU Member States, the voting power is assigned according to the same mechanism as if these countries were EU Member States
- In case there is more than one member from a country, the voting rights equivalent to the country's rights are divided amongst the members from that country. The distribution of voting rights is decided mutually by the members of the country (rights may not be equally divided).
- For instance, UK is assigned twelve (12) votes (as of 2014) which it divides among its four (4) member entities with National Grid (National Grid Electricity Transmission PLC) getting nine (9) votes and SONI (System Operator for Northern Ireland ltd.), SHE Transmission (Scottish Hydro Electric Transmission plc), SP Transmission (Scottish Power Transmission PLC) each getting one (1) vote

The Transparency Regulation (EU) No. 543/2013 regarding the submission and publication of data in electricity markets (Transparency Regulation) was enforced in June 2013. To comply with the same ENTSO-E redesigned and significantly upgraded its existing transparency platform

### c) *Operating Framework* [153]

The overall mandate of ENTSO-E revolves around the following key areas:

[152] https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/General%20ENTSO-E%20documents/General%20ENTSO-E%20documents/140930_Articles_of_Association.pdf
[153] https://www.entsoe.eu/publications/general-publications/at-a-glance/

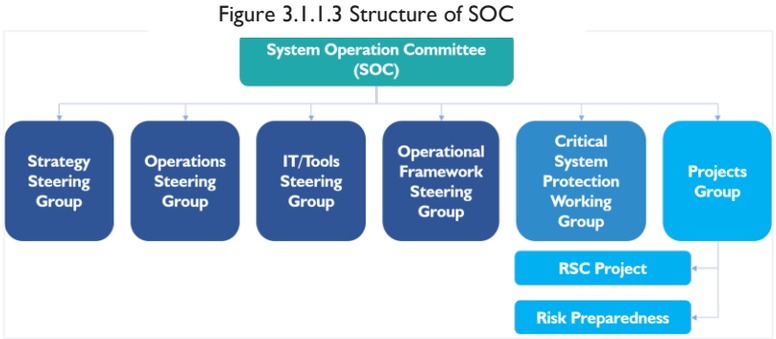
- **Development of pan European Transmission Plan** - This is undertaken by developing the Ten-year Network Development Plan (TYNDP) every two years, supported by six detailed regional investment plans as well as a Scenario Outlook and Adequacy Forecast (SO&AF). TYNDP helps in identification of Projects of Common Interests (PCI) for EU.
- **Preparing Adequacy Forecasts** - The forecasts are published by ENTSO-E looking 15 years into the future as a part of the SO&AF. It also publishes annual summer and winter forecasts to ensure the region's security of supply.
- **Formulating Network Codes** - Codes prepared with guidance from ACER are published by ENTSO-E after approval by EC. The codes are classified into Connection, Operational and Market Codes.
- **Ensuring Energy Market Transparency** - This is maintained through the central information and transparency platform which publicly shares important market pertinent data.
- **Building TSO Cooperation** - Tools and mechanisms (like ENTSO-E Awareness System (EAS) and Regional Security Coordination Initiatives) ensure cooperation and secure operations of the networks.
- **Setting Annual Work Program** - Program covers aspects such as strategy, resources, codes, plans, innovation etc. It highlights the path being taken to achieve Europe's energy goals.
- **Drive Research and Development** - ENTSO-E develops a R&D roadmap to set priorities and is supported by the R&D implementation plan which follows top down and bottom up approaches in meeting the objectives of the plan. The annual R&D monitoring report assesses the progress against the set targets for R&D in the roadmap.
- **Collection and Dissemination of Data** - ENTSO-E collects, collates and shares relevant data with the stakeholders to streamline coordinated operations.

There are four committees that help ENTSO-E perform its tasks. These include:

1. **System Operation Committee -** ensures coordinated system operation
2. **System Development Committee -** undertakes system planning and development
3. **Markets Committee -** facilitates development and functioning of European energy market
4. **R&D Committee -** coordinates research and innovation activities

The **System Operation Committee**[154] (SOC) is divided into four steering groups, one working group and two project groups (Figure 3.1.1.3). SOC also has five permanent regional groups reporting to Steering Group operations (five synchronous areas of Continental Europe, Nordic, Baltic, Great Britain, and Ireland-Northern Ireland). Each of these are defined below:

Figure 3.1.1.3 Structure of SOC




- **Operations Group** focuses on planning, operational security and frequency control. It helps in defining and updating technical and operational rules. It also develops proposals for harmonizing

[154] https://www.entsoe.eu/about/system-operations/

operational procedures to promote operational alignment among regions and synchronous areas. It promotes evolution of current operational processes and applications to cope with the regular operational challenges. It works closely with Steering Group Operational Framework for developing pan-European methodologies and regulatory reports.

- **Strategy Group** aims to develop operational strategies for the SOC to face evolving challenges and changes in the electricity sector beyond regular operations. Key focus of the group is on coordination of the power system operation- between TSOs, with DSOs and inter-sectorial. It helps SOC in the assessment of infrastructure, regulatory changes, technological improvements and their impacts on operation, and making requisite proposals for building security, resilience and efficiency in the power system operation.
- **IT and Tools Group's** main role is to offer technical and business inputs to SOC for ensuring that IT systems and projects are properly planned, built, delivered, implemented and operated. It directs, monitors and provides assurance on both project and operational delivery of relevant SOC decisions. It initiates project proposals and assesses proposals from other parties for validating that the scope of work, governance, resource requirements etc. fits the purpose and aligns with SOC decisions. It represents SOC at the digital committee of the board.
- **Operational Framework Group** focuses on development, implementation and monitoring of the system operation frameworks for the transmission network in Europe. It also ensures further sustainable development and change management in the framework, as per the needs of supply security, TSO and grid users. It represents the SOC at the European Stakeholder Committee for European network codes and guidelines.
- **Critical System Protection Group** focuses on development of critical systems and protection of infrastructure at a pan-Europe level.
- **RSC (Regional Security Coordinators) Project** aims to implement seven defined services for increasing regional cooperation in system operations and markets.
- **RPR (Risk Preparedness) Project** aims to define the methodology for identification of Regional Electricity Crisis Scenarios and Short Term and Seasonal Adequacy Assessment. [155]

Since 2011, development of Network Codes (NCs) and guidelines for electricity has been initiated by the European Commission (EC), the Agency for the Cooperation of Energy Regulators (ACER), the European Network of Transmission System Operators for Electricity (ENTSO-E), associations representing Distribution System Operators (DSOs), the European Association of Energy Exchanges (Europex) and other stakeholders such as consumer organisations, generators, suppliers and many others from across the European electricity sector. Accordingly, ACER and ENTSO-E proposed to co-organize three **European Stakeholder Committees (ESC),** one per family of network codes (Market, Operational and Grid Connection network codes).

- These ESCs aim to complement, and not to replace, the legal obligations of stakeholder consultation and information included in the NCs during the implementation period
- Members to the ESC are nominated through a formal call of interest open to any interested association representing pan-European interests. The number of representatives from each organization are limited to keep to total number of members under 25
- ACER chairs all ESCs, and nominates the Chairperson of each subgroup after consulting the ESC
- The European Commission will be invited to observe all meetings of the ESC
- The ESC meets indicatively four times a year, but the Chairperson may increase or decrease this number according to the ESC's needs.

* https://www.entsoe.eu/about/system-operations/
[155] https://www.entsoe.eu/about/system-operations/

The system operation ESC (SO ESC) is the third ESC to be set up with the objective of ensuring stakeholder engagement in the implementation process of Network Codes and Guidelines by providing the stakeholders a platform to express their views and feedback on the implementation.

In order to support efficient system operation and to support the optimal functioning and enhancement of internal energy markets ENTSO-E publishes detailed documents and reports such as the ten year network development plan (TYNDP), yearly statistics on adequacy, outlooks and adequacy reports, monthly statistical reports, R&D roadmaps, implementation plan and monitoring reports.[156,157]

**Coordinated System Operation Activities at ENTSO-E are undertaken collaboratively by SOC through its groups, projects and other committees:***

- Development and maintenance of European operational framework through a framework of **network codes**/guidelines, agreements and standards.
- *Network codes are developed through an extensive consultation process. ENTSO-E prepares draft network codes based on guiding principles of ACER. This is followed by consultation with stakeholders. Further, through comitology process (voting by members in the Parliament), the draft codes become legally binding on all the members.*
- ENTSO-E ensures operational coordination across the region through tools like **Regional Security Coordinators (RSCs)** which monitors the operational security of the transmission system.
- *RSCs are companies owned by TSOs and monitored by ENTSO-E. These RSCs help TSOs in Europe, cooperate, exchange data to better plan their system, performs security analysis, provide TSOs with forecasts of network security levels and propose coordinated measures and recommendations within the standard framework of ENTSO-E.*
- It establishes rules to facilitate the development and implementation of a **Common Grid Model (CGM)** for all stages of system operation.
- *CGMs provide standardized data sets for European power systems. They contain vast amount of data providing a strong base for statistical and probabilistic analysis and decision making.*
- ENTSO-E maintains an online tool **E- Awareness System (EAS)** providing a real-time pan-European view on the state of transmission systems.
- *EAS provides details about network flows, demand and supply scenarios to the member entities in a transparent manner.*

### d) *Financing Mechanism* [158,159]

ENTSO-E is entirely funded through membership fees paid by its members. The membership subscription fee is determined based on the voting powers enjoyed by the member. Associated members and observer members pay a fixed annual fee. For 2019, the budget of ENTSO-E amounted to EUR 30.1 million funded by TSO member fees for EUR 28.7 million and by other revenues for EUR 1.5 million (H2020 grants and additional TSO funding).

### e) *Inter Organization Relationship and Cooperation*

Both ACER and ENTSO-E were created under the Third Package with the vision of implementing the Internal Energy Market. The two organizations work closely to achieve this goal. ENTSO-E provides its

[156] https://eepublicdownloads.entsoe.eu/clean-documents/Network%20codes%20documents/Implementation/stakeholder_committees/SO%20ESC/System_Operation_ESC_ToR.pdf
[157] https://www.entsoe.eu/network_codes/esc/#system-operations-stakeholder-committee
[158] https://eepublicdownloads.blob.core.windows.net/public-cdn-container/clean-documents/General%20ENTSO-E%20documents/General%20ENTSO-E%20documents/140930_Articles_of_Association.pdf
[159] https://annualreport2019.entsoe.eu/annex-3-resources/

inputs to ACER on regulation formulation and ACER provides guidance to ENTSO-E on preparation of network codes.

| ENTSO-E Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Development of policy positions, drafting of network codes and contributing to their implementation, enabling regional cooperation through Regional Security Coordination Initiatives (RSCIs), facilitating technical cooperation between TSOs, publishing of seasonal outlooks for short term system adequacy, development of long term pan Europe network plans and coordinating R&D plans. | |
| **Organizational Setup** | |
| **Legal Framework** | Association created in line with EU Mandate under Belgian Law[160] |
| **Formation/Initial Period** | 6 former regional TSO Associations (namely ETSO, ATSOI, UKTSOA, NORDEL, UCTE, BALTSO) merged to create a continent wide system operator association in 2008-09 |
| **Membership** | 42 TSOs from 35 European countries |
| **Headquarter Location** | Brussels, Belgium |
| **Governance Mechanism** | |
| **Governance Layers** | Assembly & Board |
| **Apex Body Members** | Assembly with all members representatives |
| **Board Members** | 12 elected members |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | 4 key committees (System Operation, System Development, Markets and R&D) |
| **Regional Inter-entity Relationship** | Works closely with ACER on regulations and codes |
| **Secretariat and Roles** | 8 HoDs leading different functions headed by secretary general-4 year term |
| **Staffing** | 103 employees with own staff in secretariat |
| **Finance** | |
| **Funding** | Membership Fee |
| **Budget** | EUR 30.1 million in 2019 |
| **Other Details** | |
| **CBET Supported** | Over 450 TWh of CBET supported in 2017 constituting 14% of total consumption (3329 TWh) |
| **Capacity Mix** | Generation capacity of 1,060GW in 2017 comprising of hydro (20%), nuclear (12%), Fossil Fuels (39%) and RE (29%). |

[160] Inter-governmental agreements form the basis of EU whose executive arm, the European Commission mandated the creation of ENTSO-E as a part of its third legislative package. ENTSO-E is registered in Brussels as an International association without lucrative purpose (Association internationale sans but lucratif- AISBL)

**Key Observations:**

- ENTSO-E was created on the basis of the third legislative package of European Commission which led to the ***amalgamation of six (6) regional TSO associations into a continental association***
- Its ***members are forty two (42) transmission system operators*** from the thirty five (35) member countries
- ENTSO-E has its ***independent permanent headquarters*** in the member country of Belgium staffed by its ***own workforce***
- It has a ***multi-layer governance structure*** comprising of the Assembly and the Board. The organization works through a ***no. of fixed committees and working groups,*** which have defined focus areas
- ENTSO-E manages its system operation tasks through a ***dedicated System Operation Committee***
- The organization has a ***sustainable funding mechanism based on fees paid by its members*** (fee amount dependent on membership type and voting rights)

## 3.2 North America

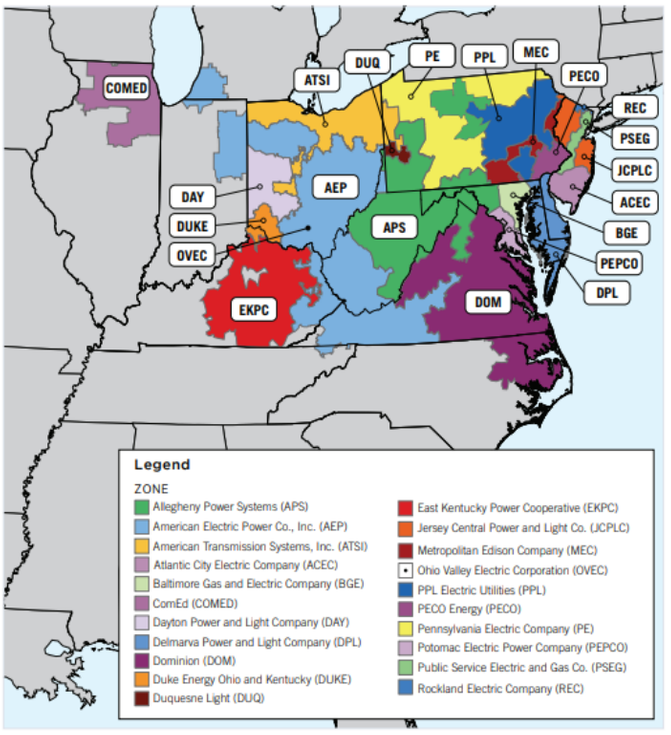
### 3.2.1. PJM Interconnection[161,162,163]

PJM started in 1927 as Pennsylvania-New Jersey power pool between Public Service Electric and Gas Company, Pennsylvania Power & Light Company, Philadelphia Electric Company. General Public Utilities and Baltimore Gas and Electric Company joined the power pool in 1956 and the same was expanded to Pennsylvania -New Jersey - Maryland (PJM). Additional utilities joined the power pool in subsequent years, but the organization was operated by a department of one-member utility and was not an independent organization.

* https://www.pjm.com/library/~/media/about-pjm/pjm-zones.ashx
[161] https://www.pjm.com/about-pjm/who-we-are/pjm-history.aspx
[162] https://pjm.com/about-pjm/who-we-are.aspx
[163] https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_PJM%20Interconnect-Developed%20Countries.pdf

The goals of the power pool were to ensure dispatch of the generating stations on the lowest cost order basis to ensure cost optimization for the utilities. PJM operated its member utilities as a singular system for scheduling of generation units and dispatch of power in order to improve economies of scale and the generated savings were passed on to the member utilities. PJM also recovered its costs through this administration of the pool. The pooled system of dispatch was initially centered around the city of Philadelphia as the primary load centre. The pool grew significantly by 1965 and that led to the more serious consideration of transmission issues and focus on system operation aspect to optimize use of transmission assets. This emphasis grew with the push for procurement of power from third party power generation entities in 1978. In 1993 PJM Interconnection Association was formed as it started transitioning to become an independent and neutral organization for administering the power pool. PJM became a fully independent organization by 1997 with membership opened to non-utilities and election of an independent board of managers.

Figure 3.2.1.1 PJM Member Entities*




Following Federal Electricity Regulator Commission's (FERC) orders, in 1997, PJM became the first fully functional ISO that did not own transmission assets but independently operated the grid. PJM also began administering a bid-based energy market in 1997. Subsequently as FERC encouraged creation of Regional Transmission Organization (RTO) for operating multistate transmission networks, PJM transitioned to become an RTO in 2002. Currently, PJM coordinates wholesale electricity flows in 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 (Figure 3.2.1.1). PJM operates over 84,236 miles of transmission network serving a population of 65 million. Energy transmitted over PJM network was 787 TWh in 2019 with a peak demand of 165.5 GW[164]. The installed capacity of the PJM region in 2019 was 186 GW comprising of coal based capacity (30%), nuclear capapcity (18%), gas based capacity (41%), petroleum based capacity (5%) and RE capacity (7%) along with the additional demand response resource (10 GW) and energy efficiency (3 GW)[165]. The system operators at PJM monitor the grid continously and utilize computer algoriths to effectively predict the electricity demand 2 hours in advance to match with the aforementioned generation capacity in the most cost effective manner.

### a) *Organizational Setup* [166]

PJM was originally hosted as a power pool before being established as an ISO/RTO. The goal of the power pool was to dispatch the generating stations on merit order thereby reducing the electricity costs for the pool members.

[164] https://www.pjm.com/-/media/about-pjm/newsroom/annual-reports/2019-annual-report.ashx?la=en
[165] https://www.pjm.com/-/media/markets-ops/ops-analysis/capacity-by-fuel-type-2019.ashx?la=en
[166] https://pjm.com/about-pjm/who-we-are/pjm-history.aspx

- PJM is incorporated as a limited liability company and was recognized as an Independent System Operator (ISO) in 1997 under the Federal Electricity Regulator Commission (FERC) Order 880.
- PJM was designated as RTO in 2001 under the FERC's mechanism for operating multistate transmission projects. PJM operates as a not-for-profit/profit neutral entity.
- It is headquartered at Valley Forge in Pennsylvania, USA. It also operates a conference and training center, a business center, a service center and a technology center in the same area as its headquarters.

### b) *Governance Model* [167,168,169]

There is a two-tiered governance structure at PJM comprising of the PJM Board and the Members committee.

- The Board is currently comprised of 10 members and ensures that the grid in PJM operates safely and reliably and creates and operates competitive and non-discriminatory electric power markets with no undue influence.
- The board consists of nine voting members and the tenth member of the board is the CEO who is nominated by the board and is a non-voting member
- Voting members of the board serve a 3- year term with three new members elected each year. The members are proposed by the nomination committee to the Members Committee, which elects three new members at each Annual Meeting through a simple majority in a sector weighted vote

Figure 3.2.1.2 Structure of PJM


- The board member candidates are required to have no relationship with or financial stake in any PJM market participant along with other defined criteria
- Members Committee has representatives from every member organization (comprising of five sectors namely gencos, transcos, discoms, suppliers and consumers). There were 1,047 members to PJM in 2019
- The members committee advices the Board by proposing and voting on changes and new programs
- Each Member has one Primary Representative and up to three Alternate Representatives on the Members Committee, and all other committees, subcommittees, and task forces with the authority to act for that member
- Each PJM Member may vote in only one of the 5 sectors for which it qualifies as primary member
- A Liaison Committee to the PJM Board facilitates direct communication from the members to the Board on key issues.

PJM's operations and interactions with its members are outlined in a group of governing documents to ensure **transparency**. The documents include:[170]

[167] https://learn.pjm.com/pjm-structure/governance.aspx
[168] https://www.pjm.com/-/media/about-pjm/newsroom/annual-reports/2019-annual-report.ashx?la=en
[169] https://www.pjm.com/~/media/about-pjm/newsroom/fact-sheets/pjm-board-nominations-fact-sheet.ashx
[170] https://www.pjm.com/-/media/about-pjm/newsroom/fact-sheets/pjm-governing-documents-fact-sheet.ashx?la=en

- Operating Agreement which is signed by any organization seeking to be a member of PJM.
- Reliability Assurance Agreement which is signed by all load-serving entities.
- Transmission Owners Agreement which provides for the coordinated planning and operation of the high-voltage transmission system.
- The Open Access Transmission Tariff which mandates non-discriminatory access to the region's high-voltage transmission system.

### c) *Operating Framework*[171,172,173]

As per the mission statement of the organization, the key tasks for PJM are:

- Ensuring safety, security and reliability of bulk electricity system in the region.
- Creating and operating robust, competitive and non-discriminatory power markets.
- Understanding consumer needs and delivering services to meet them in a cost-effective manner.
- Achieving productivity by combining superior technology and advanced knowledge of workers.

PJM works through a network of Senior Standing Committees, Standing Committees, Subcommittees, Task Forces and User Groups (Figure 3.2.1.2).

- The Members Committee (MC) and Markets Reliability Committee (MRC) form the senior standing committees and report to the ***PJM Board of Managers*** who are responsible for maintaining PJM's independence and fulfilling its obligations.
- The ***MC*** has a representative from each member and meets on a monthly basis to discuss and decide on the proposals made by other committees and Task Forces. It ensures the creation and operation of a robust, competitive and non-discriminatory electric power market with no undue influence over operations by any member or group of members.
- The ***MRC*** reports to the MC and oversees the working of other Committees, Subcommittees and Task Forces. The standing committees on Operation, Planning and Market Implementation report to the MRC. MRC ensures the continuing viability and fairness of the PJM markets; reliable, economic and secure operation of the PJM grid and review of proposed changes to the rules and procedures in the agreements/manuals.
- ***Planning Committee (PC)*** is a standing committee established under the Operating Agreement and reports to the MRC. It reviews and recommends system planning strategies designs for the bulk electricity supply system for ensuring reliable and economic operation in a competitive market environment.
- ***Operating Committee (OC)*** is a standing committee that reports to MRC. It reviews system operations from season to season, identifying emerging demand, supply and operating issues.
- ***Markets Implementation Committee (MIC)*** is a standing committee reporting to MRC. It develops proposals for consideration by MRC with the objective of promoting competitive wholesale power markets in the PJM region.

Besides the aforementioned committees, PJM currently has eleven (11) other committees, twenty (20) Subcommittees, thirteen (13) Task Forces and two (2) User Groups. The three standing committees are permanent while the other committees and Subcommittees are created for accomplishing certain tasks. Task Forces are temporary stakeholder groups that address specific non-routine subjects and any other roles defined as per their charter. User Groups are formed by five or more voting members with a common interest in the item who feel the same has not been properly addressed in the standard

[171] https://www.pjm.com/about-pjm/who-we-are/mission-vision.aspx
[172] https://learn.pjm.com/pjm-structure/member-org.aspx
[173] https://www.pjm.com/-/media/committees-groups/committee-structure-diagram.ashx?la=en

stakeholder process (so User Group can be created only after the item goes through the standard process)

The ***key roles*** defined for PJM by FERC are:[174]

- Tariff administration and design
- Congestion management
- Planning and expansion
- Ancillary services (provider of last resort)
- Interregional coordination
- Addressing parallel path flow
- OASIS site administrator for total transmission capability and available transmission capability
- Market monitoring

The ***system operation role*** is facilitated by the System Operation Subcommittee (SOS) which reports to the operating standing committee. The SOS is further divided into generation and transmission SOS. The SOS ensures the implementation of all the system reliability functions. It also provides recommendations for revision of PJM operating codes, standards, procedures and practices. This is done for assuring the safe, efficient and reliable operation of the system.

PJM operates ***wholesale power markets*** in its control area. There are three types of power markets which exist under PJM. [175]

- Energy Market which allows for day head and real time (five minutes) power procurement.
- Capacity market (reliability pricing model) allows for procurement of power three years ahead
- Ancillary services market which helps in correcting demand supply mismatches

**Coordinated System Operation Activities in PJM are conducted using Real-Time Reliability Model and System Operating Limits:[#]**

- North American Electricity Reliability Cooperation (NERC) defines the system operation limits (SOL) and the reliability standards for the RTO/ISOs in US
- Using SOL as boundary conditions, PJM systems perform 'What if' scenarios every 4 seconds on the transmission grid data for continuous assessment of the developments on the grid as well as ensuring system reliability under all scenarios
- PJM uses a real-time reliability model on its energy management system network application which uses inputs transmission owners, generators, load serving entities and other balancing authorities for generating the outputs
- The model is utilized to continuously calculate the real time state and security of the system and is utilized for running the security constrained economic dispatch of all the generators in the model
- The model is also used to develop the locational marginal prices across the transmission system considering the network availability, scheduled dispatch and SOLs.

### d) *Financing Mechanism* [176,177]

- As per Federal Regulations, PJM is mandated to operate as a profit neutral entity with revenues and expenses equaling each other over a long term

[#] https://www.pjm.com/~/media/documents/manuals/m03.ashx ; https://www.nerc.com/pa/stand/prjct201403rvsnstotopandirostndrds/2014_03_second_posting_white_paper_sol_exceedance_20140804_clean.pdf
[174] https://www.pjm.com/-/media/about-pjm/newsroom/fact-sheets/pjms-role-as-an-rto-fact-sheet.ashx?la=en
[175] https://learn.pjm.com/-/media/about-pjm/newsroom/fact-sheets/understanding-the-difference-between-pjms-markets-fact-sheet.ashx
[176] https://learn.pjm.com/who-is-pjm/how-does-pjm-make-money.aspx
[177] https://www.pjm.com/-/media/about-pjm/newsroom/annual-reports/2019-financials.ashx?la=en

- PJM Interconnection and its subsidiary that handles member billing are regulated by the FERC and are non-stock companies, so they do not have a right to issue stock shares to raise equity funding. Also, neither company has 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
- PJM recovers its administrative costs – the costs of operating the electric transmission system and the wholesale electricity markets - through fixed rates billed to members based on their activity levels
- For the year 2019, the Total Operating Revenue of PJM was $369 million with major contribution from service fees ($320 million), study and interconnection fees ($4.3 million) and membership fees (3.6 million)
- Total Operating expenses for 2019 were $365 million with major contributors being Compensation ($150 million), FERC fees ($62.4 million) and Outside Services ($60 million)

### e) *Inter Organization Relationship and Cooperation* [178,179]

PJM is regulated by FERC which is an independent federal agency that regulates the interstate transmission of electricity, natural gas and oil as well as hydropower and natural gas projects. It complies with applicable standards of the North American Electric Reliability Corporation and the North American Energy Standards Board.

PJM Settlement, Inc. is a FERC-regulated public utility affiliate of PJM Interconnection LLC that handles all market settlements, billing issues, credit management and financial settlements for the wholesale electricity market and other transactions conducted by PJM members. PJM Connext is a subsidiary of PJM Interconnection that offers consulting, training and operational services to the global energy industry. PJM Environmental Information Services, Inc. is a wholly- owned subsidiary of PJM Connext

[178] https://learn.pjm.com/pjm-structure/governance/how-pjm-interacts-with-ferc.aspx
[179] https://www.pjm.com/about-pjm/who-we-are.aspx

| PJM Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Tariff administration and design, congestion management, planning and expansion, ancillary services (provider of last resort), interregional coordination, addressing parallel path flow, market monitoring and OASIS site administrator for total transmission capability and available transmission capability | |
| **Organizational Setup** | |
| **Legal Framework** | Limited Liability Company (profit neutral over long term) |
| **Formation/Initial Period** | Started in 1927 as a power pool association which later evolved into an LLP designated as an ISO and then RTO (current) |
| **Membership** | 1040 Members with membership to genco, transco, discoms, end consumers and other suppliers |
| **Headquarter Location** | Valley Forge in Pennsylvania, USA |
| **Governance Mechanism** | |
| **Governance Layers** | Board & members committee |
| **Apex Body Members** | Members' Committee with all members representatives |
| **Board Members** | 10 members (9 voting members and CEO as the non-voting member) |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | Market reliability committee overseeing 3 permanent standing committees (Planning, Operating and Market Implementation) |
| **Regional Inter-entity Relationship** | Regulated by FERC and follows standards set by NERC |
| **Staffing** | Employee base ~1000 personnel with diversity focus |
| **Finance** | |
| **Funding** | Fee for operating transmission system and market |
| **Budget** | Total operating revenue of PJM in 2019 was $369 million |
| **Other Details** | |
| **Energy Transfer Supported** | Facilitated the transfer of 787 TWh across its network area in 2019 |
| **Capacity Mix** | Installed capacity of 186 GW in 2019 comprising of coal based capacity (30%), nuclear capacity (18%), gas based capacity (41%), petroleum based capacity (5%) and RE capacity (7%) along with the additional demand response resource (10 GW) and energy efficiency (3 GW) |

**Key Observations:**

- PJM ***started as a power pool*** in 1927 among three utilities and eventually, ***matured into an independent interconnection association*** in 1993
- ***Initially, PJM membership was limited to only utilities*** but as the it matured, the membership was ***expanded to non-utility stakeholders***
- PJM in its ***initial period was operated by a department of a member*** utility but eventually ***transitioned to an independent headquarter with own staff***
- PJM has a ***multi-tiered governance model*** comprising an oversight body and a management body.
- It has a **hybrid organizational structure** comprising ***three permanent standing committees and multiple other temporary committees***, sub committees, working groups etc. which are created only for accomplishment of specific tasks
- PJM has a ***sustainable funding mechanism where its members pay for its expenses*** based on fixed, long-term rates of open access transmission tariffs

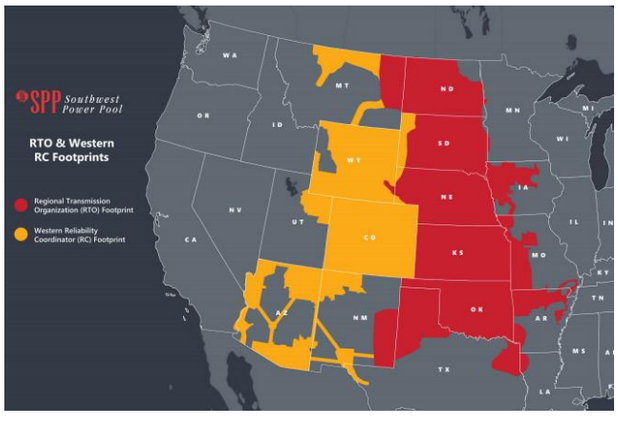
### 3.2.2. Southwest Power Pool (SPP) [180,181]

SPP was created in 1941 during second world war to facilitate adequate and uninterrupted supply of power to aluminum mills in Arkansas. Witnessing the benefits that accrued from creation of the power pool, it was retained after the war. The power pool was used to leverage economies of scale from unified dispatch of generation to achieve optimum cost of supply.

After the significant blackout of 1965 in America and Canada, emphasis was given to ensuring reliability of operations. In response to the same, in 1968, SPP along with 11 other regional and area entities helped create the National Electric Reliability Council. Over the years SPP broadened its area of operation and started operating reserve sharing, reliability coordination and tariff administration.

SPP continued to operate as an association of power sector entities for operating the bulk electricity system and acting as a regional reliability body till 1994 when it got incorporated as nonprofit corporation for mutual benefit, opening its membership to a larger number of entities. Subsequently with FERC's promotion of RTOs, it took on the roles of regional transmission operator across multiple states and also implemented the integrated energy market. SPP currently oversees the bulk electric grid and wholesale power market in the central United States on behalf of a diverse group of utilities and transmission companies in 14 states - Arkansas, Iowa, Kansas, Louisiana, Minnesota, Missouri, Montana, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota, Texas and Wyoming (Figure 3.2.2.1). SPP's members include investor owned utilities, municipal systems, generation and transmission cooperatives, state authorities, federal agencies, independent power producers, contract participants, power marketers and independent transmission companies. SPP has an Operating region of 370,000 square miles across 14 states with 50,575 miles transmission lines. In 2019, 271 TWh of energy was generated within the SPP region and the peak load served was 50.6 GW (Aug 2019). In 2019 SPP region had an installed capacity of 90GW comprising coal based capacity (26%), natural

Figure 3.2.2.1: SPP Member Areas[#]




[180] https://spp.org/about-us/
[181] https://www.spp.org/documents/46282/spp-75th-anniversary-online.pdf
[#] https://spp.org/documents/62057/2019%20annual%20report%2020200428%20web.pdf

gas based capacity (41%), wind based capacity (24.9%), hydropower capacity (3.8%), fuel oil based capacity (1.7%), solar based capacity (0.2%) and others (0.1%).

### a) *Organizational Setup*

The Southwest Power Pool started as a power pool between 11 utilities in 1941. SPP was a founding member of the North American Electric Reliability Corporation.

- SPP was recognized as a FERC approved RTO in 2004
- SPP is incorporated in the state of Arkansas, USA as a 501(c)(6) nonprofit corporation set up for mutual benefit
- Headquartered at SPP Corporate Centre at Little Rock, Arkansas, US; with a staff of 600 employees
- SPP joined 11 other entities to form North American Electric Reliability Corporation Regional Council in 1968. The 11 other entities were:
  - East Central Area Reliability Coordination Agreement (ECAR)
  - Mid-Atlantic Area Coordination Group (MAAC)
  - Mid-America Interpool Network (MAIN)
  - Mid-Continent Area Power Planners (MAPP)
  - Northeast Power Coordinating Council (NPCC)
  - Western Systems Coordinating Council (WSCC)
  - Texas Interconnected System (TIS)
  - Carolinas-Virginias Power Pool Agreement (CARVA)
  - Southern Services, Inc.
  - Tennessee Valley Authority (TVA)
  - Florida Power Corporation

**11 entities who partnered for creation of SPP were -**

- Arkansas Power & Light
- Louisiana Power & Light
- Mississippi Power & Light
- Southwestern Gas and Electric
- Public Service Company of Oklahoma
- Nebraska Power
- Texas Power & Light
- Southern Light and Power

### b) *Governance Model* [182]

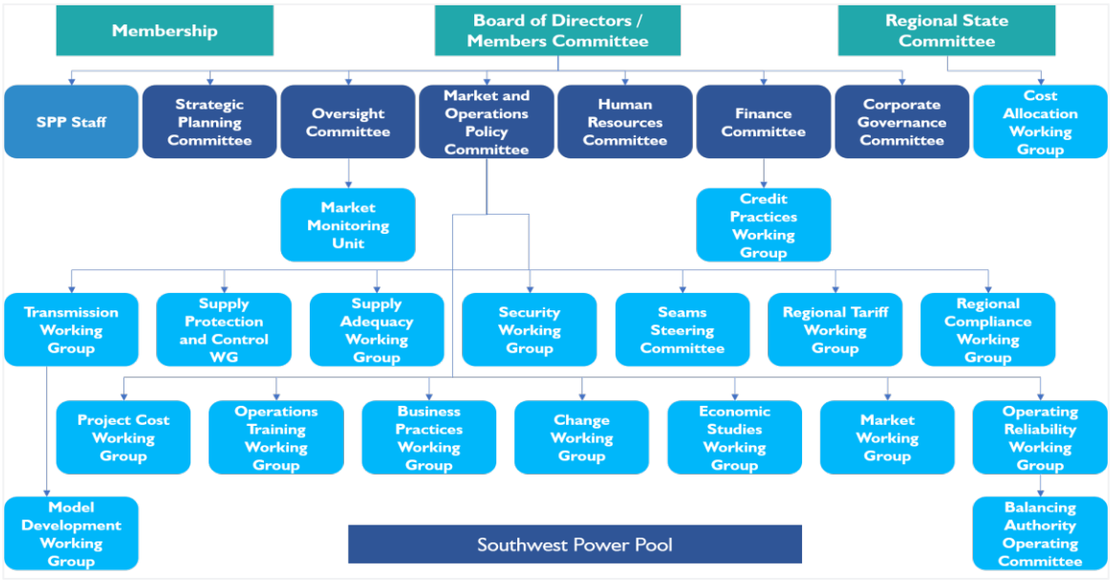
- The governance structure of SPP has two layers – the first comprising Board of Directors and Members Committee; and the second layer comprising committees of the Board
- The Board of Directors is comprised of 7-10 board member who are elected for a 3 year period
- The candidates for director are required to be independent of any member and are nominated by the corporate governance committee for election by the members with chair and vice chairperson elected for a two- year term
- The President of SPP is also a member of the board of directors but does not have voting rights
- The Board of Directors are required to solicit and consider advice from the Members Committee
- Members Committee consists of upto 24 persons with representation from different member groups defined in the bylaws
- Candidates for members committee are nominated by the corporate governance committee and elected each year at the meeting of all members to staggered three-year terms
- Besides this the regulatory bodies which have jurisdiction over the members of SPP form the Regional State Committee and have the same rights as the members except voting rights

[182] https://www.spp.org/documents/13272/current%20bylaws%20and%20membership%20agreement%20tariff.pdf

- The chairperson of all organizational groups in SPP are nominated by Corporate Governance Committee for consideration and appointment by the board of directors. The vice chairperson is elected by the members of the organizational group unless provided otherwise in organizational bylaws
- The chairperson and vice chairperson of the organizational groups reporting to the board of directors serve a term of two years
- The chairperson and vice chairperson of all organizational groups reporting to the Markets and Operations Policy Committee also serve two-year terms, with half of such terms expiring in even

Figure 3.2.2.2 Structure of SPP

years and the remainder in odd years, as determined by the Corporate Governance Committee




Membership in SPP is voluntary and is open to any electric utility, Federal Power Marketing Agency, transmission service provider, any entity engaged in the business of producing, selling and/or purchasing electric energy for resale, and any entity willing to meet the membership requirements.

The representation by members of SPP varies at different levels and bodies of the organization. The Membership is comprised of all the members of SPP. Members Committee has representation from members (covering all member stakeholder types). Representatives are nominated by the Corporate Governance Committee and elected by the members.

The Board of Directors is independent of members and staff but are elected at the meeting of members after nomination by the CGC (except for the Director who is President). The President and the Corporate Secretary are elected by the Board and like all officers, they must be independent of any member entity.

### c) *Operating Framework* [183,184]

Primary roles mandated for SPP are ensuring reliable supply of power; adequate transmission infrastructure and competitive wholesale price of power. To accomplish the said roles, SPP provides a host of ***services*** namely:

[183] https://spp.org/about-us/fast-facts/
[184] https://spp.org/documents/23115/spp_group_org_chart.pdf

- ***Transmission Operation:*** SPP operates the electricity transmission grid in its service area.
- ***Reliability Coordination:*** SPP monitors power flow across its operating area and coordinates regional response during emergencies/blackouts.
- ***Tariff Administration:*** SPP facilitates use of the region's transmission lines and administers an Open Access Transmission Tariff independently with consistent rates and terms.
- ***Regional Scheduling:*** SPP coordinates the scheduling within its operational area across the states.
- ***Transmission Expansion Planning:*** SPP identifies system constraints, prepares transmission upgrade plans, and tracks project progress to ensure timely system reinforcement completion.
- ***Market Operations:*** SPP's Integrated Marketplace allows sale and purchase of power across the 14-state region bringing competition and efficiency.
- ***Compliance:*** SPP ensures compliance with federal and regional reliability standards for the users, owners and operators (maintainers) of the region's grid.
- ***Training:*** SPP facilitates continuing education for its operations personnel across its service region.
- ***Contract Services:*** SPP offers services like tariff administration, scheduling and reliability for non-members on contractual basis.

SPP's ***Organizational Structure*** works through a series of committees and working groups[185] (Figure 3.2.2.2).

- All the members of SPP form the ***Membership***.
- The ***Regional State Committee*** comprises of the retail regulatory commissioners from agencies in Arkansas, Iowa, Kansas, Louisiana, Missouri, Nebraska, New Mexico, North Dakota, Oklahoma, South Dakota and Texas. They provide collective state regulatory input on subjects of region relevance pertaining to development of the transmission network. The Committee has a working group on cost allocations.
- The ***Board of Directors and the Members Committee*** oversee the functioning of the majority (except Membership and Regional State Committee) of the organization through six committees supported by the SPP staff.
- The committees reporting to the Board are:[186,187, 188, 189, 190, 191, 192,193]
  - ***Strategic Planning Committee*** - develops and recommends strategic direction for the organization.
  - ***Oversight Committee*** - monitors compliance with SPP's internal as well as regulatory policies.
  - ***Human Resources Committee*** - ensures development of personnel policies including the benefit structures.
  - ***Finance Committee*** - oversees financial aspects of SPP's business by ensuring documentation and adherence to controls, policies and procedures for accurate reporting and risk avoidance.
  - ***Corporate Governance Committee*** (CGC) - is responsible for the overall governance structure and nominations.
  - ***Market and Operations Policy Committee*** - manages the bulk of organizations operations through 15 working groups and an operating committee. It develops and recommends policies and procedures pertaining to technical operations.

In its system operation role, SPP abides by NERC standards and is registered with the NERC as the regional Reliability Coordinator (RC), Balancing Authority (BA), Transmission Service Provider (TSP) and Reserve Sharing Group (RSG).

[185] https://spp.org/organizational-groups/board-of-directorsmembers-committee/
[186] https://spp.org/documents/5715/fc%20scope%2020171205.pdf
[187] https://spp.org/documents/5714/cgc%20scope%2020181204.pdf
[188] https://spp.org/organizational-groups/board-of-directorsmembers-committee/human-resources-committee/
[189] https://spp.org/documents/37821/spc%20scope%20170425.pdf
[190] https://spp.org/documents/13906/oc%20scope.pdf
[191] https://spp.org/documents/5730/mopc%20scope%20181204.pdf
[192] https://spp.org/about-us/
[193] https://spp.org/organizational-groups/

As an RC, SPP acts as the coordinating agency between transcos, gencos and balancing authorities (three others besides its own), maintaining a wide view of the grids' operation and stability. As a BA, the organization maintains a real time balance between the load and generation along with demand forecasting to ensure sufficient supply availability. As a TSP, SPP makes available transmission service to the transmission customers under applicable transmission service agreements and administers the provisions of Open Access Transmission Tariff. As an RSG, the organization maintains, operates and allocates operating reserves for use in recovery situation (emergencies) and other contingencies. It provides RSG service to three BAs (including its own). SPP also undertakes outage planning and management in consultation with its members to manage forced outages, planned outages for maintenance and system expansion.

SPP launched its ***Integrated Marketspace*** in 2014 which includes the following features:

- Day ahead market with transmission congestion rights.
- Reliability unit commitment mechanism.
- Real time balancing mechanism (replaced energy imbalance services market).
- Price based operating reserve market.
- Combination of multiple balancing authorities in to SPP BA.
- Market-to-Market mechanism (mandated by FERC).
- Long term congestion rights (mandated by FERC).
- Regulation Compensation Mechanism (mandated by FERC).
- Pseudo tie out and environment build out.

**Coordinated System Operation Activities in SPP are coordinated through the Transmission, Market and Operating Reliability working groups along with other support from working groups of the organization[$]:**

- SPP as an RTO and market operator undertakes multiple roles for ensuring smooth and efficient system operations.
- SPP acts as a balancing authority for selected transmission operators and generators in its area ensuring matching of demand and supply.
- It operates an Oasis node to provide real time network information and allowing requesting of transmission services for supporting its role in scheduling and dispatch.
- SPP acts as the reliability coordinator for transmission operators, generators and balancing authorities in its area ensuring the enforcements of NERC's system operation limits and reliability criterion.
- As a reserve sharing group, SPP maintains, allocates and supplies operating reserves for use in situations of recovering from emergencies.
- SPP ensures security constrained economic dispatch which takes into account congestion and losses to provide the locational marginal price for serving each node while adhering to operating and reliability reserve requirements.

### d) *Financing Mechanism* [194,195]

To meet its revenue requirements, SPP has multiple revenue streams such as:

- ***Transmission Fees:*** Applied to SPP's Open Access Transmission Tariff as an administrative charge. Part of this is offset against a monthly ***member assessment fee*** that is charged as per a specified rate set by SPP board and the average peak demand in part 12-month period.
- ***Membership Fee:*** Fixed membership fee collected from all members annually.
- ***Transmission Service Charge:*** Collected from transmission customers but passed on to the FERC.
- ***Contract Services:*** Revenue received from providing contractual services.
- ***Miscellaneous Revenues:*** Covers other small revenue sources such as non-operating income.

For the year 2019, SPP had a total revenue of $196 million with and key expenses being towards Salary and benefits ($101 million) and Other expenses ($71 million)

[194] https://www.spp.org/documents/60711/sw%20power%20pool%20report.pdf
[$] https://www.spp.org/markets-operations/; https://www.spp.org/markets-operations/operating-reliability/; http://www.oatioasis.com/SWPP/index.html ; http://pricecontourmap.spp.org/pricecontourmap/
[195] https://spp.org/spp-document-fillings/?id=18274

| Southwest Power Pool Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Transmission operation, reliability coordination, tariff administration, regional scheduling, transmission expansion planning, market operations, compliance with federal and regional standards, training and contract services | |
| **Organizational Setup** | |
| **Legal Framework** | Association[196] |
| **Formation/Initial Period** | Started as a power pool association between 11 utilities in 1941, co-created NERC council in 1968, and then RTO (current) |
| **Membership** | 98 Members with membership to investor-owned utilities, municipal systems, govt agencies, IPPs, cooperatives, contract participant, power marketers and independent transmission companies |
| **Headquarter Location** | Little Rock, Arkansas, USA |
| **Governance Mechanism** | |
| **Governance Layers** | Members committee & Board |
| **Apex Body Members** | Membership & Members Committee |
| **Board Members** | 7-10 elected members with voting rights and SPP president as non-voting member |
| **Other Bodies/Layers of Governance** | Also has a Regional State Committee comprising of regulators from operating area states |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | 6 key committees (Strategic Planning, Oversight, HR, Finance, Corporate Governance and Markets & Operations Policy) |
| **Regional Inter-entity Relationship** | Regulated by FERC and was the founding member of NERC |
| **Staffing** | 600 direct employees of SPP |
| **Finance** | |
| **Funding** | Transmission Fee, Membership Fee, Contract Service charges and other miscellaneous revenue |
| **Budget** | SPP had a total revenue of $196 million in 2019 |
| **Other Details** | |
| **Energy Transfer Supported** | In 2019 SPP supported transfer of 271TWh of generation within its service area |
| **Capacity Mix** | SPP region had an installed capacity of 90GW in 2019 comprising coal-based capacity (26%), natural gas based capacity (41%), wind based capacity (24.9%), hydropower capacity (3.8%), fuel oil based capacity (1.7%), solar based capacity (0.2%) and others (0.1%). |

[196] Registered as a nonprofit corporation for mutual benefit

**Key Observations:**

- SPP was ***started as a power pool*** in 1941 among eleven (11) utilities and was ***eventually incorporated as a non-profit corporation*** for mutual benefit in 1994
- The organization's ***membership was initially limited to utilities*** but was gradually ***opened up for larger number of stakeholder entities***
- SPP has a ***multi layered governance structure*** with apex members committee/board and lower layer comprising committees of the board.
- Transmission, Market and Operating Reliability ***working groups help in ensuring coordinated system operation*** across the region.
- SPP along with eleven (11) other entities ***helped create North American Electric Reliability Corporation Regional Council which sets the reliability standards for system operation*** across the country.
- SPP charges a ***fixed fee from all its members*** besides other revenue sources such as those from services offered.

## 3.3 Africa

### 3.3.1. Southern African Power Pool (SAPP) [197,198]

Electricity trading in Southern Africa started with trade between DRC and Zambia and grew to trade between northern regions (DRC, Angola, Tanzania, Zambia, Malawi, Mozambique and Zimbabwe) and the southern regions (Namibia, Botswana, South Africa, Lesotho and Swaziland). The driver of the trade was the difference in the resource mix with the northern region dominated by hydro resources and the southern region dominated by thermal resources. The northern and southern network interconnection created a platform for regional trade and cooperation. The northern and southern networks were originally connected by weak 220kV and 132kV links via Botswana until 1995.

* http://www.sapp.co.zw/about-sapp
[197] https://sari-energy.org/oldsite/PageFiles/What_We_Do/activities/sapp_eev_feb_2010/Presentations/Feb_14/Overview_of_the_SAPP.pdf
[198] http://www.sapp.co.zw/sites/default/files/SAPP%20ANNUAL%20REPORT%202019.pdf

Before the establishment of SAPP in 1995, most of the electricity exchange between Southern African Development Committee (SADC) member countries took place under long-term bilateral agreements between vertically integrated utilities. Most of the bilateral agreements were for firm energy sales, although increasing domestic demand for energy due to economic growth in exporting countries made it difficult to continue to guarantee contractual firm capacity. Prices for bilateral contracts were based on negotiations between the buyer and the seller. Most contracts were subject to review on an agreed periodic basis to take account of changed circumstances, usually inflation or quantities supplied or demanded. Some wheeling arrangements involved tripartite agreements in which the supplier negotiated a power purchase price with the off taker and the off taker negotiated a price for wheeling the power through a third party.

Figure 3.3.1.1 SAPP Member Countries*


In 1995, a new 400kV link was constructed to mitigate the transmissions weakness and Southern African Power Pool (SAPP) was created through intergovernmental MoU. It is composed of 12 countries namely Botswana, Mozambique, Malawi, Angola, South Africa, Lesotho, Namibia, Democratic Republic of Congo, Swaziland, Tanzania, Zambia, and Zimbabwe (Figure 3.3.1.1).

During 2019, volumes in competitive markets of SAPP reached 18.2 TWh in terms of sell bids and 2 TWh of matched bids. 9 SAPP members participated in the competitive market in 2019 leading to an exchange of USD 107 million. The competitive market trades formed 32% of the total trades in the region with the remaining 68% accounted for bilateral trades (~6TWh). The installed capacity of the region in 2018-19 stood at 71 GW with the operating generation capacity being 59 GW. The peak demand in 2019 was 58 GW and the region had a surplus of 1.2 GW. The capacity mix of SAPP in 2018-19 was coal based capacity (60%), hydro capacity (21%), oil and gas base capacity (9%) , RE capacity (7%) and nuclear capacity (3%).

### a) *Organizational Setup* [199][200]

- SAPP was established in 1995 (SADC meeting, South Africa), as a corporation of national electric companies to coordinate the planning and operation of electric power system among member utilities.
- It was created through the signing of inter-governmental MoU amongst the SADC countries (except Mauritius) for the creation of a power pool in the region. A revised IG-MoU for the same was signed in Feb 2006.
- It is incorporated in Zimbabwe as a non-profit making organization with its headquarters at Harare, Zimbabwe.
- All national electric utilizes of the member countries are members of SAPP

[199] http://www.sapp.co.zw/about-sapp
[200] http://www.sapp.co.zw/sites/default/files/30955_Sapp%20Annual%20Report%202018.pdf

### b) *Governance Model* [201]

SAPP is governed by five agreements, namely:

- ***Inter Government MoU (IGMOU):*** IGMOU was signed by SADC member countries in 1995 for the formation of a power pool in the region. The document was revised in 2006 and then subsequently in 2010 the MOU granted permission for the utilities to participate in the SAPP and enter into new contracts and guarantees the financial and technical performance of the power utilities. The IGMOU establishes that the SAPP agreements must be interpreted in a manner consistent with the SADC treaty and the final and binding dispute resolution forum is the SADC dispute resolution tribunal
- ***Inter utility MoU*:** SADC passed the SAPP Inter-Utility MOU on 7th December 1994. The MOU established an official cooperation among SADC Member States for sharing the costs and benefits of energy generation. The document was revised in 2007. The MOU specifies the power pool's operating principles, objectives, and organizational structure, stipulating a system of committees and subcommittees dedicated to aspects of power generation – operations, planning, environmental effects, technical and administrative work – and naming each group's duties, schedule of meetings, and decision-making procedures.
- ***Operating members agreement*:** It determines the interaction between the utilities w.r.t operating responsibilities under normal and emergency conditions. This agreement lays down the specific rules of operation and pricing.
- ***Operating guidelines:*** These guidelines were framed in 1996 and define the sharing of costs and functional responsibilities for plant O&M, including safety rules and standards and operating procedures.
- ***CC Constitution:*** This has been developed to help create a well-defined operating structure and ensure smooth functioning of the Coordination Centre.

SAPP has a multilayered governance structure led by ***SADC Directorate of Infrastructure and Services*** which maintains the highest level of oversight. The Infrastructure and Services Directorate is within the portfolio of the Deputy Executive Secretary (Regional Integration).

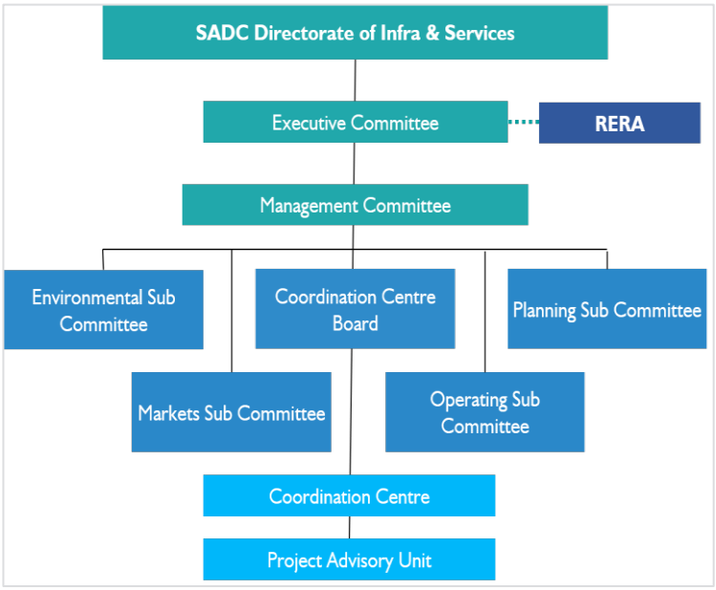
***The Executive Committee (EXCO)*** forms the next layer of governance, acting as the Board of SAPP and reports to the SADC Directorate.

- EXCO comprises of Chief Executives from Member Electricity Supply Enterprises
- The chairpersonship of EXCO is decided on a rotational basis amongst signatories of Agreement Between Operating Members (ABOM), with chairpersonship tenure of 1-3 years
- The decisions in EXCO are taken through a voting process
- Each member has one vote of the Executive Committee and only Members who are signatories of the Agreement Between Operating Members can vote on Service and Operational issues
- The EXCO determines/amends the roles and duties of the committees, Subcommittees and other Working Groups/Task Forces

[201] http://www.sapp.co.zw/sapp-governance

- It also coordinates with Regional Electricity Regulators Association of Southern Africa (RERA) on regulatory matters
- Countries with multiple utilities designate one utility to represent it on the EXCO
- The Executive Committee specifies and amends from time to time the duties of the Management Committee, the Sub-Committees and any Working Group or Task Force, which may be established
- Each member represented at the Executive Committee arranges and finances the participation of its own representative(s) in the various committees, task forces and sub-committees.

Figure 3.3.1.2 Structure of SAPP




Functional level coordination and oversight is maintained by the ***Management Committee (MANCO)*** which reports to the EXCO.

- MANCO comprises of the functional level representatives of the member entities
- The activities of the coordination center are overseen by the coordination center Board which reports to the MANCO
- MANCO also oversees the work and decide on the recommendations of the Sub-Committees and the ***Coordination Centre Board.***

Despite being a non-profit entity, SAPP consistently makes its audited annual reports public, giving details on achievements, actions, future outlook etc. and financial accounts.[202]

### c) *Operating Framework* [203]

The ***key objectives*** of SAPP are:

- Development of competitive electricity market in SADC region
- Promoting competition and enabling choice
- Driving investment in requisite areas
- Sustainable energy development
- Providing forum for development of world class, efficient, reliable power systems
- Coordinating and enforcing common regional standards
- Monitoring of performance
- Harmonizing relationships between member utilities

The ***organizational structure*** of SAPP comprises of SADC Directorate, Executive Committee and Management Committee at oversight level. It works through Subcommittees and Coordination Center (Figure 3.3.1.2).

[202] http://www.sapp.co.zw/annual-reports
[203] http://www.sapp.co.zw/about-sapp#structure

SAPP Coordination Centre (CC) reports to a Board under the Management Committee. The CC undertakes the operational roles like operating the trading platform, facilitating interconnector development and other supporting activities etc.

The roles undertaken by the Subcommittees are:

- **Planning Subcommittee**[204] facilitates the setting of operating procedures by establishing and updating standards for planning, reliability and compliance criteria as well as review of integrated planning.
- **Operations Subcommittee**[205] is tasked with conducting system operational studies and establishing/updating methods and standards for grid operations.
- **Markets Subcommittee**[206] drives the development of electricity market through design and recommendations on market structure and is responsible for all market operations.
- **Environment Subcommittee**[207] is tasked with keeping abreast on matters relating to environment- land, air, water etc. for developing/updating Environmental Guidelines, providing KPIs for environmental impact assessment and liaising with environmental organizations of Member States to harmonize regional environmental legislation.

Over the years, SAPP has evolved and added different types of ***power markets*** to the pool, namely:[208]

- Short-term Energy Market (2001)
- Competitive electricity market development for SADC region (2004)
- Day-ahead Market (DAM) (2009)
- Forward Physical Markets and the Intra Day Market (2015)

Key ***system and market operation roles***[209] (including projects and assignments by the operating Subcommittee) are undertaken by the Coordination Center such as facilitating the day ahead market, monitoring the operation of power pool as well as the transactions between operating members and between members and non-members. Its role entails establishing and updating databases of relevant data for transaction record keeping, planning, system operation studies and implementation of adequate reserves. It is also responsible for preparing routine daily reports, data and information relevant to the operation of the power pool for presenting to the operating Subcommittee and to the members.

It is tasked with monitoring, reporting and advising on the control performance criteria, as specified in the operating guidelines, to all the operating members. Its purview also includes performing studies to determine transfer limits, informing operating members on feasibility of transactions and monitoring adherence to the set limits. It is responsible for performing operational planning studies to evaluate possible problems as well as impact of future projects on the operation of the pool. It is also responsible for advising the operating Subcommittee accordingly as well as convening a post disturbance committee, following a disturbance affecting the parallel operation of the pool for providing technical advice and support. It is also involved in the monitoring protection performance across the network and ensuring adherence to the agreements by the operating members (including penalties for insufficient accredited capacity obligation and re-allocation among members). The CC is a body charged with disseminating maintenance schedules given by operating members (generation and transmission) and advising on the adjustments to maintain contractual pool reserves and services.

[204] http://www.sapp.co.zw/coordination-centre/planning-sub-committee
[205] http://www.sapp.co.zw/coordination-centre/operating-sub-committee
[206] http://www.sapp.co.zw/markets-sub-committee
^ http://documents1.worldbank.org/curated/en/126211468323330432/pdf/773070v110ESMA0h0African0Power0Pool.pdf
[207] http://www.sapp.co.zw/coordination-centre/environmental-sub-committee
[208] http://www.sapp.co.zw/about-sapp
[209] http://www.sapp.co.zw/sub-committee/coordination-centre

It is also responsible for coordinating the training of the members staff and if necessary, organizing training seminars focusing on the operation of the interconnected system.

**Coordinated System Operation Activities undertaken by SAPP Coordination Centre to facilitate market mechanisms^:**

- SAPP was originally dominated by bilateral contracts for trades of surplus but a move to market- based mechanisms was envisioned which requiring coordinated system operation.
- Before transitioning to the current competitive market, Short Term Energy Markets (STEM) were run by the SAPP Coordination Center.
- The system limits were defined in the signed operating guidelines (currently under review).
- To facilitate the trade, an online platform only for participating utilities was developed which allowed the placing of bids.
- The coordination center evaluated the bids and matched them with the transmission capacity available (after allocating bilateral contract capacity) for confirming successful contracts.
- The schedule was published within four hours of bid placing cutoff and a bulletin board of all demands and offers made to drive future STEM trade.

### d) *Financing Mechanism*

SAPP initially secured funding from World Bank and NORAD to first establish a competitive regional electricity market in 2003-04.

SAPP currently has three major means of funding:

- Annual contributions from members
- Grants from donors - EU, World Bank, NORAD, SIDA, ADB, DANIDA, DFID etc.
- Market administration fee (for operation the pool)

For the year 2019, the total income for SAPP was USD 12.3 million with major components being grant income (USD 6 million), market trading platform – admin fees (USD 4 million) , member contribution (USD 586,427) and participation fees (USD 108,412) . Total Expenditure for 2019 was USD 8.3 million with major contributors being administration costs (USD 6.5 million), staff costs (USD 1.1 million), communications costs ($42,739), marketing trading platform expenses ($267,701), travel and subsistence ($199,544)

### e) *Inter Organization Relationship and Cooperation* [210]

SAPP signed an MoU with RERA on 25th April 2007 in Harare basis which it collaborates with RERA (also created under SADC) on regulatory subjects such as harmonization of power trade regulations in the region and transformation of RERA into a Regional Autonomous Regulator *(Super Regulator)*.

| **SAPP Summary Sheet** | |
|---|---|
| **Key Focus Areas** | |
| Development and administration of energy markets in the region, monitor operations of power pool, driving investment for requisite infrastructure creation, preparation and implementation of operating procedures/guidelines, system limits assessment & planning, capacity building and reporting | |
| **Organizational Setup** | |
| **Legal Framework** | Inter-governmental and inter-utility agreements/MoUs |
| **Formation/Initial Period** | Created under SADC with support from Directorate of Infrastructure & Services |

[210] https://erranet.org/wp-content/uploads/2017/05/RERA_Update-on-Regional-Regulatory-Initiatives_High-Level-Mtg_Bp2017.pdf

| | |
|---|---|
| **Membership** | 17 national electric companies of 12 member countries |
| **Headquarter Location** | Emerald Hill, Harare, Zimbabwe |
| **Governance Mechanism** | |
| **Governance Layers** | SADC Directorate of Infrastructure & Services; Executive Committee and Management Committee |
| **Apex Body Members** | SADC Directorate of Infrastructure & Services |
| **Board Members** | Chief executives of member utilities (1 utility per country allowed) |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | 4 Subcommittees (Environment, Markets, Planning & Operating) along with Board of coordination center (CC) and CC itself. |
| **Regional Inter-entity Relationship** | SAPP collaborates with on regulatory subjects |
| **Staffing** | In 2018 SAPP had a staff of ~20 employees in its coordination centre and project advisory unity |
| **Finance** | |
| **Funding** | Member contributions, Donor grants and Market Administration Fee |
| **Budget** | Total income for SAPP was USD 12.3 million in 2019 |
| **Other Details** | |
| **CBET Supported** | In 2019 2TWh of market matched bids forming 32% of cross border trade with the remaining 68% (~6 TWh) undertaken through traders. CBET in SAPP region forms ~3% of the total generation in the region (~311 TWh in 2018). |
| **Capacity Mix** | The installed capacity of SAPP in 2018-19 was 71GW with a generation capacity mix if coal based (60%), hydro (21%), oil and gas based (9%), RE capacity (7%) and nuclear based (3%) generation. |

**Key Observations:**

- SAPP was created as a ***corporation of national electric companies*** through ***signing of intergovernmental MoUs*** amongst SADC members
- Its ***membership is limited to the national utilities*** of member countries
- SAPP has an ***independent secretariat and permanent headquarters*** in the member country of Zimbabwe
- It has a **multi-layered governance system** comprising of SADC Directorate, EXCO, MANCO and CC Board
- SAPP has a fixed ***formal structure with four committees*** on planning, operations, market and environment as well as a ***coordination centre to manage the system and market operations.***
- To ensure its financial sustainability, SAPP collects ***annual contributions from its members*** along with **support from donors** and market administration charges.

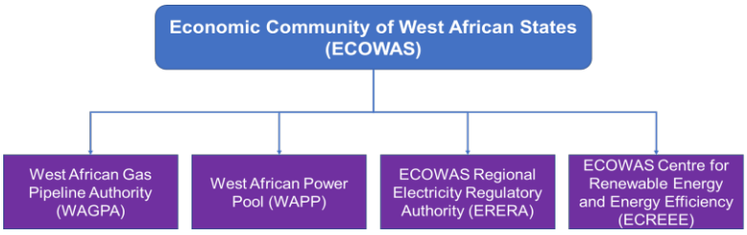
### 3.3.2. West African Power Pool[211,212,213]

Figure 3.3.2.1 WAPP Member Countries[#]


The Economic Community of West African States suffered huge deficit in electricity supply despite abundant resources. CBET in the region has been in existence since 1969 with the primary mode of trade being bilateral and trilateral. Bilateral /Trilateral trading was undertaken as per the MoUs/contracts/agreements entered into by the parties, which primarily were the state governments/utilities. The terms and conditions were different in every contract/agreement since there was no standardized procedure that was being followed. All the decisions related to tariff, dispute resolution, etc. were decided mutually amongst the trading parties. This even at times resulted in over payment or under payments by the importing countries. In November 1999 the Economic Community of West African States (ECOWAS) Ministers of Energy adopted the indicative master plan for the development of energy production facilities and the interconnection of electricity grids of member States (Benin, Côte d'Ivoire, Burkina Faso, Ghana, Gambia, Guinea, Guinea Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo), including the establishment of the WAPP. This was an important step towards the establishment of a formal institutional framework for regional cooperation in electricity exchange. Subsequently, in order to tackle the challenges, eliminate energy shortages, driving investments in energy sector and ensuring long term energy trade, ECOWAS Authority of Heads and State and Government, approved the ECOWAS Energy Protocol in 2003. Further to this, 4four regional bodies (West African Gas Pipeline Authority- WAGPA, West African Power Pool-WAPP, ECOWAS Regional Electricity Regulatory Authority-ERERA, and the ECOWAS Centre for Renewable Energy and Energy Efficiency-ECREEE) were established to drive the regional integrated energy program. The West African Power Pool (WAPP) is a cooperation of national electricity companies in Western Africa under ECOWAS. Under coordination of the ECOWAS Department in charge of energy, WAPP works in collaboration with other entities i.e. ECOWAS Regional Electricity Regulatory Authority (ERERA), ECOWAS Center for Renewable Energy and Energy Efficiency (ECREEE) and West African Gas Pipeline (WAGP) Company.

[211] https://www.saarcenergy.org/wp-content/uploads/2019/02/2.-The-ECOWAS-Experience.pdf
[#] https://www.ecowapp.org/en/content/creation-wapp
[212] https://www.ecowapp.org/sites/default/files/wapp_2019_annual_report_finver-f_25_05.pdf
[213] https://www.usaid.gov/powerafrica/wherewework

Figure 3.3.2.2 Regional Bodies of Energy Sector under ECOWAS




WAPP is made up of Public and Private Generation, Transmission and Distribution utilities involved in the operation of the electricity in West African Countries (Figure 3.3.2.1). The primary objective of WAPP is to construct additional transmission and generation infrastructure to facilitate cross border trading and improve upon energy supply within the ECOWAS by integrating national power system operations into a unified electricity market. Articles of Agreement set out the objectives of WAPP and its operating procedures among the member states. Further, WAPP enjoys the status of a specialized legal institution under the authority of the ECOWAS.

WAPP planned a three-phase approach to transitioning to a regional market. Phase 1 entailed designation of a system market operator who can develop market operation functions as by 2015 majority of the regional generation and transmission infrastructure was expected to be commissioned. Phase 2 involves development of short & medium-term electricity exchanges through day ahead market. Phase 3 involves a long-term vision of a liquid and competitive market. The early activities of WAPP towards development of infrastructure have been primarily funded through donor or development funds.

In 2019, the total generation in the WAPP region was 69.7 TWh and of this, 8.8% (6.1 TWh) was exchanged over the WAPP Interconnected Power System. The total installed capacity in the WAPP region for 2019 was 23GW of which 13.4 GW was available during the year. The generation capacity mix of the region is dominated by fossil fuels like oil and gas (75%) followed by hydropower (24%) and other RE sources (1%). The peak demand of the region in 2019 was 10.9 GW which was 6.5% higher than previous year. Detailed network map of WAPP provided in Annexure 2.

### a) *Organization Setup* [214]

West African Power Pool (WAPP) is an executive body which was created at the 22nd Summit of Economic Community of West African States (ECOWAS) through a decision by Authority of Heads of State and Government. The adoption of Articles of Agreement for WAPP organization and functions was done at the 29th Summit of ECOWAS.

- WAPP has the status of Specialized Institution of ECOWAS by Decision A/DEC.20/01/06 of ECOWAS
- Further to the signing of the Headquarter Agreement in 2006 with the Republic of Benin, the headquarter of the WAPP was set up in Cotonou, Benin.
- The headquarter houses the Secretariat which is staffed by WAPP's own employees.
- Consultants are also recruited on a short-term basis to strengthen the organizational capacities and fill skill gaps.

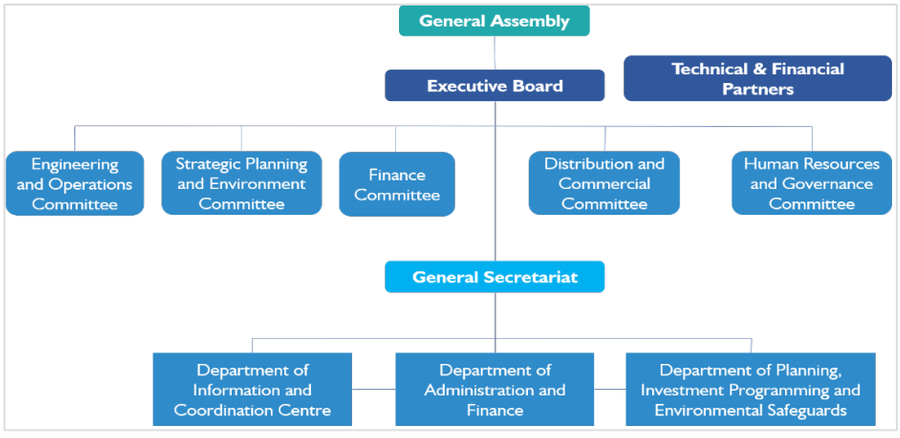
### b) *Governance*[215,216,217]

WAPP has a two- tiered governance structure.

[214] http://www.ecowapp.org/en/content/governing-structures
[215] https://www.ecowapp.org/en/content/governing-structures
[216] https://www.ecowapp.org/sites/default/files/articles_of_agreement_0.pdf
[217]https://www.ecowapp.org/sites/default/files/decision_adopting_the_report_of_ad_hoc_committee_for_the_review_of_the_composition_of_the_executive_board.pdf

- The **General Assembly** (GA) is the highest decision body of the WAPP and is composed of all the member utilities (29 member utilities). The chairperson of the Executive Board convenes and presides over the meetings of the GA.
- **Executive Board** (EB) composition has been revised multiple times since creation of WAPP to reflect the changes in the region and addition of new members. Currently it is composed of 15 members which includes 13 Director Generals/Managing Directors and Chief Executive Officers of ECOWAS National Power Utilities, Secretary General, an Honorary Member. Amongst the representatives of the power utilities, 10 are permanent members to the EB while remaining 3 are rotating members. The Chairperson of EB is elected from amongst the EB members for a 2- year team. The EB is responsible for implementing the decisions of the General Assembly.

Figure 3.3.2.3 Structure of WAPP




Roles of General Assembly include facilitating co-ordination of appropriate measures towards the implementation of principles of the WAPP Articles of Agreement; engaging the Members in accordance with the prescribed provisions; approving new applications for membership and any removal or re-instatement of a member; electing the members of the EB; as well as examining and adopting the annual reports of the EB.

The EB is responsible for defining policies and monitoring the operations of the WAPP as well as the planning of its future development. Activities of the EB include examining and recommending to the GA, entry, exit and re-entry of members to WAPP. It authorizes all major contracts and (finance/debt) instruments. It also selects and reviews the performance of officers; determines positions, duties, qualifications, salaries, benefits and other matters pertaining to the officers and staff. It reviews, approves, disapproves or recommends revision to the actions of any organizational committee. It can approve or revise the operating and capital budgets and any additional expenditures of the WAPP structure. It is responsible for convening the GA at least annually. It may recommend amendments to the Articles of Agreement/Member Agreement for the Approval of the General Assembly. The EB can approve guidelines pertaining to standards and policies of the organization, penalties for non-compliance; and authorize filings with relevant regulatory bodies. The Code of Conduct outlines the independence required of all employees of WAPP.

### c) *Operational Framework*[218]

WAPP's vision is to integrate the national power systems into a unified regional electricity market with the ultimate goal of providing-in the medium and long term-a regular and reliable energy at competitive

[218] https://www.ecowapp.org/sites/default/files/articles_of_agreement_0.pdf

cost to the citizenry of the ECOWAS region. The mission of the organization is to promote and develop power generation and transmission infrastructures as well as to coordinate power exchange among the ECOWAS Member states.

WAPP comprises of Public and Private Generation, Transmission and Distribution companies involved in the operation of the electricity in West Africa. It has 36 members including one observer member. The West African Power Pool (WAPP) structure comprises of General Assembly, Executive Board (EB), Organizational Committees and General Secretariat as shown in Figure 3.3.2.3:

The WAPP has five Organizational Committees i.e. Engineering and Operations Committee (EOC), Strategic Planning and Environment Committee (SPEC), Finance Committee (FC), Human Resource and Governance Committee (HRGC) and Distribution and Commercial Committee (DCC). The Organizational Committees are composed of technical experts drawn from the WAPP Member Utilities. The Chairperson of any Organizational Committee may appoint Task Forces as necessary to carry out its mission.

Task Force appointments under the auspices of any Organizational Committee is made with due consideration to the competence and expertise of the Members and their geographical location. Organizational Committees provide support and expertise to the EB on all matters of collective policy formulation functions for developing, maintaining and updating common "rules of practices" on technical, planning, operational and environmental aspects of the WAPP.

- **Engineering and Operating Committee (EOC)** is responsible for recommending operating practices for regional system design, planning, adequacy of interconnections, operation, operational reliability and efficiency in WAPP. Its role also is to recommend to the Executive Board criteria for operational planning and to assist in the efficiency and vitality of the cross-border electricity trading.
- **Strategic Planning Committee (SPC)** gathers information and assesses industry environment; assesses capabilities and competencies of WAPP; and thereby formulates strategies and recommends necessary modifications to the internal processes of the organization.
- **Finance and Human Resources Committee** ensures compliance of WAPP with financially based legal and regulatory requirements. It develops policies for long- term contracting; development and administration of employee benefit programs and for ensuring the effectiveness of WAPP's compensation plan for employees and executives.
- **The WAPP Secretariat** is the administrative organ to support the Executive Board for day-to-day management. It comprises of a team of independent professionals and a restricted number of permanent core staff responsible for implementing the day-to-day activities. The Secretariat is empowered to employ qualified technical and administrative employees; engage office space; employ outside technical and professional service organizations; execute contracts; serve as the representative of WAPP to the Regional Power Regulatory Authorities other regulatory bodies of ECOWAS.

- Under the Secretariat, the **Information and Coordination Center (ICC)** is responsible for promoting operational coordination between Transmission Owning/Operating Members through actual day-to-day information sharing/exchange between the operational Coordination Centers of WAPP Members. The role of the ***Administration and Finance Department*** is to strengthen the organizational structure of the WAPP and to manage the financial and accounting system of the WAPP Secretariat. The implementation of priority investment programs is coordinated by the WAPP Secretariat through the **Planning, Investment Programming & Environmental Safeguards (PIPES)** Department that ensures that the WAPP Priority Projects, as defined in the approved ECOWAS Master Plans, are developed. ICC in its capacity as the system and market operator[219]:

[219] https://www.ecowapp.org/sites/default/files/dec_76_amendment_articles_agreement_icc.pdf

- Coordinates the schedules of pool interconnections in collaboration with the transmission system operators and control areas
- Allocates transmission capacity at interconnectors thereby coordinating their use
- Monitors load flows and takes actions on variances
- Carries out settlement activities
- Undertakes operational planning of the interconnectors
- Allocates transmission capacity to contracts and administers contracts
- Manages operational level disputes
- Administers meter readings
- Administers commercial databases

**Coordinated System Operation Procedures under WAPP are enshrined in the Operation Manual's 8 policies*:**

- Policy 1 deals with frequency control and details the use of Primary Control installed on units, Secondary Control installed in the Load Despatch Centre and tertiary reserves.
- Policy 2 talks about the determination of capacity of tie lines, scheduling and implementation of interchange, monitoring of power flows and accounting for deviations.
- Policy 3 highlights points on operational security and system security requirements.
- Policy 4 pertains with operational planning around system reliability study and adequacy plan.
- Policy 5 highlights emergency procedures detailing operations under normal and abnormal states, limitation of large-scale failures and system restoration after collapse.
- Policy 6 deals with communication infrastructure requirements and procedures.
- Policy 7 pertains with information exchange and details technical standard, specifications and confidentiality requirements.
- Policy 8 talks about operator personnel, their training and capacity building.
- The Operation Manual is currently under review for revision.

### d) *Financing Mechanism* [220,221]

The primary sources of WAPP's operating revenue is contributions from member utilities (as a part of revenue from exchange transactions) and grants from donor agencies (as revenue from non-exchange transactions).

Priority projects are financed by organizations like KfW, EIB, NEPAD- IPPF, USTDA, USAID, GiZ etc. Training programs are funded through WAPP funds[222], Technical and Financial Partners (TFPs) i.e. organizations like GiZ, KfW, African Finance Corporation (AFC), JICA, etc.

For the year of 2018, the revenue for WAPP was UA 4.9 Million which as primarily composed of revenue from exchange transactions (UA 4.7 Million). The operating expenditure in the same period was UA 4.2 Million of which the most significant expenditure was personnel expenses (UA 2.3 Million) followed by other key expenses such as administrative expenses, board and committee meeting expenses as well as other general expenses.

[220] https://www.ecowapp.org/sites/default/files/wapp_2019_annual_report_finver-f_25_05.pdf
* http://icc.ecowapp.org/content/operation-manual-wapp-interconnected-power-system
[221] https://www.ecowapp.org/sites/default/files/wapp_2019_annual_report_finver-f_25_05.pdf
[222] Article 13 of Articles of Agreement, https://www.ecowapp.org/sites/default/files/articles_of_agreement_0.pdf

| WAPP Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Coordinating the activities of the power pool along with scheduling and allocation of transmission capacity at interconnectors, load flow monitoring and operational planning, undertaking settlement activities, administering contracts and managing operational disputes. | |
| **Organizational Setup** | |
| **Legal Framework** | Inter-governmental agreements of Economic Community of West African States (ECOWAS)[223] |
| **Formation/Initial Period** | Formally created by ECOWAS through the Energy Protocol to support transition to regional energy trade from existing bi-trilateral energy trade |
| **Membership** | 29 national electricity companies in Western Africa of ECOWAS member countries |
| **Headquarter Location** | Cotonou, Benin |
| **Governance Mechanism** | |
| **Governance Layers** | General Assembly and Executive Board |
| **Apex Body Members** | General Assembly with representatives of all members |
| **Board Members** | 15-member board (13 member MD/CEOs, secretary general & an honorary member) |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | 5 Committees (Engineering & Operations, Strategic Planning & Environment, Finance, Distribution & Commercial, and HR & Governance) |
| **Regional Inter-entity Relationship** | Collaborates with WAPGA, ERERA and ECREE which were created along with WAPP |
| **Secretariat and Roles** | General Secretariat with three (3) departments |
| **Staffing** | Permanent staff at secretariat augmented by consultants hired on short term basis |
| **Finance** | |
| **Funding** | Primary revenue from fee on exchange transaction |
| **Budget** | In 2018, the revenue for WAPP was UA 4.9 Million |
| **Other Details** | |
| **CBET Supported** | In 2019, 6.1 TWh was exchanged over the WAPP Interconnected Power System which formed 8.8% of the total generation of 69.7 TWh |
| **Capacity Mix** | The generation capacity mix in 2019 was dominated by fossil fuels like oil and gas (75%) followed by hydropower (24%) and other RE sources (1%) |

[223] Registered as a specialized institution of ECOWAS in Benin

**Key Observations:**

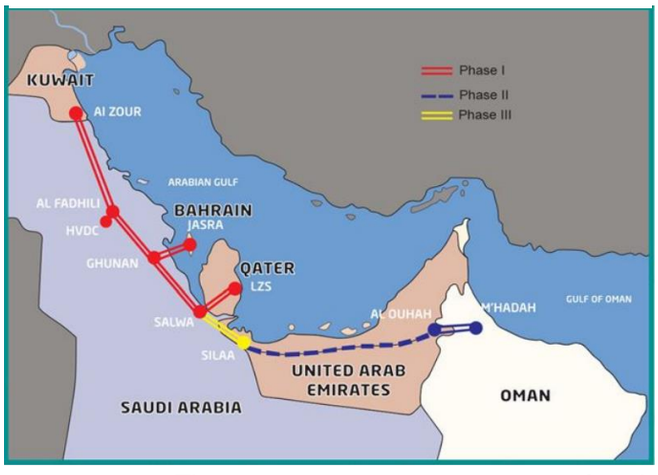
- WAPP was created through ECOWAS Energy Protocol to ***build upon the existing bilateral and trilateral energy trade*** that existed in the region
- The WAPP ***membership is limited to the utilities*** of the ECOWAS member countries
- It has a ***multi layered governance structure*** with a General Assembly and an Executive Board.
- WAPP has a fixed working structure and operates through a ***number of permanent committees and departments***
- To ***ensure ethical behavior, it has a defined code of conduct*** that is required of all its employees.
- It has a ***permanent headquarters*** at Benin and its workforce consists of a ***mix of permanent core staff as well as a team of independent professionals.***

## 3.4 Asia

### 3.4.1. Gulf Cooperation Council Interconnection Authority (GCCIA)[224,225,226,227]

The idea for Gulf Cooperation Council Interconnection Authority (GCCIA) was conceived in 1986 after a study highlighted the technical benefits and feasibility of an interconnection project. The Gulf Cooperation Council Interconnection Authority (GCCIA) was established in 2001. Subsequently in 2004 the national governments of the six member states—Kuwait, Saudi Arabia, Bahrain, Qatar, United Arab Emirates (UAE) and Oman—agreed to finance the interconnections and the control center. Development of the -physical infrastructure was implemented in three phases: the *first phase* which interconnects Kuwait, Saudi Arabia, Bahrain and Qatar; the *second phase* is the internal integration of the UAE and Oman power systems; and the *third phase* will connect phase one with phase two. In 2019, the GCCIA system supported 8829 MWh of energy across multiple support levels with 75% of it being in the obligatory support level of 30 minutes. The operation of the interconnect helps reduce reserve capacity requirements in member countries by allowing cross border utilization of reserve capacity. The spinning reserve requirement for the interconnected GCCIA system in 2019 was 664 MW against 3GW requirements if the systems were isolated. The GCCIA network currently consists of over 1150 Kms of transmission lines including 100Km long submarine transmission network (Figure 3.4.1.1). The interconnect capacity for the member countries are Kuwait - 1200MW; Bahrain - 600MW; Saudi Arabia - 1200 MW; Qatar - 1200 MW; UAE 1200 MW and Oman - 400 MW. The total installed capacity of the GCC region in 2017 was 145 GW with nearly entire capacity based on oil and gas and only 1% RE capacity.

Figure 3.4.1.1 GCCIA Member Countries[$]




[224] http://www.gccia.com.sa/Data/Downloads/Reports/FILE_25.pdf
[225] https://sari-energy.org/wp-content/uploads/2019/04/Experience-of-GCCIA-in-developing-GCC-Regional-Electricity-Market-Final.pdf
[226] https://www.kapsarc.org/wp-content/uploads/2018/06/KS-2018-DP36-The-Costs-and-Gains-of-Coordinating-Electricity-Generation-in-the-GCC-Utilizing-the-Interconnector.pdf
[227] https://www.irena.org/publications/2019/Jan/Renewable-Energy-Market-Analysis-GCC-2019

### a) *Organizational Setup* [228]

GCCIA was set up as an interconnection authority owning international transmission assets and dispatching the cross-border power trade. It is a joint stock company subscribed by the six Gulf States, whose Articles of Association and By-Laws were approved by Royal Decree No. M/21 in July 2001 for establishing the Authority with its official domicile in Dammam, Kingdom of Saudi Arabia.

- GCCIA is physically located in Al Khobar, Saudi Arabia, and was set up in 2003.
- The dispatch center is located at Ghunan, also in Saudi Arabia, and is under the control of GCCIA.

### b) *Governance*

GCCIA has a three-layered governing structure comprising of the GCC Ministerial Committee, the Advisory Regulatory Committee (ARC) and the Board of Directors.

- GCC Ministerial Committee is the highest oversight body and comprises ministers of electricity and water from each member country.
- ARC ensures compliance of regulatory principles and performance standards. Each member state nominates a senior national electrical regulatory official to be its representative. It advises member states and GCCIA on use of interconnection.
- GCCIA has a Board of Directors which includes 12 members—two from each country—with chair rotated among member states every three years. It addresses issues of policy (Board of Directors), strategy (CEO, corporate services, and executive affairs), and operations (support services, finance and accounting, system operations and maintenance, and engineering and planning).
- Ministerial committee along with inputs from the Advisory Regulatory Committee (ARC) guides the GCCIA Board of Directors on its policies and procedures.

Figure 3.4.1.2 Structure of GCCIA


GCCIA is governed by a ***General Agreement*** and a ***Power Exchange Trading Agreement (PETA)***. The General Agreement lays out the fundamental agreement between member states with respect to the electrical interconnection. It sets out rules and regulations to be applied on member states with respect to the interconnector. PETA comprises of three key components i.e. **Trading agreement,** which sets out the terms on which the parties may use the interconnector for scheduling transfers of energy and power; **Interconnection use of system agreement,** which sets out the terms on which the parties will connect to/have access to the interconnector; and **Transmission code** which 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. Parties covered in PETA include GCCIA, six TSO's, and two procurement parties (Abu Dhabi Water and Electricity Company and Oman Power and Water procurement).

[228] https://www.gccia.com.sa/P/company_profile/11
[$] http://www.gccia.com.sa/Data/Downloads/Reports/FILE_25.pdf

### c) *Operating Framework*[229]

The organizational framework of GCCIA comprises of ***Ministerial Committee*** and ***Advisory and Regulatory Committee (ARC)*** in the top tier, which guides the ***Board of Directors*** and the ***Working Committees*** (Figure 3.4.1.2).

The GCCIA board together with the planning committee and the operating committee (also nominated by GCC member states) form a ***General Assembly***, which makes decisions on codes and agreements governing trade among member utilities and governing the activities of the GCCIA itself. Each member state nominates a representative for the Operations Committee and the Planning Committee.

- ***Planning Committee*** coordinates planning between the GCCIA and member states and advises on planning issues. It recommends rules and procedures to determine capability of installed capacity resources. It also advises GCCIA and member states on technical aspects and proposes long-term solutions to operational problems. It recommends charges to be imposed on procurement parties; reviews fees, charges, and tariff proposals raised by the Operations Committee and presents recommendations to the ARC. It also advises Operations Committee on required changes to the interconnector transmission code.
- ***Operations Committee*** coordinates and advises on operational issues between GCCIA and member states. Its duties include operational matters such as metering, accounting, and payment; security and stability, including proposal of Loss of Load Expectation (LOLE) targets; coordinating maintenance schedules; considering short-range load forecasts and related capacity requirements; advising on operating-reserve measurement methodology and allocation of losses. It manages matters of interconnector transmission code; recommends tariff, charge-calculation methodologies; annually reviews operations and use of the interconnection; investigates and reports major faults related to the interconnection and any other operating matter that may arise.

Currently, there are two primary vehicles for ***trade on the GCC interconnection:***

- ***Scheduled exchanges -*** Bilateral transactions (in accordance to guidelines of bilateral contracts) are freely negotiated between members. On agreement, members must procure transmission capacity rights for use of the GCC interconnection from the GCCIA. This trade is conducted through an agreed standard template.
- ***Unscheduled exchanges -*** Member states are entitled to use the interconnection during emergency situations and are also required to maintain operating reserves. This has been established to help ensure system reliability amongst member states. Operating reserves of one or more member states can be dispatched by the dispatch center to support the system of another member state which experiences emergency generation shortfalls. Unscheduled exchanges are not paid for financially; peak power drawls are only repaid through peak power supplies for under 25 MW. Deviations of more than 25 MW are settled in cash at regulated price.

### d) *Financing Mechanism* [230,231,232]

The costs in GCCIA are shared in proportion to the net present value of estimated reserve capacity savings. Each country is responsible for sourcing their share of the capital required, which could be from combinations of debt or equity as decided by each member state.

The capital cost of the project over its three phases has reached USD 1.5 Billion and the operational cost since 2009 till end of 2018 has amounted to USD 350 Million. The economic savings provided by

[229] https://documents.worldbank.org/en/publication/documents-reports/documentdetail/415281468059650302/middle-east-and-north-africa-integration-of-electricity-networks-in-the-arab-world-regional-market-structure-and-design
[230] Annual Report-2018; https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_Gulf%20Countries-Transmission%20&%20Trading.pdf
[231] http://www.gccia.com.sa/Data/Downloads/Reports/FILE_25.pdf
[232] https://sari-energy.org/wp-content/uploads/2019/04/Experience-of-GCCIA-in-developing-GCC-Regional-Electricity-Market-Final.pdf

the interconnect since 2009 till end of 2018 is estimated to be over USD 2.7 Billion. The economic savings due to the interconnect in 2019 alone are over USD 264 Million. The interconnect is expected to deliver savings of ~USD 30 Billion over the next 23 years.

GCCIA also charges a cost for the use of the interconnect system. The transmission charge for the use of the interconnector is currently set at USD 0.5/MWh (90% discount to the price that was being charged since 2010).

### e) *Other Important Points*[233]

Prospects of GCCIA are focused on exploring expansion of grid capacities and studying opportunities to interconnect with neighboring continents of Europe, Africa and Asia, further increasing energy efficiency and sustainability.

Financial corporate strategic objectives of GCCIA over the next 5 years include recovery of cost of services, optimization of cost of operation and development of the financial model.

| GCCIA Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Ensuring regional grid reliability, expanding energy trade, operation and maintenance of GCCIA interconnect system, enhance cooperation between stakeholders of energy sector and explore new markets for grid expansion | |
| **Organizational Setup** | |
| **Legal Status** | Joint stock company subscribed by member countries |
| **Initial Period & Handholding** | Established as interconnection authority in 2001 after benefits of such a system got highlighted in a study |
| **Membership** | 6 Member Countries in that are part of the Gulf Cooperation Council |
| **Headquarter Location** | Al Khobar, Saudi Arabia |
| **Governance Mechanism** | |
| **Governance Layers** | Ministerial Committee, Advisory & Regulatory Committee (ARC) and Board |
| **Apex Body Members** | Ministerial Committee: Ministers of electricity and water members |
| **Board Members** | 12-member board (2 nominated by each country) |
| **Other Bodies/Layers of Governance** | ARC: Nominated a senior national electrical regulatory official |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | 2 Committees (Planning Committee and Operating Committee) |
| **Staffing** | Over 100 employees between GCCIA office and dispatch centre |

[233] http://www.gccia.com.sa/Data/Downloads/Reports/FILE_25.pdf

**Key Observations:**

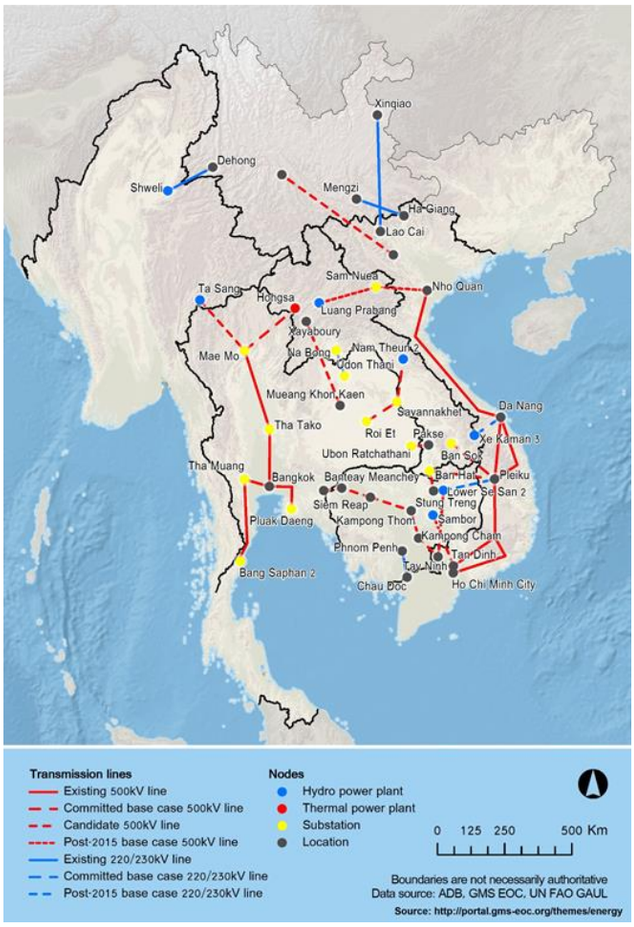
- GCCIA's ***permanent headquarter*** and dispatch center are located in Saudi Arabia, a member country
- It has a ***multi layered governance structure*** comprising of ministerial committee, ARC and board of directors
- GCCIA has a ***uniform representation from all member*** countries in the governing bodies of the organization
- It has a fixed working structure which is ***operated permanent committees*** on planning and operation
- GCCIA is ***fully financed by the member countries*** in proportion to the net present value of estimated reserve capacity savings and interconnect usage charges

| **Finance** | |
|---|---|
| **Funding** | Funded by contributions from member countries and interconnect usage charges. Project funding distributed on basis of NPV of benefits |
| **Budget and Savings** | USD 264 Million capex across 3 phases with estimated savings of ~USD 3 billion by since 2009. USD 264 Million savings in 2019 alone |
| **Other Details** | |
| **CBET Supported** | Supported 8.83 GWh of energy across multiple support levels in 2019 with 75% of it being in the obligatory support level of 30 minutes supporting a regional peak demand of 117.3 GW in 2019. The share of cross border transfers stood at ~0.001% with a total regional generation of 661 TWh in 2018. |
| **Capacity Mix** | The total installed capacity of the GCC region in 2017 was 145 GW with nearly entire capacity based on oil and gas and only 1% RE capacity |

### 3.4.2. Greater Mekong Subregion (GMS)[234,235]

Power trade in the GMS commenced with power exports from Nam Ngum plant in Lao PDR to Electricity Generating Authority Thailand (EGAT) in 1971. The plant was developed in three stages and maintained an installed capacity well in excess of the requirement of the domestic market. The surplus was sold to EGAT. However, various wars and border tensions that followed in Thailand during the 1970s and 1980s prevented any significant progress until the 1990s.

Figure 3.4.2.1 GMS Member **Countries**^




From 1990 onwards, bilateral power trade gained impetus with the signing of several MOUs between governments across the GMS and growing investor interest in cross-border generation investments. As the transactions were through bilateral mode, no specific arrangements were in place to facilitate broader trade. The terms and conditions of bilateral trade were determined by the utilities (owned by the respective governments) on a case to case basis. The trade framework comprised each project governed by specific contractual arrangements between utilities (PPAs), concession agreements and financing arrangements. Additionally, the initial activity in 1990's included: focus on regional policy development, project preparation, information sharing, and familiarization with the national power system of the GMS countries. Subsequently, the development of Theun Hinboun and Houay Ho HPPs in Lao PDR provided further momentum to the bilateral power trade.

This era also initiated the development of regional power integration for cross border trade through the GMS program launched in 1992. The Greater Mekong Subregion (GMS) cooperation started with the ADB Greater Mekong Subregion (GMS) Economic Cooperation Program (GMS Program) in 1992. The countries of the region documented the intention to set up the infrastructure and institutions needed for CBET in 1998 through a policy statement on regional power trade and the same was adopted at the fifth Electric Power Forum Meeting. This was further strengthened through signing of Inter- governmental Agreement in 2003 and MoU in 2008. Currently it is comprised of Cambodia, Guangxi Zhuang Autonomous Region and Yunnan Province of the People's Republic of China, Lao People's Democratic Republic (Lao PDR), Union of Myanmar, Thailand and Vietnam (Figure 3.4.2.1).The installed capacity of the region (including CSG-China) in 2017 was 332 GW dominated by thermal generation capacity (56%), followed by hydropower capacity (39%), nuclear capacity (2%) and other capacity including RE (3%).

[234] http://documents1.worldbank.org/curated/en/843261468006254751/pdf/703710WP0P111140Border0Power0Trading.pdf
^ http://portal.gms-eoc.org/themes/energy
[235] http://documents1.worldbank.org/curated/en/541551554971088114/pdf/Greater-Mekong-Subregion-Power-Market-Development-All-Business-Cases-including-the-Integrated-GMS-Case.pdf

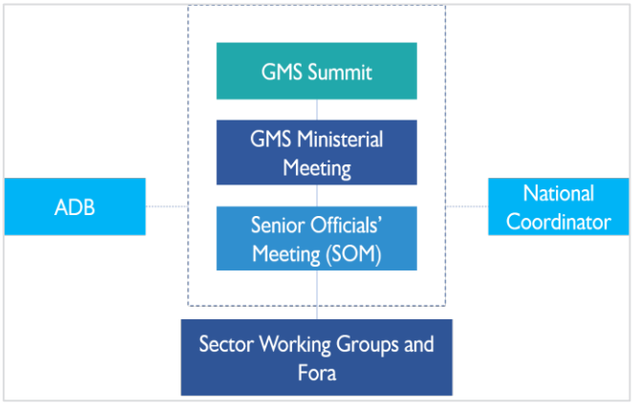
### a) *Organizational setup*

- GMS regional market was established in a Policy Statement adopted in 2000.
- Signing of Intergovernmental Agreement in 2003 led to the creation of Regional Power Trade Coordination Committee.
- The Secretariat is provided by the host country for each meeting & the Asian Development Bank (ADB)

### *b) Governance*

The ***GMS Summit*** of Leaders, generally held every three years, is the highest forum in the Greater Mekong Subregion program. It culminates in a joint statement signed by the heads of government of member countries. Its roles include examination of how global trends are affecting the subregion; progress that has been made in cooperation and integration and best strategy for moving forward in the years ahead.

Figure 3.4.2.2 Structure of GMS




The ***Ministerial Conference*** is an annual meeting of GMS Ministers and provides policy direction for the program. It also oversees progress in identifying and implementing results-oriented sub-regional cooperation initiatives.

### c) *Operational Framework* [236]

The objectives for the regional power market, as identified by the GMS Program participating countries, are set out in the Policy Statement issued in January 2000:

- Promote efficient development of electric power sector in GMS with objective of aiding economic growth.
- Promote opportunities for extended economic cooperation between members in the field of energy.
- Facilitate the implementation of priority electric power projects.
- Address technical, economic, financial and institutional issues relevant to GMS.
- Promote electric power trade.
- Protect and improve the environment through the adoption of appropriate technologies and plans.

The GMS program has identified and implemented priority programs and projects in a range of sectors, including human resources development and environmental management. Power market integration is one of the top priorities of GMS. Power interconnection in the GMS region was planned to progress into four stages. Stage 1 is bilateral cross-border connections. In Stage 2, there would be grid-to grid power trading between any pair of GM countries. During this stage, the country's transmission facilities will be used for such trading. Stage 3 involves transmission links for cross-border trading. Stage 4 envisions a fully integrated GMS regional competitive power market will be established. Currently GMS countries have reached Stage 1, where bilateral trade is ongoing, and are moving towards Stage 2 with limited progress.

GMS Program has been pursued through an institutional arrangement with the Organizational Structure[237] (Figure 3.4.2.2) consisting of:

- GMS Leaders' Summit at the political level.
- Ministerial-level conference supported by meeting of senior officials at the policy level.

[236] https://openknowledge.worldbank.org/handle/10986/17506
[237] https://greatermekong.org/

- Sector forums and working groups at the project and operational levels.

The ***GMS Summit*** is attended by Prime Ministers of participating countries. In each of the GMS countries, there is a ***National Inter-ministerial Committee*** assisted by a designated focal point or ***National Secretariat*** that coordinates the GMS activities. Secretariat support is provided by a unit at ADB headquarters.

The power sector activities in the region are coordinated by the ***Regional Power Trade Coordination Committee (RPTCC)*** which meets twice a year**.** The Committee was established in 2004 as the main institution for GMS power connectivity. It is composed of representatives from ministries and energy departments from each country, has two Working Groups namely ***Working Group on Strategic Planning and operation (WGPO)***[238] and ***Working Group on Regulatory Issues (WGRI***).

The ***WGPG functions***[239] include compliance assessment of the GMS Grid Code; strategizing enforcement of GMS Grid Code; completion of Regional Master Plan and feasibility studies of short-term projects (Lao PDR-Myanmar Interconnection). Tasks achieved include preparation of GMS common performance standards, Transmission Regulations, standard regional metering arrangements and GMS regional grid code.

***WGRI functions***[240] include creating a roadmap for integration of regional and national wheeling charges which includes development of national regulatory processes and procedures, completion of regulations and licenses supporting third party access etc.

RPTCC had prepared the ***Regional Power Trade Operating Agreement (RPTOA)*** and the updated GMS Regional Master. It has been leading the discussions for revitalizing the existing ***Regional Power Coordination Center (RPCC)***, to coordinate regional power trade with a synchronous area[241]. Functions of the RPCC include recommendation of arrangements for policymaking and day-to-day management of regional power trade, including the necessary coordination bodies; establishing the short, medium and long-term actions required to achieve the objectives for regional power trade; Identifying the necessary implementation steps, including financing arrangements. The member countries have suggested a new role for the Coordination Center of enforcing grid code as well.

### d) *Financing Mechanism*

The Asian Development Bank (ADB) has provided vital support to GMS since beginning, acting as its Secretariat. In addition to that of ADB, energy cooperation in the GMS benefits from the assistance of various international agencies and bilateral donors, including the World Bank, the Swedish International Development Agency (SIDA), the Australian Agency for International Development (AusAID), and the Agence Française de Development (AFD).

[238] https://greatermekong.org/26th-meeting-regional-power-trade-coordination-committee-rptcc-26-1
[239] https://greatermekong.org/sites/default/files/Attachment%208.%20WGPO%20TOR.pdf
[240] https://www.greatermekong.org/sites/default/files/Attachment%208_GMS%20Transmission%20Pricing%20and%20Devt%20of%20Transco%20Model.pdf
[241] https://greatermekong.org/26th-meeting-regional-power-trade-coordination-committee-rptcc-26-1

| GMS Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Facilitating regional interconnection; coordinating regional power trade; harmonization of codes, practices and standards; integration of regional and national wheeling charges; development of regional masterplans | |
| **Organizational Setup** | |
| **Legal Status** | Inter-governmental agreement/MoU with GMS Summit attended by heads of states[242] |
| **Initial Period & Handholding** | Started under ADB Greater Mekong Subregion (GMS) Economic Cooperation Program in 1992 |
| **Membership** | Six (6) Member Countries in the Mekong river basin (including 2 provinces of China) |
| **Headquarter Location** | ADB, Manila – Philippines |
| **Governance Mechanism** | |
| **Governance Layers** | GMS Summit, Ministerial Meeting, Senior Officials' Meeting |
| **Apex Body Members** | GMS Summit attended by heads of states |
| **Board Members** | Ministerial committee formed of the respective ministers responsible for the sector in member countries |
| **Other Bodies/Layers of Governance** | Senior Officials' Meeting: Senior Officials from respective ministries of members |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | 1 committee - Regional Power Trade Coordination Committee (RPTCC) with 2 working groups on Strategic Planning & operation and Regulatory Issues |
| **Secretariat and Roles** | GMS secretariat is run by ADB. National secretariats in member countries coordinate with GMS |
| **Staffing** | Secretariat provided and staffed by ADB |
| **Finance** | |
| **Funding** | Primarily funded by ADB and additional financial support from other multilateral donor/ funding agencies like WB, AFD, AusAID |
| **Other Details** | |
| **Capacity Mix** | The installed capacity of the region (including CSG-China) in 2017 was 332 GW dominated by thermal generation capacity (56%), followed by hydropower capacity (39%), nuclear capacity (2%) and other capacity including RE (3%). |

[242] Created through ADB Greater Mekong Subregion (GMS) Economic Cooperation Program

**Key Observations:**

- The regional power coordination committee of GMS was ***created through signing of inter-governmental agreement***
- GMS ***Secretariat is provided by the handholding organization*** namely ADB.
- It has ***fixed working groups*** on Strategic Planning & Operation as well as Regulatory Issues
- As GMS is still in its ***early phase, funding*** for its activities is provided by ***donor organizations and handholding body***

### 3.4.3. Forum of Load Despatchers (FOLD)

Forum of Load Despatchers i.e. FOLD is a forum of organizations carrying out System Control activities in India.

#### a) *Organizational setup*

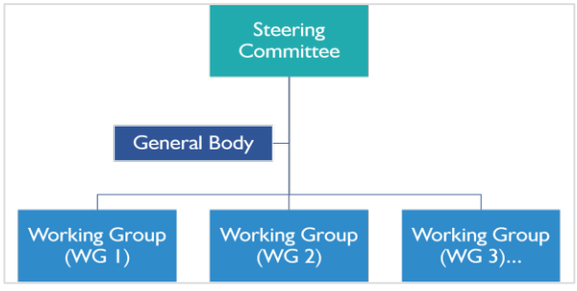
FOLD is an association of state regional and national load dispatchers in India. The vision of FOLD is to be a catalyst in reliable, efficient and economic operation of the Indian bulk electric power supply system. Its mission is to strive to achieve its vision through technical cooperation, knowledge sharing, regular interaction, active collaboration, mutual respect, cooperation, consensus building, international benchmarking and promoting ethical, non-discriminatory and fair practices.

- It has been created based on the decision arrived at in the ninth meeting of Forum of Regulators (FOR) held at Bhubaneshwar on 14th-15th November 2008 (vide reference no.: 15/8(1)/2008-FoR/CERC).
- As per the aforementioned decision, FOLD Secretariat is housed under NLDC building in Delhi.
- Its General Body consists of all executives working in SLDCs, RLDCs, NLDC, and working groups have volunteers/nominated members from the General Body and invited experts.

#### b) *Governance*

The structure of FOLD comprises of the Steering Committee, General Body and Working Groups (Figure 3.4.3.1).

Figure 3.4.3.1 Org Structure of FOLD




- Steering Committee is the governing body of FOLD and comprises of the Head of State/Regional/National Load Dispatch Centers or its authorized representative which would be constituted to steer the activities of FOLD.
- General Body comprises of all the executives working in SLDCs, RLDCs, NLDC as members.
- Working Groups advise the Steering Committee on matters related to power system and electricity market operation. The Working Groups have volunteers/nominated members from the General Body and invited experts.
- The organization follows a simple governance structure where decisions are taken through discussions and consensus building

The members of FOLD adopted in 2015, a declared commitment towards codes of ethical and professional conduct in recognition of the importance of their function in ensuring secure and economic

operation of the electricity grids across the country and the higher cause of making an improvement towards humanity.[243]

### c) *Operational Framework*

The broad contours of functions[244] of FOLD are to promote:

- ***Technological excellence -*** Help LDCs in technology management and conduct research on new technologies.
- ***Harmonization of practices*** - Documentation and sharing of best practices, suggesting SOPs and guidelines for power market operations.
- ***Compliance to reliability standards -*** Analysis of grid data for developing proposal on reliability standards etc.
- Ensure ***transparent delivery of ancillary services.***
- ***Capacity building -*** Identify focus areas, conduct trainings/workshops and develop faculty of power system and markets.
- Facilitate ***information sharing*** with stakeholders.
- Review ***performance indicators*** and deliberate issues referred by FOR.

The ***Departmental Functions*** [245] of FOLD include ***publication of reports*** on various topics. FOLD members have collaborated in conducting research on specific issues and published reports on subjects such as scheduling, accounting, metering and settlement of transaction. Reports have been published on operational analysis and optimization of hydro resources, on bringing power system operation closer to 50 hz, implementation of five-minute scheduling, and introduction of fast markets at inter-state level in India.

FOLD is also tasked with ***conducting meetings*** and as of now, 26 meetings of the FOLD have been held. Few topics deliberated in the meetings include preparation of state grid code, tightening of frequency band, ancillary services and AGC implementation, transfer capability assessment, grid security protocol adherence, frequency response characteristics, NEW-SR grid synchronization etc.

The organization also undertakes ***capacity building workshops*** on a variety of emerging issues. FOLD has also been organizing expert talks and seminars on new technologies. It has provided a platform for sharing of best practices by SLDCs. It has organized boot camps under the Greening the Grid project. It has also collaborated with Indian Meteorological Department in the ***development of weather portal*** for the FOLD members.

In association with FOLD, NPTI conducts ***certification courses*** and examinations for basic level, regulatory specialists, power system reliability specialists, electricity market specialist, logistics specialists and renewable energy specialists.

The handholding of FOLD is done by National Load Dispatch Centre (NLDC). NLDC was chosen for the role as it has the requisite experience of managing the power system at the national level and oversees the connectivity across all control areas. To accomplish the task of national load dispatch effectively, NLDC also has regular interactions with the other system operators in the country thereby allowing it to leverage the same for FOLD. NLDC with its requisite experience and existing infrastructure, provides the secretarial support to FOLD. No membership fee is charged in order to ensure simplicity at the start and the limited costs are borne by NLDC.

[243] https://forumofld.in/wp-content/uploads/2016/12/Code_of_Ethics_Adopted.pdf
[244] https://forumofld.in/wp-content/uploads/2018/03/FOLD-Charter.pdf
[245] https://forumofld.in/wp-content/uploads/2018/11/Capacity_Indian_Load_Despatch_Centres.pdf

### d) *Financing Mechanism*

Presently the FOLD is housed within the NLDC which provides infrastructure resource and secretarial services for FOLD. Therefore, the activities of FOLD are being sponsored by NLDC. The key expenses of fold that are borne by NLDC are convening of meetings and publication of documents. FOLD does not collect any fee or charges from its member entities currently.

### e) *Other Important Points*

In its recent report on Capacity building of Indian Load dispatch centers (CABIL), recommendations on working of FOLD were mentioned, which included:

- Strengthening for larger roles in institutional capacity building of the LDCs.
- Expenditure of FOLD may be recovered through the NLDC fees and charges.
- Strengthening handhold roles in emerging SLDCs and taking up activities for long-term sustainability of the load dispatch faculty.
- Sponsoring LDC personnel for national/international conferences.
- LDCs collectively negotiating with vendors and service providers for customized solutions/niche products through FOLD.
- Availing consultancy services in emerging technologies or market products on better terms and conditions.
- Constituting Working Groups on the lines of CIGRE and IEEE.

| FOLD Summary Sheet | |
|---|---|
| **Key Focus Areas** | |
| Promoting technological excellence, harmonizing practices, ensuring compliance to reliability standards, ensuring transparent delivery of ancillary services, capacity building and information sharing | |
| **Organizational Setup** | |
| **Legal Status** | Association |
| **Initial Period & Handholding** | Secretariat being provided by NLDC |
| **Membership** | 29 State load dispatchers, 5 regional load dispatchers and national load dispatcher |
| **Headquarter Location** | NLDC, Delhi, India |
| **Governance Mechanism** | |
| **Governance Layers** | General Body and Steering Group |
| **Apex Body Members** | General body comprises of all executives of all LDCs |
| **Board Members** | Steering group comprises of heads of LDCs |
| **Operating Structure** | |
| **Key Committees/ Departments/ Functions** | Working groups created on need/task basis on the lines of CIGRE/IEEE |
| **Regional Inter-entity Relationship** | FOR refers issues to FOLD for deliberation |

| | |
|---|---|
| **Secretariat and Roles** | NLDC provides secretarial support |
| **Staffing** | NLDC provides staff |
| **Finance** | |
| **Funding** | Financially supported by NLDC (no Membership Fee collected) |
| **Other Details** | |
| **Energy Transfer Supported** | The total quantum of electricity demand met in India during the year 2019-20 was of the order of 1253 TWh |
| **Capacity Mix** | The installed capacity in India in 2019-20 was 370GW comprising of coal and lignite (56%), oil and gas (7%), hydro (12%), RE (23%) and nuclear (2%) |

**Key Observations:**

- FOLD was ***created basis a decision taken*** by the Forum of Regulators at its 9th meeting
- All ***state and regional system operators along with the national system operators are the members*** of FOLD
- The ***secretariat services for FOLD are provided by the NLDC***
- It has a **simple governance structure** comprising of the steering committee and general body which provide inputs to the various working groups.
- FOLD works through a ***hybrid operational structure*** with ***permanent governance bodies and temporary working groups.***
- Activities of ***FOLD are sponsored by the secretariat housing body*** namely NLDC and FOLD does not collect any membership fees
- Operates a ***specialized forum*** for a large number of load dispatchers and ***supports development of capabilities*** of its members.

## 3.5 Summary

The analysis of international examples on regional system operator forums highlight the different frameworks and mechanisms that are employed globally across key elements of an organizational sector such as legal framework, membership, headquarter location, governance, operating structures and financing mechanisms. These offer valuable lessons for the creation and operationalization of the network. Table 3.1 compares the different frameworks employed by the international organizations studied in this chapter.

Table 3.1 Frameworks and mechanisms employed by regional system operator forums internationally

| | ENTSO-E | PJM | SPP | SAPP | WAPP | GCCIA | GMS | FOLD |
|---|---|---|---|---|---|---|---|---|
| **Legal Framework** | Association/Society formed in line with EU mandate and registered under Belgian Law | Limited Liability Company | Association incorporated of diverse group of utilities and transmission entities | Inter-government and inter-utility agreements/MoUs | Inter-governmental agreements | Joint Stock Company | Inter- Government Agreement/MoU | Association |
| **Member Countries** | 35 EU countries | Parts of 13 states in USA and District of Columbia | Parts of 14 states in USA | 12 Southern African Countries | 15 West African Countries | 6 Gulf Countries | 6 Member Countries (only 2 provinces of China are members of GMS) | States and regions of India |
| **Organizational Membership** | 42 TSOs of member countries | 1040 members across genco, transco, discoms, end consumers and other suppliers | 98 members across investor-owned utilities, municipal systems, govt agencies, IPPs, cooperatives, contract participant, power marketers and independent transmission companies | 17 national electric companies from member countries | 29 national electric companies from member countries | Ministries of Energy and Water of member countries | Governments of member countries | 29 State load dispatchers, 5 regional load dispatchers & national load dispatcher |
| **Headquarter Location** | Brussels, Belgium | Valley Forge in Pennsylvania, USA | Little Rock, Arkansas, USA | Emerald Hill, Harare, Zimbabwe | Cotonou, Benin | Al Khobar, Saudi Arabia | ADB, Manila - Philippines | NLDC, Delhi, India |

| | ENTSO-E | PJM | SPP | SAPP | WAPP | GCCIA | GMS | FOLD |
|---|---|---|---|---|---|---|---|---|
| **Governance Mechanism** | Assembly, Board, Committees and Secretariat | Board, Members committee, User Groups, Market Reliability Committee and other permanent and temporary committees | Membership, Board/Members Committee, Regional State Committee and other committees | SADC Directorate of Infrastructure & Services; Executive Committee, Management, Coordination centre board and Committee, other committees | General Assembly, Executive Board, general secretariat and committees | Ministerial Committee, Advisory & Regulatory Committee (ARC), Board and other committees | GMS Summit, Ministerial Meeting, Senior Officials' Meeting and sector working groups | General Body, Steering Group and working groups |
| **Operating Structure** | System Operation committee, System Development committee, Market committee and R&D committee | Planning standing committee, Operating standing committee, Markets Implementation standing committee and temporary subcommittees/ task forces | Strategic Planning committee, Oversight committee, Markets and Operations Policy committee, HR committee, Finance committee, Corporate Governance committee and other subcommittees/worworn groups | Environmental subcommittee, Markets subcommittee, Operating subcommittee, planning subcommittee, Coordination Centre and Project Advisory Unit | Engineering and Operations committee, Strategic Planning and Environmental committee, Finance committee, Distribution and Commercial committee, Human Resources and Governance Committee | Planning committee and Operation committee | Regional Power Trade Coordination Committee (RPTCC), Working Group on Strategic Planning and operation (WGPO) and Working Group on Regulatory Issues (WGRI) | Working groups to advise the Steering Committee on matters related to power system and electricity market operation |
| **Funding Mechanism** | Membership Fee | Fee for operating transmission system and market | Transmission Fee, Membership Fee, Contract Service charges and other miscellaneous revenue | Member contributions, Donor grants and Market Administration Fee | Primary revenue from fee on exchange transaction | Funded by contributions from member countries and interconnect usage charges. Project funding distributed on basis of NPV of benefits | Primarily funded by ADB Additional financial support from other multilateral donor/ funding agencies like WB, AFD, AusAID | Financially supported by NLDC (no Membership Fee collected) |

# 4. Study of Regional Multilateral Forums in South Asia

It has been highlighted earlier in this report that the South Asian Region offers unique complementarities in terms of resources, demand patterns and growth expectations. The region also has a shared history which lends itself to certain nuances in terms of handling subjects, addressing concerns and building consensus. It is important to keep into consideration these nuances to develop an effective institutional mechanism for facilitating the alignment in system operations for enabling greater CBET. In order to understand the regional collaboration perspective, this chapter focuses on analyzing the role, responsibility structure and functions of various multilateral regional forums and institutional mechanisms in South Asia.

## 4.1 SAARC

### a) Background [246]

The South Asian Association for Regional Cooperation (SAARC) was set up in December 1985 at Dhaka upon the signing of the SAARC charter by eight member countries namely Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka. It was set up as an inter-governmental organization focused on economic development, promotion of trade and regional integration. Besides its permanent members, the organization also has observer members from Australia, China, European Union, Iran, Japan, Mauritius, Myanmar, South Korea and USA.

### b) Roles and Responsibilities [247]

The objectives of the organization as defined in its charter are:

- Promoting the welfare of the people of South Asia and to improve their quality of life.
- Accelerating economic growth, social progress and cultural development in the region and to provide all individuals the opportunity to live in dignity and to realize their full potentials.
- Promoting and strengthening collective self-reliance among the countries of South Asia.
- Contributing to mutual trust, understanding and appreciation of one another's problems.
- Promoting active collaboration and mutual assistance in the economic, social, cultural, technical and scientific fields.
- Strengthening cooperation with other developing countries.
- Strengthening cooperation among themselves in international forums on matters of common interests.
- Cooperating with international and regional organizations with similar aims and purposes.

Considering the geopolitical sensitivities in the region, decisions at all levels of the organization are taken unanimously and bilateral or contentious issues are not taken up by the association.

### c) Structure [248]

The cooperation at SAARC is led by the ***heads of states*** of SAARC nations who are expected to meet at least once a year for giving strategic guidance at the SAARC Summits. The chair country of SAARC is elected on a rotational basis.

[246] http://saarc-sec.org/about-saarc
[247] http://saarc-sec.org/saarc-charter
[248] http://saarc-sec.org/saarc-charter

As illustrated in figure 4.1.1, the oversight within the SAARC structure is maintained by the ***Council of Ministers*** comprising of the Foreign Ministers of the member countries who meet twice a year. The roles of the Council of Ministers include, formulating policies for SAARC, reviewing progress, deciding on new areas of cooperation, deciding in additional matters of general interest and setting up additional mechanisms when deemed necessary.

Figure 4.1.1 SAARC Structure


The next level in the SAARC structure comprises of the ***Standing Committee*** comprised of the Foreign Secretaries of the member countries who submit periodic reports to the Council of Ministers. The key roles of Standing Committee include monitoring and coordination of programs, approving projects, programs and their financial modalities, mobilization of resources and setting inter sectoral priorities.

The ***Programming Committee*** is comprised of heads of SAARC division in the member countries and it assists the Standing Committee in fulfilling its roles. The Programming Committee manages the calendar of events, the administrative and financial matters of the Secretariat and regional centers as well as technical committees, working groups and specialized bodies.

The ***Technical Committees*** are comprised of representatives from member countries and are tasked with implementation, coordination and monitoring of programs in their respective areas. SAARC has Technical Committees on agriculture and rural development, health and population; women, youth and children; science and technology; transport; and environment. SAARC also has ***Working Groups*** which create and oversee programs and tasks within the SAARC framework to strengthen regional cooperation in the focus areas. SAARC currently has Working Groups on energy, information and communication technology, and tourism. ***Action Committees*** comprising of more than two member countries (but not all) are set up by the Standing Committee for implementation of certain projects.

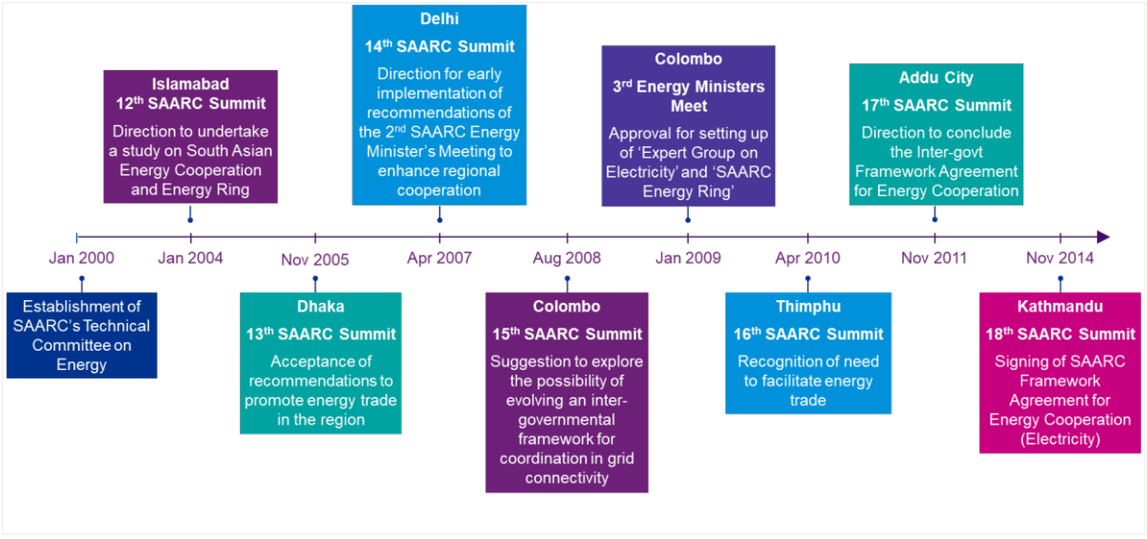
The ***SAARC Secretariat*** is located at Kathmandu, Nepal and is comprised of 61 employees including a Secretary General and eight Directors. SAARC is funded by the member countries and the national budgets of the member states are required to make ***provisions for financing*** the projects and programs under the SAARC framework including the budget for the Secretariat which is shared based in an agreed formula. According to the agreed formula, at least 40% of the institutional cost of regional institutions is borne by the host country while the rest is shared by all members. The financial provisions made are declared in the Standing Committee.

### d) Functioning Electricity Sector Focus [249]

SAARC works on its priority areas through its committees and Working Groups. SAARC has been keenly working towards building cooperation in the fields of energy amongst the South Asian countries. Some of the key milestones in this journey are illustrated in figure 4.1.2. The SAARC Framework Agreement on Energy Cooperation (SFAEC) signed at Kathmandu in 2014 strongly emphasized on the need for enhancing cross border electricity trade in the region as the same can ensure optimal utilization of regional generation assets, enhance reliability and security of the power system in the region, improve peak management and mitigate shortages. The framework agreement establishes guiding principles to enable CBET on voluntary basis amongst the SAARC member states.

[249] http://saarc-sec.org/areas_of_cooperation/area_detail/energy-transport-science-and-technology/click-for-details_10

Figure 4.1.2 SAARC Electricity Sector Timeline




Some of the key provisions of the SAARC Framework Agreement on Energy Cooperation (Electricity) include:

- ***Article 5***: Highlights the sharing and updating of technical data and information on the electricity sector in an agreed template amongst member countries
- ***Article 7:*** Delineates that the member countries 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:*** Specifying that member countries shall enable the enable joint development of coordinated network protection systems incidental to the cross-border interconnection to ensure reliability and security of the grids
- ***Article 14:*** Aims to facilitate knowledge sharing and joint research in the energy sector 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:*** Specifies that member countries shall develop the structure, functions and institutional mechanisms to resolve regulatory issues related to electricity exchange and trade.

**The aforementioned provisions highlight that the SAARC member countries have agreed to cooperate on issues related with cross border trade and the functions by the proposed Regional Network in a way would be in line with the overall objectives of SAARC Inter-Governmental Framework Agreement on Energy Cooperation (Electricity).**

Subsequent to the framework agreement and meeting of energy regulators of the South Asian Region in December 2014 and February 2016; a model set of regulations were developed under commission from SAARC Council of Experts of Energy Regulators - Electricity. The model set of regulations were designed keeping in focus the implementation of SFAEC. Subsequent discussion for action on the same is underway with the goal of advancing electricity trade in the South Asian Region.

**SFAEC Article 11: System Operation and Settlement Mechanism**

Member States shall enable the national grid operators to jointly develop coordinated procedures for the secure and reliable operation of the inter-connected grids and to prepare scheduling, dispatch, energy accounting and settlement procedures for cross border trade.

**Role of National System Operators in Section 18 of the Model Regulations in defined as:**

The National System Operator, in co-ordination with the Central Transmission Utility shall conduct system studies and publish corridor wise total transmission capacity, available transmission capacity, and available transmission margins, for the current period and forecast for the future period.

**Key Observations:**

- SAARC is body ***comprising of all countries of the South Asia*** focused on economic development and building regional integration
- It is an entity ***created through signing of an inter-governmental agreement*** namely the SAARC Charter
- A ***permanent SAARC secretariat*** is located in the member country of Nepal
- It has a strong electricity sector focus and has led to the signing of ***Framework Agreement on Energy Cooperation*** and formulation of model set of regulations for electricity sector
- The activities of SAARC are ***funded through contributions from member countries***

## 4.2 BIMSTEC

### a) Background [250]

A regional organization comprising of four countries namely Bangladesh, India, Sri Lanka and Thailand (BIST) by the littoral region of Bay of Bengal was created for Economic Cooperation (EC) through the Bangkok Declaration in June 1997 and was called BIST-EC. Subsequently, Myanmar joined the organization in December 1997 leading it to be renamed as BIMST-EC. This was followed by Nepal and Bhutan joining in 2004 leading to the creation of current Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC). The regional group is envisioned to act as a bridging platform between South Asia and South East Asia.

### b) Roles and Responsibilities [251]

The key objective of setting of the alliance is to harness shared and accelerated growth through cooperation in areas of common interests and utilization of regional resources and geographical advantages to mitigate the onslaught of globalization.

The objectives of BIMSTEC stated in the Declaration are:

- Creating an enabling environment for rapid economic development through identification and implementation of specific cooperation projects in the sectors of trade, investment and industry,

[250] https://bimstec.org/?page_id=189
[251] https://bimstec.org/?page_id=237

technology, human recourse development, tourism, agriculture, energy, and infrastructure and transportation.

- Accelerating the economic growth and social progress in the sub-region through joint endeavors in a spirit of equality and partnership.
- Promoting active collaboration and mutual assistance on matters of common interest in the economic, social, technical and scientific fields.
- Providing assistance to each other in the form of training and research facilities in the educational, professional and technical spheres.
- Cooperating more effectively in joint efforts that are supportive of and complementary to national development plans of member states which result in tangible benefits to the people in raising their living standards, including generating employment and improving transportation and communication infrastructure.
- Maintaining close and beneficial cooperation with existing international and regional organizations with similar aims and purposes.
- Cooperating in projects that can be dealt with most productively on a sub-regional basis and make best use of available synergies among BIMSTEC member countries.

### c) Structure [252]

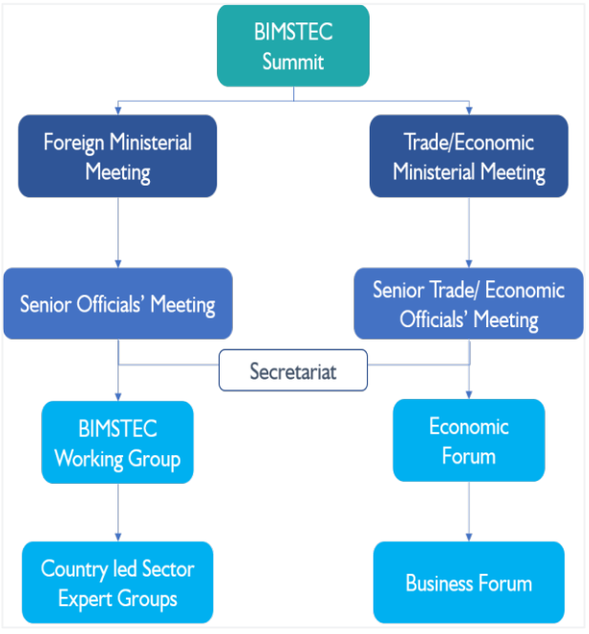
The ***BIMSTEC Summit*** is the highest policy making body in the organization and is held once every two years and is attended by heads of states. The ***Foreign Ministerial Meetings (MM)*** are the second highest policymaking body and is attended by the foreign ministers of the member countries. These meetings are preceded by Foreign Secretary level meetings called the ***Senior Officials' Meeting (SOM)***.

The other ministerial level meetings are the ***Trade/ Economic Ministerial Meetings (TEMM)*** which are attended by the trade/economic ministers of the member countries. These meetings are aided by the meeting of the senior trade/economic officials called the ***Senior Trade/Economic Officials Meeting (STEOM)***.

The ***Permanent Secretariat*** of BIMSTEC is located at ***Dhaka***, Bangladesh. The ***BIMSTEC Working Group (BWG)*** is based out of Bangkok, Thailand and acts as the coordinating body that meets monthly to monitor the progress and ensure coordination on initiatives and reports to SOM. The chairpersonship of the BWG rotates along with the chairpersonship of BIMSTEC.

Different sectors which are led by different countries have ***Expert Groups*** which hold regular meetings and report outcomes to the BWG in Bangkok via the embassies of the respective lead countries in Thailand. ***Business and Economic Forum*** under the STEOM facilitates participation of the private sector through meetings with BIMSTEC members to discuss various issues.

Figure 4.2.1 BIMSTEC Structure




[252] https://bimstec.org/?page_id=1761

### d) Functioning and Energy Sector Focus [253,254]

BIMSTEC has 14 defined areas of cooperation namely Trade and Investment, Technology, Energy, Transport and Communication, Tourism, Fisheries, Agriculture, Cultural Cooperation, Environment and Disaster Management, Public Heath, People to People Contact, Poverty Alleviation, Counter Terrorism and Climate Change. Each of these areas is led by a member country which drives cooperation in sectors led by Expert Groups which help in identification of barriers to cooperation and identification of means to improve cooperation.

Energy sector cooperation is led by Myanmar and its objective is to enhance energy cooperation through the development of a BIMSTEC Grid Interconnection Program. The energy sector business is conducted through Energy Ministers' Meeting, Senior Officials Meeting on Energy (SOM-E) and Task Force/Expert Group Meetings. Two major Task Forces have been created in this sector. One Task Force is focused on Trans Power Exchange and Development Projects and has developed the MoU for the establishment of BIMSTEC Grid Interconnection. The MoU was signed in August 2018 at Kathmandu, Nepal. The other Task Force was set up for creation of the BIMSTEC Energy Centre at Bengaluru, India; the MoA for which was signed in January 2011.

The MoU will help in ensuring:

- Optimization of usage of resources with mutual benefits on non-discriminatory basis subject to laws, rules and regulations.
- Promotion of secure and efficient system operation through development of regional electricity networks.
- Optimization of investment across the region.
- Regional power exchange working over cross-border interconnections.

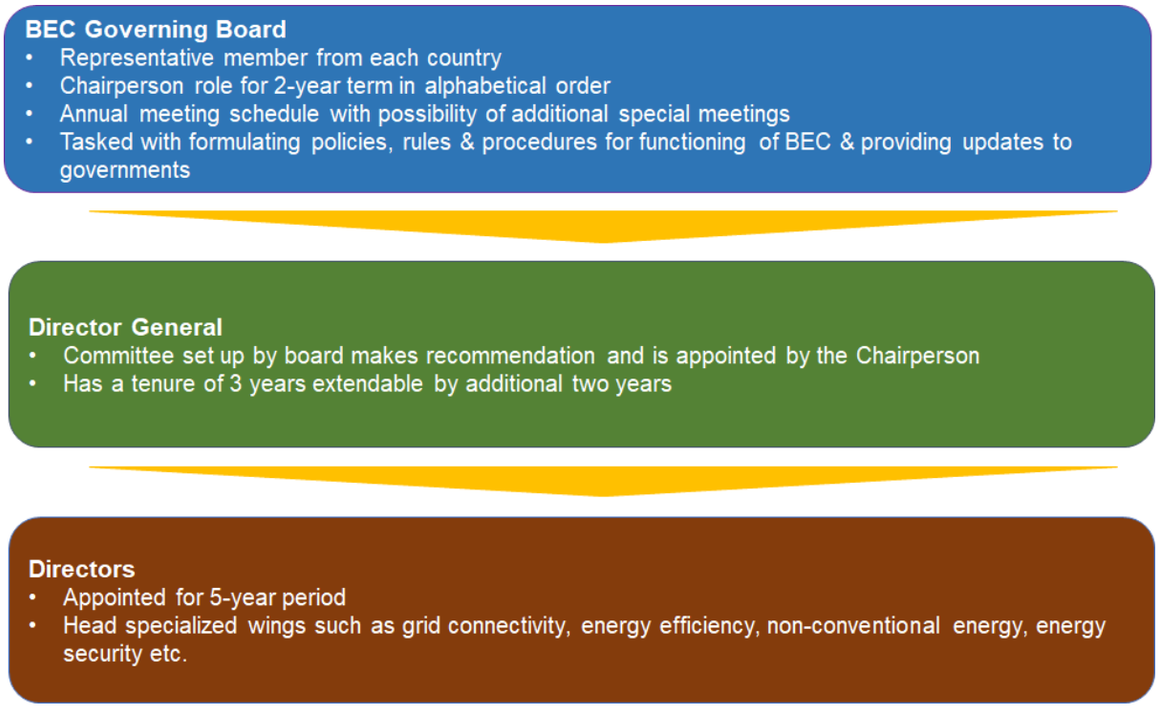
The ***BIMSTEC Energy Centre (BEC)*** is aimed at sharing best practices, conducting feasibility analysis and also acting as the Secretariat for energy cooperation activities. The objectives for BEC are[255]:

- To create, manage and evaluate energy related data-base relevant to the region; and considering the various ongoing activities, suggest a road map for meaningful intra- BIMSTEC cooperation.
- To prepare and operationalize a framework for networking among the national level institutions in the region.
- To prepare the groundwork, such as feasibility studies, data collection etc., for intra- BIMSTEC energy related projects.
- To study, compile and disseminate the prevailing policies of the BIMSTEC member countries in different areas of energy sector.
- To enhance cooperation for capacity building and sharing of experiences on best practices, including reforms, regulation and energy efficiency.
- To function as the Secretariat for energy cooperation activities.

[253] https://bimstec.org/?page_id=268
[254] https://drive.google.com/file/d/1G4WyI7ExgTt6WK4WXaL8j_4wHXyB5WCo/view
[255] https://bimstec.org/?page_id=1292

The governance structure of BEC is highlighted below:

Figure 4.2.2 BEC Structure




**Key Observations:**

- BIMSTEC was ***created through an intergovernmental agreement*** in the form of Bangkok Declaration
- It has a ***permanent secretariat located in the member country*** of Bangladesh
- The ***different priority sectors and subsectors*** of BIMSTEC are ***led by different member countries*** of the organization
- BIMSTEC has a taskforce focused on Trans Power Exchange and Development Projects and an ***MoU for creation of BIMSTEC Grid Interconnection has been signed***

## 4.3 SAFIR

### a) Background[256]

South Asian Forum for Infrastructure Regulation (SAFIR) is an association of the infrastructure sector regulators from India, Nepal, Bhutan, Bangladesh, Pakistan and Sri Lanka. The forum was established in May 1999 with support from World Bank. The memorandum of association for SAFIR mentions it as an 'Association of Persons' committed to common objectives of building strong expertise in the field of infrastructure regulation. The primary role of the organization is disseminating knowledge and best practices among infrastructure regulatory institutions in South Asia. The forum aimed at:

- Ensuring high quality capacity building and training to develop regulatory decision making potential.
- Facilitating experience sharing, exchange of knowledge, expertise and best practice sharing.
- Enhancing research in its area of interest through regional and international institutions.
- Enabling efficient and effective regulatory processes for utilities and infrastructure industries in SA region.
- Developing an information repository on regulatory subjects such as reform processes, experiences, learnings etc.

### b) Roles and Responsibilities[257,258259]

The ***agreed objectives*** of SAFIR as under its memorandum of association are:

- Providing a platform for experience sharing amongst the regulators of the region.
- Facilitating effective and efficient regulation of utility and infrastructure industries.
- Initiating beneficial exchange of knowledge and expertise.
- Evolving best practices.
- Building regulatory decision-making and response capacity in South Asia.
- Conducting training programs to serve regulatory agencies and other stakeholders.
- Spurring research on regulatory issues.
- Interacting, coordinating, facilitating and engaging with various international developments, regulation, financial bodies and governments or private entities of various countries.

In addition to the aforementioned objectives, ***additional incidental objectives*** of the forum include:

- Providing a database of information relating to regulatory reform process and experiences.
- Making, amending, rescinding or adding the rules and regulations for the conduct of affairs of SAFIR.
- Promoting, supporting, affiliating, amalgamating or merging with any other body or institution having partially or wholly similar aims or objectives.
- Preparing and printing public papers, periodicals and books, in furtherance of the objectives of SAFIR.

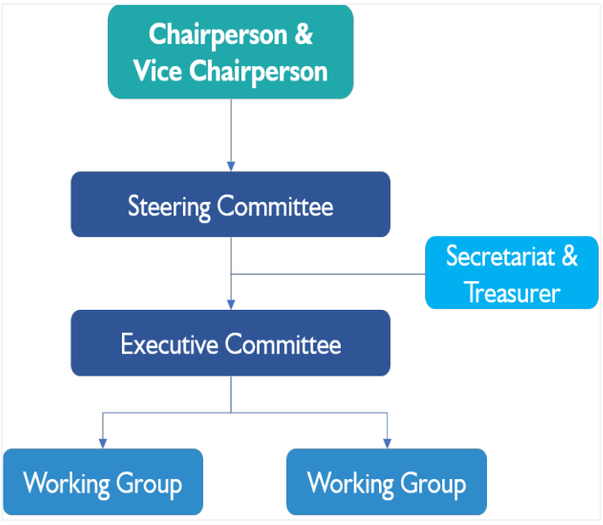
### c) Structure [260]

The organization is headed by a ***Chairperson and a Vice Chairperson*** who are elected on a rotational basis each year and hold the position on ex-officio basis (positions in the member organizations are elected).

[256] https://www.safirasia.org/about-safir
[257] https://www.safirasia.org/safir-objectives
[258] http://safirasia.org/sites/default/files/MOA-SAFIR.pdf
[259] https://www.safirasia.org/overview-0
[260] https://www.safirasia.org/about-safir

The ***Steering Committee*** is comprised of all the members of the forum including regulatory bodies, corporates/utilities, civil society groups (NGOs) and academic institutions. The Steering Committee is tasked with making all strategic decisions pertaining to the functioning of the organization.

Figure 4.3.1 SAFIR Structure




***The Executive Committee*** comprises of regulatory bodies of the countries who are members of the Steering Committee. In case of more than one regulatory body in a country who are members of the organization, the regulatory bodies of the country decide amongst themselves as to which regulator amongst them would be part of the Executive Committee. The chairperson of SAFIR is also the ex officio chairperson of the Executive Committee. The Executive Committee is tasked with operationalizing the strategic direction given by the Steering Committee. Working Groups may be created for accomplishing the set tasks/directions.

One of the members of the Steering Committee is entrusted with the responsibility of operating the ***Secretariat*** for the period decided by the Steering Committee. The Executive Head of the entrusted body is the ex officio Chairperson of the Secretariat and is entitled to commission staff for the Secretariat. The current Secretariat of SAFIR is located in New Delhi at Central Electricity Regulatory Commission (CERC).

In its early years, SAFIR was financially supported by Public Private Infrastructure Advisory Facility (PPIAF)*. SAFIR is currently funded through membership fees and voluntary contributions/donations. The host entity (CERC) being a registered body receives the fees and other funds on behalf of SAFIR. It keeps them in separate accounts subject to scrutiny by the SAFIR Steering Committee.[261,262]

### d) Functioning [263]

- Conducts core course and capacity building programs in energy, telecom and transport related sectors imparting practical knowledge and experience sharing on regulations and restructuring.
- The Annual General Meeting (AGM) is organized in the form of Annual Executive Committee Meeting and seeks inputs from all SAFIR members on current functioning and future direction.
- Any decision making at meetings is through voting with simple majority requirements with the meeting having a quorum of one third of its members.
- SAFIR also organizes an annual Conference aimed at policy makers, regulators, investors etc. presenting the new and evolving policy/regulatory ideas in the region thereby highlighting the emerging business opportunities and investment options.

The organization also conducts in-house research as well as engages and collaborates with external agencies.

[261] https://www.safirasia.org/membership
[262] https://ppiaf.org/documents/3624/download
[263] https://www.safirasia.org/activities-safir
* PPIAF is a multi donor technical assistance facility administered by the WorldBank

**Key Observations:**

- SAFIR is ***a specialized technical forum*** of infrastructure sector regulators and is ***created as an 'Association of Persons'***
- Secretariat services for SAFIR are provided by CERC which is an ***existing member institution with requisite resources and expertise***
- SAFIR operates through a ***hybrid structure*** involving permanent steering and executive committees as well as ad hoc working groups
- It was **initially funded through multi-donor funds** and has eventually adopted ***a sustainable financial mechanism of collecting regular fee*** from its members which is further augmented by donations/contributions.
- The primary goal of SAFIR is ***dissemination of information and capacity building*** for the infrastructure sector regulators

## 4.4 BBIN

### a) Background [264]

The idea of a sub-regional organization of Bangladesh, Bhutan, India and Nepal was officially endorsed by SAARC in its 9th Summit in 1997 where it recognized the special needs of few member states[265], but was later put on hold by the SAARC Standing Committee of Foreign Secretaries.

The South Asia Sub-regional Economic Cooperation supported the idea of BBIN in providing technical support to enhance interconnectivity between BBIN countries under BIMSTEC and SAARC framework.

The group came into existence after informal meetings for developing a consensus towards the need to move beyond bilateral agreements for sub-regional connectivity. It received greater impetus following the inability of other regional cooperation frameworks towards delivering substantial progress in trade, power and infrastructural linkages.

### b) Functioning and Energy Sector Focus [266,267,268]

BBIN operated through Joint Working Groups (JWG) which see representation by the four member countries for discussion, deliberation, formulation and implementation of quadrilateral agreements.

The second JWG meeting was held in Delhi in January 2015. The two JWG meetings were focused on water resource management and power/hydropower; and connectivity and transit. The JWG on water resource management and power/hydropower agreed upon the following:

- Participate in joint efforts for exploring and harnessing of hydropower and other power sources in the subregion.
- Exchange lists of potential future hydropower/power projects to be undertaken jointly involving at least three countries on equitable basis.
- Share experiences and best practices pertaining to the power sector.

[264] https://www.sasec.asia/index.php
[265] http://saarc-sdmc.org/sites/default/files/summits/summit9.pdf
[266] https://mea.gov.in/press-releases.htm?dtl/26284/third+joint+working+group+jwg+meetings+on+subregional+cooperation+between+bangladesh+bhutan+india+and+nepal+bbin+january+1920+2016
[267] https://mea.gov.in/press-releases.htm?dtl/24746/joint+press+release++the+second+joint+working+group+jwg+meetings+on+subregional+cooperation+between+bangladesh+bhutan+india+and+nepal+bbin+in+new+delhi+january+3031+2015
[268] https://mea.gov.in/press-releases.htm?dtl/32383/joint+press+release+on+the+meeting+of+bangladesh+bhutan+india+and+nepal+on+the+motor+vehicles+agreement+bbin+mva

- Share data on flood forecasting.
- Share best practice for basin-wide water resource management.

The third JWG meeting was held in Dhaka in January 2016 taking forward the earlier discussions. It focused on:

- Inter-grid connectivity and cooperation in future power projects.
- Discussion on hydropower projects under BBIN framework that could be concretized on equitable basis.
- Constitution of expert groups for sharing best practices in water resources management as well as on the specifics of identified projects, power trade, inter grid connectivity, flood forecasting and other possible areas cooperation.

A meeting of BBIN countries was held in February 2020 in New Delhi regarding the implementation of the Motor Vehicles Act which would allow movement of vehicles between the countries. The Act has not been ratified by Bhutan and it therefore joined the meeting as an observer.

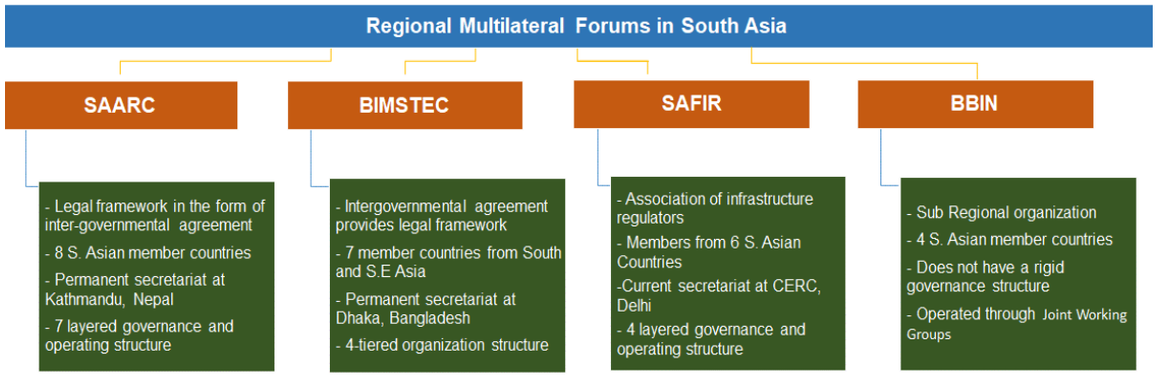
**Key Observations:**

- BBIN is a ***voluntary sub-regional organization*** in South Asia comprised of ***members having existing bilateral connections***
- It in an ***informal organization*** created with the objective to move beyond bilateral agreements for regional connectivity
- BBIN is ***informally operated*** through a system of Joint Working Groups to ensure ***minimal complexity and quick action***

## 4.5 Summary and Suitability of Hosting the Network

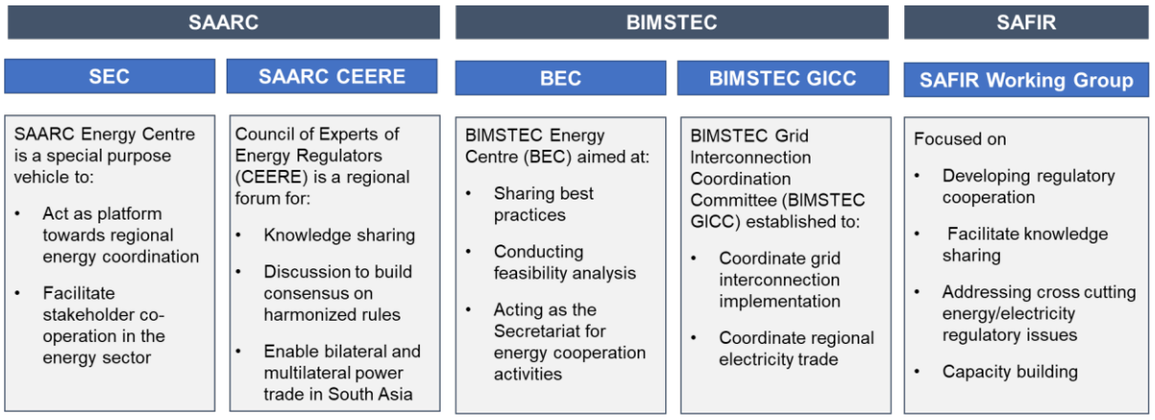
The study of regional multilateral forums has offered key learnings in terms of the legal frameworks adopted by organizations, their membership and organizational structure as well as their head quarter location. Key learnings from the chapter are highlighted in figure 4.5.1.

Figure 4.5.1: Key learnings from study of regional multilateral forums




All studied forum (except BBIN) have dedicated bodies/entities for developing and enhancing cooperation in the energy sector amongst their respective members. Knowledge sharing and sharing of best practices being an important area of cooperation, is emphasized by sector focused bodies of SAARC, BIMSTEC and SAFIR. Figure 4.5.2 highlights the key energy sector focused bodies that have been created under regional multilateral forums in South Asia.

Figure 4.5.2: Energy Sector Bodies under South Asian Multilateral Forums




This section also aims to analyze the suitability of the aforementioned South Asian forums to host an organization like the proposed network by comparing the advantages and disadvantages of each of them. Table 4.1 evaluates the pro and cons of the organizations studied.

Table 4.1 Suitability of multilateral forums in South Asia to host the proposed network

| Organization | Pros | Cons | Conclusion |
|---|---|---|---|
| **SAARC** | • Pan South Asia Organization with defined legal framework<br>• Broader mandate based on intergovernmental agreements, with electricity being one of the components in the overall agenda<br>• Has energy sector focus through SAARC Energy Centre | • Involves multiple layers of governance and oversight<br>• Need unanimous agreement amongst all member countries for initiation<br>• Last summit meet under SAARC was held sometime in the year 2014 and after that, there has been no such meet | System operation is a very specialized activity and requires technical expertise with deep dive focus.<br><br>Looking into the current situation, getting a mandate from SAARC for hosting another institution under it, with such high level of granularity and expertise may be time consuming, and may not be apt at this point of time. |
| **BIMSTEC** | • Energy sector focus through BEC *(yet to be operationalized)*<br>• 'BIMSTEC Grid Interconnection Coordination Committee' (BGICC) to look after the Grid Interconnection Master Plan in the BIMSTEC Region, which is a function very much related to the system operation. | • Some South Asian nations are not covered under BIMSTEC<br>• BIMSTEC already has its own 'BIMSTEC Grid Interconnection Coordination Committee' (BGICC) which has some of the functions similar to the proposed network. | The network envisages to be a forum comprising all countries in South Asia, while the membership in BIMSTEC does not align with that of the network.<br><br>Since BGICC has functions similar to the proposed network, hosting two organizations under its belt with similar objectives may not be feasible. |

| Organization | Pros | Cons | Conclusion |
|---|---|---|---|
| **SAFIR** | • Infrastructure sector focused organization<br>• Has been in operation for last few years and the nature of functions rendered are mainly advisory in nature, which match with the nature of functions proposed for the network. | • Expertise is more in the areas of infrastructure regulatory subjects<br>• SAFIR Secretariat is currently housed under another organization i.e. CERC | Area of focus of the network is system operation, which is a core technical area and only an organization with deep technical insight may be suitable to host it.<br>Since core focus area of SAFIR does not align with that of the proposed network, hence it may not be suitable to host the organization like this. |
| **BBIN** | • Involves countries already engaged in CBET | • Covers only four members of South Asia<br>• Energy sector focus is currently limited with strong emphasis currently on transportation<br>• Expertise on highly technical domains such as system operation may be limited | Firstly, the membership in BBIN does not align with that of the proposed network, and secondly, the level of granularity required in the network is high. Hence hosting it under BBIN (which has focus on other sectors as well), may not be an optimal solution. |

The analysis of the aforementioned regional multilateral framework offers valuable learning related to creation, in-housing and handholding of the proposed network. However, as elaborated above, under the present context, the existing regional forums studied above may not be perfectly suited to handhold the proposed network.

# 5. Options for Network's Structure and Functions

The analysis of various international organizations and regional forums undertaken in the preceding chapters clearly indicates that globally these organizations have varying structures, governance mechanisms and operating frameworks. The different organizations have charted their own path during evolution and to begin with many of these started functioning as associations based on loosely formed structures, and later as they gained momentum, transitioned into more formal structures and legal framework.

In order to decide an appropriate structure for the network, it is important to analyze a range of options across the key elements of an organization's structure viz. legal framework, governance mechanism, membership, headquarter location, operating structure and funding mechanism etc. The experience of international organizations and regional forums discussed earlier, not only provides useful learning for the network, but also puts forth different options across the above elements for consideration. The choices will have to be made keeping in perspective the objectives of the network, its functions and expectations from the network. Further, the options will have to be weighed against various stages of its evolution. For example, there are certain elements in an organization's structure where a given option may seem more appropriate during the foundation stage of the organization, however, as the same organization evolves and gains momentum, a different option may appear more suitable.

In view of the above, the main fulcrum of this chapter is two-fold:

(i) To understand the objective and nature of the network as an organization;
(ii) To put forth a range of options across the key elements of an organization's structure and analyze the merits and demerits of each option and eventually form the basis of selecting the most appropriate structure for the network, as recommendation in the next chapter. The different key elements are:
   - ✓ Organizational Setup
   - ✓ Governance Mechanism
   - ✓ Operating Structure
   - ✓ Funding Mechanism

## 5.1 Functions

In order to define the organization structure of the proposed network, it is critical to first analyze its objective and functions which have been presented below:

**Vision**: To be a regional network for cross cutting deliberations, exchange of ideas, sharing of operational best practices and capacity building in the matters related to safety, security, reliability, sustainability and economy of the Power System Operation in South Asia Region, as well as endeavor to collaborate with the neighboring regions on the issues of common interest.

**Mission:** To facilitate seamless exchange of knowledge, expertise and best practices in the domain of Power System Operation, by establishing an advisory network for enabling collaboration among Power System Operators in the South Asia and the neighboring regions.

**Functions:** The proposed network aims to be a neutral entity, that will function in a spirit of cooperation and collaboration, with the following main objectives/functions:

- ***Exchange of Ideas:*** Act as a platform for crosscutting deliberations and exchange of ideas towards promoting safe, secure, reliable and efficient power system operation in South Asia. This shall include documentation and sharing of experiences related to system operation, discussions on standard

operating procedures/guidelines and harmonization of practices including international benchmarking in the matters related to system operation;

- ***Knowledge Dissemination:*** Sharing of technical know-how on advanced/sustainable energy systems, their impact (economic, social and environmental etc.), particularly in the areas of renewable energy integration and grid balancing, taking into view the diverse sources of energy available in South Asia region;
- ***Technical Support/Expert Advice:*** Carry out technical studies/assessment in the area of power system operation for the purpose of knowledge creation and creating evidence to support CBET. This shall include leveraging expert advice and know-how including global experiences in power system operation;
- ***Skill Development:*** Facilitate and render assistance towards skill development and capability enhancement of human resource employed at the Load Despatch Centres. This shall be done with the intent to use the latest technologies and tools, in order to further enhance the level of system operation;
- ***Workshops/Conferences:*** Conduct workshops for different stakeholders in SAC on matters related to system operation. These shall include the different aspects related to sharing operational practices, promoting harmonization & excellence in system operation and matters related to greening the regional grid;
- ***Deliberation on Best Practices/Issues:*** Discuss the best practices and technical issues related to system operation in the different parts of the region and across the globe and try to build consensus through discussions on the issues of common interest and goal. This shall include deliberations and consensus building amongst the members to promote harmonization and excellence in power system operation. In this direction, the 'SAMAST' framework developed by the FoR is an important reference providing a robust, scalable and transparent framework of scheduling, metering, accounting and settlement of energy transactions, under power system operation

The network aims to act as a regional platform to discuss and cooperate in the matters of system operation by providing necessary support and inputs. The network's nature is broadly that of a facilitator and advisor and shall aim to arrive at the decisions through mutual discussions and consensus building.

Having discussed the mandate of the network, the next step is to identify the most appropriate organizational structure for the network. On the basis of the experience of international organizations and regional forums discussed earlier, the following section presents a range of options across the key elements of an organization's structure viz. legal framework, governance mechanism, membership, headquarter location, operating structure and funding mechanism etc. The following paragraphs elaborate the different options in respect of the organizational set-up, operating structure and funding mechanism etc. in respect of such regional institutions prevalent across the globe, with an aim under this study is to identify suitable options for network's organizational structure.

## 5.2 Organizational Setup

The organization set up includes elements like legal framework, membership and headquarter location etc.

### 5.2.1 Legal Framework/Type of Entity

| Options | Pros | Cons | Example |
|---|---|---|---|
| **Inter-Governmental Agreement/MoU** | • Full-fledged legal status<br>• Specific mandate through buy-in from member countries | • Requires consensus building of all member countries<br>• Decision making is complex and time consuming | WAPP<br>GMS |

| Options | Pros | Cons | Example |
|---|---|---|---|
| | • Higher enforceability of critical decisions | | |
| **Inter-Utility Agreement/MoU** | • Act as tool to carry forward, cooperation efforts under Inter-Governmental agreements<br>• Focused mandate through well-defined governance, management and operational framework | • Lack of flexibility as working principles are formally defined<br>• Formal structure with decisions generally binding in nature<br>• Not suited in early stages of cooperation | SAPP |
| **Company** | • Separate legal status<br>• Decision can be binding in nature (in case of disputes, may have to be resolved through legal recourse)<br>• Operational flexibility for investment and access to wide array of funding options | • Significant management oversight adding complexity and stronger regulatory and compliance requirements<br>• Implication of tax liability (if profit making)<br>• More suited for mature organizations with dedicated regional infrastructure | GCCIA, PJM |
| **Registered Society created under the laws of host country** | • Legal status with specific rights<br>• Separate entity status with easy access to grants<br>• Typically, non-profit in nature, hence tax exemption is possible<br>• Enable partnership with other organizations in the same sphere, as most similar international entities are registered as not for profit associations | • Subject to rules and procedures of registration (memorandum of association, articles of association etc.)<br>• Compliance requirement<br>• Restrictions can be there for activities and foreign funding<br>• Limited authority towards enforcing decisions | ENTSO-E |
| **Association (Can have both variants:**<br>**a) Backed by IG agreements;**<br>**b) Voluntary;** | • Quick and easy to implement<br>• Appropriate for limited mandate<br>• Limited compliance requirement<br>• Can also operate as an unincorporated association through a memorandum<br>• Effective during early stages of organization to quickly operationalize the entity<br>• Enough flexibility to make changes as per the need | • No separate legal status, more particularly in case of Associations formed on Voluntary basis.<br>• Undertake mainly advisory activities with no authority | FOLD |

In terms of legal framework, the options range from loosely formed structure having no separate legal status like an Association at one end, to an Inter-Governmental Agreement/MoU with full-fledged legal structure at the other end. In between the two, there are structures like Registered Society, Company and Inter-Utility Agreement/MoU. The options vary in terms of legal status, operational flexibility, compliance requirement, authority etc. Since the network is at the foundation stage, it is important to start with a loosely formed and flexible structure which is easy to establish, and with passage of time as it gains momentum, it can have transition to a more formal structure.

### 5.2.2 Member Countries

| Options | Pros | Cons | Example |
|---|---|---|---|
| **All countries in South Asia region** | • Engagement across entire South Asia region<br>• Holistic knowledge sharing across the region | • Requires efforts towards consensus building | ENTSO-E |
| **Countries already engaged in CBET and those where possibilities of interconnection/trade are being discussed** | • Builds upon existing bilateral engagements | • Limited participation may result in losing out on potential learning opportunities | PJM, SPP |

In terms of country membership, there can be two options for the network. Either it can have participation from all the countries in South Asia ensuring a regional level engagement, or participation from the countries which are already engaged in power trade. Considering the network is aimed at sharing of knowledge and best practices which can benefit all countries in the region. Therefore, engaging with all countries in South Asia is likely to add greater value to the network.

Furthermore, to take forward the coordination efforts beyond the South Asia region and bringing to the network experience and learnings from adjoining regions; countries such as Myanmar, (though not a member of SAARC), can be invited to be part of the network as Associate Member depending on the interest of the country.

#### Organizational Membership

| Preferred membership | Pros | Example |
|---|---|---|
| **(a) Core Members**<br>Heads of national power system operators (or any other designated officer as may be nominated from the respective country); and Representatives from transmission planning agencies;<br>**(b) Associate Members**<br>Heads of National Power System Operators of invited countries such as Myanmar (depending on the interest of the country) | • Focus on core function i.e. system operation<br>• Sharing of operational best practices between system operators in South Asia<br>• Wider perspective with involvement of other key stakeholders | FOLD, ENTSO-E |

| Preferred membership | Pros | Example |
|---|---|---|
| **Additional participation**<br>Representations from system operators, planning agencies, transmission utilities, government departments and invitee from academia and other relevant organizations. | | |

The preferred organizational membership for the network is to have representatives from national power system operators and transmission system planning bodies in all South Asian countries on voluntary basis. The loosely formed structure focused on knowledge sharing and capacity building would be easy to implement and manage well during the initial stage and will give pace to consensus building and decision-making.

Further, the countries such as Myanmar which are not a part of the South Asian region (not members of SAARC), but are from adjoining regions can participate as 'Associate Members'.

Additionally, based on the requirement, representatives from the different departments associated with the system related functions in the different member countries can also participate in the various groups and render necessary inputs.

### 5.2.3 Headquarter/Secretariat Location

In terms of headquarter location, there exist three options (i) The headquarter can be co-located with one of the existing system operators in a member country. (ii) It can exist as a permanent independent headquarter in a member country and (iii) It can rotate after every two/three years coinciding with the country of the elected chairperson.

The options vary in terms of ease of setup, stability, cost of resources etc. Since the network is at the foundation stage, initially it will need support across institutional, technical and financial aspects to establish itself. It is important that in the early stages, the handholding of the proposed network is done by a national power system operator which is willing to take up the role of handholding and the existing frameworks, infrastructure and resources can be leveraged for operationalizing the network.

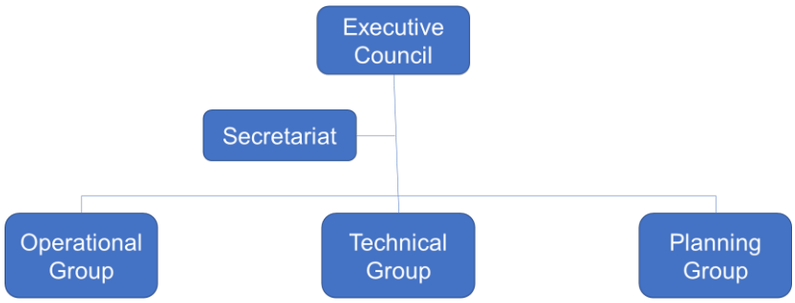
| Options | Pros | Cons | Example |
|---|---|---|---|
| **Headquarters/ Secretariat co-located with the handholding organization (one of the existing S.O. in a member country)** | • Ease of set up<br>• Effective in early stages of organization to quickly operationalize the entity<br>• Shared infrastructure and resources | • As the entity evolves and matures, need to transition to an independent structure in the long term | FOLD |
| **Permanent Independent Headquarters/ Secretariat in a member country** | • Time tested approach with recruitment of local staff<br>• Greater stability from long term perspective | • High cost of physical infrastructure<br>• Training and development of workforce<br>• Implementation takes time | ENTSO-E, PJM, SPP, SAPP, WAPP, GCCIA |
| **Headquarter/ Secretariat rotating after** | • Balanced approach with uniform sharing of authority | • Need to set up headquarters in each member country | SAFIR *(decided by Steering* |

| Options | Pros | Cons | Example |
|---|---|---|---|
| **every two/three years, coinciding with the country of the elected chairperson** | • Opportunity to engage with diverse group | • Cost of resources (infrastructure and staffing) goes up<br>• Availability of adequately trained workforce may be a challenge | *Committee from time to time)* |

## 5.3 Governance Mechanism

The governance mechanism will include the organization structure of the network including the role and objective of its constituents. The preferred structure for the network is shown in Figure 5.1.

Figure 5.1: Organizational Structure




The role, objective and composition of different constituents shown in the above structure have been discussed below.

### 5.3.1 Executive Council:

- The Executive Council to be responsible for providing strategic guidance and oversee the activities of the organization
- Representatives to include heads of national power system operators of countries in SA (or any other designated officer as may be nominated from the respective country) and representatives from transmission planning agencies
- The members would provide leadership with high degree of ownership and expertise on the subject
- The chairpersonship of the Executive Council can change on a rotational basis amongst the member countries with each country having a term of 2 years
- Associate Members, as suggested above under Para 5.2.2 can also participate in the Executive Council deliberations as observers

### 5.3.2 Subject focused Working Groups:

- The network to have various working groups, focused on specific tasks and to accomplish allocated objectives. It is proposed to include the following working groups.
  - Operational Group
  - Technical Group
  - Planning Group

- Each working group to be headed by a Chief Engineer/Director level official from the respective field who will serve as the Chairperson for the working group. Other members of the working group to comprise of representatives from operational, technical, commercial, regulatory, and other governmental departments associated with the function from the different member countries.

### 5.3.3 Secretariat:

- Administration: To support and coordinate administrative activities of the network, including managing correspondence, meetings, calendar of events, logistic, finance and online presence
- Coordination: To coordinate with the Executive Council, Working Groups and other stakeholders
- Institutional memory: Maintain records/archives, membership details, stakeholder contacts

## 5.4 Operating Structure

The operating structure of the network will include the overall working mechanism, including decision making philosophy, reporting framework, secretariat, and role of working groups in its operations. For the network, the preferred operating structure is given below.

1. **Decision making philosophy:** The network to follow a process of consensus-based decision making, wherein, members contribute to a shared proposal and shape it into a decision that meets the concerns of all members as much as possible. This will include discussions to ensure all opinions, ideas and concerns are taken into consideration. The objective is to develop a collaborative atmosphere which can foster greater cohesion and interpersonal connection.
2. **Reporting framework:** The working groups to report to the Executive Council and provide regular updates on the progress of the work allocated to them. The Executive Council to oversee the working of the working groups and provide necessary guidance.
3. **Execution through Working Groups:** The network to have various subject focused working groups, to undertake specific tasks and accomplish the allocated objectives. Role and objective of various working groups will be as follows:

   - Operational Group: To facilitate dissemination of best practices regarding procedures/processes in the matters of system operation and control, scheduling and dispatch of power and advise towards harmonization of system operation practices in the region.
   - Technical Group: To share knowledge, technical inputs and assistance in the matters related to metering standards and norms, system security and operational aspects and regional integrity, compliance to reliability standards, technical studies in the areas of common interest and support to regional regulatory institutional mechanisms of SA countries.
   - Planning Group: To enable capacity building in the field of system planning for supporting efficient and reliable system operation. To also carry out technical studies and assessments as well as leveraging expert advice and know-how including global experiences for the purpose of knowledge creation and dissemination.

   The working groups to include senior representatives from national power system operators, and from operational, technical, commercial, regulatory and other governmental departments associated with the system related functions in the different countries. Each working group is to be headed by a Senior Engineer/Director level official nominated by the Executive Council for a fixed tenure. The working group is to be assisted by the representative from the Secretariat, who will also coordinate with the Executive Council in the development of the plan of action for each working group.

4. **Role of Secretariat and Staffing:** The secretariat services including staffing and administrative support to be provided by the handholding organization. This mechanism is easy to set up and manage.

Further, it requires limited investment and resources. For example, NLDC and CERC provide secretariat services to FOLD and SAFIR respectively. The responsibilities of the secretariat will include but not limited to the following. Refer Figure 5.3.

Figure 5.3: Role of Secretariat


While initially, staffing support will be provided by the handholding organization, going forward, as the network evolves, possibility of employing regular staff for the network can also be explored.

## 5.5 Funding Mechanism

| Options | Pros | Cons | Example |
|---|---|---|---|
| **Handholding & support from the system operator of a member country on voluntary basis.** | • Self-sustained solution with little to no external support required<br>• Effective mechanism to help initiate activities during initial stages | • As entity evolves and matures, there will be need for other funding avenues in the long term | FOLD activities sponsored by NLDC |
| **Donor grant/Support from a Multilateral Forum or an International Developmental Organization** | • Can help in meeting larger initial funding requirements<br>• Can be an effective mode when combined with sponsorship for newly set up organizations | • Not a permanent solution so not sustainable in the long run | GMS, SAPP-partly |
| **Membership Fee/ Contribution** | • Sustainable mechanism without external support<br>• Members feel equitable participation and contribution | • Limited participation from smaller entities<br>• Require sanctioning of funds from respective Govt. hence challenging and cumbersome<br>• At times manning the funds/accounts is cumbersome and involved activity | ENTSO-E, SPP, GCCIA, SAPP-partly |

As can be seen on the basis of above table, the options for funding mechanism include a) handholding and support through member country, b) donor grant/support from a multilateral forum/international development organization and c) membership fee/contribution. Depending upon the need and stage of evolution; there can be a possibility to take a pragmatic approach and use the options in an amalgamated manner.

## 5.6 Summary of various options

The various options discussed above have been summarized in figure 5.4 below.

Figure 5.4: Options across key elements for institutionalizing the proposed body

| Key elements | Options | | | | |
|---|---|---|---|---|---|
| Legal framework/Type of Entity | *Inter-Governmental Agreement/MoU* | *Inter-Utility Agreement/MoU* | *Registered Society* | *Company* | *Association* |
| Members | *All countries in South Asia* | *Participation from countries engaged in CBET and those where possibilities of interconnection/trade are being discussed* | | | |
| Governance/ Representation | *1. Executive Council: Comprising heads of national power system operators (or govt. nominated officials) and representatives from transmission planning agencies. 2.Working Groups (Technical, Operational, Planning):Comprising representatives from SOs, planning agencies, transmission utilities, govt. depts. and other invitees including academia, research organization etc.* | | | | |
| Handholding/ Secretariat | *Permanent location in a member country* | *Co-located with the handholding organization (one of the SOs)* | *Rotating after every two/three years* | | |
| Funding mechanism | *Voluntary support by handholding organization* | *Donor support for occasional & substantial expenditure* | *Membership Fee/contribution* | | |

**The above options across the key elements of an organization's structure have been studied in this report and their merits and demerits have been analyzed for applicability to the network. The choices have been made keeping in perspective the objectives and functions of the proposed network.**

Based on above, the Recommendations towards the most appropriate structure for the network are given in the following chapter (Section 6).

Since the network is at the foundation stage, initially it will be desirable to keep the funding mechanism simple by exploring handholding and support, particularly in respect of housing the institution and providing secretariat assistance from the national system operator from a member country. However, in case of any occasional and substantial expenditure, like for carrying out any special technical studies or arranging any developmental/capacity building programs etc., such support can be supplemented from an external donor agency also, on case- to-case basis. However, with passage of time as it gains momentum, the concept of membership fee/contribution by the different member countries can also be brought into in order to ensure self- sustainability with limited handholding/external support requirement.

# 6. Recommendations for Creation of the Regional Network

## 6.1 Overview

Bilateral cooperation in the power sector already exist amongst countries in South Asia. Government- to-Government arrangement have facilitated power exchange amongst Bhutan, Bangladesh, India and Nepal. In this regard, following key developments have taken place:

- Committees in the form of Joint Steering Committees (JSC) and Joint Working Groups (JWG) have been constituted to carry out discussions and ensure stakeholder engagement;
- Procedure for Approval and Facilitating Import/Export (Cross Border) of Electricity by the CEA (India) also specify formation of Joint Operation Committee (JOC) and Joint Technical Team Transmission (JTT-T);

All above arrangements have been made keeping in consideration bilateral engagement amongst member countries. Since integrated system operation of cross-border interconnections is being coordinated bilaterally, these are being managed by system operator level interactions at the bilateral level. However, **going forward with emergence of newer and enhanced cross border power trading opportunities; harmonization and convergence amongst SOs across the region would help towards promoting harmonization and excellence in power system operation, across the region. This can be achieved through deeper sustained engagement, knowledge exchange and collaboration amongst SOs in the region in a collective manner.**

**The regional network proposed in this study shall supplement the present level of bilateral cooperation amongst SOs by providing an opportunity to SOs to meet, collaborate, share knowledge, exchange ideas, discuss best practices and build capabilities in the field of power system operation. The regional network would be advisory in nature. It would be formally established with flexible and voluntary participation by member countries**.

In view of the above, out of the options laid out in chapter 5, this chapter provides recommendations (refer Table 6.1) across key elements of organizational structure for the institution keeping into view that it shall act as a network for sharing operational best practices and promoting excellence in the field of Power System Operation in South Asia Region. These include:

- Legal Framework
- Member Countries
- Organizational Membership
- Governance Mechanism
- Headquarter & Handholding
- Operating structure
- Funding Mechanism

## 6.2 Recommendations on the Organizational Structure of the Regional Network

The recommendations as highlighted under Table 6.1 below will ensure that the network establishes its foundation and forms into a full-fledged organization. However, **with the passage of time when the network gains momentum, there could be few elements wherein based on the convergence amongst the members, it can undergo change like Legal Framework, Member Countries,**

**Funding Mechanism etc. whenever the need arises.** Such possible changes have also been highlighted in the table below.

Table 6.1: Recommendations for the network along with Rationale

| S. No | Key elements | Description | Rationale |
|---|---|---|---|
| 1. | **Legal Framework** | The network to be set up as an **association based on loosely formed structure and undertake mainly knowledge sharing, advisory and excelling the system operation activities across the region, based on discussions and consensus building.**<br><br>➡ *In the long run, as the network evolves and its activities become more profound, the current framework can change to a full-fledged legal status based on* ***Inter-Governmental Agreements or Inter-Utility MoU*** | • Quick setup, easy to implement and appropriate for the network's focused mandate<br>• Provide flexibility to make it effective during early stages and to quickly operationalize.<br>• FOLD and SAFIR with similar mandate, have also been established as associations |
| 2. | **Member Countries** | • **Network to allow representation from all countries in South Asian region as members on voluntary basis**<br>• Additionally, other countries like Myanmar which are in other sub-regions **can also be invited to join the network voluntarily as Associate Member**<br><br>➡ *In the long run, as the network evolves,* ***more countries from other sub-regions such as South East Asia and Middle Asia can become associate members of the network.*** | • Engaging with all countries in region likely to add greater value to the network and enrich the knowledge base<br>• Countries like Myanmar under the Associate Members category can also get associated and derive benefit as observers<br>• Voluntary mode provides flexibility of participation to other countries from SA also |
| 3. | **Organizational Membership** | • Organizational membership in the network will include **representatives from national power system operators of countries in South Asia and the members from the transmission system planning bodies**<br>• **Representatives from Associate Members** (as described above) to participate as observers to the network<br>• Additionally, based on the requirement, **representatives from Operational, Technical, Commercial, Regulatory and other Governmental Departments associated with the system operation related functions can** | • Ensure focus on core function i.e. system operation<br>• Build upon the existing bilateral coordination between power system operators in South Asia<br>• Give pace to consensus building and decision making |

| S. No | Key elements | Description | Rationale |
|---|---|---|---|
| | | **also participate in the various working groups of the network** and render necessary inputs | |
| 4. | **Headquarter/ Secretariat location and Handholding** | • It can be explored that the **national power system operator of a member country provides handholding to the network** in terms of locating the headquarters and providing secretariat support on voluntary basis.<br>• This leads to the fact that the **headquarters/ secretariat of the network to be co-located with the handholding organization** i.e. the premises of one of the member national power system operator.<br>• It is recommended that in the early stages, the handholding of the proposed network is done by a **national power system operator which is willing to take up the role of handholding and to support the fulfillment of the network's mandate** and the existing frameworks, infrastructure and resources can be leveraged for operationalizing the network. | • Effective in early stages of organization to quickly operationalize the network<br>• Provide benefits of shared infrastructure and resources<br>• Headquarter location in well-connected and operationally evolved country to ensure availability of requisite experience, resources and technology<br>*Handholding support in FOLD and SAFIR is being provided by NLDC and CERC in India* |
| 5. | **Governance Mechanism** | The governance mechanism of the network to include:<br>(i) **Executive Council**: Comprising heads of national power system operators (or any other designated officer as may be nominated from the respective country) and representatives from transmission planning agencies in South Asian Countries. The Chairpersonship of the council can be on a **revolving basis with each country getting the chairpersonship for a period of 2 year**<br>(ii) **Working Groups**: Headed by a **chief engineer/director level official from any one country** in South Asia and will include other similar level representatives from **Operational, Technical, Commercial, Regulatory and other Governmental Departments associated with** | A simple structure derived from experience of similar international organization |

| S. No | Key elements | Description | Rationale |
|---|---|---|---|
| | | **the system related functions** in different countries. The working groups will report to the Executive Council.<br>(iii) **Secretariat**: To provide administrative and coordination support. | |
| 6. | **Operating Structure** | • The **working philosophy** of the network will be based on **consensus-based decision making after discussions and brainstorming** amongst members<br>• Network's **secretariat will provide the required staff and resources for supporting the operational activities**<br>• Network will **carry out its agenda and execute the allocated tasks through the 3 working groups**<br>(i) Operational Group<br>(ii) Technical Group<br>(iii) Planning Group | • Appropriate for loosely formed associations with decisions non-binding on members<br>• Need handholding support from organizations<br>• Specific working groups to ensure focused execution |
| 7. | **Funding Mechanism** | • As stated above under the Recommendation No. 4, on the pattern of FOLD, it can be explored that the national power system operator of a member country provides handholding and takes care of locating the headquarters as well as for providing the secretariat services as the host country on voluntary basis and also taking care of the associated expenditure.<br>• Any country specific expenditure towards travelling etc. can be borne by the respective countries.<br>• Such an arrangement shall provide, self-sustained solution during the starting phase, averting the need for collection of funds/membership fees from different members towards establishment of the proposed network and therefore keeping the funding mechanism simple. | • Since the expenses towards handholding the network towards its establishment as well as operation may not be substantial, national power system operator of a member country may volunteer to provide such a support.<br>• Given the nature of organization, in case the membership-fee/contribution is sought from the members in the initial years itself, it may prolong the process of establishment of institution/ platform and may even limit participation from smaller entities<br>• During the initial phase of any such institution, for any occasional and substantial expenditure, like carrying out any technical study |

| S. No | Key elements | Description | Rationale |
|---|---|---|---|
| | | • Further, looking at the operational structure and philosophy, during the operational phase also, the expenditure towards operating the secretariat may not be substantial and that can also be met on voluntary basis by the handholding member country.<br>• However, in case of any occasional and substantial expenditure, like for carrying out any special technical studies/promotional activities or arranging any developmental/capacity building programs etc. additional support from regional multilateral forums and developmental organizations can be sought as grants, on case-to-case basis.<br>➡ In long run, as the network evolves into a mature organization, the concept of membership fee/ contribution by the different member countries can also be brought-in, in order to ensure self-sustainability with limited handholding/external support requirement. | and/or arranging any developmental /capacity building program, the external support from regional donor agencies is a standard practice and can leapfrog the whole process.<br>• During the initial period, SAFIR was established through support from multi-donor funds. However, after several year in existence, it now has started collecting the funds through membership fee and voluntary contributions also. |

The above recommendations on the organizational structure of the regional network are summarized as below:

- The network is to be set up as an **association, which can be formally established,** and undertake mainly **knowledge sharing, advisory and excelling the system operation activities** across the region, based on discussions and consensus building.
- Network to include **all South Asian countries** as **Member countries** on voluntary basis **and Myanmar as Associate Members**. Going forward, interested countries from other sub-regions can join on voluntary basis as associate members.
- Network's **organizational membership** to include representatives from **National Power System Operators** and Planning Organizations of member countries as Core Members, with participation from **Operational, Technical, Commercial, Regulatory and other Governmental Departments** associated with the system related functions in different countries, as **members of various working groups**.
- The network to get **handholding support** from the national power system operator of a member country on voluntary basis. This shall include co-locating the **headquarter** of the network in its own premises and rendering the **secretariat support.**
- The network's **governance mechanism** to consist of its **Executive Council, Working Groups and the Secretariat.**

- The network's working philosophy to be based on **consensus-based decision making** based on discussions amongst members. While **staffing and administrative** support to be provided by the secretariat, execution of tasks and activities can be undertaken through **3 working groups** (operational, technical and planning).
- The network's funding mechanism can be kept **self-sustained and simple** by seeking handholding towards locating the headquarter and providing secretariat services and associated expenditure from the national system operator of a member country on voluntary basis. For any **occasional & substantial expenditure** like technical studies/capacity building program etc., the external support from regional multilateral forums and developmental organizations can be sought as grants, on case-to-case basis.

Further, it is also recommended, that going forward, based on consensus amongst the member countries, **the proposed regional network can also collaborate with other similar networks to ensure synergy on common issues as well as to avoid working in silos**. Further, in the longer term, **they can also be made to operate and report to any of the prevailing intergovernmental regional arrangements.**

Basis the above recommendations, and inputs received from relevant stakeholders; **a Charter for institutionalization the proposed Regional Network has been developed** and included in Chapter 7 of this report.

The following section indicates the next steps for implementing the proposed network in the form of a roadmap.

## 6.3 Next Steps for Implementation and Roadmap

To carry forward the institutionalization of the Regional Network of Power System Operators in South Asia, the finalized draft report along with the executive summary was shared with the stakeholders during the 1st Week of August 2021 and country level consultations with stakeholders from different countries in South Asia were held during the period 17th-19th August 2021. The purpose for holding the consultation was to seek feedback of the stakeholders on the draft report and on certain specific issues, against which multiple options were suggested in the draft report with the request to stakeholders to select the option which may be best suited for the Regional Network. Some of the options which were discussed with the stakeholders and outcome of the same are as detailed below:

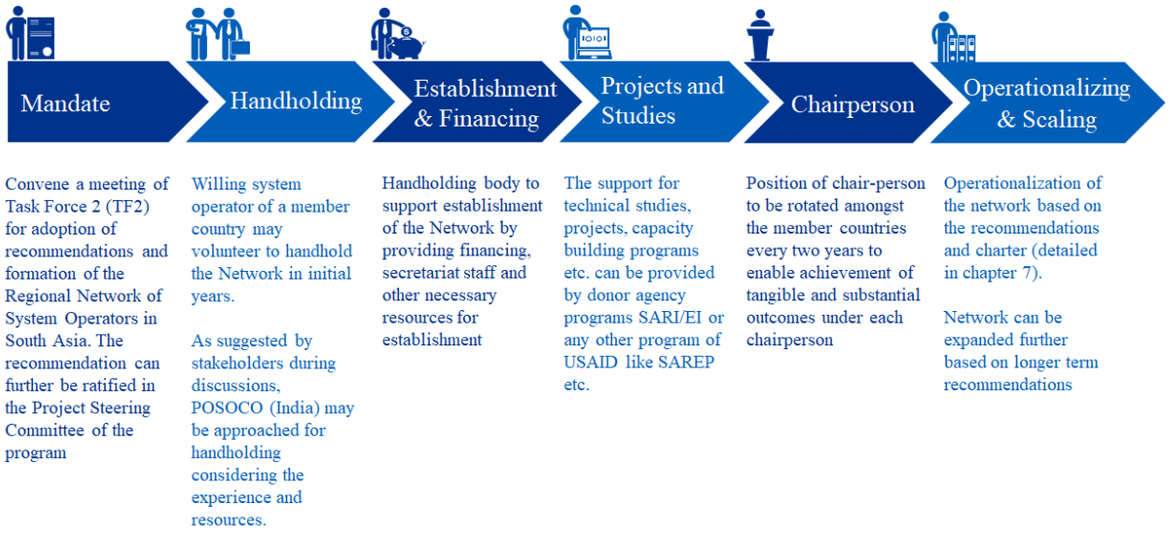
1. **Membership**: In terms of country membership, two options were presented to the stakeholders. Either it can have participation from all the countries in South Asia ensuring a regional level engagement, or participation from the countries which are already engaged in power trade. There was a uniform view from all the stakeholders that as the network is aimed at sharing of knowledge and best practices, a decision can be taken to engage all the countries in South Asia, as such an engagement can benefit all the countries in the region, irrespective of the status of the trade. Furthermore, the option to offer participation in the network to countries from neighboring regions like Myanmar is also a welcome step.
2. **Funding Mechanism**: There was almost consensus amongst the stakeholders that in the initial phase it is desirable to keep the funding mechanism simple and not charging any membership fee from the stakeholders. Members were also supportive of the suggestion that in order to have self-sustenance, the national power system operator of a member country can provide handholding and support to the network for its operation. There was also consensus on the issue to take support from some multilateral developmental agency for carrying out specialized tasks like system studies and holding capacity building programs etc.

3. **Handholding**: On the aspect of handholding, discussion with the different stakeholders was to the effect that in the initial phase, which country's national transmission operator would be suited to provide handholding and render support for the secretariat functions. It transpired that handholding of the proposed network can be done by a national power system operator, which is willing to take up this responsibility voluntarily. While in case of some of the countries, members noted that they need to deliberate this issue further in their organization, the members from Nepal, were of the view that in the initial phase the role of handholding can be entrusted to the national power system operator from India, as the existing frameworks, infrastructure, and resources over there can be leveraged for operationalizing the network with ease.
4. **Period for the post of Chairpersonship:** In terms of Chairpersonship of the Executive Council, the proposed framework provided in the draft report specifies that the post of chairperson shall be rotated amongst the members of different countries. During the discussions with the stakeholders, their specific views regarding the term of the Chairperson of the Executive Council were sought and options like a one year or two years term were deliberated. There was almost a consensus amongst the members on this issue that two-year term for rotating chairpersonship will be desirable, instead of keeping it as one year, as one year is a too frequent a change and a minimum period of two (2) years may be essential to show something substantial and tangible.

**Further strategy and Roadmap:**

Based on the feedback of the stakeholders on the draft report and their specific inputs on the different points as stated under Points 1 to 4 above, the next steps for implementation of the Regional Network and Roadmap towards its formation are as stated below:

Figure 6.1: Roadmap for implementation of the Regional Network



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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/