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Strategy Paper for creation of South Asia Forum for Electricity Market (SAFEM) for promoting cross-border electricity trade

Strategy paper for creation of South Asia Forum for Electricity Market (SAFEM)

IRADe-SARI-36 (2021)

SAFEM

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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 recently extended to 2022 and is a key program under USAID's Asia EDGE (Enhancing Growth and Development through Energy) Initiative. In its extended phase, SARI/EI will focus on moving the region from bilateral to trilateral and multilateral power trade, and establishing the South Asia Regional Energy Market (SAREM).

About USAID

The United States Agency for International Development (USAlD) 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:

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The report and its findings do not necessarily reflect the views of the SARI/EI Project Secretariat. 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.

FOREWORD

The U.S. Agency for International Development (USAID) has been working to enhance regional energy cooperation in South Asia since 2000 through its South Asia Regional Initiative for Energy (SARI/E) program. The first three phases of the program focused on building trust, raising awareness, and assessing potential transmission interconnections. The current and fourth phase of the program, called the South Asia Regional Initiative for Energy Integration (SARI/EI), which was launched in 2012, focuses on advancing regional energy integration through cross-border power trade. This is being implemented by the Integrated Research and Action for Development (IRADe), a leading South Asian think tank.

South Asia has immense socioeconomic growth potential. As the world recovers from the COVID-19 pandemic, the region could play an instrumental role in building a cleaner, greener, and sustainable future with universal access to affordable, reliable, and clean energy. Regional energy cooperation will propel South Asia's transition to a thriving and sustainable economy. One of the key mandates of SARI/EI program is to create an enabling environment to support the establishment of a South Asian electricity market, and gain consensus and support from the key decision makers and stakeholders.

SARI/EI is working on the concept of a regional forum of market players, called the *South Asia Forum for Electricity Market (SAFEM),* to support market-based electricity trade in South Asia including trilateral and multilateral electricity trade. SAFEM would focus on collaborating with different players to provide recommendations on market structure and products, market design and rules, payment mechanism of trade, conflict resolution mechanism, and to promote knowledge exchange between member countries. The paper presents the institutional mechanism for SAFEM including roles and responsibilities, organizational structure, and the roadmap for realization. It also analyzes the different markets and forums across the world and draws lessons for the region. Such a forum would help maximize the use of clean energy, enhance energy security, and improve access to clean electricity across the Indo-Pacific region.

I would like to commend the excellent work done by the SARI/EI team at IRADe and PricewaterhouseCoopers (PwC) in developing this strategy paper. We, at USAID, look forward to promoting the recommendations emerging from this strategy paper through our new regional energy program, the South Asia Regional Energy Partnership (SAREP). I hope that this paper serves as a useful resource for all stakeholders in the region who care about climate issues, regional energy cooperation and the transition to clean energy.

Sincerely,

John Smith-Sreen

John Smith-Sreen
Director, Indo Pacific Office, USAID/India

Preface

We are delighted to present the "Strategy Paper for creation of South Asia Forum for Electricity Market (SAFEM) for promoting cross-border electricity trade", 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 SARI/EI program, in its fourth phase, focuses on the facilitation and creation of a regional energy market. The SAFEM Strategy Paper is an important step for the creation of the regional energy market.

Each of the eight countries of the region have distinctive economic profiles, energy consumption patterns and energy basket. Cross border power trade, by using these complementarities, will be beneficial for all the countries in the region. For example, Bhutan and Nepal have abundant unexploited hydropower resources which is cheaper as compared to cost of generation in Bangladesh, Sri Lanka and Pakistan, which primarily depends on imported fuel for power generation. Besides, this is also a cleaner form of energy. Therefore, meeting some of the energy demand through cross border electricity trade will ensure supply of power at economic rates, while also ensuring energy security, and reduced emissions.

This paper examines international experiences of such a forum and using these experiences, while also keeping the ground realities of the South Asian Region in view, has carved out a structure of SAFEM. The Forum is proposed to be formed with the objective of taking regional trade a step forward by acting as a neutral body, facilitating regional electricity market creation and development. SAFEM will also work towards adoption and implementation of guidelines and policies, by advising the South Asian countries on power trade and markets in the region. The Forum would work towards various facets of electricity market, including market structure and products, market design and rules, payment mechanism for trade. It is envisaged that strategy paper will create consensus between stakeholders and pave way for creation of SAFEM. The study endeavors to bring out clearly the benefits stakeholders will have from formation of SAFEM.

I am very thankful to USAID for their continued and extensive support in the preparation of this paper. I also thank and appreciate the team at SARI/EI Secretariat at IRADe, for their sincere and sustained work as well as valuable contributions to complete the report by adjusting to a new way of working amidst pandemic restrictions.

Jyoti Parikh

Dr. Jyoti Parikh
Executive Director
Integrated Research and Action for Development (IRADe)

1. Executive Summary

Background

The South Asian countries comprising Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka have distinctive economic profiles and energy consumption patterns. On account of resource complementarities, Demand Diversity, Seasonal Demand Variation, differentials in cost of power and potential synergies for RE Integration and grid balancing, there exists significant potential of undertaking cross border power trade to ensure overall socio-economic development of the region. The regional power trade, which is to the tune of ~3900 MW, is currently mostly through bilateral mechanisms, confined to Bhutan-India, India-Bangladesh, and India-Nepal. Such power trades are mainly negotiated between the Governments through long-term Power Purchase Agreements and few medium/short term agreements. But there are also trades through calling for bids in these categories.

In order to gradually transition from bilateral to trilateral and multilateral forms of trade, and to switch more towards commercial and market-based mechanisms of power trade and thus facilitate regional electricity market development, the need for a regional forum is deemed critical. Against this background this strategy paper aims to provide a detailed background for the creation of SAFEM, assess the international experiences for formation of such forums, analyze the current institutions present in South Asia and suggest the proposed role, functions, institutional framework and operational roadmap for SAFEM.

In line with the broad objectives of the engagement, the report has been structured into following parts,

1. Review & analyze As-Is situation of Cross Border Electricity Trade (CBET) in SA region
2. Review and analysis of international practices
3. Proposed Institutional Mechanism of South Asian Forum for Electricity Markets (SAFEM)
4. Key takeaways from Stakeholder Consultations
5. Proposed Roadmap for SAFEM

As-is Scenario Analysis

This section briefly reviews the electricity market structure & design across SA nations. The Power market structure in South Asia is at various stages of maturity with all the countries, except India, following a single buyer model. Many of the countries still have vertically integrated utilizes managing the G, T&D functions whereas all the countries have an independent regulator. A short country-wise summary-analysis is presented below,

India: Indian Power Sector has an unbundled system with separate entities for Generation, Transmission and Distribution. The Generation sector has seen significant private sector participation with ~47% of the total installed generation capacity contributed by private sector with the rest being owned by Central public sector agencies and state utilities. The transmission is primarily owned by the public sector (Power Grid Corporation of India Ltd at the central level and the respective state transmission utilities at the provincial level) with limited private participation. The distribution sector continues to be largely owned by the state governments. Bulk electric power supply in India is mainly tied in long-term contracts (around 25 years) and the rest in medium term contracts (up to 5 years) and short-term contracts (up to 1 year). India has a market-based platform for sale/purchase of power and CBET has also commenced through the Indian Electricity Exchanges

Bangladesh: Bangladesh power Sector has a partially unbundled system with a separate entity for Power Transmission. Bangladesh follows “Single Buyer and Multi-seller Model” wherein a single public sector entity acts as a sole procurer of power which is further distributed and retailed by multiple distribution companies. In Bangladesh, Independent Power Producers (IPPs) and other public generators sell their

energy to BPDB on the basis of long/medium term Power Purchase Agreement (PPA) (varying between 5-25 years) and BPDB sells it to other supply entities and consumers.

Bhutan: In Bhutan, the wholesale market is based on a single buyer model (SBM). The electricity supply industry is partially unbundled and equipped with separate generation entity DGPC. Bhutan power corporation, the integrated T&D entity acts as the off-taker and is responsible for supplying power to the consumers. Bhutan has single-part tariff which is determined through Regulated Route regimes.

Nepal: Nepal Electricity Authority (NEA) acts as vertically integrated entity and acts as the Single buyer. Nepal currently follows a "Single Buyer model Multi seller model" where NEA is responsible for procuring power from all IPPs as a single buyer and it turn supplies electricity to the end consumers.

Sri Lanka: Sri Lanka Power Sector has a vertically integrated power system and follows a "single-buyer and multiple seller mode". Ceylon Electricity Board (CEB) transmission entity is the designated single buyer as well as the transmission service provider.

The As-is assessment also briefly reviews the existing institution/mechanism or forums facilitating CBET like SAARC, BIMSTEC, SAFIR etc., in terms of their roles and responsibilities, organization structure, etc. and the key learnings/synergies which could be considered while creating SAFEM.

Review and analysis of international practices

To have a holistic view of development of power market and how regional forums have contributed to development of regional electricity markets, markets across different geographies and in different stages of maturity/evolution were analyzed. The assessment included the evolution of power markets, the power market structure/products and a review of Role, responsibilities, Structure, function etc. of regional forums across Europe, Africa, USA, Australia, South East Asia and South America, etc. It may be worthwhile to note that regional forums across geographies vary on aspects such as roles and responsibilities, structure, function, etc., but some of the key learnings which could be useful while creating SAFEM are listed below

- Before introducing any new product or policy, SAFEM may provide extensive training to the designated members from its participating members
- SAFEM may act as an Advisor to the member nations – as and when required.
- SAFEM can act as a regional body to assist in development or advocacy of the market products in the developing power market, to benefit its members based on regional needs and demands.
- SAFEM can take steps to encourage synchronization activities for seamless power trading with member countries
- SAFEM can draft a guiding roadmap to aid phased transformation of the emerging SA Regional power market
- SAFEM can conduct various region level studies and assist the member nations in integrating renewable sources of power
- SAFEM can assist in the comprehensive planning in the SA Region by undertaking studies like transmission study, interconnection studies, capacity planning etc.

Proposed Institutional Mechanism of South Asian Forum for Electricity Markets (SAFEM)

Based on the understanding developed from the case study of regional power markets in different parts of the world, an analysis of the existing regional forums/mechanisms available in South Asia and feedback from stakeholders obtained through consultations, the following are noteworthy

Objectives: - The SAFEM is proposed to be formed with the objective of taking regional trade a step forward by acting as a neutral body, facilitating regional electricity market development and creation. Key objectives of SAFEM shall include:

- Help member countries in adoption & implementation of market rules/regulations for CBET
- Suggest market structure & products such as day ahead market in the power exchange, short term contracts, medium term contracts, long term contracts, financial derivatives, ancillary services market, etc. for electricity trade.
- Suggest market opportunity for private sector participants in regional electricity market in South Asia.
- Facilitate in addressing Issues/challenges for regional electricity market development in the region
- Facilitating renewable electricity trade in South Asian regional market.
- Facilitate capacity building, sharing of experiences and best practices among member countries

Roles and Responsibilities: -To perform the objectives listed above, proposed roles and responsibilities for SAFEM have been mentioned below.

Sl. no	Key issues to be considered for creation of electricity market	Roles and Responsibilities
1	Cross Border Regulations	Review the Power Market policies and rules/regulations for cross border Electricity trade in each of the South Asian countries in the Region
2	Market Structure with products	i) SAFEM shall help the member countries in developing an understanding of the various products which may be introduced in the market. It may conduct detailed study upon receiving a request from the member countries. ii) Assist member nations towards its implementation
3	Type of Trading contracts	Examine the current contracts for CBET in operation, for example bilateral, trilateral, power exchange-based contracts. Carry out studies to help member countries in suggesting new type of contracts and the rules, Agreements for the same.
4	Renewable Energy	Facilitate Renewable Electricity trade in South Asian regional market
5	Gas Market	Deliberate on potential of expanding the Electricity Market to include Gas

Membership Types: - Membership to the forum may be limited to a few entities from the power sector based on mutually agreed criteria. As per current structure of power market in the SA countries and experiences of international forums, the membership for SAFEM may be divided into the following two categories, (1) Direct Member (Power Market players, National Transmission Utility of each country,

Distribution Utilities and National System Operator) and (2) Associate Members (Research organizations and Academic Institutions). To have a fair representation of all the distribution utilities, SAFEM shall allow their participation on a rotating basis.

Operating Structure: - The operational aspects of SAFEM will cover the funding structure to cover the day-to-day operation and conduct studies depending on the requirements and the proposed location of headquarters.

Funding Structure: SAFEM may be initially funded by multilateral agencies. Later, to make it self-sufficient, annual budget for the forum may be met from the annual membership fees from all the members of the forum or a predetermined contribution made by the member countries.

Location of Headquarter: Location of headquarters for the functioning of forum may be selected on the basis of adequate infrastructure facilities and manpower.

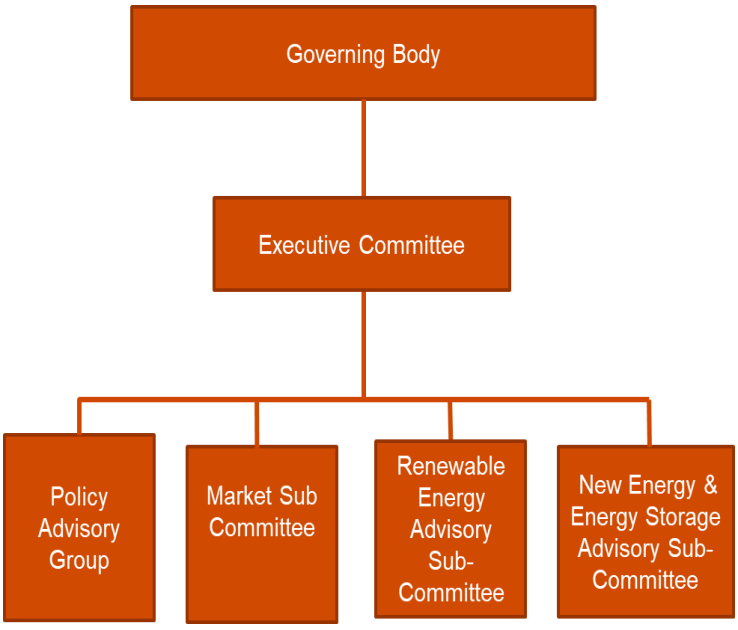
Resources of Common Interest: - SAFEM can act an advisor to the member countries for creation of infrastructure which benefits more than one country. SAFEM may be given the responsibility to carry out the feasibility study for the proposed projects and prioritization of the listed projects.

Institutional Arrangement: - The report proposed two institutional arrangements for SAFEM, (1) Regional Market Advisor which makes detailed suggestion to the member countries for achieving mutually agreed goals and (2) Regional Market Authority which ensures adhesion to the agreed policy measures by all the member countries. In-terms of Degree of Independence, SAFEM can either be established as a completely new entity for creation of electricity market in South Asia or it can be established under one of the existing institutions in the region which is working to facilitate energy cooperation among the member countries and will act as an overarching body for SAFEM.

Organization Structure: - SAFEM shall provide fair representation to all the member countries and the decisions taken shall be based upon consensus between members of the forum. The organization structure may consist of an apex body (Governing Body/Board of Members) followed by Executive/Management Committee. Individual sub-committees may be established to deliberate issues/challenges on focused area such as policy, market products, RE and New Energy. The following options emerged

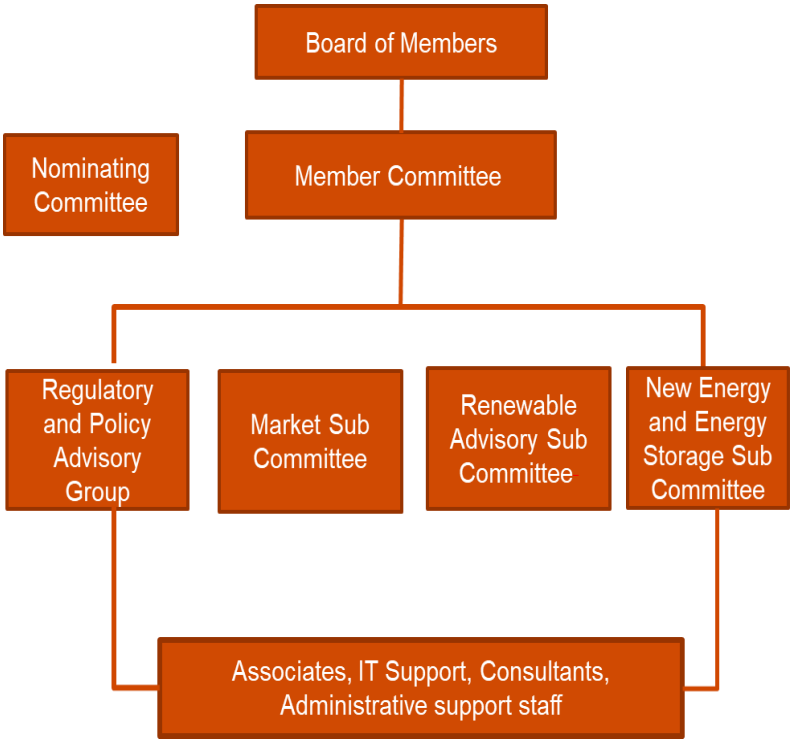
Option 1: - The Governing Body will comprise of one representative from each of the member nations of SAFEM preferably in the rank of Chief Executive Officer or an interested party nominated by the Chief Executive Officer.

This will be followed by an Executive Committee, consist of officials of the power utilities in the rank of Directors from member nations, and it will be responsible for implementing the decisions from the Governing Body. Next, there will be Sub-Committees which will be at the Working level and would be headed by Chief Engineers/Executive Directors officials from the member utilities



Option 2: - The Apex Body that is Board of Members is selected by voting. Board of Members is an independent body without any affiliation to any SAFEM member and are appointed based on recommendations made by the Nominating committee and elected by the Member committee for a term of 3 years. Nomination Committee will comprise of representatives elected annually from the Member Committee.

Member Committee will consist of representatives from each participant nation in the rank of Managing Directors (MD)/CEOs from generation utility, transmission utility, distribution utility, system operators, traders from each member nation with two representatives from each member country. This will be followed by the Sub Committees which will consist of representatives in the rank of Directors from generation utility, transmission utility, distribution utility, traders, System Operators and new energy markets from each member nation. Sub-committees may also include middle level officials from policy making and regulatory bodies.



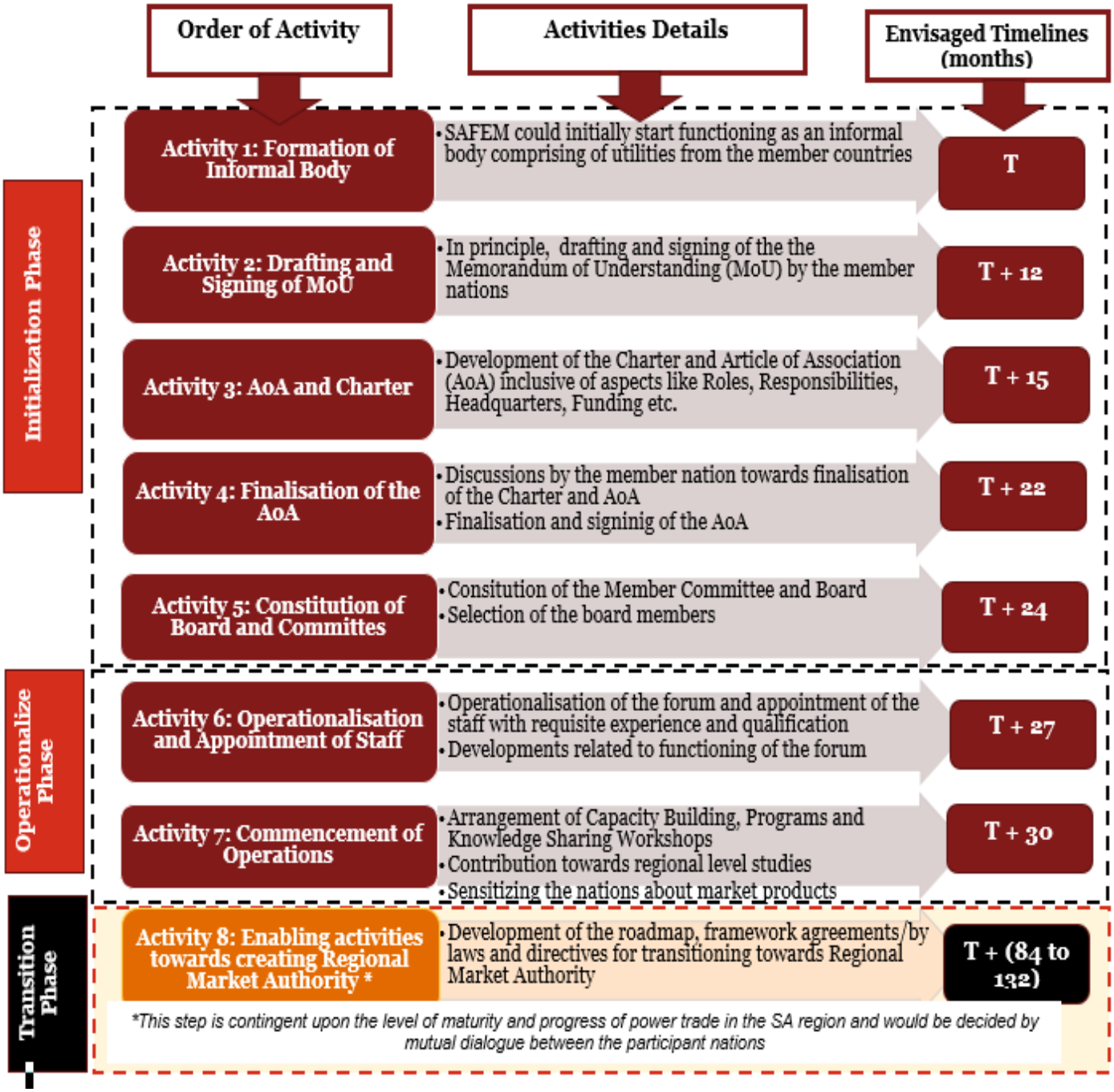
Key takeaways from Stakeholder Consultations

The stakeholders welcomed the initiative of South Asia Forum for Electricity Market (SAFEM) and agreed that SAFEM will promote regional trade and facilitate regional electricity market development and creation. This section briefly covers key points of exhaustive stakeholder consultation with representatives from Bangladesh, Bhutan, India, Nepal, and Sri Lanka. Such views and suggestions have been captured as below:

Membership Types	Stakeholders suggested that inclusion of the regulatory and policy makers from (mid-level experience) in the subcommittees would not only aid in smooth functioning of SAFEM but also ensure quicker decision making due to confidence among the governments and regulators.
Funding Structure	Stakeholders agreed that initial financial support from multilateral agencies is critical. However, in the long run, it will have to be self-sustaining by funding through member contributions.
Location of Headquarter	During the stakeholder discussion it was observed that the headquarters shall be selected with mutual consensus among all the members and shall provide all the facilities for proper functioning of the forum.
Institutional Arrangement	During the stakeholder discussions, majority of the stakeholders agreed on the role of SAFEM as an advisory body for initial stage of development. However, with gradual evolution and maturity of market in South Asian region, SAFEM's role as a regional market authority may be explored.
Organization Structure	Based on the views of majority of the stakeholders received during the consultations, it would be apt for SAFEM to have an organization structure as formulated under Option-1

Proposed Roadmap for SAFEM

The proposed roadmap for the formulation, development, and operations of SAFEM has been disaggregated into three phases based on the time requirement and the level of maturity of the forum in the respective stage.



Conclusion

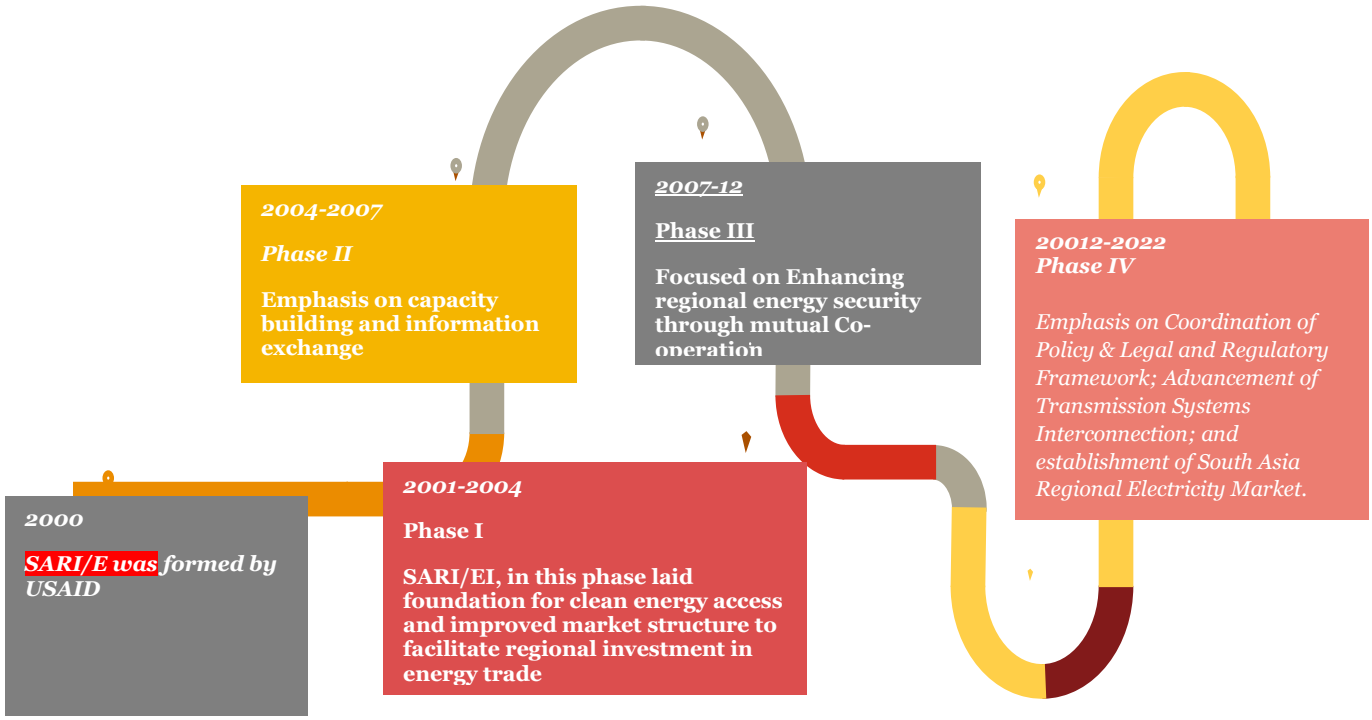
It is therefore an imperative to formulate a regional market body/forum/entity in the region which can facilitate regional electricity market development and creation. Owing to the imminent need of a regional level market forum in South Asia, the creation of South Asian Forum of Electricity Market is felt to fulfil the aforementioned need and ensure envisaged benefits in the South Asian power ecosystem. SAFEM may start functioning as an informal body to advise the member countries and later take up the role of a formal body subject to acceptance by government of the member countries.

2. Introduction

2.1. Background

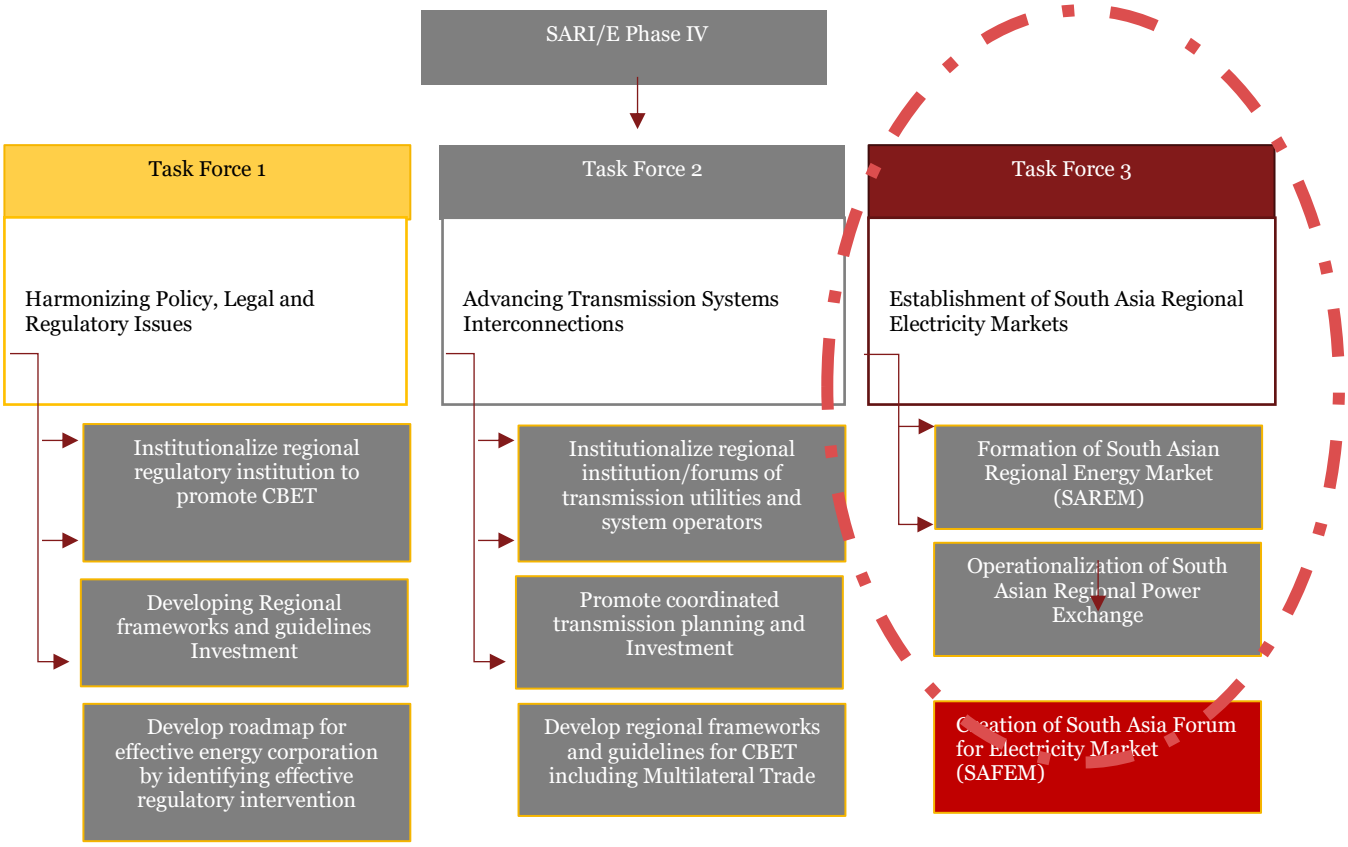
US Agency for International Development (USAID) initiated the South Asia Regional Initiative for Energy (SARI/EI) program in the year 2000, covering the eight countries namely Afghanistan, Bangladesh, Bhutan, India, The Maldives, Nepal, Pakistan and Sri Lanka. With the aim to promote energy security in the South Asian nations across three focus areas – cross-border electricity trade (CBET); regional energy market formation for South Asian Region; and regional clean energy development.

SARI/EI program of USAID is now in its fourth phase which aims to further enhance regional energy integration in eight South Asian countries. The program aims to increase regional energy cooperation between these countries and facilitate in creation of regional energy market.



SARI/EI structure

To achieve these outcomes, three dedicated Task Forces (TFs) have been constituted under the program, primarily represented by nominated members from South Asian Country governments (Energy/Power Ministries), Electricity Regulatory Commissions, Planning Authorities, National Power Transmission utilities, Power Market Institutions etc. The program strategy for SARI Phase IV is described in the exhibit below:



Extension of Phase IV (2018-2022) will focus on the following activities

USAID extended the SARI/EI program, implemented by IRADE, for another four years, from 2018 to 2022 as announced on August 30-31, 2018. The extended phase will have the following objectives as its primary focus:

Task Force 1

"**Harmonizing Policy, Legal and Regulatory Issues**"
To create the enabling systemic conditions for a sustainable market for investment and implementation of CBET

Task Force 2

"**Advancing Transmission Systems Interconnections**"
To create enabling, systemic conditions for a sustainable market for investment and implementation of sub-regional bilateral transmission interconnections in the eastern sub-region of South Asia

Task Force 3

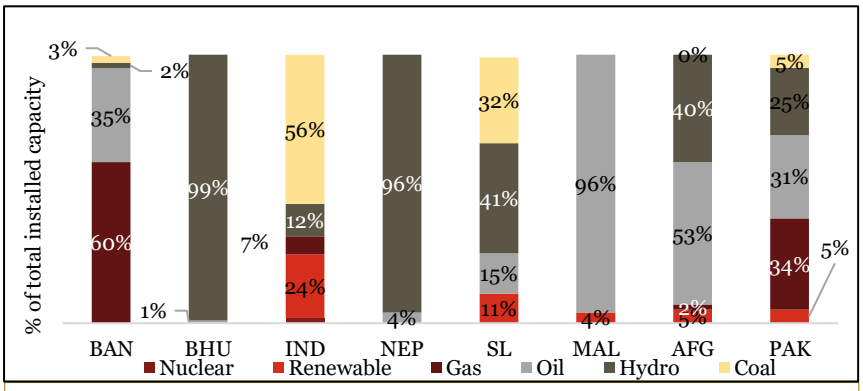
"**Establishment of South Asia Regional Electricity Markets**"
To create an enabling and systemic conditions for a sustainable energy trading and exchange market in the eastern sub-region of South Asia

The present assignment is pertaining to '***Building Consensus and developing a strategy paper for creating the South Asia Forum for Electricity Markets*** "under the extended TF3 Phase IV. However, the comprehensive set of other activities envisaged to be conducted under Phase IV are enclosed as the Annexure-A.3.

2.2. Need for SAFEM

The South Asian countries comprising Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka have distinctive economic profiles, energy consumption patterns and energy basket. The following are the major drivers of regional energy cooperation in electricity sector in the South Asian Region.

Figure 1: Country wise energy mix (2019)



- Bhutan, Nepal, Sri Lanka dependent on **Hydro**
- Bangladesh, Pakistan & Maldives dependent on **oil**
- India and Sri Lanka dependent on **coal and hydro**

Source: CEA, NEA, DHPS Bhutan, NEPRA Pakistan, BPDB

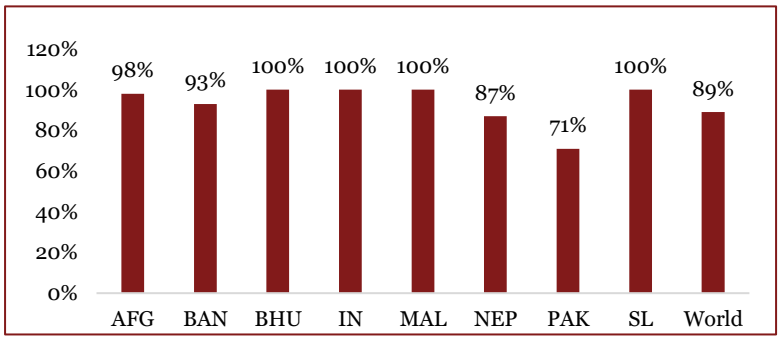
Resource Complementarities: The different countries in SAR have different sources as primary fuel. India continues to be dependent on coal as the leading resource for energy generation. whereas Pakistan has high dependency on oil/diesel and natural gas. On the other hand, Nepal and Bhutan are hydropower rich and have excess resources compared to their demand. Bangladesh and Maldives are dependent on imported natural gas and diesel respectively.

A South Asian regional market will be beneficial for the South Asian Countries to trade energy at cost effective rates. This will also boost investor confidence to develop regional generation projects.

Enhanced Energy Security:

The peak demand is the overall region is about 220 GW. South Asian Region countries are expected to observe substantial increase in demand for electricity owing to potential increase in access, economic growth and rising per capita income. The countries are meeting their demand mainly through own generation and imports. The power demand is likely to necessitate increase in generation capacity as well as substantiate the need for a regional power market.

Figure 2: Access to electricity (% of population)



Source: MoP, GoI, BPDB,NEA, AFG, PAK, World-World Bank, Bhutan statistical yearbook, Island Electricity Databook, Maldives, CEB Sri Lanka

Regional cooperation to develop generation capacity will improve energy affordability, access and low carbon transition for each country

Demand Diversity

The peak demand is the overall region is about 220 GW. South Asian Region countries are expected to observe substantial increase in demand for electricity owing to potential increase in access, economic growth and rising per capita income. The countries are meeting their demand mainly through own generation and imports. The power demand is likely to necessitate increase in generation capacity as well as substantiate the need for a regional power market.

Power Demand Supply Scenario in FY2024 and FY 2030 in South Asia Region:

Bhutan and Sri Lanka are expected to surplus position, India and Maldives will become self-sufficient while Afghanistan and Bangladesh will languish with deficits >10% of annual power demand. This highlights the avenues of intra-SAARC power trade within two nations where supply to a deficit nation may be seamlessly transferred from a surplus one through interconnections.

Table 1: Demand and Supply Projection

Countries	2024			2030		
	Demand (GWH)	Domestic Supply (GWH)	Deficit/surplus	Demand (GWH)	Domestic Supply (GWH)	Deficit/surplus
AFG	7428	5466	-26%	11028	7473	-32%
BAN	91,093	79,825	-12%	123,941	101,212	-18%
BHU	3,145	21,035	568%	6,572	23,691	259%
IND	1,769,609	1,776,224	0.4%	2,470,238	2,452,106	-0.7%
MAL	2,046	2,046	0%	3,172	3,172	0%
NEP	9,305	11,094	19%	15,836	18,978	20%
PAK	151,583	150,301	-1%	191,828	190,781	-1%
SL	19,985	20,610	6%	28,188	28,503	-1%

Source: SAARC Energy Outlook Report, Dec 2018

Complementarity in seasonal/peak demand is another remarkable trait of the South Asian power scenario. The deficit season of Bangladesh complements with surplus season of hydro dominated nations like Bhutan, Nepal and Myanmar. The deficit season of Bhutan, Nepal, and Sri Lanka complements surplus in India and Bangladesh which can be leveraged to meet their peak deficit.

Table 2: Seasonality in SA Nations

SA Member Nation	Seasonality	
	Peak Season	**Off Peak Season**
Bangladesh	April – September	October – March
Bhutan	December – April	May – November
India	March – June September – October	December – February
Nepal	December – May	June – November
Sri Lanka	December – February	May – November
Pakistan	June-September	January-February

Source: SAARC Energy Outlook Report, Dec 2018

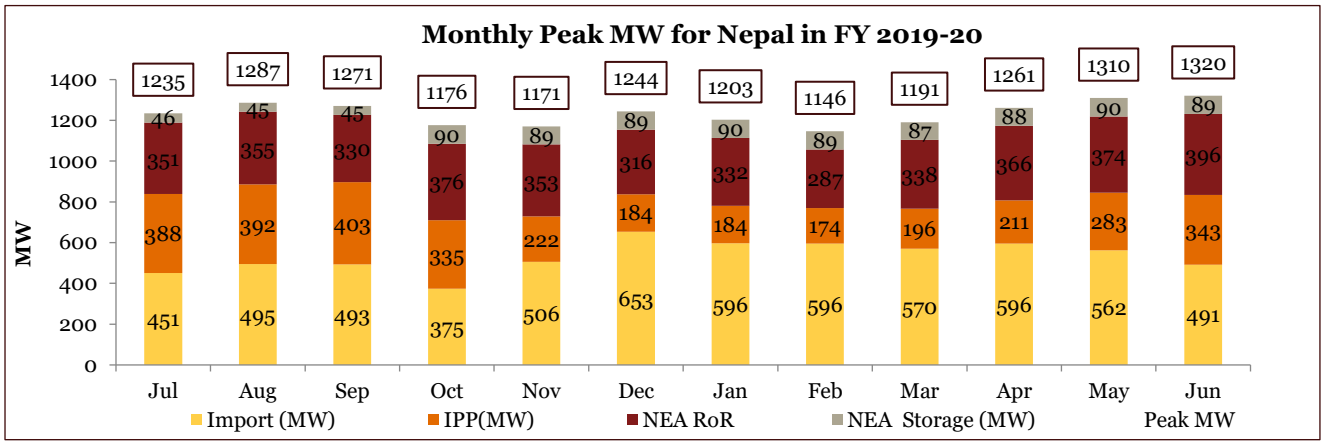
The South Asian region as a consolidated system can leverage complementarity of surplus and deficits season to meet the regional demand

Seasonal Demand Variation

Nepal:

Imports from India increase during dry season. Generation significantly drops in dry winter months (~60% of peak generation) owing to owing to reduced inflows affecting generation from RoR projects .Most of this deficit energy is met through imports.

Figure 3: Monthly Peak MW for Nepal in FY 2019-20

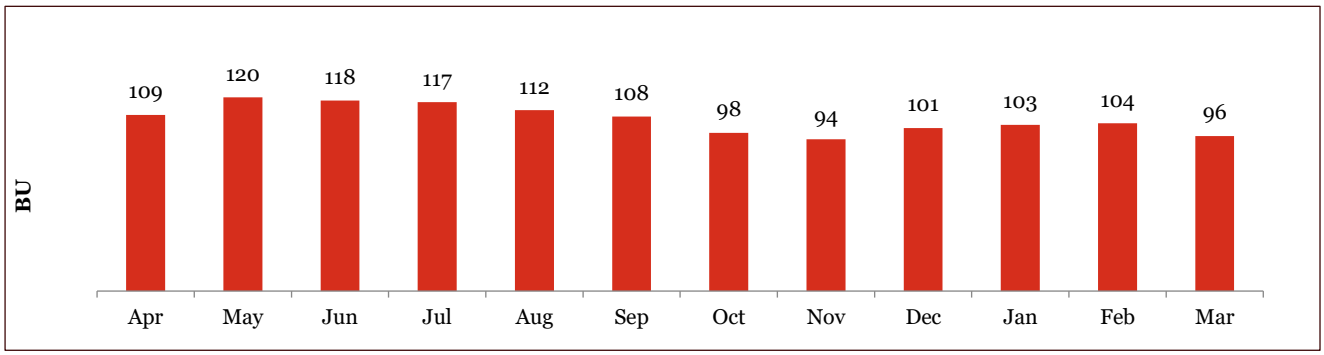


Source: NEA Monthly data FY 2019-20

India:

The seasonal demand in India decreases by 9% in term of energy in Oct-Nov and 10% in terms of peak MW. During this time, India is in surplus condition and it complements the deficit season of Nepal

Figure 4: Monthly Energy in BU (2019-20)

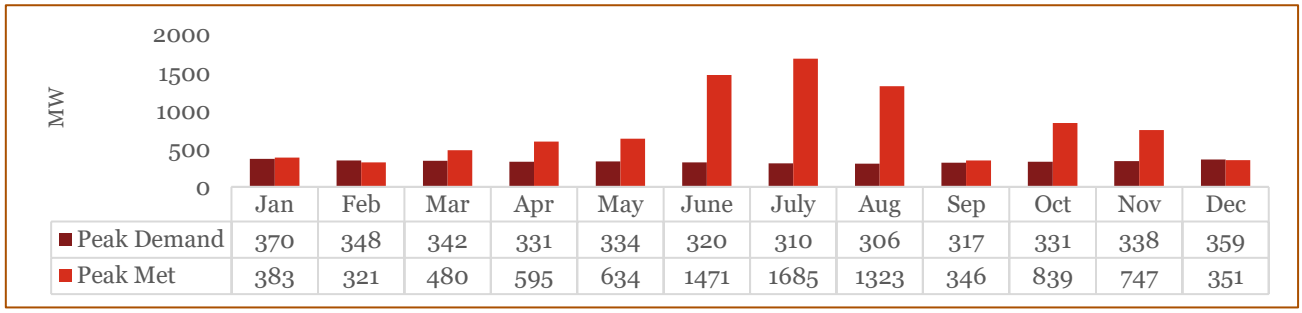


Source: CEA Monthly Report, 2019-20

Bhutan:

Bhutan's peak demand is ~390 MW against the total installed capacity of 2326 MW. Since all the existing plants are run-of-the-river types, the total generation drastically drops to about 300-350 MW during the winter dry season (December–March) due to low water levels. The overall demand profile of the Bhutan is flat which lies within 300-380 MW against the supply trend which has tapped as high as 1680MW during wet season. Hence it can be inferred that during the wet months of Bhutan (May to November) as exhibited in the Figure 4, the nation is an exporter of power to India to supplement the capacity during relatively drier months of India viz. May-June and Sep to November. Majority of export-oriented generation capacity in Bhutan is committed to India through long term PPAs and the limited capacity not committed through long term contracts can be used to support seasonal variation in other SA countries.

Figure 5: Total Grid (2019)



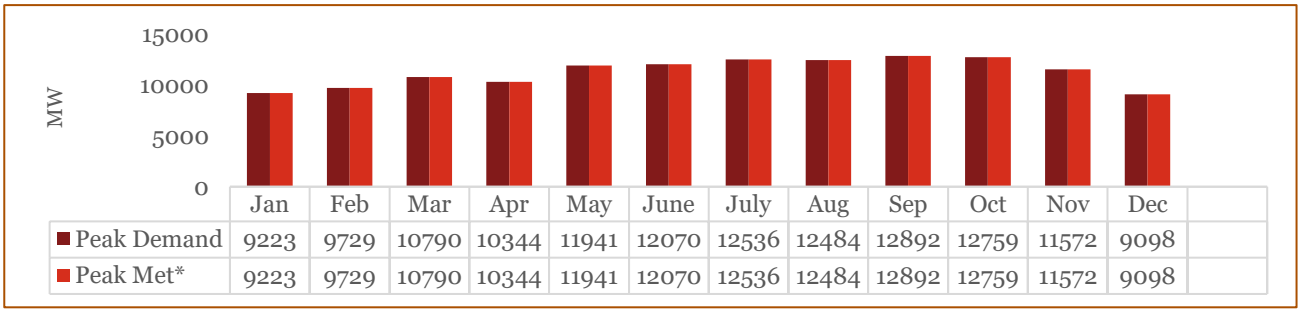
	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Peak Demand	370	348	342	331	334	320	310	306	317	331	338	359
Peak Met	383	321	480	595	634	1471	1685	1323	346	839	747	351

Source: Bhutan Power System Operator, BPC

Bangladesh

The Bangladesh power generation capacity has significantly grown. Bangladesh is currently dependent on gas for majority of its electricity generation. Gas fuels account for 66% of the nations' electricity generation. Due to reduced gas discovery in recent years, the country is facing shortage of gas supply that has resulted in stranded gas assets. The seasonal variation is given in the exhibit below. It is noteworthy that 8% of the demand is met through imports.

Figure 6: Electricity Demand (2019-2020)



	Jan	Feb	Mar	Apr	May	June	July	Aug	Sep	Oct	Nov	Dec
Peak Demand	9223	9729	10790	10344	11941	12070	12536	12484	12892	12759	11572	9098
Peak Met*	9223	9729	10790	10344	11941	12070	12536	12484	12892	12759	11572	9098

Source: BPDB Annual Report; *Peak Met includes self-generation and imports from India

The annual and monthly diversity factor for BBIN region is shown in the exhibit below. Details of calculation are in **Annexure 4.**

Annual Diversity factor= (peak MW of IND+ peak MW of NEP+ peak MW of BHU+ peak MW of BAN)/Maximum system load of the BBIN Region

A. Df(calculated)=1.01

Monthly Diversity factor= (peak MW of IND+ peak MW of NEP+ peak MW of BHU+ peak MW of BAN in a particular month)/Maximum system load of the BBIN Region in that month

Table 3: Monthly diversity factors for BBIN Region

Month	Diversity factor
APR-19	1.00
MAY-19	1.00
JUN-19	1.01
JUL-19	1.01
AUG-19	1.01
SEP-19	1.02
OCT-19	1.00
NOV-19	1.01
DEC-19	1.00
JAN-20	1.00
FEB-20	1.01
MAR-20	1.01

Source: PwC Analysis, NEA, BPDB, DGPC Annual Reports, CEA Reports, Sri Lanka Power Generation Expansion Plan, Indicative Generation Capacity Expansion Plan 2018-40, Pakistan

Optimise overall cost of power procurement:

The cost of generation widely varies across the member nations based on type and capacity of generating assets, availability of fuel, fuel costs etc. For instance, Bhutan and Nepal have abundant unexploited hydropower resources which will be cheaper as compared to cost of generation in Bangladesh/Sri Lanka/Pakistan which primarily depends on imported fuel on generation. Hence, it would be beneficial for the South Asian member

nations to meet some of the energy demand through cross border power trade compared to building its own generation capacity to ensure supply of power at affordable tariffs to the end consumers

Figure 8: Average generation cost-2018 (in US cents/kWh)

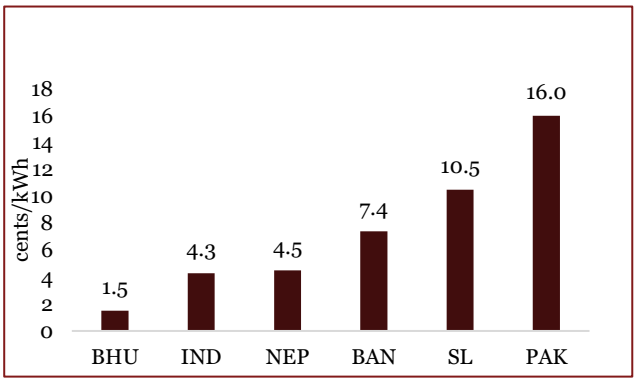
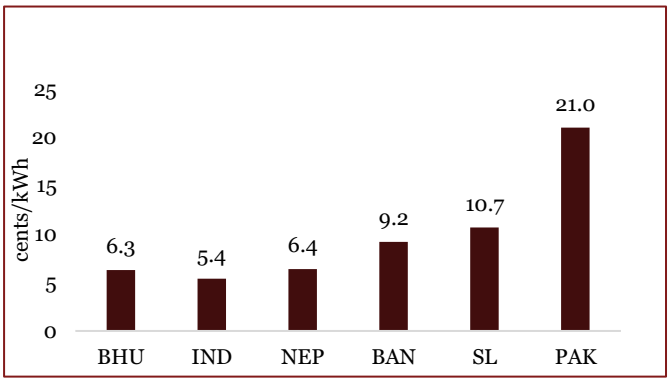


Figure 7: Marginal Cost of Generation (in US cents/kWh)



Source: PwC Analysis, Respective country energy planning and annual reports[1]

The South Asian countries can leverage the benefit of lower cost of generation in neighbouring countries to meet the burgeoning demand and ensure supply of electricity to the consumers at affordable tariffs.

Access to Electricity

A low access to electricity offers potential for regional energy cooperation including

- Import power from other regions, if access issue is related to power deficit
- Extend the grid from other countries in the region, if access issue is related to difficulties in accessibility in border areas

In case of SA region there are multiple instances of countries utilizing regional cooperation for solving access to electricity challenges. For example

- India has built multiple 11 kV and 33 kV lines that supply power across the border enabling Nepal to expanding access to electricity in the border areas
- Bhutan imports power from India through 11kV and 33 kV lines from West Bengal and Assam to supply power to inaccessible border areas which did not have grid connections from Bhutan

As countries go ahead to move for 100% electricity access, the same also drives increased regional energy cooperation, especially in the case of extending access to border areas.

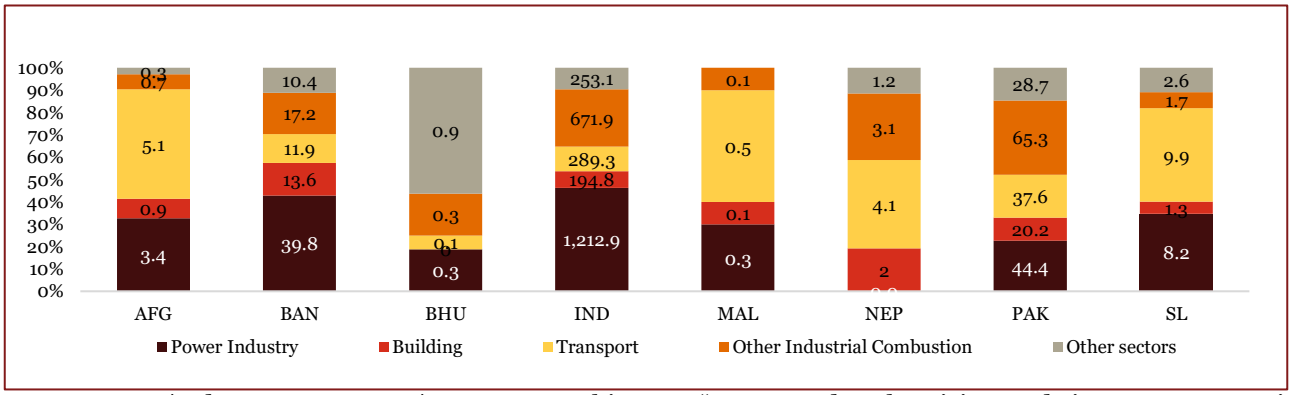
Climate Change and need for sustainable power development:

CBET can boost renewable energy use by tapping into cross-border renewable energy resources. The integrated power grid underpinning CBET can allow a higher level of penetration of variable renewable energy than each national grid in isolation. Large capacity of solar and wind projects in India provide a chance for Bangladesh to buy power from such plants at competitive rates rather than waiting to develop such projects in their own nation which will expedite their sourcing of power from RE projects

[1] https://www.drukgreen.bt/wp-content/uploads/2020/09/CAD_Publication_AnnualReport19_2019.pdf
https://pfcindia.com/DocumentRepository/ckfinder/files/Operations/Performance_Reports_of_State_Power_Utilities/Report%20on%20Performance%20of%20State%20Power%20Utilities%202018-19.pdf
https://www.nea.org.np/admin/assets/uploads/supportive_docs/annual_report_2076.pdf
https://www.bpdb.gov.bd/bpdb_new/resourcefile/annualreports/annualreport_1574325376_Annual_Report_2018-19.pdf
https://ceb.lk/front_img/img_reports/1601877736Statistical_Digest_2019_Web_Version.pdf
https://www.nepra.org.pk/Admission%20Notices/2019/09-September/IGCEP%20Plan%20(2018-40).pdf

Currently, the power industry contributes a significant portion of Co2 emissions from 20 % to 50% of the total emissions.

Figure 9: SAARC Countries fossil Co2 emission by sector in Mt Co2/year (2018))



Source: SARI/E document sources/2020-SEC Webinar on "Cross Border Electricity Trade in SAARC Countries.

Most of the SAR countries have intended national Determined Contribution (INDC) targets to achieve towards sustainable power development as listed in the exhibit below:

AFG	13.6% reduction in GHG emissions by 2030 compared to a business as usual (BAU) 2030 scenario. Afghanistan's renewable energy potential is estimated to be over 300,000 MW. Afghanistan has set target for 2032 is to achieve around 5,000 MW of Renewables(Hydro, Solar, Wind and Biomass). (Source: ADB Roadmap for RE for Afghanistan)
BAN	An unconditional contribution to reduce GHG emissions by 5 per cent from Business As Usual (BAU) levels by 2030 or 12 Mt CO2e by 2030 in the power, transport, and industry Sectors. Renewables include solar, wind, biomass, mini hydro and micro hydro projects.
BHU	1. Bhutan intends to remain carbon neutral where emission of greenhouse gases will not exceed carbon sequestration by our forests, which is estimated at 6.3 million tons of CO2. 2. In addition, Bhutan can offset up to 22.4 million tons of CO2e per year by 2025 in the region through the export of electricity from clean hydropower projects 3. Renewable energy projects in the country includes solar, wind, bio fuel, geothermal, fuel cells and small hydro
NEP	By 2050, Nepal will achieve 80% electrification through renewable energy sources having appropriate energy mix. Nepal will also reduce its dependency on fossil fuels by 50%. Solar, wind, biomass and hydro are sources of renewable energy in Nepal.
IND	1. To reduce the emissions intensity of its GDP by 33 to 35 % by 2030 from 2005 level. 2. To achieve about 40 per cent cumulative electric power installed capacity from non-fossil fuel-based energy resources by 2030 with the help of transfer of technology and low-cost international finance, including from Green Climate Fund (GCF). 3. To create an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030. 4. Solar, Wind, small hydro, biomass, waste to energy, geothermal, hydrogen and tidal energy contribute to renewable energy in the country.
PAK	Pakistan intends to reduce up to 20% of its 2030 projected GHG emissions subject to availability of international grants to meet the total abatement cost for the indicated 20 percent reduction amounting to about US$ 40 billion at current prices. Wind, solar, bio energy and small hydro contribute to renewable energy in Pakistan

SL	Intends to reduce the GHG emissions against BAU scenario unconditionally by 7 per cent (energy sector 4 per cent, and 3 per cent from other sectors), and conditionally 23 per cent (energy sector 16 per cent and 7 per cent from other sectors) by 2030. Solar, wind, hydropower, biomass, geothermal and ocean energy are major sources of renewable energy in Sri Lanka.

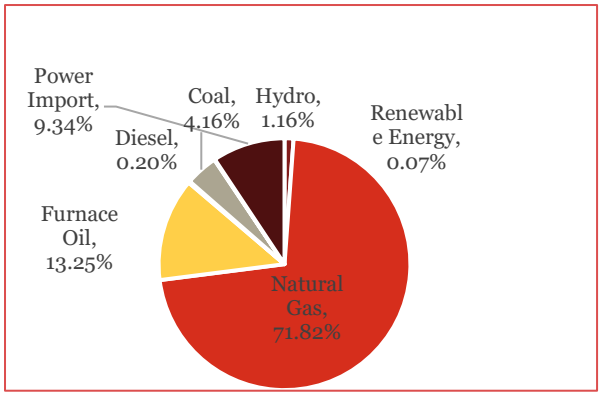
Source: indc.worldbank.org

In going ahead, SA nations are faced with challenges or potential roadblocks which can impede the achievement of National Development Commitments:

1. **Trade-Offs in Development** – The NDC commitments aim to support the development of nations in a sustainable way. However, all the SA Nations are currently developing in nature and as a result NDC commitments will pose the dual challenge of reconciling the economic growth trajectory with a pressing need to address the emerging climate change.
2. **Incoherent Implementation in Different Territories** – In SA region, the policies have been formulated at national levels, but this has been impeded by inadequate financing and lack of coordination between national and state/territorial implementation.
3. **RE Segment Roadblocks** – One of the options to decarbonize the energy supply is by enhancing the share of zero carbon sources viz. RE sources. However, major hindrances for the development of solar and wind projects is availability of sites for the implementation of the projects and subsequent prolonged land acquisition process.
4. **Change in Customer Behavior** - GHG Emissions are also subjective to improving the energy productivity by introducing new production processes, technologies, and efficient energy consumption behaviors. This would further require policy level interventions and additional investments to redefine the behind the meter consumption patterns.
5. **Grid Integration** - Cost-effective and reliable electricity grid planning and operations is a major challenge for SA nations given renewable energy generation is variable in nature.

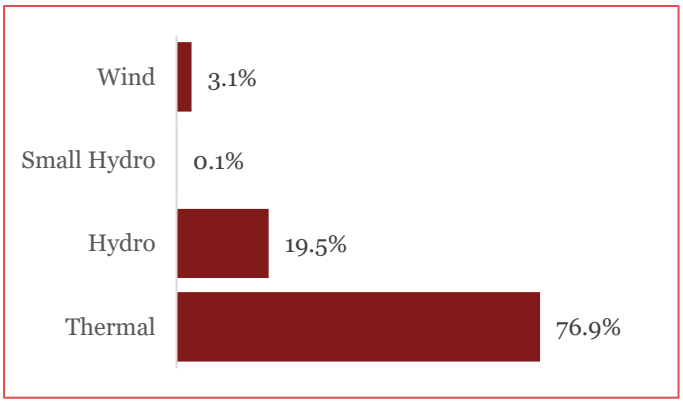
If we look into the Electricity Generation Mix of these countries, countries like Bangladesh and Sri Lanka have very little potential for renewable. Renewable is only ~1% and 3% in Bangladesh and Sri Lanka respectively currently. For these countries to achieve INDC target, cross border trade can play a pivotal role.

Figure 11: Bangladesh Energy Generation Mix



SOURCE: BPDB Report, 2020

Figure 10: Sri Lanka Electricity Generation Mix



SOURCE: CEB Report, 2010

Besides these, countries like India and Bangladesh are heavily dependent on coal/oil and are among the top ten world's greenhouse gas emitting countries. Such countries can leverage resource complementarities and trade power from neighboring countries like Bhutan and Nepal which are rich in hydro power.

Synergies in RE Integration and grid balancing:

Integration of large scale RE with the existing system and grid infrastructure would necessitate enhancing flexibility of the overall electricity system in terms of grid operation, commercial arrangement and market structure. The variabilities from renewable integration will lead to violations of voltage and frequency limits of the grid and will cause transient stability issues. Subsequently, there are other factors as well which further add-

on to the predicament like insufficient transmission capacity, low regional coordination, operation costs and inflexibilities associated with thermal and hydro plants. The RE commitments of the SA member nations are shown in the exhibit below:

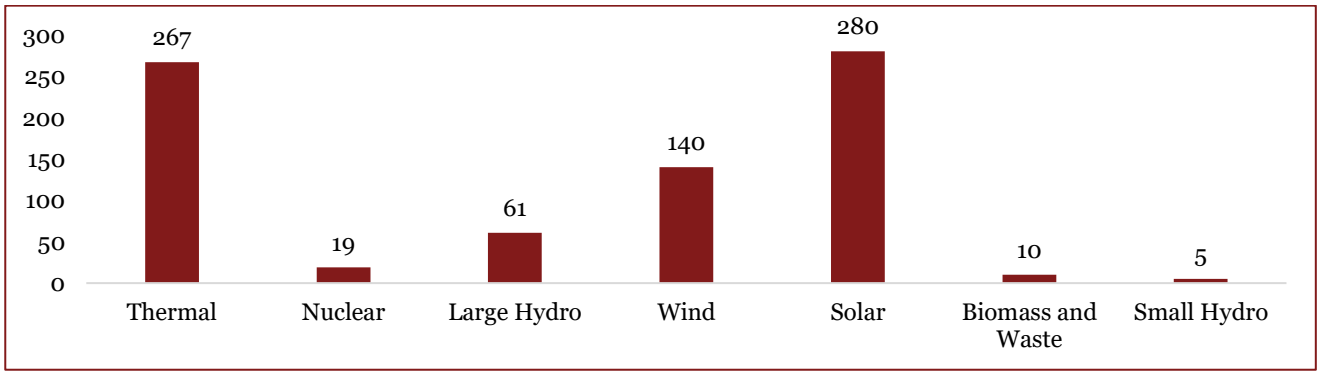
Table 4: RE targets of some countries in South Asia

Member States	Targets
Afghanistan	To achieve 10% of total energy mix through renewable energy (450-500) MW by 2032
Bangladesh	7.9 GW of Renewables by 2041
Bhutan	To achieve 20 MW of renewable (excl. hydro) power by 2025
India	To achieve 450 GW of renewable energy by 2030
Nepal	80% electrification through renewable energy sources having appropriate energy mix by 2050
Maldives	Renewable energy share to 70 percent of total capacity by 2030
Pakistan	16 GW of renewables by 2040
Sri Lanka	To achieve 50% generation from Renewables by 2030

Source: CEA optimal generation mix report, PSMP report 2016,Bangladesh,www.nerpa.org.pk, https://www.pucsl.gov.lk/

According to CEA Optimal Generation Plan 2029-30, renewables (excluding large hydro) would account for 53% of the total installed capacity and 315 of the total gross generation in 2029-30. The total renewable installed capacity (excluding large hydro) is expected to be 435 GW by the end of FY 2030.

Figure 12: Projected Installed Capacity in 2030 (GW)

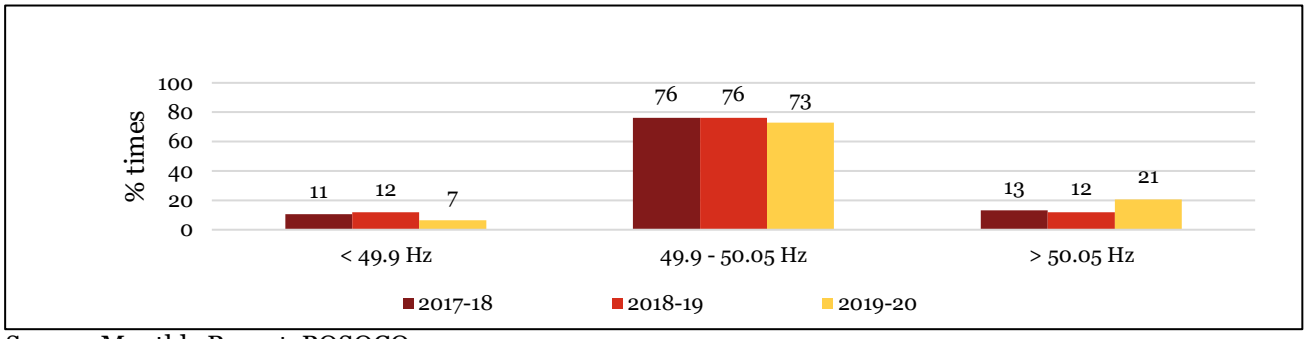


Source: CEA Optimal Generation Plan 2029-30

Impact of RE integration on Grid Frequency-India

The present frequency profile shows frequency to be outside the IEGC mandated frequency band (49.9-50. 05) for an average of 23% times. Such variation in frequency may also trigger (primary, secondary or tertiary response) from the different sources available in the system in similar order. The frequency response of India from 2017 to 2020 is exhibited in the graphical representation below:

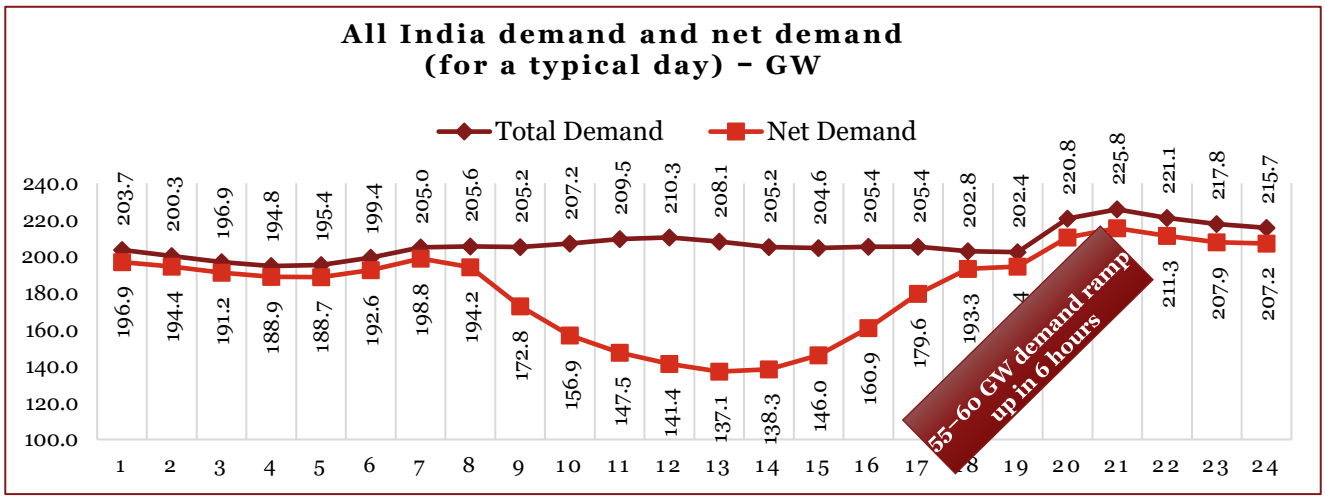
Figure 13: Frequency Profile Scenario in India



Source: Monthly Report, POSOCO

The figure below demonstrates the total demand vs net demand in a day during the high RE condition considering 175 GW of renewable capacity. The net demand (= total demand – RE power) is seen to exhibit a steeper ramp rate and lower generation levels. At present, the summer ramp-up is estimated to be 170 MW/min during evening peak hours and the winter ramp-up is estimated to be 200 MW/min in the morning.

Figure 14: Projected All India Demand and Net Demand (for a typical day in 2022) - GW



SOURCE: POSOCO Data

With RE penetration, there will be need of flexible resources like hydro to accommodate the variability of RE. Renewable sources such as solar and wind exhibit variability and intermittency in generation due to seasonality and changes in weather conditions. Countries such as India and Bangladesh could leverage the benefit of storage/pondage hydro from Nepal and Bhutan for balancing support.

Such a model for grid integration is used for Norway and Denmark where the hydro plants of Norway are utilised to balance Denmark's wind energy can be thought of for the south Asian countries.

Economic Gain from Cross Border Trade:

In countries like Nepal, only ~3% of the total hydropower potential of 43,000 MW, has been explored. Through Nepal-India electricity trade, Nepal can gain by developing its hydropower potential, its major electricity resource, for which India/Bangladesh could provide a ready market. The export earnings from electricity trade with India will boost Nepal's economy and human development. India, on the other hand, can promote renewable energy sources like solar and wind power whose intermittency can be balanced by hydropower import from Nepal.

A significant amount of revenue for Bhutan has been from sale of power and revenue so generated has helped it in its growth trajectory. Bhutan's domestic demand for electricity is relatively low, but power exports to India are an important source of revenue. According to International Hydropower Association, Energy export from hydropower contributes over 27 per cent of government revenue and 14 per cent of Bhutan's GDP

Hence would be an imperative that South Asian countries co-operate and benefit from each other's strength considering the crucial impact of power in the economy of a country. This necessitates the creation of a regional forum which will be responsible to build consensus and facilitate cross border trade.

Existing Frameworks and need for SAFEM

Table 5: Forums for Regional trade in South Asian Region

Forums for Regional trade in South Asian Region	AFG	BAN	BHU	IND	NEP	PAK	MAL	SL
SASEC Power Trade Working Group#		✓	✓	✓	✓		✓	✓
BBIN		✓	✓	✓	✓			
BIMSTEC*		✓	✓	✓	✓			✓
SAFIR		✓	✓	✓	✓	✓		✓
SEC (SAARC Energy Centre)	✓	✓	✓	✓	✓	✓	✓	✓
SAFEM	✓	✓	✓	✓	✓	✓	✓	✓

AFG-Afghanistan, BAN-Bangladesh, BHU-Bhutan, IND-India, NEP-Nepal, PAK-Pakistan, MAL-Maldives, SL-Sri Lanka
*Includes Myanmar and Thailand
Includes Myanmar

Traditionally, CBET in SA region has been facilitated through various agreements initiated and worked upon at inter-governmental level. A distinct shift towards competitive bidding models has been lately observed. Further, medium as well as short-term trade agreements are being executed. In the South Asian context, USAID, ADB, the World Bank, and SAARC have played a vital role in highlighting the need for regional cooperation in the energy sector and have helped in the creation of various forums for undertaking studies to identify various issues, mobilizing support from stakeholders, and providing financing for the implementation of the identified projects.

The SAFEM (South Asia Forum for electricity Markets) is proposed to be formed with the objective of taking regional trade a step forward by acting as a neutral body, facilitating regional electricity market development and creation. SAFEM will also work towards adoption and implementation of guidelines and policies by advising the South Asian countries on power trade and markets in the region. The Forum would work towards various facets of electricity market, including market structure and products, market design and rules, payment mechanism of trade. The following are the envisaged functions of SAFEM:

- ✓ Review the Power Market policies and rules/regulations for cross border Electricity trade in each of the South Asian countries in the Region.
- ✓ Assess market opportunity for private sector participants in regional electricity market in South Asia.
- ✓ Identify issues/challenges for regional electricity market development in the region.
- ✓ Assess new and upcoming market products such as financial derivatives, capacity markets, etc. for electricity trade.
- ✓ Renewable Electricity trade in South Asian regional market
- ✓ Creation of Regional Ancillary Market for South Asia Region
- ✓ Provide framework for multilateral and trilateral power market development in South Asian region.
- ✓ Deliberate on potential of expanding the Electricity Market to include Gas
- ✓ Deliberate on potential to expand electricity market to South East Asia

3. As-is Scenario Analysis

3.1. South Asian Power Market

The Power market structure in South Asia is at various stages of maturity with all the countries except India following a single buyer model. Many of the countries still have vertically integrated utilizes managing the G, T&D functions whereas all the countries have an independent regulator. The exhibit below outlines the key characteristics of market structure in South Asian Region.

Vertically Integrated	Single Buyers	Private Sector Participation in Generation	Independent Regulator
Afghanistan *Maldives* *Nepal* *Sri Lanka*	*Afghanistan* *Bangladesh* *Nepal* *Pakistan* *Sri Lanka* *Bhutan* *Maldives*	*Bangladesh* *Bhutan* *India* *Nepal* *Pakistan* *Sri Lanka* *Maldives*	*Bangladesh* *India* *Nepal* *Pakistan* *Sri Lanka* *Bhutan* *Maldives*

Private sector participation in generation segment of the business is allowed across all the SA member nations whereas transmission and distribution remain largely under ownership of Government across the region. In India, private investors are permitted to invest in the creation of transmission infrastructure under a license under the competitive bidding guidelines. The Indian power sector is slowly opening to private sector participation in distribution sector although currently there exist only few private sector Discoms.

Table 6: Sector Participation

Country	Private Sector Participation
India	➢ A little over **47 per cent** of the total installed **generation capacity** is contributed by private sector. ➢ In cities such as Delhi, Mumbai, Ahmedabad, and Kolkata, private entities own the distribution business. Discoms (or distribution licensees) purchase power from generation companies through power purchase agreements (PPAs), and supply it to their consumers (in the area of distribution). ➢ Some key private companies in the **distribution sector include Tata Power and Reliance Energy Limited** ➢ **Transmission** system is publicly owned by PGCIL
Nepal	➢ Total number of IPP (Independent Power Producer)- owned entirely by the private sector-owned generation projects in operation is 98 with a combined installed capacity of 696. MW which **is 52%** of the total installed capacity of Nepal ➢ **Transmission** and **Distribution** system are publicly owned.
Bangladesh	➢ Private **generation** contributes to 6503 MW which is about **30%** of the total installed capacity ➢ Power Grid Company (PGCB), a subsidiary of BPDB looks after **transmission** ➢ BDPB functions as the single power buyer. Distribution entities purchases electricity from BPDB. **Distribution** utilities are Dhaka Power Distribution Company (DPDC), Dhaka Electric Supply Company (DESCO), West Zone Power Distribution Company Limited (WZPDCL), Rural Electrification Board (REB) and Northern Electricity Supply Company Ltd (NESCO), which are all publicly owned.

Pakistan	➢ There are around 42 independent power producers (IPPs) that contribute 6100 MW **(16%)** to the total installed **generatio**n capacity in Pakistan ➢ National Grid Company, a publicly owned entity is responsible for **transmission** ➢ **Distribution** is publicly owned. There are 11 Distribution and Supply companies under NEPRA
Sri Lanka	➢ Private sector participation in the electricity industry is limited to power generation as IPP (Independent Power Producer) and SPP (Small Power Producers). About **30%** of the total installed **generation** capacity is owned by private sector ➢ There are two **distribution utilities** CEB and LECO which are both public entities ➢ **Transmission** is owned by CEB, a public entity.

Source: CEA, NEA Annual Report, BPDP Annual Report, eefa.org/wp-content/uploads/2018/11/Pakistans-Power-Future_December-2018.pdf, https://www.adb.org/sites/default/files/institutional-document/547381/sri-lanka-energy-assessment-strategy-road-map.pdf

The tariff determination process in each of the member nations can be a key determinant on the commercial framework under which cross border power trade takes place. The tariff determination process for generation and sale of power varies within each country in the South Asia region. Depending on the power procurement route adopted, tariff is either determined using principles specified in regulations / guidelines, discovered through a process of competitive bidding and / or provided in PPAs or negotiated with developers. However, in most of the countries in the SA region, tariff for most of the power sale is determined by the independent regulator based on tariff determination mechanisms of the independent regulator. Further in some countries such as Nepal a significant part of generation happens through NEA (the government-owned vertically integrated utility), and hence the generation tariff is not determined separately by the Nepal Electricity Regulatory Commission.

In Bangladesh, Independent Power Producers (IPPs) and other public generators sell their energy to BPDB on the basis of long/medium term Power Purchase Agreement (PPA) (varying between 5-25 years) and BPDB sell it to other supply entities and consumers.

In Bhutan, the wholesale market is based on a single buyer model (SBM). The electricity supply industry is partially unbundled and equipped with separate generation entity DGPC. Bhutan power corporation, the integrated T&D entity acts as the off-taker and is responsible for supplying power to the consumers.

Nepal Electricity Authority (NEA) acts as vertically integrated entity and acts as the Single buyer. Nepal currently follows a "Single Buyer model Multi seller model" where NEA is responsible for procuring power from all IPPs as a single buyer and it turn supplies electricity to the end consumers.

In Sri Lanka, The Electricity Act 2009 introduced a single buyer model, with Ceylon Electricity Board as the designated single buyer as well as the transmission service provider. About 69% of the total installed capacity in the country is owned by CEB, while IPPs and SPPs own the rest. All the IPPs are oil-fired, operating on 10-20 year power purchase agreements; all the SPPs are renewable energy-based, with 15-20 year contracts.
India has shifted to competitive auctions for procurement of power from private generators since the last decade. Further the competitive auctions for procurement of power from RE sources (solar and wind) has resulted in rapid reduction in cost of RE power from a high of ~ 17 INR/kWh for solar power in 2010 to as low as INR 2.36/kWh in 2020. India further has power exchanges (IEX, PXIL) where price is determined across various products such as Day Ahead Market, Intra Day market etc. through transparent matching of bids.

Bangladesh and Pakistan have also been gradually moving towards competitive auctions for procurement of power although regulated/negotiation mode continues to be the dominant mode for power procurement. The table below provides a snapshot of the method of power procurement and tariff structure across various member nations.

Table 7: Procurement Methodology

Country	Regulated Tariff	Competitive Bidding	Structure of Tariff
AFG	Yes	No	Single part
BAN	Yes	Yes (Selective)	Two-part

Country	Regulated Tariff	Competitive Bidding	Structure of Tariff
BHU	Yes	No	Single part
IND	Yes	Thermal, Renewable (competitive bidding) Hydro-Regulated Route	Two-part; Deviation from Schedule handled through DSM/UI
MAL	Yes	No	Two-part
NEP	Yes	No	Single part
PAK	Yes	Yes (Selective)	Two-part
SL	Yes	No (fixed upfront for RE)	Single part

Source: Respective country websites

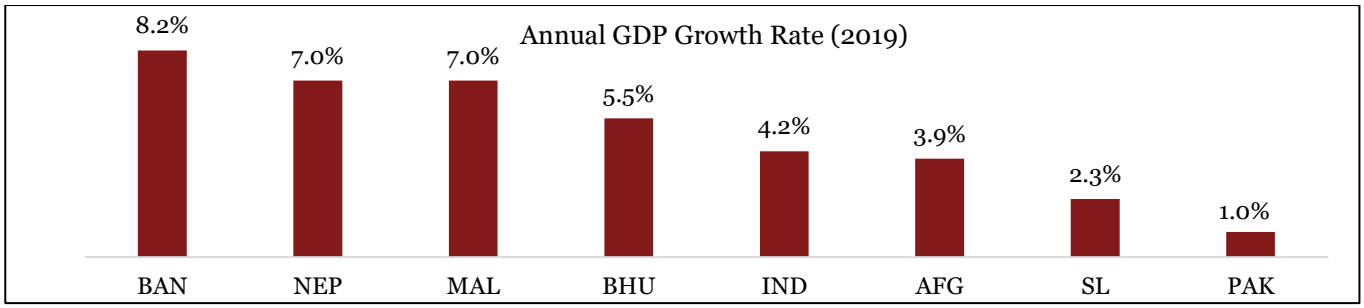
The cross-border power trade started in the SA region under bilateral agreements. The CBET continues to be mostly bilateral in nature where the tariff/other terms and conditions of power trade are primarily based on inter Government negotiation. In the recent past although there has been a gradual shift towards commercial form of cross border power trade with even power being procured under competitive auctions. The creation of a regional market will make price more competitive and transparent.

Demand and Supply Scenario:

The region has been growing at an average annual rate of 6 per cent GDP per capita and this is expected to be maintained in the coming years. As COVID-19 spreads across the region, South Asia is likely to register one of its worst economic performance for 2020. The region will likely experience its worst economic performance in the last 40 years, with temporary contractions likely across multiple countries.

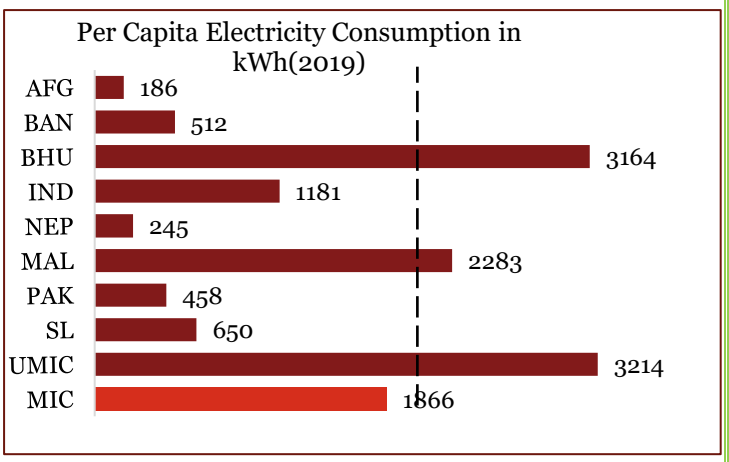
However, a robust rebound in the economic growth has been projected for most of the countries for 2021. It's long been axiomatic that economic growth and energy demand are linked. As SA returns to its long run growth trajectory in the next year, the electricity sector is expected to sustain the growth over the next decade.

Figure 15: Annual GDP Growth Rate of SA Countries



Source: World Bank

Figure 16: Per Capita Electricity Consumption in kWh



Source: MoP, GoI BPDB-Annual Report-BAN, Ministry of Finance - GoN , AFG-ESMAP ,Island Electricity Data Book-MAL, Status of Industry Report-PAK, CEB Annual Report-SL, Bhutan statistical yearbook, 2020-BHU, UMIC,MIC-WB

The per capita consumption of power is one of the important indicators of economic development. However, with less than 1000 kwh per capita annual consumption in the region, almost all countries are struggling to provide reliable 24x7 electricity to its people let alone providing enough power for accelerating the growth of the economy in general.

With many of the South Asian countries targeting to achieve "**Middle Income/Upper Middle-Income status**" in the next decade, significant growth in power demand is expected for the region.

Almost three fourth of the demand is expected to come from India and there will is a need for substantial additional capacity addition. Regional cooperation to develop generation capacity will improve energy affordability, access and low carbon transition – essential imperatives to achieve Sustainable Development Goals (SDG).

Evolution of Indian Power Market

The Indian power sector has evolved from a quite rigid market structure to a more open yet regulated one. The enactment of the Electricity Act, 2003 has opened power market which was characterized by long-term PPAs, mandated for bulk power market with de-licensing of thermal generation, open access and trading, setting the tone for a competitive environment in the Indian power sector.

The introduction of non-discriminatory open access provided the necessary impetus for enhancing competition in the power market. As per Section 2(47) of Electricity Act 2003, open access is defined as:

"open access" means the non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission.

The figure below shows a timeline of introduction of key regulations and significant developments related to the power market:

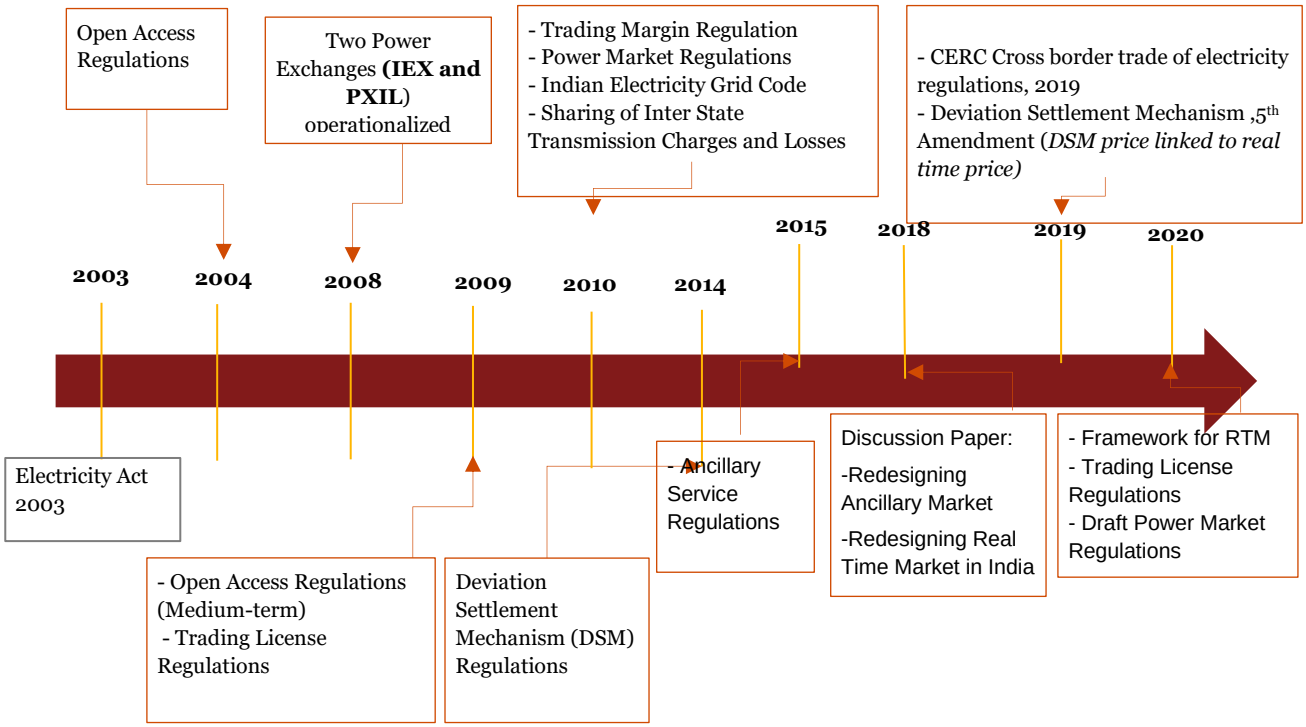


Figure 17- Timeline of regulations related to power market

Source: CERC Regulations, MoP website

The second major development happened in 2008 with the start of power exchange. This pioneered the development of power trading in India. It provides an electronic platform to the various participants (utilities, generators, IPPs) in power market to buy and sell power.

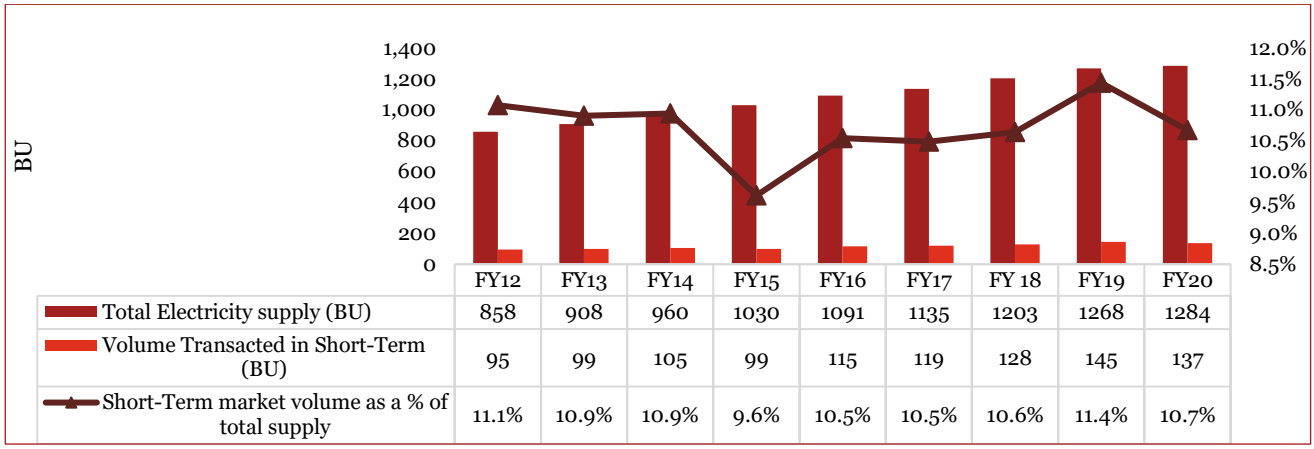
The power market related developments in the recent years such as Deviation Settlement Mechanism (DSM) regulations and linking DSM prices to Power Exchange (PX) prices, ancillary services, Real-Time Market (RTM) and draft power market regulations (2020) are paving the way for transforming the Indian power market into a more efficient one. Further, the integration of large-scale renewable energy into grid is expected to bring about major transformation in real time and ancillary markets.

Indian Power Market

Bulk electric power supply in India is mainly tied in long-term contracts (around 25 years) and the rest in medium term contracts (up to 5 years) and short-term contracts (up to 1 year). The DISCOMs who have the obligation to provide electricity to their consumers mainly locked in through long term contracts (~ 86% of transaction). To meet the short-term requirements of the market participants, short term trading plays an important role in the power market. Short-term transactions of electricity refer to the contracts for less than one year involving the trades as illustrated in the diagram below. Amongst the various mechanisms for Short Term trading, trade

between DISCOMS and Power Exchange mechanisms (Day Ahead Market) combined, generally constitute above 50% of total electricity transacted in the short-term market. The volume of transactions in the short-term markets as a percentage of total generation over the years is shown in the graph below

Figure 18: Volume of transactions in the 'Short Term' power markets in India



	FY12	FY13	FY14	FY15	FY16	FY17	FY 18	FY19	FY20
Total Electricity supply (BU)	858	908	960	1030	1091	1135	1203	1268	1284
Volume Transacted in Short-Term (BU)	95	99	105	99	115	119	128	145	137
Short-Term market volume as a % of total supply	11.1%	10.9%	10.9%	9.6%	10.5%	10.5%	10.6%	11.4%	10.7%

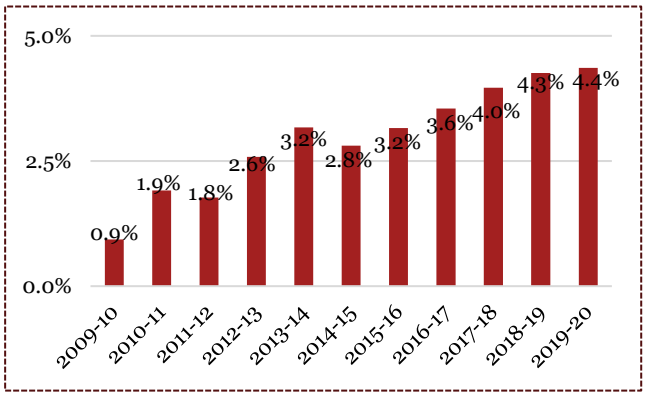
Source: CERC-Report on Short Term Power Market in India

- The volume of short-term transaction electricity has increased from 9% of total energy generation in 2009-10 to 11% in 2019-20.
- The size of the short-term market in India was 137 BU in the year 2019-20, which was 6% lower than the short-term market in the year 2018-19 (145 BU).

Although the volume on spot market and short-term trades have steadily grown over last few years, the dominance of long-term contracts hinders price discovery through transparent real time market. Such market structure also lacks flexibility to support integration of variable renewable resources.

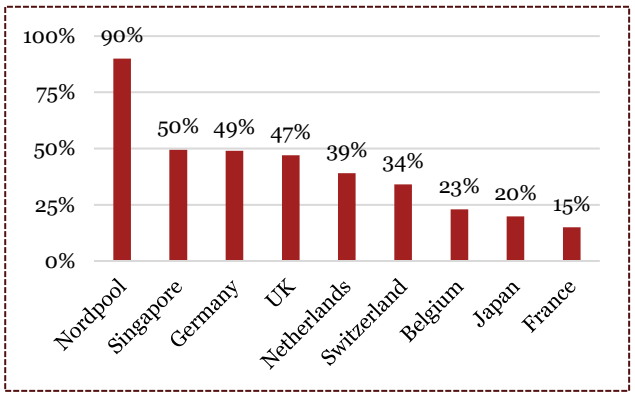
A comparison on share of electricity transacted through exchanges to the total consumption for various developed nations is represented as below:

Figure 19: Percentage share of volume transacted through exchange



Source: CERC-Report on Short Term Power Market in India

Figure 20: Share of exchange transactions (%)



Source: Individual Country Websites

The graphical representations conclude that volume of the electricity transacted in the developed economies is much higher as compared to India.

Considering the country is transitioning away from the thermal generation sources towards variable renewable sources, large scale integration of renewable energy resources would necessitate flexible grid operation, market structure and commercial arrangement

Ancillary Markets in India

The Central Electricity Regulatory Commission (CERC) has issued notification for ancillary services operation on 13th August 2015. Subsequently the Power System Operation Corporation Limited (POSOCO) has published the detailed procedure of ancillary services operation in March, 2016.

The existing regulatory framework limits ancillary services only to providing frequency support. The frequency support or the 'reserves regulation ancillary services' /RRAS market is governed by the CERC 'Ancillary Services Operations' Regulations, 2015 and the RRAS market has been in operation since April, 2016. The box below represents the salient features of the Ancillary Services Market in India.

Emerging Ancillary Market structure

The nominal frequency of operation in Indian grid is 50.0 Hz and the permissible frequency band specified by Indian Electricity Grid Code (IEGC) is 49.5 Hz to 50.2 Hz w.e.f. 3rd May, 2010. System frequency is a continuously changing variable parameter determined and controlled by real-time balance between system demand and total generation. The existing ancillary services regulation specifies stipulations for frequency response support to be provided by generators to stabilize the grid. The figure alongside shows the status of Frequency response ancillary services status in India.

The framework enables use of un-requisitioned surplus generation capacity of existing generators as ancillary services.

Primary Response

- Partially Exists in the form of RGMO

Secondary Response

- Automatic Generation Control (Presently only Pilot Project implemented)

Tertiary Response

- Tertiary Fast Control : Pilot project under implementation
- Tertiary Slow Control: Operational through CERC (Ancillary Services Operations) Regulations since April 2016

Figure 21: Volume traded in RTM (MU) with price

Ancillary Services Market in India: Salient features

- All Regional Generators, whose tariff for full capacity is determined by CERC are mandated to provide the Ancillary Services as RRAS Providers.
- NLDC, through the RLDCs has been designated as the Nodal Agency for Ancillary Services Operations and it prepares the merit Order Stack based on the variable cost of generation.
- The energy dispatched under RRAS is deemed delivered ex-bus and any variation from the scheduled values beyond revised schedule is settled as per CERC Deviation Settlement Mechanism (DSM) Regulations.
- RRAS Energy Accounting is conducted along with the DSM account on weekly basis by the respective Regional Power Committee.
- Any post-facto revision in the rates/charges by RRAS providers is not permitted.
- In Regulation Up, fixed and variable charges along with pre-specified mark-up are payable to RRAS providers from the pool. CERC specified mark-up for participation regulatory up is INR 0.50/kWh.
- In Regulation Down, 75% of variable charges are payable by RRAs providers to the pool
- No commitment charges are payable to the RRAS providers.

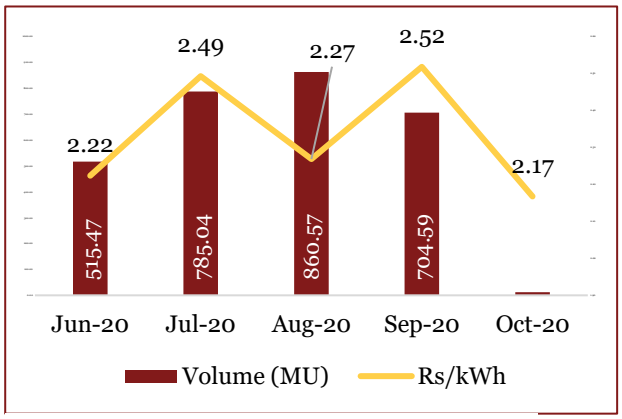
Key changes suggested by CERC in Ancillary market structure

- All Inter-State / Intra-State generation (Public or Private) sources may qualify to provide Ancillary Services
- Introduction of competition and transparency in the Ancillary Services Market
- Price for Ancillary Services to be calculated as the cost of the marginal resource providing the Service
- Uniform market clearing price to be discovered for each block of time for all services in the market
- Demarcation between highest quality tertiary reserve (fast spinning reserve) and slow reserve

Real time Markets:

The Real Time Market was launched by CERC in June 2020.Procedure for Scheduling Collective Transactions in the Real Time Market are carried out as per guidelines as issued by Power System Operation Corporation Ltd; CERC Power Market Regulations, 2010; CERC Open Access in inter-State Transmission Regulations, 2008; CERC Indian Electricity Grid Code Regulations, 2010 as amended from time to time and the Bye-Laws, Rules and Business Rules of the Exchange.

The Real-Time energy market lets market participants buy and sell wholesale electricity during the course of the operating day (intra-day). The primary purpose of the real-time market is to allow changes in production and consumption schedules, to accommodate differences between day-ahead forecasts of system conditions and actua



Source: CEA Market Monitoring Report

Salient features:

- Trading of 15-minute contracts
- Double-sided anonymous auction bidding process
- Buyers and sellers to obtain Clearance from SLDC by based on availability of network and ABT meters
- Exchange to publish Area Clearing Price (ACP) and Area Clearing Volume (ACV)
- Exchange to manage risk management leveraging bank balance, requisite margin, including any additional margin as specified for the respective trading segment or the type of contracts

Following are the available market products in the power exchanges in India:

Product	Features	Trading mechanism
Day-Ahead Market (June 2008)	• Delivery for next day • Price discovery: Closed, Double-sided Auction Trading of 15-minute contracts • Prior clearance obtained from Regional/State Load • Dispatch Centre by buyers and sellers	Auction
Term-Ahead Market (September 2009)	• For delivery up to 11 days • Daily Contracts, Weekly Contracts • Regional Contracts • Firm Delivery • Delivery Point: Seller's regional periphery • Scheduling: As per Procedure for Scheduling of Bilateral Transactions as notified by CERC	Continuous
Intraday Market & Day-Ahead Contingency Market (July 2015)	• Intraday: For Delivery within the same day • DAC: Another window for next day, Gate closure: 3.5 hours	Continuous
Renewable Energy Certificates (February 2011)	• Green Attributes as Certificates. Sellers: RE generators not under feed in tariffs Buyers: Obligated entities; 1MWh equivalent to 1 REC	Auction

Product	Features	Trading mechanism
Energy Saving Certificates (September 2017)	• 1 Escert= 1 Mtoe (Metric Ton Oil Equivalent) • Trading Session every Tues of Week, Trading time 1300 hrs. to 1500 hrs.	Auction
Real-Time Market (1 Jun'20)	• Delivery within an hour • Price discovery: Closed, Double-sided Auction • No. of trading sessions in a day: 48 • Bid duration of each session: 15 minutes • Bidding session starts: 22:45 hrs. (D-1) • Gap between two consecutive bid-sessions: 30 minutes • Each session: 2 blocks of 15 minutes	Auction
Green Term Ahead Market (August 2020)	• Intraday, DAC, Daily and Weekly	Continuous

Current Regional Trade in SAR

The regional power trade which is to the tune of ~3900 MW is bilateral, confined to Bhutan-India, India-Bangladesh and India-Nepal. Such power trades are mainly through long-term Power Purchase Agreements and few medium/short term agreements. The CASA project is currently under construction which will allow for the export of 1300 MW from Tajikistan and Kyrgyzstan to Afghanistan and Pakistan.

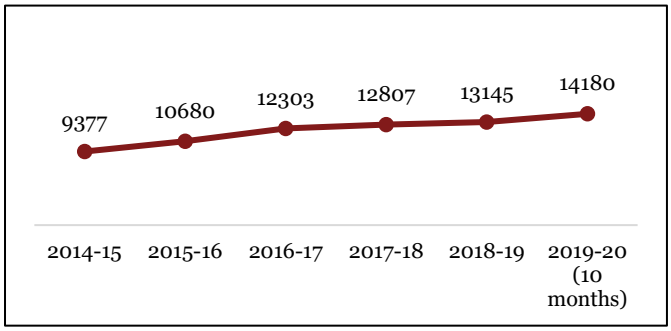
The tables below provide the details of the existing cross-border electricity transactions along with the structure of the power trade agreements in the South Asian region

Table 8: Existing Scenario

Particulars	Source	Type
India → Bangladesh (~1160 MW)	250 MW NTPC	G-G
	250 MW Market	Comml
	160 MW Tripura	G-G
	500 MW Market	Comml
Bhutan → India (2260 MW)	1020 MW Tala	G-G
	336 MW Chukha	G-G
	60 MW Kurichhu	G-G
	126 MW Dagachhu	Comml
	720 MW Mangdechhu	G-G
India → Nepal (~587 MW)	237 MW India	G-G
	80-190 MW Market	Comml
	160 MW Market	Comml
Kyrgyzstan & Tajikistan **→Afghanistan → Pakistan (CASA - Project-1000 MW)**	Afghanistan → Pakistan (1000 MW)	CASA Project (Yet to commence)

Traditionally, CBET in SA region has been facilitated through various agreements initiated and worked upon at inter-governmental level. However, lately, a distinct shift towards commercial/competitive bidding models has been observed in the CBET particularly India-Bangladesh power trade with ~ 790 MW of power being traded through commercial mechanisms.

Figure 22: Electricity Energy (MU) traded amongst SA



Source: Power Trade data collected from BPDB Annual Reports, NEA Annual reports and DGPC Annual Reports, Corresponds to Indian Financial Year

The CBET in SA region has more than doubled in the past six years from ~9377 MU to ~14,000 MU and is expected to increase significantly in future with the planned/proposed development of several regional generation/ and cross border transmission interconnections across South Asian countries Such power system integration shall also enable trading on a multilateral basis wherein two countries having no common border could trade electricity through a third country acting as transit.

Trilateral Trade in South Asian Region

The Cabinet Committee on Public Purchase (CCPP) in Bangladesh has approved a proposal for importing about **500 MW electricity** from the proposed 900 MW Upper Karnali Hydroelectricity Project being developed by GMR in Nepal.

The power from Nepal will be exported to Bangladesh via NTPC Vidyut Vyapar Nigam Limited (trader), India and using the Indian transmission corridor following the **Central Electricity Regulatory Commission (Cross Border Trade of Electricity) Regulations, 2019 and Guidelines on import and export of Electricity issued by Ministry of Power, Government of India**

3.1.1. Regional Projects

Regional projects will include all such generation/transmission projects that trade or facilitate trade of power to two or more countries. There are several projects which are under implementation to facilitate cross border trade. There has been about 400 billion USD of foreign direct investment for projects in the developing countries in South Asia Region. The list detailing projects in each category is provided in the Annexure 1.

3.1.2. Renewable Penetration in SA countries and Integration

The energy sector is the largest source of greenhouse gas (GHG) emissions and it is expected to increase by about 16% by 2040. There is an urgent need for the SA member states to diversify its energy mix to meet their energy demands. The installed capacity of renewables is only a fraction of the total potential renewable energy resources that could be utilized. Increasing policy push and private participation have given an impetus to RE adoption in India. Usage of solar and wind resources in Bangladesh, Pakistan and Sri Lanka continues to be very low (<1%). The scope of diversification into renewable sources is higher than ever before, given that the cost gap between electricity generated from renewables and that from fossil fuels is narrowing quickly

Secondly, renewable energy costs in the subregion are highly competitive, offering some of the lowest installed costs of renewable energy systems globally. These costs are expected to further decline in line with the global tariff reduction curve on renewables. A further advantage is the fact that much of the energy consumption or production infrastructure that will exist in in 2030 has yet to be built, allowing South Asian countries to leapfrog to more advanced technologies. The installed capacity of RE sources for various member nations are provided in the table below:

Table 9: Renewable Capacity in SA Nations-2019

Member States	Solar (MW)	Wind (MW)	Hydro (MW)/SHP	Bio Energy (MW)
Afghanistan	1.8	0.23	53	-
Bangladesh	415	2.9	230	1
Bhutan	-	-	1615	-

Member States	Solar (MW)	Wind (MW)	Hydro (MW)/SHP	Bio Energy (MW)
India	34,915	37,756	4683*	10,028
Nepal	1	-	1181	-
Maldives	16	-	-	214
Pakistan	600	-	201	144
Sri Lanka	392	690	413*	124

Source: Country specific websites
*excl. large hydro

RE targets

South Asian countries have lined up aggressive renewable energy targets to which their renewable energy programs are aligned. The targets of the various member states of South Asian Region are provided in the Table below

Table 10: Targets by SA nations

Member States	Targets
Afghanistan	To achieve 10% of total energy mix through renewable energy (450-500) MW by 2032
Bangladesh	7.9 GW of Renewables by 2041
Bhutan	To achieve 20 MW of renewable (excl. hydro) power by 2025
India	To achieve 450 GW of renewable energy by 2030
Nepal	80% electrification through renewable energy sources having appropriate energy mix by 2050
Maldives	Renewable energy share to 70 percent of total capacity by 2030
Pakistan	16 GW of renewables by 2040
Sri Lanka	To achieve 50% generation from Renewables by 2030

Source: Country specific websites

The role played by an interconnected power grid for South Asia in boosting renewable energy, enhancing Affordability and access while lowering emissions will have a bearing on the subregion's efforts to achieve the SDGs. Given the central role played by energy across the 17 SDG[2]s, the sustainable energy dividends from power grid integration can help achieve many other SDGs in the subregion, including those on poverty, hunger, health, water and sanitation, infrastructure as well as the environmental dimensions of urbanization, climate change, and life under water and on land.

Challenges to grid due to increasing share of renewable in SA Region:

The large-scale renewable capacity addition planned by the SA nations, which is known for variable and intermittent generation, is likely to have significant implications on the reliability and stability of the SA power system.

Apart from incurring system costs for integration of renewables in the grid (in terms of upgrade to the transmission and distribution networks), the need for additional firm balancing capacity has been observed in

[2] The agenda includes a set of 17 Sustainable Development Goals (SDGs) to end poverty, fight inequality and injustice, and tackle climate change by 2030.Eg(No poverty, no hunger, good health, quality education, gender equality, clean water and sanitation, RE, good jobs and economic growth, innovation & infrastructure etc)

renewable rich countries worldwide for ensuring grid reliability and stability. Variable generation from renewables impacts system stability not only in case of reduced power output, but also in case of excessive generation. In the past years, power produce of several wind farms has been asked to back-down by load dispatch centers in multiple states in India to maintain grid stability.

While improved forecasting techniques of sunshine and wind velocity would definitely help in better planning for variations, complete accuracy of forecasts is often difficult to achieve. Notwithstanding, forecasting alone will be insufficient to ensure seamless integration of renewables without impacting overall grid stability. Thus, considering the government's firm resolve to achieve its renewable capacity addition targets, the power sector needs to be able to firmly support the variability and intermittency of the generation output of renewables through the provisioning of peaking support and ancillary services.

Table 11: Challenges of RE Integration

Challenge / Issue	Options to address the challenges
Frequency fluctuations / stress on grid due to intermittent generation	• Commercial mechanisms: Ancillary services market (Frequency, Voltage, reactive power etc), evening market, and Suitable power market design. • Demand response / demand side management
Monitoring and managing RE sources scattered across the region	• Centralised institution to periodically conduct steady-state and dynamic stability/security analysis • Strict enforcement of Grid Code, Regulatory directives

In a system with high penetration of renewable energy sources (RES), there are several flexibility options available which include:

- RES technology mix (using complementing technologies)
- RES generation management (e.g. curtailing of RES)
- Storage systems (e.g. pumped hydro)
- 'Controllable' power plants (fossil fuel, hydro)

The adoption of a flexibility option depends on grid requirements, scale of operations, the characteristics of the system and the cost involved. While thermal power generators are capable of providing flexible generation to overcome the variability of renewable power, they are often polluting sources of power and subject to limitations of fuel availability. Hydropower, on the other hand, is the only clean renewable source capable of providing flexibility, grid balancing and ancillary services.

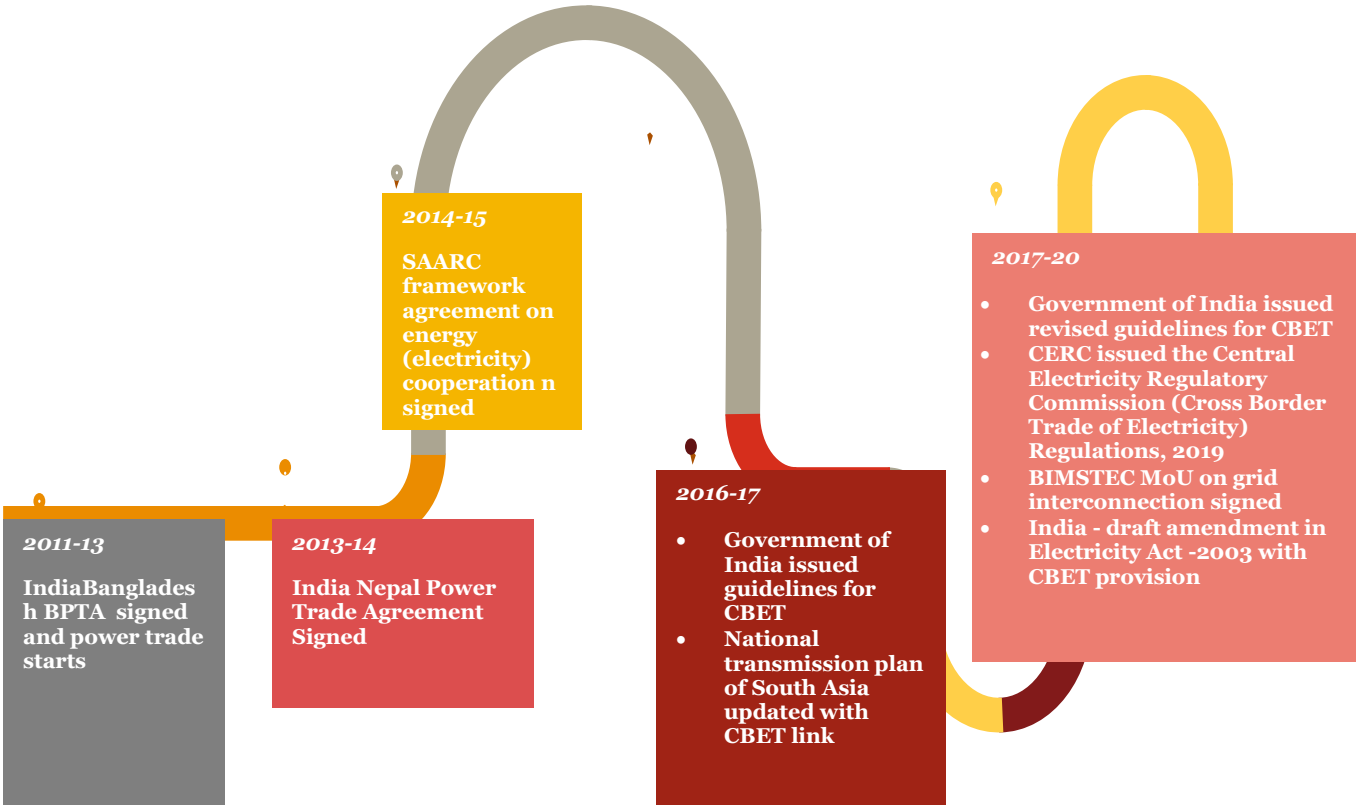
Under the current context, Cross border trading of hydropower could play an important role in Renewable Integration and Grid Balancing. A case in point could be India which plans to develop 175 GW of RE projects by 2022 and further 450 GW of RE by 2030 which would require significant balancing capacity. An assessment of the evolving power mix shows that the proportion of installed hydropower capacity in relation to the overall installed capacity has observed a steady decline in India, with hydropower accounting for only 12 percent of the total installed capacity as of March 2020. Hydro imports from SA countries such as Nepal and Bhutan which have abundant unexplored hydropower potential could help in integration of renewables in India.

3.1.3. Policies and Regulation for CBET

Various bilateral arrangements for CBET in South Asia have emerged out of necessity induced by severe power shortages and growing demand. The past practice has been of scattered project based and localized CBET under bilateral agreements, due to lack of a platform for integrating these components into a regional grid. With the signing of the SAARC Framework Agreement for Energy Cooperation (Electricity), the platform now exists. The

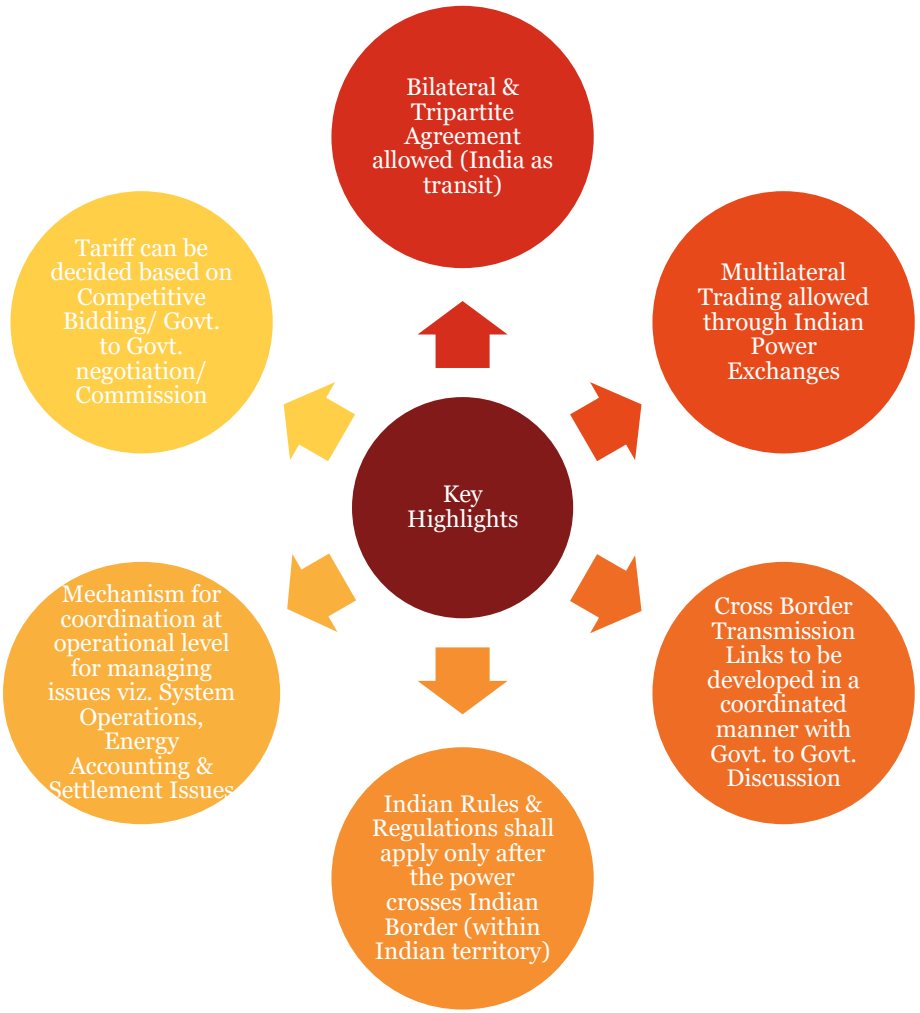
Framework Agreement contains broad-based provisions for cooperation among member states for promoting cross-border electricity trade.

The graphic below provides the key developments in policy and regulatory framework during the last decade



Among the SAR countries only India has come up with its own guidelines or cross border trade in 2016 whereby it laid definite guidelines to facilitate cross border trade which was further modified in 2018. This among other provisions provides a framework for undertaking trilateral power trade with India as the intermediate country under the overall framework of bilateral agreements signed between Government of India and the Government of respective neighboring country(ies) Further CERC subsequently issued the Cross Border Trade of Electricity Regulations,2019 to facilitate cross border trade with India. Some of the salient features of these policies and regulations are provided below

Guidelines to Cross Border Trade dated 6th Dec 2016	Guidelines to Cross Border Trade 2018	CERC (Cross Border Trade of Electricity) Regulations, 2019
➢ MoP to designate an authority for process of approval and laying down procedure for cross border trade ➢ Only Term Ahead Contracts, Intraday Contracts and Contingency Contracts allowed in power exchange ➢ No explicit provision for Trilateral Power Trade	➢ Imports may be permitted when demand exceeds generation and exports in case of excess demand ➢ Procedure of determining tariff for import and export was detailed in this guideline ➢ Transmission interconnection will be planned jointly by transmission planning agencies of the respective country ➢ Provision for trilateral power trade ➢ All products of PX allowed in CBET	➢ Designated authority will be responsible for the planning of the transmission system to facilitate cross-border trade of electricity ➢ Settlement nodal agency will be responsible for settling all charges related to grid operations ➢ National Load Dispatch Centre shall act as the System Operator for cross border trade of electricity between India and the neighboring countries

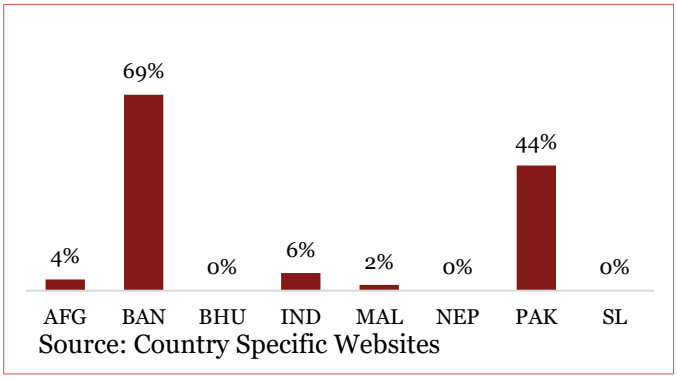


As per current cross border regulation in India, National Load Dispatch Centre shall act as the System Operator for cross border trade of electricity between India and the neighboring countries and shall be responsible for granting short-term open access and for billing, collection and disbursement Central Transmission Utility shall be responsible for granting long-term access and medium-term open access with respect to cross border trade of electricity.

3.1.4. Existing Gas Market Structure

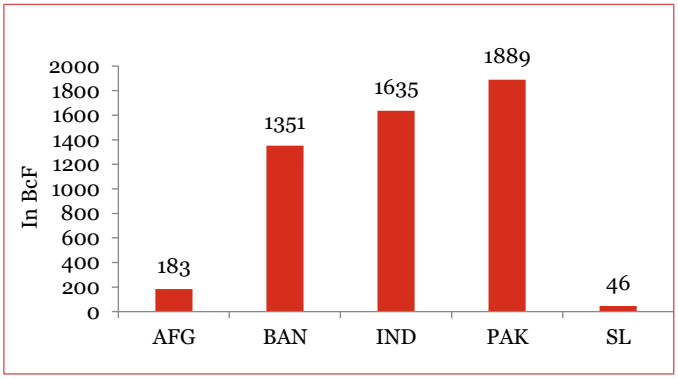
With the aggressive INDC commitments made by multiple SA member nations and the shared vision of reducing carbon footprint of energy sector, natural gas is expected to play a major role in foreseeable future in the energy sector of the SA countries. Natural gas is among the cleanest fossil fuels (amongst available fossil fuels) and has been often used as a fuel for electricity generation, manufacture of fertilizers, plastics and other commercially important organic chemicals vis-à-vis for cooking in domestic households and a transportation fuel for vehicles.

Figure 24: Gas in primary energy mix



Source: Country Specific Websites

Figure 23: Gas Demand-2018



Among the SA member states, Pakistan and Bangladesh have gas as their primary fuel. The energy mix of Bangladesh is changing slowly but indigenous natural gas still accounts for about three-quarters of commercial primary energy. With a view to facilitate the Government of Bangladesh to attain the targets of Vision 2021, SDGs 2030, and Vision 2041, measures have been taken to accomplish all necessary activities relating to LNG including installation of floating and land-based terminals. 2 floating storage and re-gasification units (FSRU) have been installed at Mohakhali for supplying 500 MMscfd of re gasified LNG (RLNG) each.

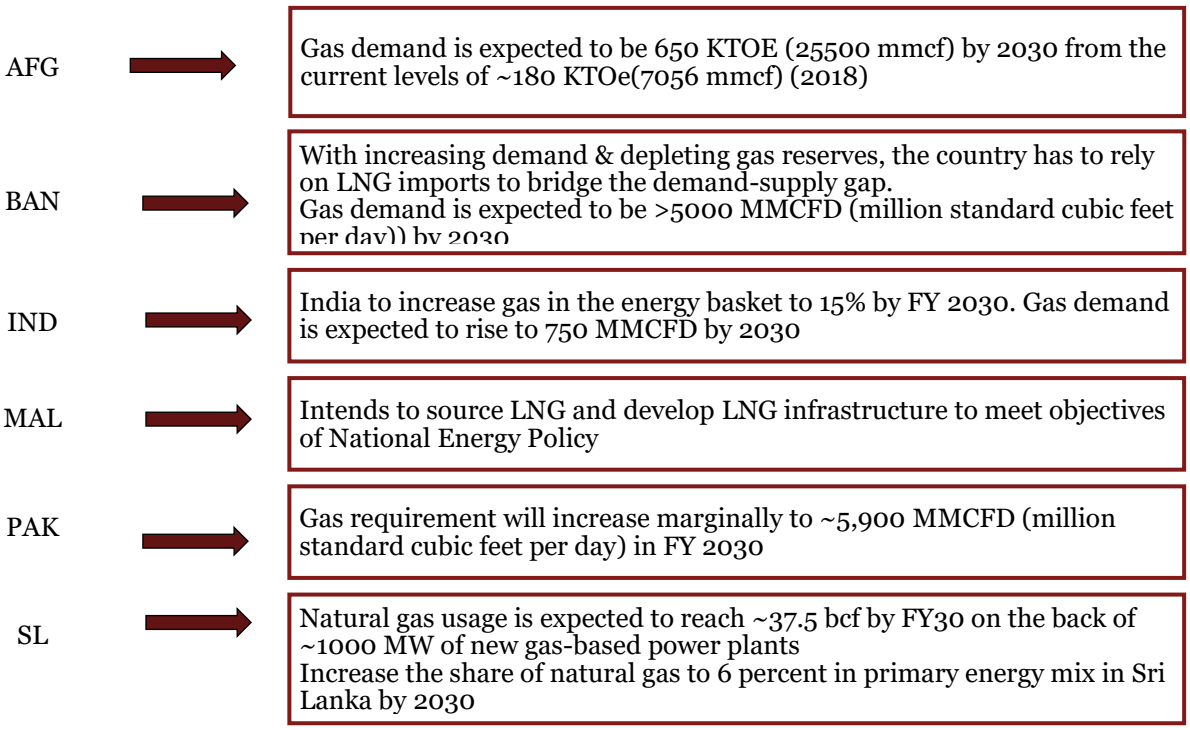
India's natural gas sector is on the threshold of rapid growth backed by increasing demand, greater exploration efforts under the New Exploration Licensing Policy, the commissioning of liquefied natural gas (LNG) import terminals on the western coast, upcoming LNG terminals and the government's initiatives on a nation-wide natural gas pipeline grid.

Pakistan has long depended heavily on gas for its primary energy. This has partly been because gas was plentiful and cheap when its indigenous reserves were first developed and partly because it lacks reserves of other fuels. The government has been striving to boost gas supply by incentivizing indigenous production and with other efforts to import gas by pipeline and as LNG. However, the nation's Oil & Gas Regulatory Authority (OGRA) predicts a rapid decline in indigenous production, from 3.3bn ft^3/d in FY2018 to 1.7bn ft^3/d by FY2028. All the growth in Pakistan's gas consumption since 2015 has come from LNG imports, with domestic gas production remaining stubbornly flat at around 35bn m^3/yr. (3.4bn ft^3/d).

Country-wise Gas Demand and Target:

Most of SA countries moving towards cleaner sources of fuel, gas demand in the South Asian region is expected to increase rapidly. In India, gas demand is forecasted to increase due to natural gas consumption to meet the growing demand of CGD and Fertilizer Segment. Natural Gas consumption is forecasted to increase at a CAGR of 4.18% to 143.08 million tonnes by 2040 from 58.10 million tons in 2018. In Bangladesh, gas demand is expected to increase due to increase in gas fired power generation and Natural Gas consumption. In Sri Lanka, gas demand is expected to increase due to increase in Natural Gas consumption.

However, considering domestic gas production has dwindled in most of the SA countries, a major portion of the incremental demand is expected to be met through LNG imports. The graphic below provides the key targets and the projected demand of natural gas for various SA countries.



Source: SAARC energy Outlook 2030, dated 2018

Existing Market Structure

The gas market in most of the SA countries have separate players for upstream (exploration) and downstream (transmission and distribution). Considering gas is a strategic energy resource for most of the SA countries, the exploration is primarily handled by state owned agencies with gradual private sector participation being allowed. The gas distribution sector continues to encourage private sector participation in most of the countries led by India which has multiple CGD players selected through competitive auctions. Most of the countries continue to have an independent regulator.

Table 12: Market Structure in SA Nations

Countries	Exploration & Production	Transmission & Distribution	Private Sector Participation	Independent Regulator
India	Oil and Natural Gas Corporation, Reliance Industries Limited,	Transmission: GAIL Distribution: Multiple City Gas distribution companies	Yes	Petroleum and Natural Gas Regulatory Board
Bangladesh	Petro Bangla International Oil Companies	Transmission: Gas Transmission Company Limited (GTCL) Distribution: Tit1 as, Bakhrabad, Paschimanchal, Rupantarita Patrik	Yes	**Downstream:** Bangladesh Energy Regulatory Commission (BERC) **Upstream:** Petrobangla Supervision
Pakistan	OGDCL, PPL International Oil Companies	SNGPL SSGC	Private participation only in exploration and production	Oil and Gas Regulatory Authority (OGRA)
Sri Lanka	Ceylon Petroleum Corporation	Ceylon Petroleum Corporation, Lanka Indian Oil Company, Litro Gas, LAUGFS Gas	Yes	No (Regulated by Ministry of Petroleum Resources Development)

Source: Country Specific Websites

Ongoing infrastructure Projects to facilitate Gas Trade in SA countries

The key projects currently being undertaken/proposed to facilitate increased trade in gas among the SA countries are as follows

India-Bangladesh:

- Petroleum products' pipeline from NRL's Siliguri terminal to Parbatipur in Northern Bangladesh
- Natural Gas pipeline from Chittagong to Tripura to meet the crisis of LPG in the North-Eastern region of India

India-Nepal:

- The second meeting of the Nepal-India Joint Working Group on oil and gas cooperation held through video conferencing on August 13 talked about building a natural gas pipeline from Gorakhpur to Bhairahawa and an oil pipeline from Siliguri to Jhapa. Officials also discussed extending the oil pipeline from Amlekhganj to Lothar in Chitwan

Bangladesh-India-Maldives-Sri Lanka

- Infrastructure project on LPG break-bulk opportunity

Iran-Pakistan-India Natural Gas Pipeline

The Inter State Gas Systems of Pakistan and the National Iranian Oil Company of Iran initialed a gas sale and purchase agreement on 24 May 2009 and was signed bilaterally on 5 June 2009 at Istanbul in Turkey, leaving room for India to join the project at a later stage. The 2,775-kilometre (1,724 mi) pipeline to deliver gas from Iran to Pakistan is still under construction.

Way forward for Gas market through regional cooperation

Under the SASEC umbrella of ADB, a Regional Gas and Petroleum Working Group has been formed to support the member nations in harness the benefits from expanded regional gas and petroleum trade, to support in building the project portfolio and to help build capacity for project implementation and program monitoring. Some of the key priority projects/measures to increase hydrocarbon trade among the SASEC member nations to meet their energy requirements has been provided in the table below:

Table 13: Gas Market for Gas Market

Country	Areas of Regional Cooperation
Bangladesh	• Leverage North East India's refining capacity to source petroleum products • Import LPG from transhipment hub • Unlock cross border hydrocarbon trade between India, Nepal and Bhutan
Bhutan	• Source LNG and LPG from India to ensure access of cleaner fuel
India	• Leverage port infrastructure in Bangladesh for energy supplies including crude (from Pyra) to Northeast region • Import LPG from transhipment hub
Maldives	• Import LPG from transhipment hub • Explore the options of sourcing LNG from terminals in India
Nepal	• Sourcing Natural gas/LNG from India • Create LPG infrastructure
Sri Lanka	• Facilitate the LPG transhipment hub • Explore the opportunity to source LNG along with Maldives

As evident increasing cooperation is planned among the SA member nations in enhancing cooperation in the gas subsector to increase energy security of the member nations.

Case Study: IGX (India Gas Exchange)

India has recently launched the Indian Gas Power Exchange which allows buyers and sellers of natural gas to trade both in the spot market and in the forward market. Similar kind exchange for gas will facilitate trade among countries in South Asia Region

Indian Gas Exchange Limited (IGX) is India's first Natural Gas trading platform which provides a national level market to all participants for trading in gas. IGX facilitates automated trading where multiple buyers and sellers can trade for physical delivery of natural gas. IGX currently, offers spot and forward contracts at designated physical hubs. Being a neutral and transparent marketplace, IGX enables efficient and competitive discovery of gas prices in India. At present there is no statutory authority to regulate trade / transactions happening on the IGX platform

The participants are mainly City Gas Distribution (CGD) entities, major gas consuming industries- Fertilizers, Glass, Ceramics, Power, Steel, Chemical, Gas producers and marketers and large Natural gas buyers, buying more than 50,000 cubic meter per day

The different products traded in the market are Day Ahead,Daily,Weekly,Week Day,Fortnightly and Monthly

At present there is no statutory authority to regulate trade / transactions happening on the IGX platform. PNGRB is in the process to draft the regulation for Natural gas trading hub / natural gas exchange in India. Whenever such a regulation will come in place, activities of IGX will be governed and regulated by such PNGRB regulations. IGX has drafted Market Rules and Bye laws which governs the functioning of the platform

3.2. Review of As-is situation of CBET in South Asia

3.2.1.1. Existing institution/mechanism or forums facilitating CBET

3.2.1.1.1. SAFIR

The South Asia Forum for Infrastructure Regulation (SAFIR) acts as a platform for experience sharing amongst the regulators of countries-Bangladesh, Bhutan, India, Nepal, Pakistan, Sri Lanka. SAFIR was established in the year 1999 with the support of World Bank.

The secretarial service to SAFIR is provided by Central Electricity Regulatory Commission.

Aims & Objectives:

Facilitate effective & efficient Regulation	Platform for Experience Sharing	Build Regulatory Decision Making	Initiate beneficial exchange of knowledge & expertise	Spur research on Regulatory issues and conduct trainings

Organizational Structure-Roles and Responsibilities

3 main institutions were developed under the SAFIR framework to facilitate it operations and decision making namely steering committee, executive committee and virtual working groups. The roles and responsibilities are described below:

Structural Bodies:	Steering Committee	Executive Committee	Virtual Working Groups
Function:	Formulating strategic decision	Executing all decisions of Steering Committee	To discuss any issue of importance among
Members	36 members Chairperson of regulatory bodies, academic & research Institute, Corporates, etc. from each country	6 members Chairperson of select Regulatory bodies from member states	Representatives from each member nation

The Steering Committee Meeting and Executive Committee Meeting are held once every year. An annual general meeting is also held once a year where suggestions and views are sought from member nations on working of SAFIR.

Key Activities of SAFIR

- **Conduct Capacity Building Programmes in Energy, Water and Transport:** Such studies will focus on infrastructure and restructuring and will also act as a medium for knowledge transfer among the South Asian Region
- **Conduct Infrastructure Conference**: This will be held annually to address key challenges in policy and regulatory aspects in the SAR.
- In-house research as well as studies by engaging external agencies

Key Achievements of SAFIR

1. **Common Minimum Grid Code for South Asian Countries** was drafted and presented in the 2nd working Group meeting of SAFIR. The Common Minimum Grid Code is structured in four parts: i)

Connection Code, ii) Operating Code, iii) Scheduling and Despatch Code, and iv) administration of the Grid Code.

The Common Minimum Grid Code is applicable to all countries of South Asia, who will get connected to the South Asia grid through a synchronous or asynchronous (i.e. HVDC) connection. Each country will initially be represented by a single point of contact for the initiation of implementation of the Common Minimum Grid Code. The single point of contact would be supported by the relevant Ministry dealing with power, the regulator, the transmission agency, the system operator and the accounts settlement/ market operator of the respective country

2. SAFIR Working group took up two studies - i) Regulatory interventions for Grid discipline and Grid reliability in the South Asian region and study cross border trade ii) Study /Research on South Asia electricity/electricity regulations to develop regulatory pathway/Road Map for Electricity/Energy exchange and Energy Cooperation (EC) in SA

3. South Asia Energy/Electricity regulatory compendium has been prepared from regulatory commission websites of each countries. This is being currently reviewed.

4. SAFIR finalized its TOR with the following objectives to facilitate cross border trade

   - Study on South Asia electricity regulations to develop regulatory pathway for electricity/ energy exchange and energy cooperation in South Asia:
   - Study on regulatory interventions for Grid discipline and Grid reliability in the region
   - Study on 'Benefits of Cross Border Electricity Trade - Potential Optimum Utilisation and Reduction in Cost of Supply'
   - Organizing a 'South Asia Energy Sector Training and Capacity Building program on Energy Regulation for Energy Cooperation and Exchange of Electricity in South Asia'
   - Developing South Asia Energy/Electricity Regulatory Compendium
   - SAFIR Regulatory Newsletter (quarterly)
   - Creating a web portal on 'South Asia Energy/ Electricity Knowledge Resource Database'

Key Lessons which could be leveraged by

3.2.1.1.2. SAFIR

- **Harmonization of Grid Codes**

  SAFIR is in the process of finalizing a common minimum grid code, which will be relevant for every South Asian country. The study will come out with: a) detailed set of regulatory measures/ intervention and mechanism needed for enhancing Grid discipline & Grid reliability in SA region, along with detailed explanatory memorandum; and b) roadmap (regional and country-wise) and action plan for implementation of above suggested regulatory measures/ interventions. This can facilitate cross border trade and facilitate the objectives of SAFEM

- **Advocating Grid Balancing Services**

  SAFIR has highlighted in many studies the importance of flexible resources like hydro with RE penetration. It has also conducted studies on "Regulatory interventions for Grid discipline and Grid reliability in the region" highlighting the need for Ancillary market. This could be leveraged by SAFEM as development of hydropower and increase in hydropower trade is critical to ensure balancing reserves with anticipated rapid increase in RE penetration in the SA member nations

3.2.1.1.3. BIMSTEC

BIMSTEC (The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation) came into being on 6 June 1997 through the Bangkok Declaration. It constitutes seven Member States: five deriving from South

Asia, including Bangladesh, Bhutan, India, Nepal, Sri Lanka, and two from Southeast Asia, including Myanmar and Thailand. The member countries have identified 14 sectors of cooperation: trade, technology, energy, transport and communication, tourism, fisheries, agriculture, public health, poverty alleviation, counterterrorism, environment, culture, people-to-people contact, and climate change. The BIMSTEC region comprises 1.6 billion people with a combined GDP of US$ 2.8 trillion.

Aims and Objective:

The objective of building such an alliance was to harness shared and accelerated growth through cooperation in different areas of common interests by mitigating the onslaught of globalization and by utilizing regional resources and geographical advantages

Institutional Mechanism-Role and Responsibilities

The Bangkok Declaration provides for the following institutional mechanisms:

Policy Making Bodies

BIMSTEC Summit is the highest policy making body in the BIMSTEC process. The Summit is held every two years
Ministerial Meetings covers the area of foreign affairs and the area of trade and economic affairs

BIMSTEC Working Group

BIMSTEC Working Group (BWG) is the lower tier of the BIMSTEC process
It consists of Ambassadors/Representatives from Member States to carry on the work in between Annual Ministerial Meetings

Governing Body

Consists of The Chairman, Director General and Directors
Chairmanship of the BIMSTEC is a member country. This rotates every 1 year

Expert Group

Consist of lead Countries of the 13 priority sectors of cooperation and 15 sub-sectors
Responsible for hosting expert group meetings regularly and report the result to the BIMSTEC Working Group in Bangkok (BWG)

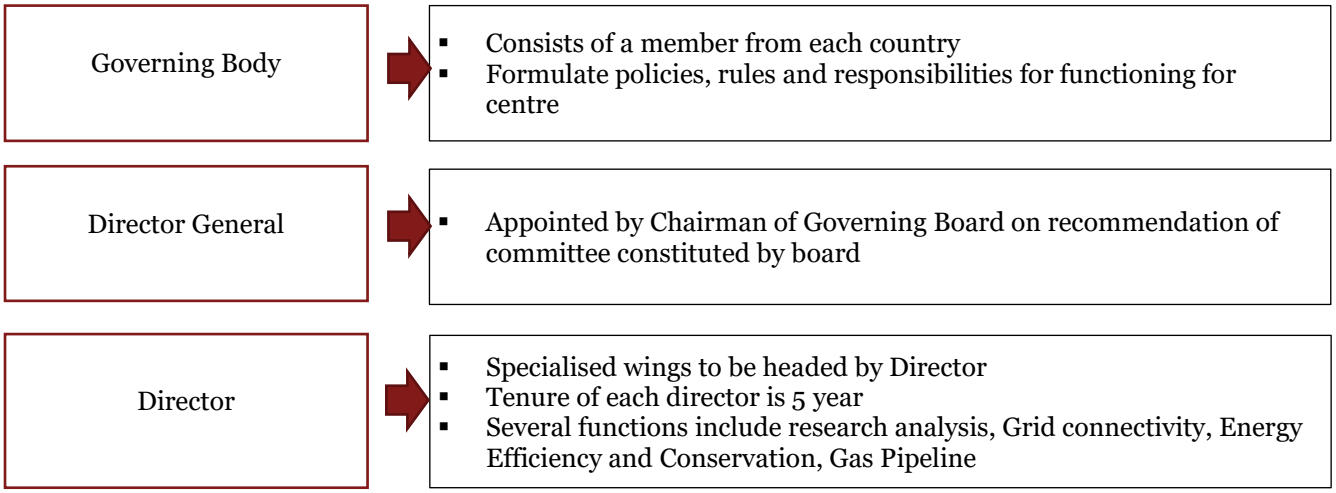
BIMSTEC Energy Centre:

BIMSTEC Energy Centre was formed in Bangalore in 2011 with the objective of inter-regional sharing of reform, restructuring, regulation and best practices in energy sector

Broad Objectives:

- ✓ To create, manage and evaluate energy related data-base relevant to the region; and taking into view various on-going activities and 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.

BIMSTEC Energy Centre Structure:



Key Achievements of BIMSTEC

Inter Grid Connection:

The grid interconnection MoU was signed in 2018 by member-states of BIMSTEC. The objective of this MoU is to create a broad framework for the parties to cooperate towards the implementation of grid interconnections for the trade in electricity with a view to promoting rational and optimal power transmission in the BIMSTEC region.

The development is significant in two respects. First, it can make a difference to the improvement of electricity supply in the region, given the acute shortage of electricity encountered by several BIMSTEC members. Several measures to initiate the harmonization of technical, planning and operational standards to remove barriers to grid interconnections will be taken. Second, the model of sharing electricity from the surplus-generating parts of the region to its deficient corners is an ideal framework to expand regional connectivity and can inspire the group to proceed on other forms of infrastructure connectivity as well as in institutional cooperation.

Trilateral Power Trade:

BIMSTEC member nations as per the 2018 Summit declaration have instructed relevant agencies in their respective countries to take concrete measures for harmonization of technical, planning and operational standards for removing barriers to grid interconnection. A trilateral cooperation between India-Myanmar-Thailand was underway for setting up a power grid which is 3,000 km long. Asian Development Bank (ADB) and Asian Infrastructure Investment Bank (AIIB) are likely to invest in the BIMSTEC regional power grid. India aims to have an electricity grid that is connected to Myanmar, Thailand, Cambodia, Laos, and Vietnam as part of an evolving energy security architecture.

Lessons for SAFEM

Provides model for Multilateral Trade: Trilateral trade discussion is underway between India-Myanmar and Thailand as a result of BIMSTEC initiatives. This could help SAFEM leverage Such trilateral model will form the first step for SAFEM in creating models for multilateral trades between the South Asian countries

Compendium of energy related data: The BIMSTEC energy center is responsible for providing the groundwork, such as feasibility studies, data collection etc. for intra- BIMSTEC energy related projects. It is also responsible to create, manage and evaluate energy related data-base relevant to the region; and taking into view various on-going activities and form a road map for meaningful intra- BIMSTEC cooperation. This will help SAFEM in creating a compendium of energy related data base for cross border trade between South Asian Region.

3.2.1.1.4. SAARC (South Asia Association for Regional Cooperation)

The South Asian Association for Regional Cooperation (SAARC) is an economic and political organization of eight countries in South Asia. It was established in 1985 when the Heads of State of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka formally adopted the charter. Afghanistan joined as the 8th member of SAARC in 2007.

Aims and Objective

Growth	Trust	Co-operation
• Promote welfare and improve quality of life • Accelerate economic growth, social progress and cultural development	• Strengthen collective reliance among SAR nations • Contribute to mutual trust, understanding and appreciate among SAR nations	• Strengthen cooperation among SAR nations • Foster cooperation with other developing nations • Cooperate with international and regional organizations with similar aims and purposes

eight countries in South Asia. It was established in 1985 when the Heads of State of Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan and Sri Lanka formally adopted the charter. Afghanistan joined as the 8th member of SAARC in 2007.

Institutional Structure:

The SAARC comprises six layers of Institutional structure.

1 Council	• It is apex policy making body • It is represented by heads of the Government of member nation
2 Council of Ministers	• Represented by foreign ministers of each country • Functions are -1) Policy formulation 2) Review progress 3) Decide new areas of cooperation 4) Establishing additional mechanism as deemed necessary 5) Decide on other matters of general interest to Association
3 Standing Committee	• Represented by foreign secretaries of each member country • Functions include -1) overall monitoring and coordination of modalities of financing 2) Determine inter sectoral priorities 3) Mobilizing regional and external resources 5) Identifying new areas of cooperation
4 Programming Committee	• Comprises of senior officials • Main function is selection of regional projects and review of activities
5 Technical Committee	• Consists of representatives of member countries • Formulate programmes and prepare projects in respective fields, monitoring and implementation of such activities
6 SAARC Secretariat	• The Secretariat is headed by the Council of Ministers. It includes 7 directors who are representatives from each member country • Responsible for coordination, execution and monitoring of different activities of SAARC

SAARC Inter-Governmental Framework Agreement for Energy Cooperation (Electricity)

During the 18th SAARC Summit, the eight-member state's foreign ministers signed an agreement on energy cooperation "**SAARC Inter-Governmental Framework Agreement (IGFA) for Energy Cooperation (Electricity)'** on 27 November 2014.

Objective: Enable cross-border trade of electricity on voluntary basis subject to the laws, rules and regulations of the respective Member States and based on bilateral/trilateral mutual agreements between the concerned states

Salient Features of the SAARC Framework Agreement

Non-discriminatory access to transmission grids for the purpose of CBET	International coordination in transmission interconnection planning, system operations, and	Promotion of information sharing between Member States	Encouraging countries to undertake power sector reforms in their respective jurisdictions, to	Identification of SAARC Arbitration Council as the forum for resolution of unresolved

The following aspects will be finalized after agreement among the members:

a) Develop regional regulatory guidelines;
b) Prepare guidelines to cover principles on open access, settlement of energy imbalances, transmission pricing, transmission planning etc. in term sheet format;
c) Identify and highlight consequent changes/amendments required in legal, regulatory and policy framework of respective countries to operationalize regional regulatory guidelines;
d) Country-wise strategy, specific recommendations and road map for electricity trade within the SA region.

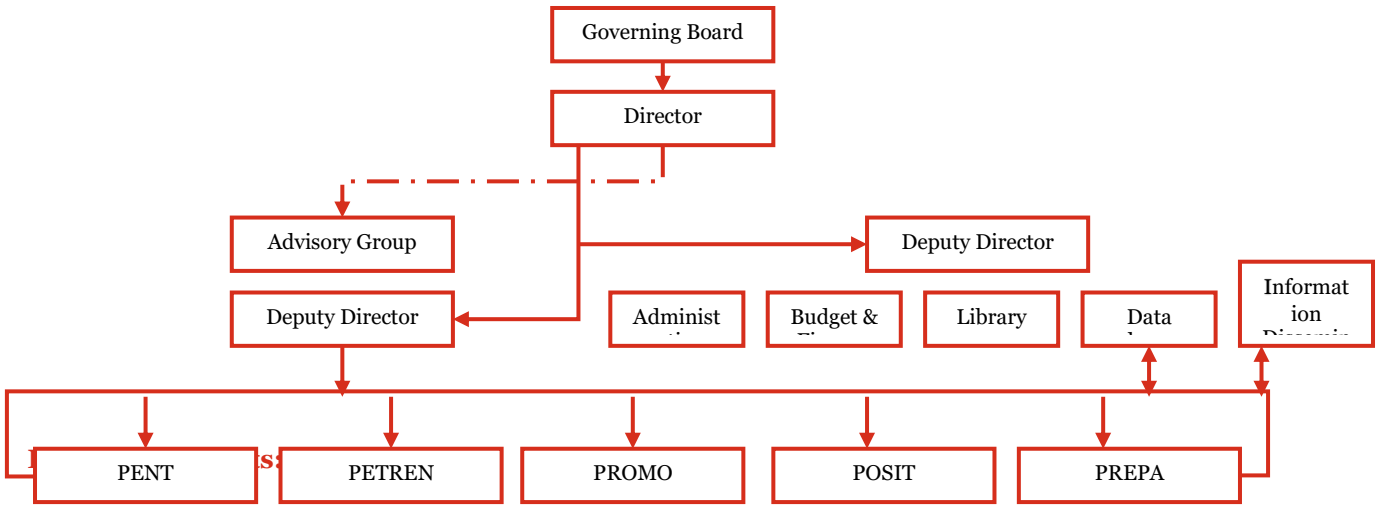
SAARC Energy Center

SAARC Energy Centre was formed during Dhaka Declaration in 2005, as the Special Purpose Vehicle to realize the vision of SAARC leaders to establish an Energy Ring in South Asia. The major function of SAARC Energy Centre was to act as an institution fostering initiation, coordination and facilitation in terms of energy for member nations.

Key areas of SAARC Energy Center:

- Energy Trade between SAARC Countries (PENT)
- Integrated Assessments of Energy, Transport and Environment (PETREN)
- Minimize Oil Imports (PROMO) through Improvements in Energy Efficiency and Fuel Substitution
- Successfully Implement Technology Transfer (POSIT); and
- Rural Electricity for Poverty Alleviation (PREPA)

Organizational Structure of SAARC Energy Center is shown in the exhibit below:



Enablers for Cross Border Electricity Trade: The SAARC Energy Centre (SEC) has identified two enabling articles of the SAARC Framework Agreement for promoting cross-border trade and exchange of electricity:

- Article 4 refers to the Duties & Taxes which states that "Member States may work towards exempting from export/import duty/levies/fees etc. for cross-border trade and exchange of electricity between Buying and Selling Entities."
- Article 13 refers to facilitating Buying and Selling Entities and states "Member States shall enable Buying and Selling Entities to engage in cross-border electricity trading subject to the laws and regulations of the concerned Member States

Lessons for SAFEM

Availability of flexible resources for RE Grid Integration: The SEC laid the basic framework and the importance of hydro-power development in SAARC member states with the increasing RE penetration This can also emerge as an important lesson for SAFEM to act as a regional body to guide the mediation and advocacy of the ancillary power market

4. Review and analysis of international practices

Increasing cross-border trade of electricity can play a major role in overcoming the challenges to economic development and poverty reduction. Trade of power between multiple countries shall help in reducing energy prices, mitigate risks of abrupt power disruption, relieve shortages, facilitate greater use of less polluting sources of energy and provide incentive to better performers in the value chain. This trade of power between multiple countries can be facilitated through a common power market. Within a single country it is easy to coordinate among different entities to facilitate power trade through the market established in the country. As the number of countries involved in a power trading market increases, it becomes increasingly complex to accommodate the needs and priorities of all the countries. Therefore, it becomes important to develop a forum having representation from all the member states to prepare and implement the common objectives agreed by the members. The forum shall also be sufficiently empowered for decision making, implementation and monitoring the status of various tasks under its purview.

In order to have a holistic view of development of power trading market, various markets have been studied across different geographies , developed over different time periods and in different stages of maturity. Following broad parameters/criterion were used to shortlist these markets with differing market maturity/different market characteristics. A brief overview of the various power trading markets selected to understand markets has been given below:

Table 14: Market Selection Parameters

Region	Parameters Used	Markets Reviewed	Markets Selected for Study
Africa	• Market Coverage (Participating Countries) • Trading quantum • Tenure of operation • Level of Maturity (Legal/Regulatory Mechanisms) • Product Variety (Day Ahead/Term Ahead/Intra Day)/Trade through specific interconnections	SAPP, WAPP, EAPP, Nile basin initiative	SAPP, WAPP
South East Asia		ASEAN, GMS	GMS
Central America		SIEPAC	SIEPAC
Europe		ENTSO-E, South East Europe (SEE),	ENTSO-E
Australia		AEMO	AEMO
United States of America	• Geographic Coverage • Volume of power traded • No of consumers served • Tenure of Operation • Cross Border interconnections • Product Variety (Day Ahead/Term Ahead/Intra Day)/Ancillary Markets etc.)	Pennsylvania-New Jersey and Maryland Interconnection (PJM), ISO New England (ISO-NE), the Electric Reliability Council of Texas (ERCOT), New York ISO (NYISO), Midcontinent ISO(MISO), California ISO (CAISO)	PJM, ISO-NE

The graphic below provides a summary of the salient features of each of the markets considered for our further in-depth review

South African Power Pool (SAPP)	• 12 countries of South Africa are members • Formed in August 1995 • Total trading of 2054.2 Gwh through competitive market in 2018-19
West African Power Pool (WAPP)	• 15 countries of West Africa are members • Formed in December 1999 • WAPP Information and coordination committee is building consensus for market rules, staffing, synchronization and pricing model
Greater Mekong Sub Region (GMS)	• 6 countries partcipating in the GMS energy cooperation • Initiated in 2002 after Policy Statement on Regional Power Trade • Power tarde of ~21,000 GWh in 2016
Market and Reliability Commitee, PJM	• 13 states of The USA are members of PJM • PJM was formed in 1927 and new members joining in 1956, 1965 and 1981 • PJM caters to the need of more than 65 million people
Australian Energy Market Operator (AEMO)	• Opeartion across 5 regions in Australia with 419 registered participants in NEM • Founded in year 1999 • Caters to the customer base of ~10 million
Central America Regional Electricty Market (SIEPAC)	• 6 countries participating in the regional electricity market • Initiated in 1996 after Marco Treaty • 2182 GWh energy traded in 2019

The selected markets for study consists of highly evolved markets operating since decades to some of the new markets for which final rules and regulations are still being framed. Power generation, transmission and consumption also exhibits diversity in different markets.

Markets are studied on five different areas which gives a detailed view of the formation, organisation structure, responsibilities, achievements and key learnings.

Key learnings from these markets have been in the areas of:

- Technical and operational aspects
- Policy, planning and strategy aspects

- Organizational and commercial aspects
- Sustainability and diversification aspects

4.1. South African Power Pool (SAPP)

Introduction

South African Power Pool (SAPP) was formed in the August 1995 with the South African Development Community (SADC) countries signing an Inter-Governmental Memorandum of Understanding for the formation of an electricity power pool at the summit held in Kempton Park, South Africa.

The SAPP was formed as a result of promoting energy development undertaken as a part of regional integration of the South African Development Community (SADC). SADC aims to ensure, through efforts and commitment from all its members, the progress and well-being of the entire region and providing access to electricity to all the residents. The table below represents the features of SAPP:

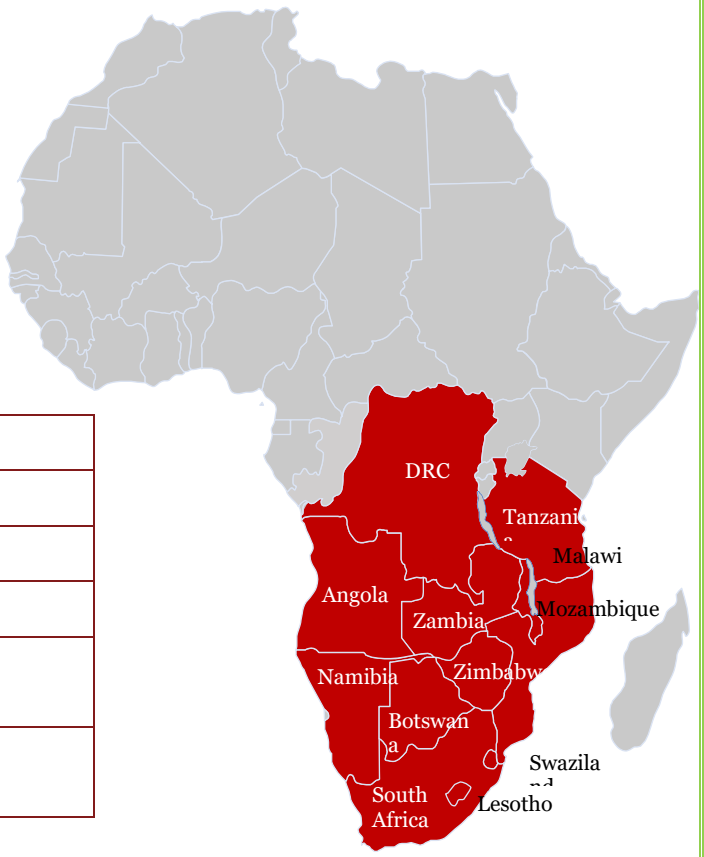


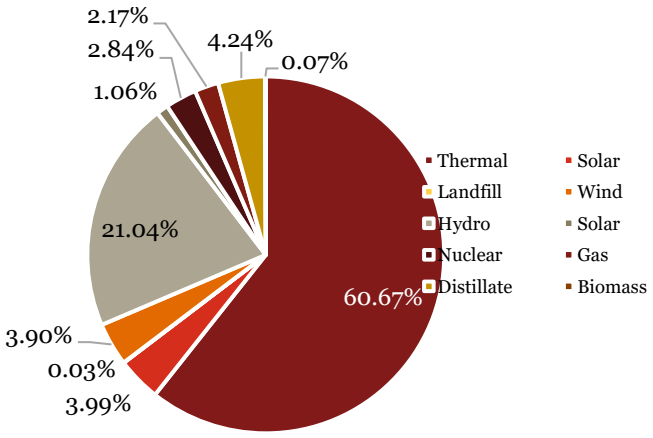
Table 15: Features of SAPP Market

Particulars	Details
No of member countries	12
Installed Capacity (GW)	70
Peak demand (GW)	58
Trade in competitive market (GWh)	2054
Market size of competitive market ($ millions)	107

- SAPP pool has a total generating capacity of ~70 GW of which 75.5% capacity is in South Africa.
- The top three countries are South Africa, Angola, and Zambia with an aggregated generation capacity of 84.2%
- The bottom three countries namely Lesotho, Malawi and Swaziland have an aggregated generation capacity of ~0.74%.
- South Africa has the largest surplus of 7089 MW among all the market participants followed by Angola having a peak surplus of 362 MW.

The SAPP generation mix is predominantly coal (61%). Other generation technologies include hydropower, solar, wind and biomass. The figure below depicts the installed generation mix.

Figure 25:Generation Mix



Source: SAPP Annual Reports

Membership: Membership to the pool is open to electricity enterprises situated in a country which was SADC member in September 1994. Full membership is restricted to one per country as designated by countries. Enterprises which are not a member can get membership subject to the approval of SAPP Executive Committee.

SAPP countries have power transmission capacity across different voltage levels. Majority of the power transmission capacity is available at higher voltage levels of 400 and 765 kV.

Table 16: Power Transmission Capacity Across Different Voltage Levels

Voltage Level (kV)	110	132	220	275	330	400	533	765
Transmission Capacity (MW)	430	606	1249	133	1201	5795	700	3515

Source: http://www.sapp.co.zw/transfer-limits

Membership to SAPP participants can be classified in the following three broad categories:

- **National Power Utility Member:** Meant to recognize members entrusted by Governments for SAPP ownership and is a member that
  a) operates the National Control Centre or national grid in its country; and,
  b) carries out transmission system and/or market operations functions; and,
  c) is a Member State owned entity or is designated as such by a SADC Member State.
- **Operating Member:** Meant for members which
  a) operates a permanent generation facility of total capacity of at least 300 MW physically connected to the SAPP Grid at a voltage level of at least 110 kV; and/or,
  b) operates a transmission system of 110 kV and above which is physically connected to the SAPP Grid at a voltage level of at least 110 kV; and,
  c) has capability to provide ancillary services.

- **Market Participant:** Meant for members which
  a) operates or contracts generation capacity or a load of at least 5 MW that is physically connected to the SAPP Grid at a minimum voltage of 110 kV; and
  b) complies with respective national legislation on cross-border trading; and,
  c) is not be tied to a single buyer contract; or, where such contract exists, must have counter party consent to trade the contracted power on the market; and,
  d) possess capability of balancing agreed schedules or must have a contract for balancing agreed schedules with a SAPP operating member.

The list of members currently in SAPP are attached the **Annexure – A.4**

Evolution of SAPP:

The evolution of South African Power Pool is described in the exhibit below:

1950	• First contract for trade of power was established between DRC and Zambia
1960	• The interconnection of Zambia and Zimbabwe took place and facilitated trade of power between the two regions
1975	• Songo Apollo High voltage direct current link was completed between Mozambique and South Africa. This development resulted in two separate interconnected power systems (northern and southern)
1975-1994	• The northern and southern systems were electrically interconnectedwith the construction of the 400 kV line betweenMatimba (South Africa) and Insukamini (Zimbabwe). • This trading, however,remained in the form of bilateral contracts
1995	• SAPP was formed to enable trade of electricity in the South African region.It included national utilities of each country
2006	• The 2006 revised intergovernmental MoU for the SAPP extended thescope of members to include new entities such as service providers,transmission utilities,associated members,institutions etc

Market Products in SAPP

Energy is both traded in bilateral and through competitive market in SAPP. Though the volume traded through bilateral have decreased gradually, it still accounts for ~68% of the Energy traded in SAPP, as on 2019. The share of competitive market as percentage of total trade has been increasing continuously as a result of steps taken to promote trade through competitive trading.

The existing market products as on date are described in the exhibit below:

Table 17: Existing Products in SAPP

Product	Description	Trading Day
FPM-Monthly	• Trade either an off-peak product for a single month (same volume and price in off-peak hours for the month) or a non-off-peak product for a single month (same volume and price in non-off-peak hours of the month). • Acts as a bridge between bilateral contracts and the FPM-W	Every Wednesday and at least five days before delivery month starts
FPM-Weekly	• Trade off-peak, standard and Peak products for a week (with the same volume and price for all off-peak, standard and peak hours of the week respectively). • Acts as a bridge between the FPM-M and the DAM	Every Thursday in the week prior to the Delivery Week
Day Ahead Market (DAM)	• An open and competitive sub-market traded on a day-ahead basis with gate-closure at 12h00 for next delivery day to meet short-term supply-demand balances between SAPP market participants • The market clearing price of the DAM is the main reference price for the competitive electricity market in the SAPP	Day before delivery day-gate closure is at 12 noon
Intra-day market (Dec 2015)	• Continuous trading up to one hour prior to delivery • Replaces the previous post- DAM • Matches market participants automatically on a first-come first-served basis if a seller's offer price is less than a buyer's bid price and a seller's volume is lower than (or equal to) a buyer's volume	Continuous trading
Interchange imbalance energy	• Settled based on the differences between schedules and actuals in a specific hour of operation • Settled in the SAPP by averaging the system frequency over the dispatch period (one hour) and requiring a rate to be paid as a function of the frequency deviation from nominal (50 Hz). • This is currently linked to the average and highest generation cost in the SAPP, but there are proposals to link this deviation to the DAM MCP	Settled on hourly basis

Source: SAPP Annual Reports

Bilateral Contracts - Bilateral Trading Objectives are mainly to meet long-term demand and supply balance. Trading arrangements mutually agreed between participants and transmission corridor to be secured in advance. Bilateral contracts dominate the power trading arrangements in the SAPP and contributed to ~99% trade of the region in 2010, and still contributes to 65-70%% (in 2018 and 2019) power traded of the region. The legacy bilateral contracts have acted as a reliable market instruments to guarantee security of supply on long term basis. However, these instruments lacked adequate flexibility to accommodate the varying demand profiles and price trends, and as a result, the need of more competitive electricity market was felt which led to the development of short-term electricity market (STEM).

Day-Ahead Market - SAPP started the short-term energy market (STEM) in year 2001 to lay the foundation of the competitive market in the region and allow the market participants to trade electricity on a shorter timeframe between SAPP members in addition to the legacy bilateral contracts. The task of development of the competitive market was initiated in 2004, with an aim to introduce a competitive setup where buyers and sellers could participate and compete in the trading of electricity. As a result, the market subcommittee started DAM for trials in February 2008. In late 2009, DAM was finally operationalized with an aim to introduce a tool which is flexible in accommodating varying demand , to plug in the growing supply deficit in some of the member countries in the region and to induce competition in the energy market... Markets committee finalized DAM governance documents and circulated them to members for approval. An Implementation plan for Market Opening was also developed and shared with the members. Markets committee faced challenges in overcoming governance and surveillance issues raised by the member countries. Capacity building programs were conducted to facilitate members to trade on the platform. Market sub-committee also set standards for implementation of internal controls, accounting and information systems aimed at providing reasonable assurance to participants that the platform is safeguarded, and the risk of error, fraud or loss has been reduced in a cost-effective manner.

Post Day Ahead Market (PDAM) - PDAM was launched with an objective to increase trade volume by matching bids in the PDAM that could not be matched in DAM. The Markets sub-committee played a key role in the introduction of Post Day Ahead Market (PDAM). It is a day ahead hourly market where trading is concluded a day ahead for delivery the following day. MSC developed the guidelines for functioning of PDAM.

Participants are requested to submit their bids and offers on the PDAM market. The Market Operator then matches the offers and bids in PDAM and confirms trade where offers and bids match. PDAM trades are then scheduled for delivery on the following day similar to the DAM.

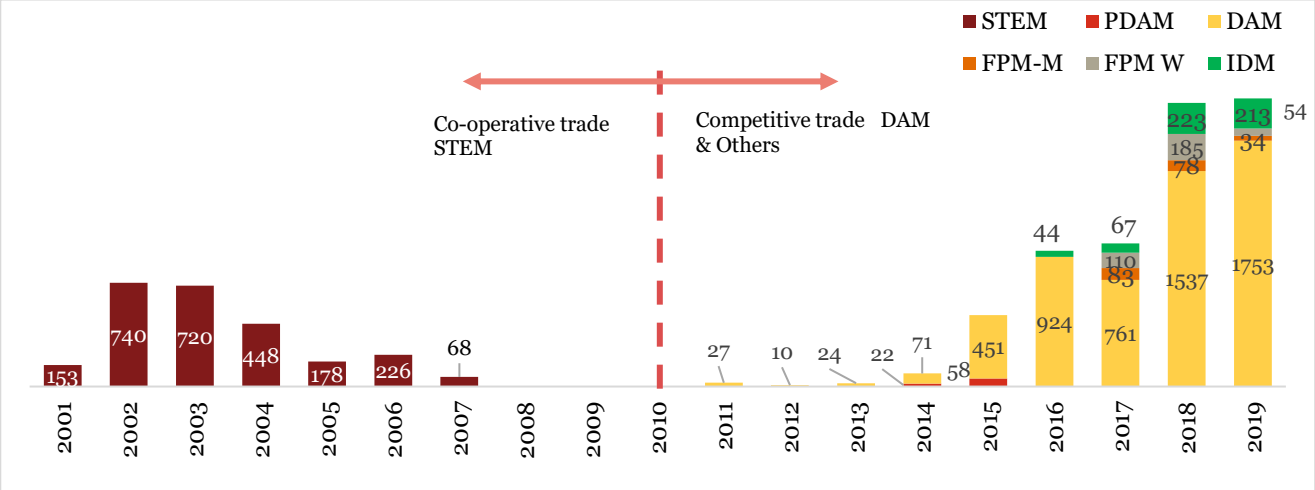
Intra Day market (IDM) – In order to make the trading regime more dynamic and flexile to match the demand trend, IDM was propounded and finally launched in December 2015 to essentially replace the preceding PDAM Market. A sub-market where market participants can continuously trade up to one hour prior to delivery. The IDM matches market participants automatically on a first-come first-served basis if a seller's offer price is less than a buyer's bid price and a seller's volume is lower than (or equal to) a buyer's volume. The Intra-Day Market (IDM) is open for trading of power after DAM and up to a configurable time before real time – typically one hour ahead. The IDM supplements DAM and helps participants to secure their balance between supply and demand on an hourly basis. IDM aims to help the participants to adjust the power balance and manage the unplanned incidents and failures in power system between the closing of the DAM and the delivery the next day.

The Forward Physical Market (FPM) – Forwards markets based weekly and monthly product, were introduced with the help of markets sub-committee in April 2016 to increase trading among the members. The FPM is an auction-trading model just like the Day Ahead Market. FPM gives the participants flexibility and the ability to secure prices for power deliveries in the medium term. The committee revised rules and regulations for the participants after introduction of new products for trading. These rules were approved by the SAPP Management Committee in February 2016. The market is based on physical delivery of the traded power volume. The objective of the FPM market is to facilitate trading of longer-term physical contracts for:

- Primarily base load in the monthly product - with provision of time-of-use products, and
- The weekly market where the products are more designed to cover the participants' weekly profiles

The exhibit below outlines the transition from co-operative market to market-based mechanism. The volume traded in FY2019 was 2054 GWh - out of which 85% was traded through Day Ahead Market (DAM) and the remainder was Forward Physical Market-Weekly (FPM -W) viz. 3%, Forward Physical Markets-Monthly, FPM-M(2%) and IDM (10%).The volume traded in Day Ahead Market has increased at a CAGR of 40 % since the last five years. The Intra Day market is growing and has registered a CAGR of 70% since last three years.

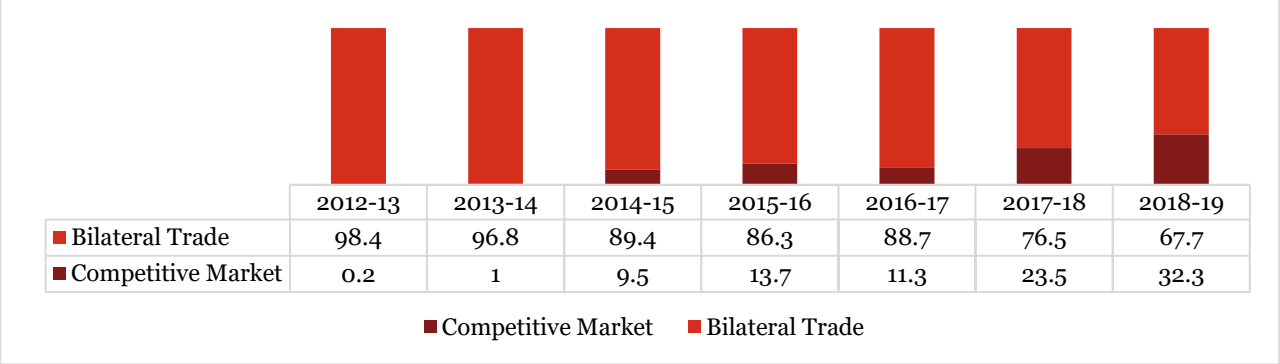
Figure 26: Annual Energy Trade (GWh)



Source: SAPP Annual Reports

The market clearing price for the different products are shown in the exhibit below. DAM consist of ~80% of the volume every year and the prices have come down from 7.23 USc/kWh to 4.94 USc/kWh from 2017 to 2019.

Figure 27: Share of total energy Traded in SAPP (in %)

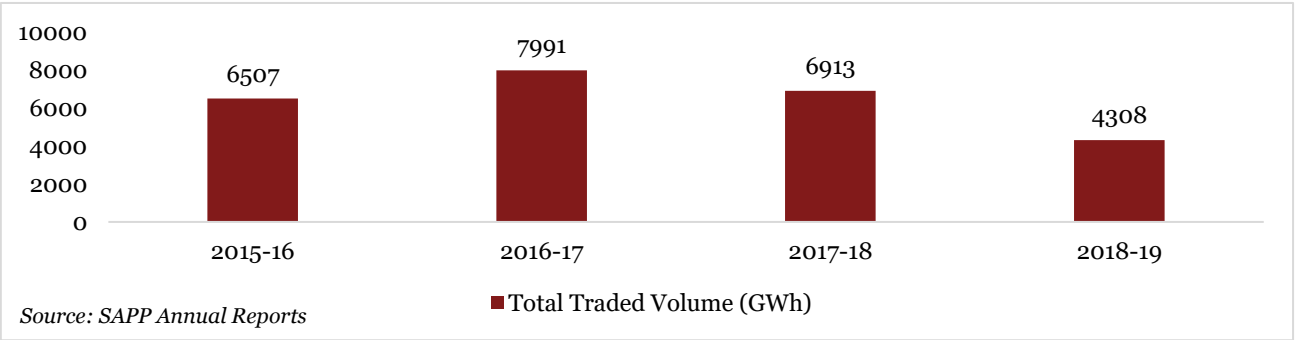


	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19
Bilateral Trade	98.4	96.8	89.4	86.3	88.7	76.5	67.7
Competitive Market	0.2	1	9.5	13.7	11.3	23.5	32.3

Source: SAPP Annual Reports

The graphical representation, as exhibited below details out the volume of the trade through bilateral market.

Figure 28: Total Traded Volume in Bilateral Market (GWh)



Source: SAPP Annual Reports

Price is negotiated between willing buyer & seller. Some of the bilateral contracts are as shown in the exhibit below:

Table 18: Bilateral Contracts in SAPP

Seller	Buyer	Capacity [MW]
ESKOM	SEC LEC BPC	1024
	Nam Power	
	ZESCO ZESA	
EDM	SEC LEC BPC	350
	NamPower	
	ESKOM ESKOM ZESA ZESCO	
EDM North	EDM South	300
	EDM North	300
HCB	EDM EDM ESKOM ESKOM ZESA	2000
	ZESA	
ZESCO	SNEL (KCC) EDM NamPower SNEL ESKOM	890
	BPC	
	ZESA	200
ZESA	NamPower	150
	ESKOM	As available
SNEL	BPC ZESA ZESA	150
ESKOM EDM	SEC	300
ESKOM EDM	LEC	74
ESKOM EDM SNEL	BPC	250
ZESCO		100
ZESCO ZESCO	SNEL (KCC) SNEL	40
		100
ZESA ZESCO EDM ESKOM	Nam Power	550
HCB HCB	EDM	600
ZESCO		
HCB HCB EDM EDM ZESCO ZESA	ESKOM	1500
EDM ESKOM	ZESCO	300
HCB SNEL EDM ZESCO SNEL HCB	ZESA	200

Source: JICA Report on SAPP Data Collection Survey 2017

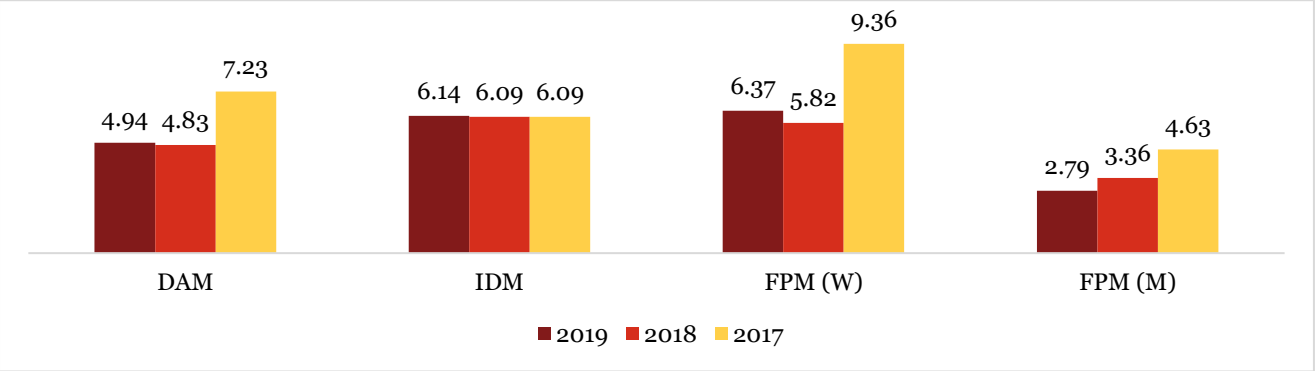
Competitive Market:

Trading on SAPP competitive market has grown through the years as a result of number of steps taken by the market sub-committee. The committee has worked to promote continuous trading through Intra-Day Market (IDM), facilitate reduction of energy imbalances, increase in number of market players, ensure fairness & transparency in transactions, and implement capacity building for traders and controllers. Before the formation of the markets sub-committee in April 2007, the Operating Sub-committee held the responsibilities of power market.

Price of Market Products traded in SAPP

The share of competitive market as percentage of total trade has been increasing continuously as a result of steps taken to promote trade through competitive trading. The marginal clearing price of different product segments are described in the exhibit below. The average DAM price has decreased by 31% in the last three years. FPM(M) and FPM (W) price has also reduced sharply by 40% and 32% respectively since 2017.IDM price has remained stable since the last three years.

Figure 29: Average MCP for different trading products in SAPP (USc/kWh)

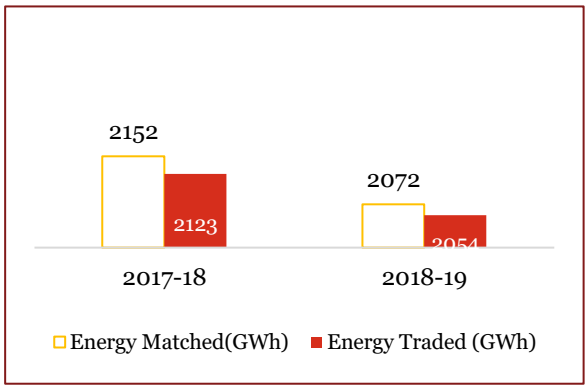


Source: SAPP Annual Reports

Impact of Transmission Constraint in SAPP

In 2018-19, SAPP could not trade about ~20 GWh due to transmission constraint. However, the performance has improved considerably from 2016-17 when ~30 GWh of the volume could not be traded due to constraints in transmission. There is a 400 KV transmission infrastructure development going on in Mozambique - Malawi interconnection which is being funded by Millennium Challenge Corporation (MCC). SAPP is also proposing to establish a Regional Transmission Infrastructure Financing Facility (RTIFF) to promote transmission investment in the next few years. This RTIFF project is funded by World Bank and Government of Norway and Sida.

Figure 30: Energy Matched vs Energy Traded



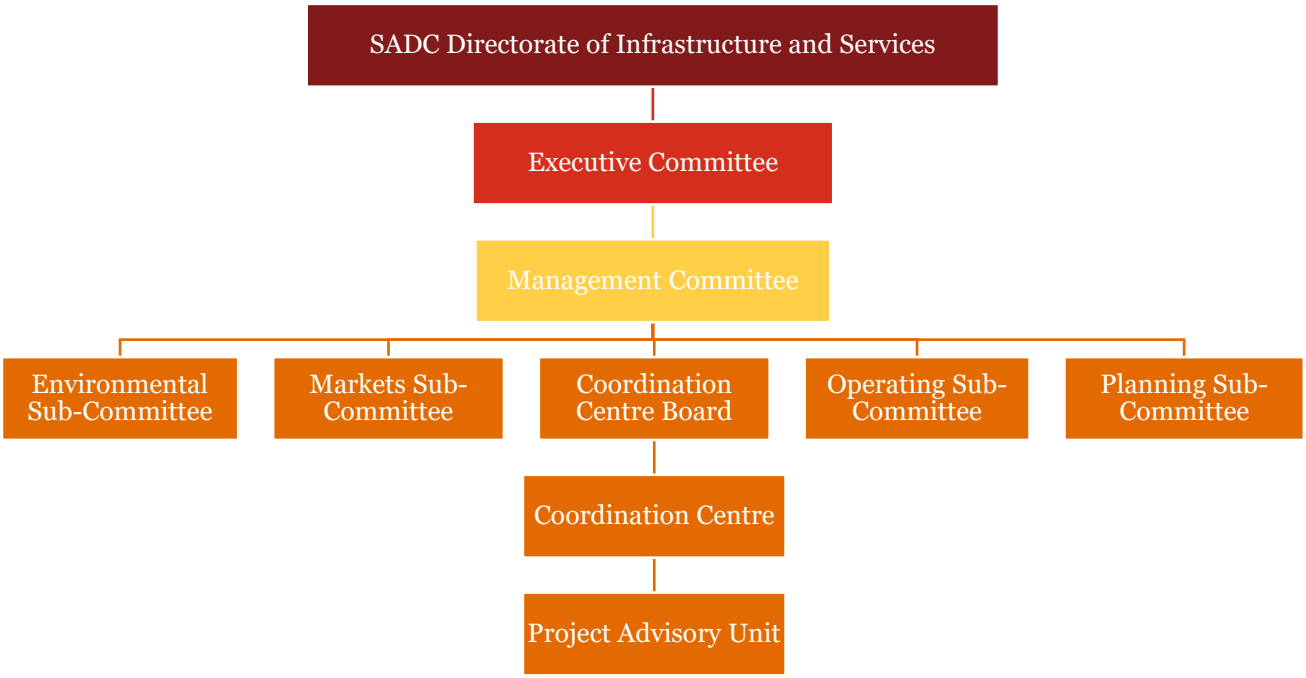
Source: SAPP Annual Reports

Organizational Structure

The SAPP provides a forum to address issues related to regional energy integration based upon coordinated planning and operation of the electric power system of member utilities.

The SAPP is a formal body backed by the MoU signed between the member countries. The SAPP is governed by four agreements:

- Inter-Governmental MoU enabling the establishment of SAPP, 1995 (Revised in 2006)
- Inter-Utility MoU establishing basic management and operating principles, 1994 (Revised in 2007)
- Agreement between operating members establishing rules of operation and pricing (Revised in 2008)
- Operating Guidelines (Revised in 2014)



The two main committees of SAPP itself are the Executive Committee and the Management Committee.

Executive Committee: It consists of the chief executives of the various power utilities form the Executive Committee. They will refer to matters such as requests for membership by non-SADC countries and major policy issues that may arise to the SADC energy ministers.

Management Committee: It will consist of officials from the member utilities form the Management Committee. The major function of this committee is to oversee the management of SAPP.

There are four subcommittees which report to the Management Committee as described as follows:

Environmental Sub-Committee: The Environmental Sub-Committee develops environmental guidelines for the SAPP, amongst other issues the environmental impact of power systems.

Coordination Centre: Functions of the Coordination Centre include monitoring operation, transaction, inadvertent power flow of power pool, providing technical advice, future infrastructure planning, maintaining operational database, coordinating training of staff, prepare annual performance report and facilitating Day Ahead Market (DAM).

Markets sub-committee: The market sub-committee was formed in April 2007 following the signing of Revised Inter-Utility MoU by the SAPP executive committee. Sub-committee is responsible for framing policies, implementing new initiatives and ensuring compliance to the rules and regulations of energy trading in SAPP. All members of the SAPP are signatories to inter utility MoU and are members of markets sub-committee.

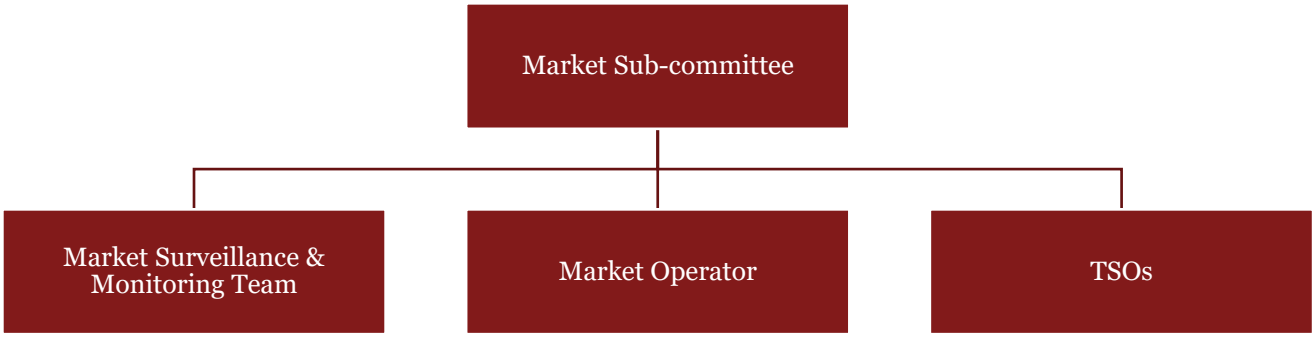
Market sub-committee was set-up with the following objectives:

- Facilitate development of competitive power market in South African region.
- Give users a choice of electricity supply
- Increase investment attractiveness of the South African region power sector
- Ensure sustainable development through sound economic, environmental and social practices

The duties of the Market Sub-Committee include but not limited to the following:

- Continuous development in the energy trading market
- Recommend suitable structure of the market
- Determine criteria to permit member to trade
- Risk management, research and benchmarking for energy trading
- Present all findings and make recommendations for decision making to the management committee
- Monitoring all market related operations in SAPP

The market sub-committee is supported by Market Surveillance & monitoring team, Market operator and Control areas & TSOs for its efficient functioning. Currently the SAPP Coordination Centre acts as the Market Operator for all SAPP trading. Control areas and TSOs are Responsible for dispatch scheduling and imbalance management of the energy trades being carried out between the members.



- **Market Surveillance and Monitoring Team:** Market surveillance promotes ethical behavior from all market participants by realizing market practices based on fairness, accuracy, equal treatment of all players, transparency and confidentiality. Market surveillance function has access to the database of market operators and monitors market pricing, behavior of individual participants, reports trend in development of fundamental figures with influence in pricing.

Responsibilities of Market Surveillance and Monitoring team are to:

- Ensure adherence to market trading rules and conduct investigations of possible breach of laws and regulations
- Ensure all participants and benefit from the same level of protection regardless of type, size and country
- Monitor trade and price development
- Keep track and report anomalies in bidding behavior
- Ensure that market participants do not get or use material nonpublic information
- Monitor that participants do not indulge in price manipulation

- **Market Operator:** Responsibilities of Market Operator include, but are not limited to the following:

- Monitoring operations of Power Pool.
- Monitoring transactions between all market participants, looking for anomalies and taking corrective actions to ensure adherence to all operating rules and regulations.
- Monitoring inadvertent power flows and the returns in kind between participants.
- Provide routine daily reports, data and information relevant to the operation of power pool to the Operating Sub Committee and members.

- Advice if any upgrade in the trading rules and regulations is required.
- Provide technical support to Members of SAPP in matters pertaining to parallel operations.
- Evaluate the impact of upcoming projects on the operation of the pool and advise the Operating Sub-Committee accordingly.
- Carry out operation planning study to find out possible problem areas.
- Maintain data pertaining to transactions between market participants.
- Facilitate trading in the Day Ahead Market.
- Inform members of the upcoming maintenance of generation and transmission facilities to avoid any unexpected disruption in activities.

- **TSO:** TSOs are responsible for performing a number of key functions in real time such as a) monitoring, control and co-ordination of operations b) scheduling and settlement of energy exchanges between national power grids

Operating sub-committee: Operations Committee manages power system demand, develop guidelines for quality of power, monitor & measure quality of power, monitor system disturbances & take remedial measures and restoring power supply after natural disaster. The operating sub-committee consists of representatives of all members which are signatories of Operating Agreement. It shall have a maximum of two representatives per Member and these representatives shall be of sufficient seniority in their own organization to make all relevant decisions.

Planning sub-committee: Planning Subcommittee was given the responsibility of developing a coordinated development plan. It consists of a maximum of two representatives per member who are of sufficient seniority in their own organization to make all relevant decisions. This seniority criterion applies to all three subcommittees

Key Achievements

Steps taken by the market sub-committee to strengthen trading in the region can be broadly categorized under four categories:

Rules and Products

- Task Team was established to develop market guidelines for SAPP for greater benefits, 2010
- Rules and regulations established for participation of non-SAPP members in DAM, 2011
- Revision of SAPP market Book of Rules to account for new products, 2015
- Development of SAPP-MTP and integration of all four trading platforms, 2016
- Implementation of Revised SAPP Transmission Capacity Allocation Criteria and Management, 2016
- Workshop for discussing potential structuring and operation of balancing market, 2018
- Review of SAPP membership categories, 2018

Trade Facilitation

- Live DAM trading started on 15 December 2009
- Post Day Ahead Market was introduced in April 2013 with an objective to match buy and sale volumes which could not be matched in DAM
- Finalized design for new trading platform with objective of reducing support and maintenance cost, 2014
- Prepared roadmap for development of Balancing market, 2017

Institutional Measures

- Agreement to establish Markets Monitoring and Surveillance Team (MMST), 2010
- Obtained Third Phase of support from Government of Norway and Swedish International Development Cooperation Agency (Sida) for the development of SAPP, 2012

Market Integration

- Trainings were organized for all market participants to boost trading on the platform, 2009
- Decision to increase transmission network in the participating countries, 2014
- Established SAPP Transmission Infrastructure Financing Facility (TIFF), 2017
- Started study on impact of inter-connecting with Eastern African Power Pool (EAPP), 2017
- SAPP and EAPP secretaries met for discussions on interconnection of two pools, 2018

Key learnings for SAFEM

- **Developing Guidelines**
  The rules and regulations developed by SAPP market sub-committee for fair representation of members from each of the participating countries and doesn't give special privilege to any country. Chairmanship of every sub-committee is also rotated between member countries. Rules and regulations developed by SAFEM shall ensure equitable treatment and equal representation of all member countries. It must also be ensured that no market participant benefits at the expense of another participant.

  SAFEM may contemplate to draw market rules that would necessarily provide equitable opportunity to the member nation to participate

- **Diverse Products**
  Market sub-committee of SAPP has progressively updated product portfolio over the years catering to the changing dynamics of the sector in the region. The market sub-committee introduced short term market, Day Ahead Market, Post Day Ahead Market, Forward Physical Market and intraday market at appropriate times to cater to changing energy needs of the member countries. Along with introducing new products the market committee also kept updating the guidelines for trading for providing equal opportunities to all market participants.

  SAFEM may design a catalog of products for the proposed regional power market to benefit its members based on regional needs and demands.

- **Capacity Building of the Market Participants**
  Market sub-committee of SAPP provided extensive trainings to all the market participants along with introducing new products. Training and development provided all members with an equal opportunity to gain from new developments and also ensured enthusiastic participation from all members which contributed to the success of newly launched products.

  Before introducing any new product or policy, SAFEM may provide extensive training to the designated members from its participating members

- **Attracting Investments**
  The trading activities under market sub-committee has always been suffering from the chronic issue of inadequate transmission capabilities to execute trades. Because of this issue 18.4 GWh trade could not

  SAFEM may have group of experts who specialize in raising funds for activities which are expected to benefit all the member countries.

  be completed even after matching bids in the market. In order to overcome this issue, the market sub-committee established Transmission Infrastructure Financing Facility (TIFF) to raise funds for development of transmission infrastructure in the region.

- **External Support**

The markets sub-committee along with other bodies under SAPP have constantly been supported by The Government of Norway and Swedish International Development Cooperation Agency for carrying out reforms for the development of market and achieving international benchmarks in power trading.

SAFEM may support in investment mobilization with an objective to eliminate bottlenecks impacting regional power trade

- **Advisory Services to Members**

The Markets sub-committee under SAPP undertakes various studies at regular interval to advice member in the areas of generation, transmission and distribution assets in order to plan sufficient infrastructure to meet future demand. It also suggests members on the optimal energy mix to reliably fulfill all its energy needs while taking care of environmental commitments and cost considerations.

SAFEM may act as an Advisor to the member nations – as and when required.

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

ENTSO-E is the Transmission System Operators (TSOs) is European region which is has the representation of the 43 electricity TSOs from 35 Nations spread across Europe. ENTSO-E is mandated to promote cooperation among TSOs to assist in the development of pan-European electricity transmission network and aims to promote closer cooperation across Europe's TSOs to support the implementation of EU energy policy and achieve Europe's energy & climate policy objectives, which are changing the very nature of the power system.

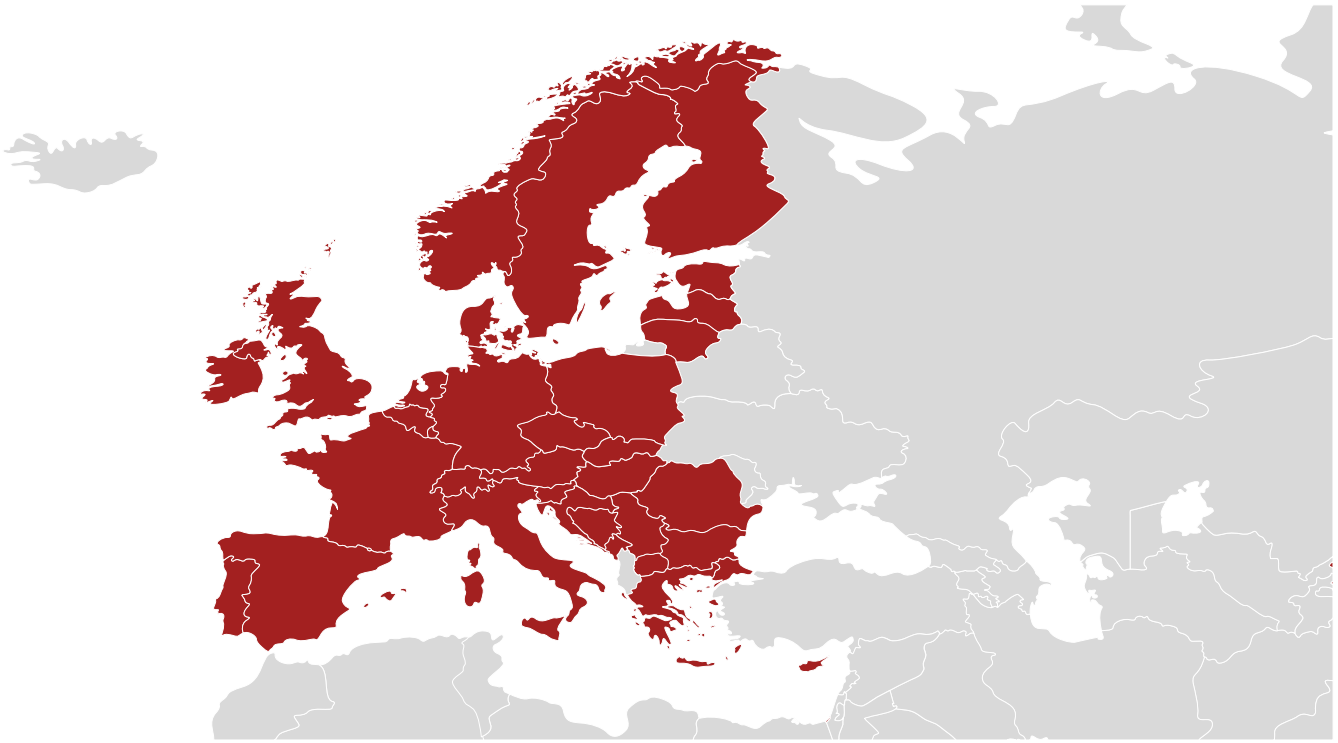


Table 19: Salient Features of ENTSO-E (2018)

Particulars	Description
Installed Capacity (GW) as per 2018	1163.4
Peak Load (GW)	589.7
Cross Border Energy Exchanged* (BU)	467
No of TSOs	43
AC Tran. Line Length (ckt km)	474700
Retail Tariff (Euro/kWh)	0.2048

*Transaction within ENTSO-E nations as well as other external nations

ENTSO-E was formally planned in June 2008, when 38 European electricity TSOs came together in Prague and signed declaration of Intent for the formation of a consolidated body which could represent these 36 TSOs. As a result, in December 2009, ENTSO-E was established by the TSOs with the headquarters in Brussels. ENTSO-E was established and given legal mandates by the EU's Third Legislative Package for the Internal Energy Market in 2009, which aims at further liberalizing the gas and electricity markets in the EU. Furthermore, in December 2010, in order to be fully compliant with the obligations under Article 5 of Regulation (EC) No 714/2009 regarding the establishment of the Association, ENTSO-E submitted its Articles of Association and Internal Regulations to the Agency for the Cooperation of Energy Regulators (ACER) and the European Commission (EC).

Membership

ENTSO-E is the consortium of multiple European TSOs are entities which are operating independently from the other electricity market players and are responsible for the bulk transmission of electric power on the main high voltage electric networks. TSOs provide grid access to the electricity market players like generating companies, traders, suppliers, distributors and directly connected customers, according to non-discriminatory and

transparent rules. In many countries, TSOs are in charge of the development of the grid infrastructure too. The detailed list of the members of the ENTSO-E is attached as the **Annexure – A.5.**

Financials

ENTSO-E is a non-for-profit organization under Belgian law and the budget is ENTSO-E is majorly driven by the membership fees along with allied revenue and income sources. As in 2019, the budget of ENTSO-E amounted to EUR 30.1 Mn funded by TSO member fees for EUR 28.7 Mn and by other revenues for EUR 1.5 Mn.

Evolution of ENTSO-E

The Evolution of the ENTSO-E is described in the exhibited below:

2009	• Pilot project on the development of Network Codes • Pilot project in North West Europe on intraday target model
2013	• Developmemt and pilot on balancing market products like Frequency Restoration Reserves Automatic (FRR-A) and Frequency Restoration Reserves Manual (FRR-M)
2014	• Project for implementation of DA market coupling arcross throughout Europe involving TSOs and PXs
2015	• Capacity Allocation and Congestion Management (CACM) entered into force creating liquid and competitive market • Pilot on forward capacity allocation and electrcity balancing
2017	• System operationsguidelines,electrcicity balancning guidelins and emergency restoration network code eneterd into force • Adoption of Common Grid Model Exchange Specifictaions by IEC • Harmonised alloctaion rukes for long-term transmission rights
2018	• First long-term auction of transmission right performed as per FCA Regulation • Launch of Cross Border Intra Day (XBID) platform for making single intraday market
2019	• Clean Energy Package launched • Agreement for future synchronous ineterconnection of Baltic States • Second wave of SIDC went live to expand operations

Market Products in ENTSO-E

Under the jurisdiction of ENTSO-E, there are broadly two category of products which are transacted with further sub-categorization of the products. These products are – Market Integration Products and Balancing Products.

Market Integration Products

The market integration is the mechanism of free flow of the power across the nation in the European region facilitated by market coupling which is the process of integration of two or more harmonized process by optimizing inputs and communicating outputs. In this regard, broadly three market products have emerged for which ENTSO-E is responsible to monitoring the progress and potential problems in concordance with CACM regulation and FCA regulation. These products are explicated as below:

1. **Single day-ahead Coupling**

Single day-ahead coupling (SDAC) uses a common price coupling algorithm to calculate electricity prices across Europe and to implicitly allocate auctions based on cross-border capacity. Currently nearly 27 countries from the ENTSO-E pool – which includes 33 TSOs and 16 NEMOs - are participating in the SDAC transactions which accounts for nearly 90% of the European electricity consumptions.

As of December 2018, 27 nations have connected by a quantum of 5213 TWh of power under the SDAC mechanism by Day-ahead Operational Agreement (DAOA)

2. Single Intraday Coupling

Single intraday coupling enables continuous cross-border trading across Europe. It is based on a common IT system with a shared order book a single capacity management module, and a shipping module. As of 2018, the majority of Europe is now served by the Intraday Operational Agreement (IDOA) with 26 countries signed up to the agreement. The TSOs from 11 nations have jointly started cross border intraday platform for transacting a transparent and expeditious manner. In the same vein, 14 nations have been transacting power where ~3818 TWh quantum of energy is connected via XBID mechanism.

As of December 2018, 26 nations have been connected by a quantum of ~5139 TWh of power under the SIDC mechanism via Intraday Operational Agreement (IDOA)

3. Forward Capacity Allocation

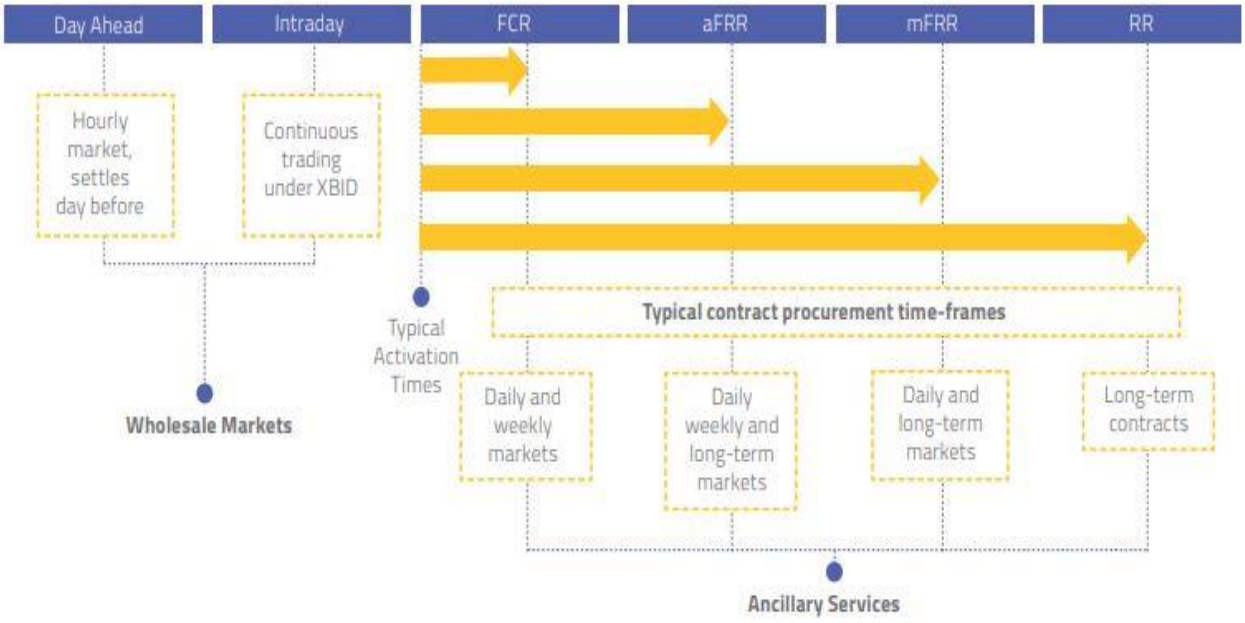
Forward capacity allocation (FCA) serves as a market product which is employed to allocate the long-term transmission rights across the operational area of ENTSO-E. Under FCA mechanism a single allocation platform enables long-term auctions of transmission capacity and is observing participation of the TSOs from 26 countries

As of December 2018, more than 1,000 auctions have been conducted at 73 bidding zone directional borders, 36 of which are bidirectional borders and 1 of which is unidirectional

Balancing Services

Balancing or Ancillary Services are market facilitation activities which help system operators maintain and restore the balance between supply and demand of electricity after the (wholesale) market has closed. They play an important role in ensuring that the electricity system is balanced second by second and can respond flexibly to sudden changes in supply or demand. Ancillary services in Europe are deployed in tandem to the day-ahead and intraday markets to keep the frequency within the limits. Ancillary services are generally contracted in advance of the day-ahead market on various time scales mentioned as below:

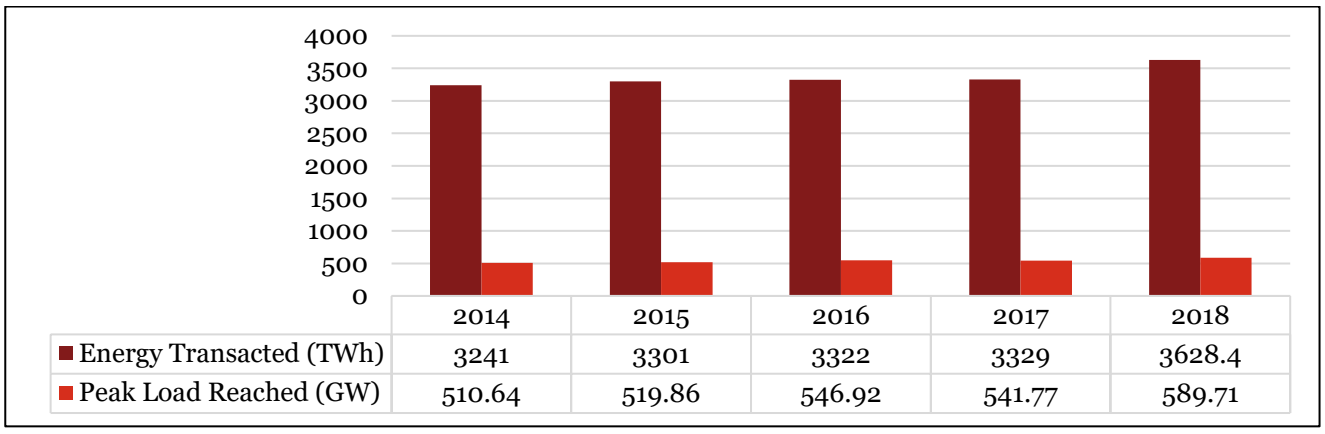
- Weekly Basis
- Monthly Basis
- Annual Basis
- Long-Term Basis



As of December 2017, ~4560 GW capacity has been contracted as the balancing reserve out of which the daily contracts capture nearly ~ 2200 GW capacity

As in 2017, the total energy transacted or consumed nations under ENTSO-E was in the range of 3,329 TWh which has grown significantly from the mark of 3241 TWh in 2014 - at a CAGR of 0.9%. However, the peak load has been observing an upward thrust due to dry cold spells and a result the peak load has tapped 541.8 GW (in 2017) as compared to 510.6 GW (in 2014) – growth at a CAGR of 2%.

Figure 31: Energy Consumed and Peak Load under ENTSO-E

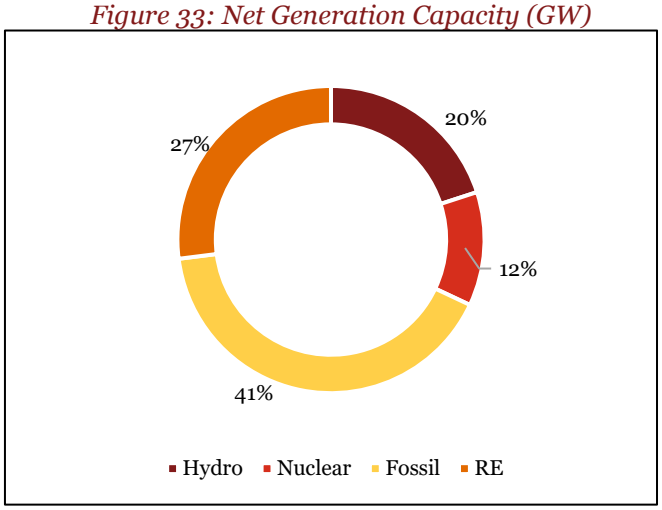


	2014	2015	2016	2017	2018
Energy Transacted (TWh)	3241	3301	3322	3329	3628.4
Peak Load Reached (GW)	510.64	519.86	546.92	541.77	589.71

SOURCE: ENTSO-E Power Facts Report, 2019

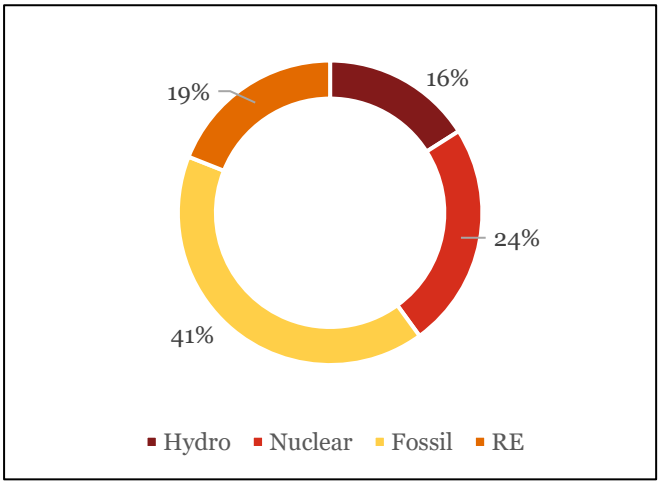
As in 2017, the cumulative installed capacity of the generation fleet under ENTSO-E jurisdiction summed up to 1060 GW. The overall generation mix is dominated by the fossil fuel-based generation which is immediately followed by the RE (which includes solar, wind, biomass and other RE resources. Hence, the share of clean energy is ~47% of the total installed capacity.

Figure 33: Net Generation Capacity (GW)



SOURCE: ENTSO-E Power Facts Report, 2019

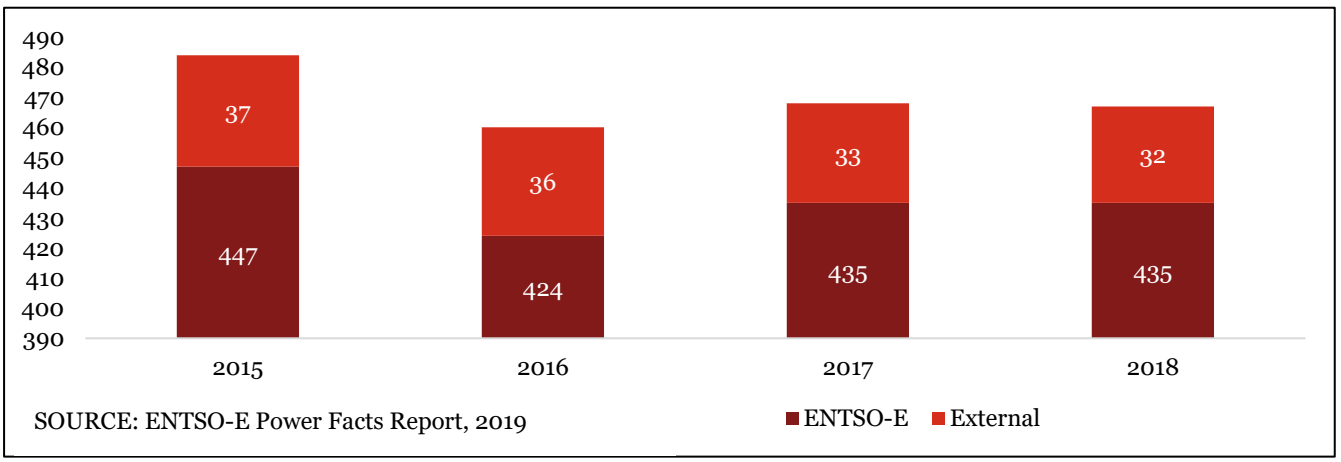
Figure 32: Energy Mix (TWh)



SOURCE: ENTSO-E Power Facts Report, 2019

From reference year 2016 to 2018, the total cross border energy trade taken place within ENTSO-E members and with external exchanges inclusive of nations like Azerbaijan, Belarus, Georgia, Iran, Moldovia, Morocco, Russia and Ukraine has been of the order of ~1880 TWh (1880 Billion Units). The detailed bifurcation of the cross-border energy trade which has happened under the jurisdiction of ENTSO-E is exhibited as below:

Figure 34: Cross-Border Power Trade Volume (TWh)



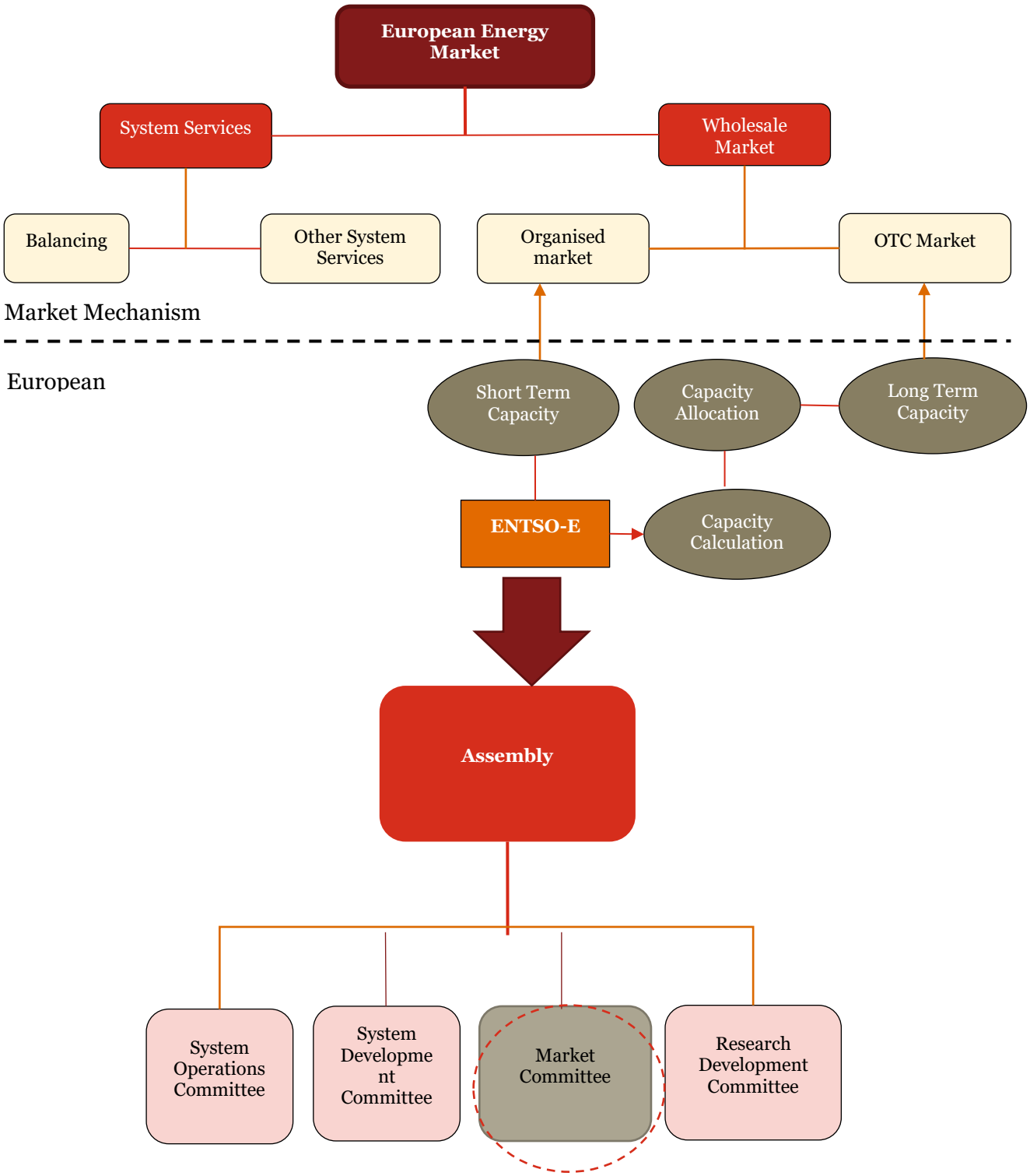
SOURCE: ENTSO-E Power Facts Report, 2019

Organization Structure

The formation of an integrated European electricity market is propelled by various key drivers and enablers which have assisted in manifestation of the ENTSO-E:

1	**Competitive Market**	More competition in the electricity market would provide more choices for businesses and consumers, which would further bring down electricity cost
2	**Energy Security**	Larger and more connected market could address the energy security issues with a resilience power network providing fast access to electricity during the crisis
3	**Environmental Concerns**	Decarbonising the electricity sector through promotion of low carbon and renewable energy as well as energy efficiency condition of stressed assets

The broad market structure of the integrated European energy market with bifurcation of market mechanisms and products alongside the interaction of ENTSO-E within the system (as an EU wide entity) is exhibited as below:



System Operations Committee - ENTSO-E's operations activities are overseen by the ENTSO-E System Operations Committee which broadly overs the actions taken to ensure the secure and optimal real-time operation of the grid, enduring resilience of the transmission system. The system operations activities of ENTSO-E include following activities:

- Development and maintenance of European operational framework - operations network codes/guidelines, agreements and standard.
- Developing and maintenance of communication infrastructure and systems like real-time data exchange communication network, and the ENTSO-E Awareness System
- Establishment of European rules for facilitating the development and implementation of a common grid model for all stages of system operation
- Defining and implementing methods for system balancing, and facilitation of development of Operational Planning Data Environment
- Coordinating measures for protection of critical infrastructure alongside Classification and follow up of operational incidents
- Regional security coordination and its evolution through the Regional Security Coordinators
- Proactively assessing innovations and power system future needs and proposing the best operational strategies for the power system

Market Committee – Market Committee of ENTSO-E closely works with TSO members in all areas relating to the development of market mechanisms from design elements to network code implementation but also transparency publications. The broad objectives of the Market Committee and associated Working Groups and Regional Groups is to ensure that the objectives of the 3rd Internal Energy Market package and the Clean Energy Package are realised and also aims at facilitating the development of a well-functioning European electricity market. Key areas of the work undertaken by the Market Committee includes:

- Working towards market integration and congestion management
- Working to enhance the regional cooperation
- Working towards creating harmonized approach for balancing and ancillary services markets
- Work towards integration of the Renewable Energy Sources (RES)
- Working towards market related network codes on Capacity allocation, congestion management, forward capacity allocation, electricity balancing
- Working towards European Transmission Tariffs and Inter TSO Compensation
- Working towards Transparency Platform for European Electricity Market Information and Electronic Data Interchange (EDI)

ENTSO-E's Market Integration Working Group - ENTSO-E's Market Integration Working Group is the focal point for all network code work related to capacity allocation and congestion management (including the network codes on Capacity Allocation & Congestion Management and on Forward Capacity Allocation) and the timely implementation of the Target Model agreed by the European Commission, ACER, ENTSO-E and stakeholders of the Florence Forum.

ENTSO-E's Working Group Ancillary Services – This group is responsible for working towards creating a harmonized approach towards the ancillary services and the electricity balancing. The group works towards the preparation of proposals for methodology on implementation of frameworks for European Balancing Platform, pricing and activation purposes of balancing energy bids, energy exchanges related to balancing, imbalance settlement harmonization, cross-zonal capacity allocation and calculation and standard products for balancing capacity.

ENTSO-E's Working Group for Market Design and Renewable Energy Sources – EU has aimed for an ambitious target of enhancing the RE penetration and reducing the greenhouse gases emission by increasing contribution from RE sources to make 32% of the final consumption mix, and 57% of EU's generation mix. In this regard, WG for market design and RE sources is playing a pivotal role assessing challenges, sharing national best practices, and proposing solutions for an efficient integration of renewables into markets and grids. WG MD RES worked towards reviewing the main types of current European renewables support schemes and providing some policy recommendations for RES promotion and integration, with an ongoing paper on examining the various challenges and solutions brought about by different types of regulatory frameworks for the promotion of

RES with specific focus on market integration and on the role of TSOs. WG MD RES has contributed to ENTSO-E work aiming at promoting further integration of RES, demand response and new market players at both transmission and distribution level. WG MD RES has also undertaken the responsibility of conducting internal survey amongst the TSOs on RE support schemes in place.

In market design side responsibility of WG MD RES, the activities undertaken by the groups is to draft several policy papers in recent years on market design, capacity mechanisms, demand response.

ENTSO-E's Market Information & Transparency Working Group – With the aim for the creation of efficient, liquid and competitive wholesale markets. In this regard, the Commission Regulation (EU) No 543/2013 of 14 June 2013 was published and under its purview, ENTSO-E was endowed with the responsibility for establishing a central information transparency platform and for leading the work required to define the data to be published on it . In 2015 ENTSO-E's transparency platform was launched and Market Information & Transparency Working Group is responsible for the coordinating and supporting the workflow.

ENTSO-E's Common Information Model Expert Group – Within the bounds of EU Energy policy goals, it has been envisaged to facilitate the formation of a well-functioning liberalized and harmonized European internal energy market (IEM), both wholesale and retail; enable smart grid deployment and further enhance cooperation between all the different market parties . Harmonization and implementation of standardized and reliably functioning electronic data exchanges contribute to these objectives, and common business process descriptions and a harmonized role model are therefore necessary. This group is responsible for developing and maintaining the detailed descriptions of these processes and model, partially in collaboration with other electricity and gas associations and through liaison with European and international standardization bodies.

Projects of Common Interest (PCI)

Projects of common interest are key cross-border infrastructure projects that link the energy systems of EU countries. PCIs are expected to have a significant impact on energy markets and market integration in at least two EU countries, boost competition on energy markets and help the EU's energy security by diversifying sources as well as contribute to the EU's climate and energy goals by integrating renewables.

PCI projects benefit from favorable treatment such as single national authority for obtaining permits, improved regulatory conditions or increased visibility to investors. Project with PCI status are also eligible to apply to funding from the Connecting Europe Facility (CEF).

The Connecting Europe Facility (CEF) is a key EU funding instrument to promote growth, jobs and competitiveness through targeted infrastructure investment at European level. CEF has a total fund size of 30.4 billion Euros and it invests in Energy, Telecom and Transport sectors. A total budget of 5.35 billion Euros was made available for energy infrastructure projects for 2014 to 2020 period.

Key Achievements

Various steps taken by ENTSO-E and the subordinate SOC in the European region are exhibited as below:

- **Development of System Operation Guidelines**

System Operations Committee is endowed with the responsibility of specifying TSOs the initiatives which should be taken in managing their grid. In this regard, System Operation Guideline was successfully developed to aid seamless integration of more and more renewables and further enhance interconnections and enhance the cross-border competition. Hence, the guidelines so developed helps in laying the ground for the next power system and for example makes regional coordination a legal obligation for grid operators.

- **Promoting integrated grid operations in Europe**

ENTSO-E has been successfully undertaking initiatives to in enhancing the cooperation between its member TSOs across the EU to assist in the development of a pan-European electricity transmission network in line with European Union energy policy goals. These broadly include ensuring the secure and reliable operation of the increasingly complex network; facilitating cross-border network development and the integration of RES and enhancing the creation of the Internal Electricity Market (IEM).

- **Development of Capacity Allocation & Congestion Management (CACM) Guidelines**

ENTSO-E has successfully developed Guideline on Capacity Allocation and Congestion Management which sets out the methods for calculating how much space can market participants use on cross border lines without endangering system security. It also harmonizes how cross border markets operate in Europe to increase competitiveness but renewables' integration. CACM is the cornerstone of a European single market for electricity.

- **Development of Electricity Balancing Guidelines**

ENTSO-E has played a pivotal role in developing electricity Balancing Guidelines which help create a marketplace where countries can share the resources used by their transmission system operators to make generation equal demand. It also allows new players such as demand response and renewables to take part in this market, and help in increasing security of supply, limit emissions and diminish costs to customers.

- **Development of Forward Capacity Allocation Regulations**

The Network Code on Forward Capacity Allocation deals with rules for long term markets, the forward markets. which have an important role in allowing market participants to secure capacity on cross border lines a long time in advance and therefore provision a safety equivalent of a trade insurance

- **Development of Single Day Ahead Coupling (SDAC)**

ENTSO-E has been developing a Single Day-ahead Coupling (SDAC), which aims to create a single pan European cross zonal day-ahead electricity market. An integrated day-ahead market will increase the overall efficiency of trading by promoting effective competition, increasing liquidity and enabling a more efficient utilisation of the generation resources across Europe.

- **Development of Single Intraday Coupling (SIDC)**

Launching Single Intraday Coupling (SIDC) which will create a single EU cross-zonal intraday electricity market where buyers and sellers of energy (market participants) are able to work together across Europe to trade electricity continuously on same day basis. This has played a pivotal role in promoting competition, increasing liquidity, promote easy energy share and improved market participation.

Key Learnings for SAFEM

- **Development and strengthening of power market operation**

  ENTSO-E has continuously played a pivotal role in maintaining the robustness, transparency and liquidity by helping the market in matching supply and demand in the most efficient way, in the process enabling strong price signals and assisting local, regional and European security of supply.

  SAFEM can assist in providing support in market operations related modalities in SA region

- **Drafting Network Codes**

  ENTSO-E has played a vital role in design of EU Member harmonized tariff network codes has emerged as an opportunity to improve tariff methodologies to help promote trading, such as the transfer of variable charges (CVs) from the entry to the exit points. This can emerge as a lesson for SAFEM to be implement harmonized network.

  SAFEM can assist in outlining the network codes in the SA regional market

- **Important role in RE integration**

  ENTSO-E has played a pivotal role in enhanced integration of RE sources in the power market and provision a level playing field to all the generators. In this regard, ENTSO-E has also established Clean Energy Package (CEP) which shall enhance framework for regional cooperation through the establishment of Regional Coordination Centres (RCCs).

  SAFEM can assist in facilitating smooth integration of the RE resources in the SA region

- **Developing Grid Balancing Services**

  The growing share of renewable energy sources in Europe's power generation mix is expected to lead to more frequent periods dominated by close to zero bids from generators with very low marginal costs of production. The output from RE supply is integrally entailed with intermittency and volatility which might potentially give rise to more frequent and higher price peaks. In this regard, ENTSO-E has run R&D and implemented pilots for development of innovative balancing tools like automatic frequency restoration reserves, imbalance netting, replacement reserves, manual frequency restoration reserves, frequency containment reserves.

- SAFEM can act as a regional body to assist in development or advocacy of the ancillary power market in the SA region

  ENTSO-E has developed market products like SADC which allocates scarce cross-border transmission capacity in the most efficient way by coupling wholesale electricity markets from different regions through a common algorithm, simultaneously taking into account cross-border transmission constraints thereby maximizing social welfare. Moreover, products like SIDC will further promote competition, increase liquidity and promote transparency.

SAFEM can act as a regional body to assist in development or advocacy of the market products in the developing power market

4.3. West African Power Pool (WAPP)

Introduction

The West African Power Pool (WAPP) was formed in December 1999 after building consensus during the Twenty-Second Summit of the Economic Community of West African States (ECOWAS) Authority of Head of States and Government. This decision was taken following the realization that the abundant energy potential in the region can be used for economic development. The headquarters of WAPP is in Cotonou, Benin.

The WAPP was formed with a vision 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 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.

The 15 member states of the WAPP are Benin, Burkina Faso, Cabo Verde, Cote d'Ivoire, The Gambia, Ghana, Guinea, Guinea-Bissau, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone, and Togo. A total of 30 utilities are a member of WAPP.

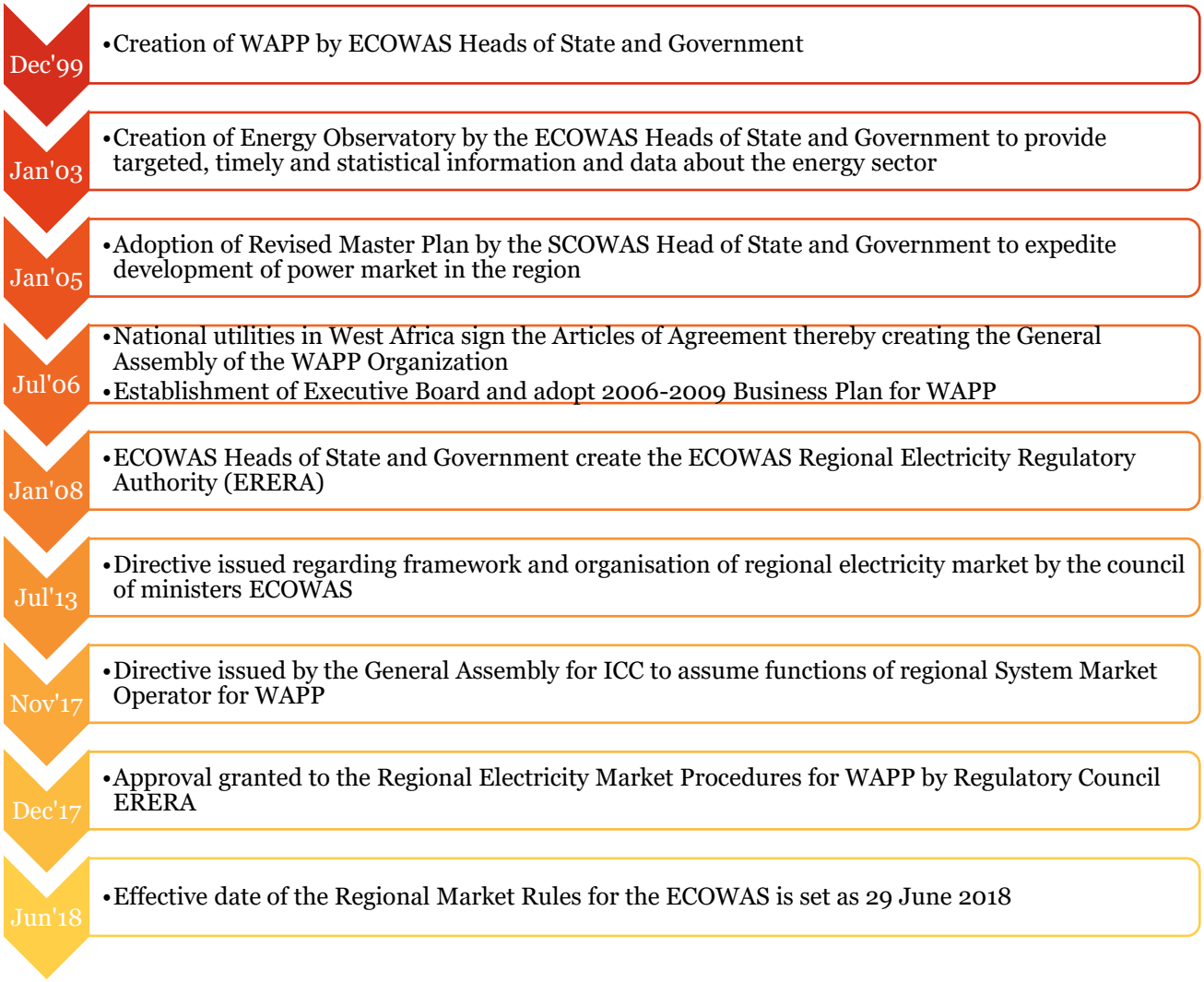
In order become a participant an entity shall fulfill the following criteria:

- Be a resident of or have a permanent establishment in any of the WAPP member countries
- Licenses to perform electricity transmission and/or distribution and/or generation and/or sale and/or supply and/or import or export and/or system and/or market operations business in any of the WAPP Countries by the component regulatory authority of that country
- Not being immune from suit
- Being capable of being sued in its own name in a court
- Have an acceptable credit rating according to predefined criteria set up by the SMO

The list of the WAPP members is attached as an **Annexure – A.6**

Evolution of the WAPP

The evolution of WAPP is described in the exhibit below:



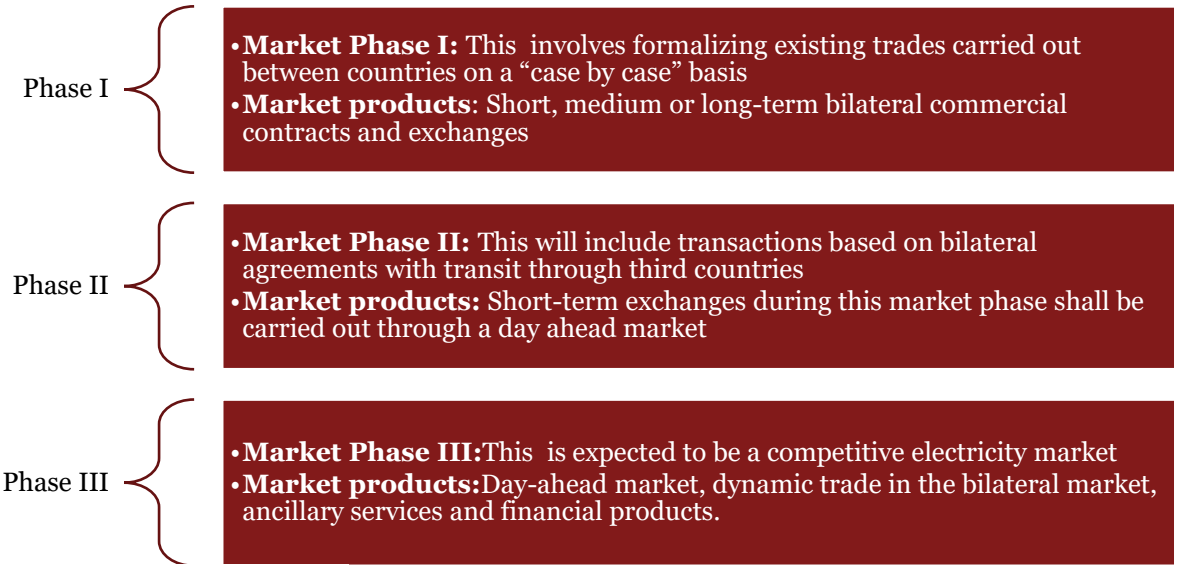
- The West Africa Region has been endowed with substantial energy potential, yet the region was reeling under energy scarcity due to lack of adequate power infrastructure and financing options. The region accounted for only 9% of the total Africa's installed capacity and about 7% of the total electricity generation in the continent in year 2000.
- In 2000 the foundation stone of WAPP was laid and the aim of the promote energy trades between member countries through the integration of the national power systems in order to provide stable, reliable and to ensure affordable electricity supply.
- Up until 2012, the regional trade activities in WAPP nearly non-existent. The main reason was inadequate existing installed capacity and poor infrastructures among the member nations. Unlike the Southern African Power Pool (SAPP), whose installed capacity at inception in 1995 was 48,461 MW (with about 38,000 MW in South Africa alone), WAPP had only 9,705MW capacity as at the time it was formally created.[3] Moreover, the WAPP trading framework is based on net pool mechanism wherein primarily the internal demand at national level is met and subsequently the surplus is transacted on the common platform.
- The predicament of low generation capacity and inadequate transmission infrastructure posed a challenge to the nations to competently meet the internal demand. Hence, the major effort was directed towards transmission infrastructure developmental activities to furnish the adequate capacity for regional integrations.

[3] Institutional Arrangements for the Promotion of Regional Integration of Electricity Markets, World Bank

- As a result, building of power plants and transmission networks, and perfecting other technicalities required for loads scheduling and power trading were prioritized in WAPP project financing, with few investments on information, transparency and regulation.

Market Products

The Electricity Market Design, in accordance with the principles of gradual implementation proposed three (3) market phases. Currently, WAPP is implementing phase II. Each phase with the market products is described in the exhibit below:



Source: Market Plan WAPP

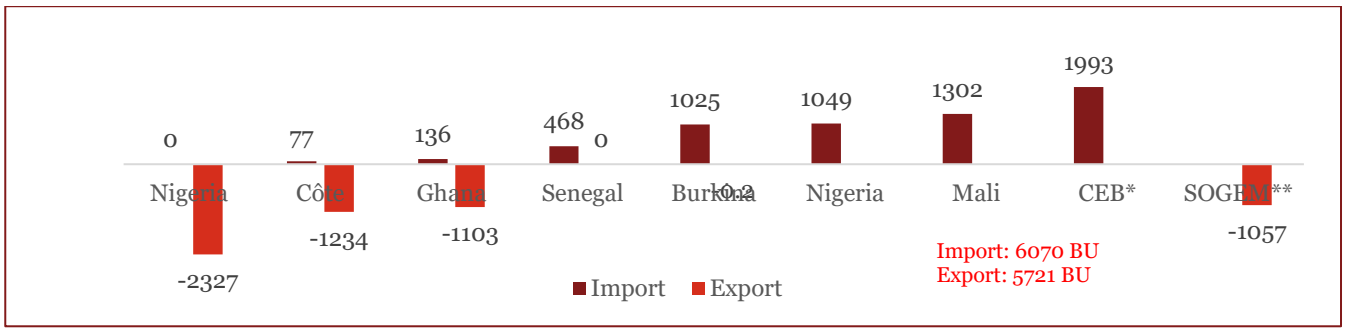
Table 20: Current WAPP Interconnected Power System

Particulars	Description
Installed Capacity (GW)	23.0
Available Capacity (GW)	13.4
Peak Load (GW)	10.9
Energy Generated (BU)	69.7
Energy Exchanged (BU)	6.1

Source: WAPP Annual Report 2019 (ECOWAS)

Total energy traded for import is 6050 BU and exports is 5721 BU for 2019.Imports and Exports of the region has increased by 18% and 13% respectively since 2017. The bilateral trade in the market is on the basis of a commercial agreement signed between the buyer and seller.

Figure 35: Imports and Export of Electricity in WAPP(BU) in 2019



Source: WAPP Annual Reports 2019
**-CEB and SOGEM are utilities and not countries

Organizational Structure

The General Assembly- The General Assembly is the highest decision-making body of the WAPP and consists of representatives from all the member utilities.

The Executive Board- The EB is responsible for implementing the decisions of the General Assembly. To this effect, it has the highest power to ensure the realization of WAPP mission and objectives.

The Executive Board is composed of 15 members namely:

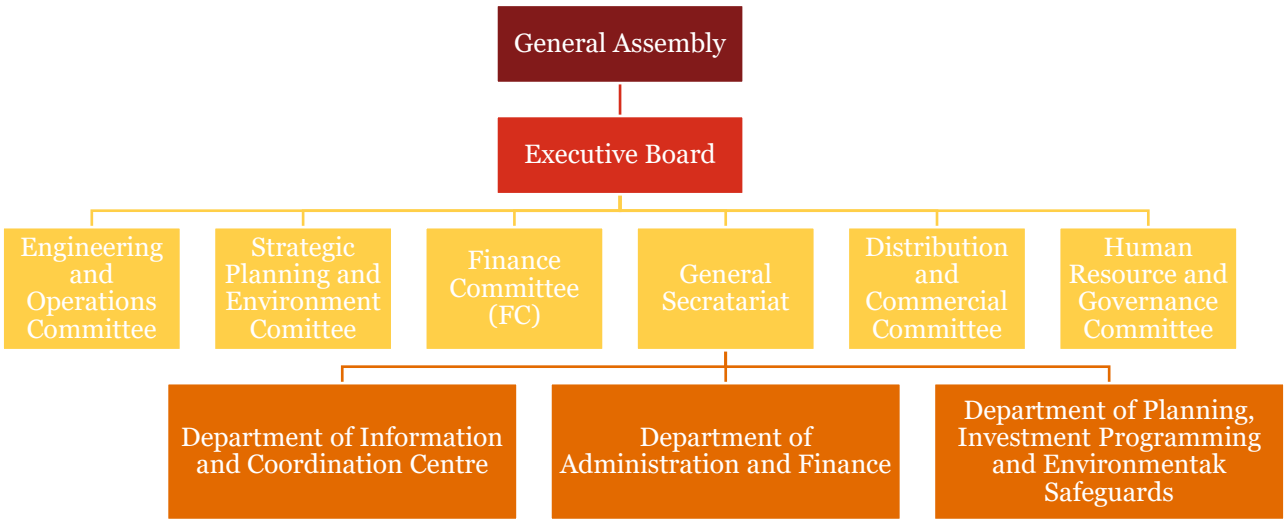
- 15 Director Generals/ Managing Directors and Chief Executive Officers of ECOWAS National Power Utilities
- The Secretary General
- An Honorary Member

The Organizational Committees (OC)

The OC provides support and expertise to the Executive Board on all matters in respect of collective policy formulation functions for developing, maintaining and updating common 'rules of practices' on technical, planning, operational and environmental aspects of the WAPP.

The WAPP has five OC:

- The Engineering and Operations Committee
- The Strategic Planning and Environment Committee (SPEC)
- The Finance Committee (FC)
- The Human Resource and Governance Committee (HRGC)
- The Distribution and Commercial Committee (DCC)



The General Secretariat is the administrative and technical body responsible of the day-to-day management of the activities of WAPP.

The General Secretariat is composed of three Departments:

- The Department of Information and Coordination Centre
- The Department of Administration & Finance
- The Department of Planning, Investment, Programming and Environmental Safeguards

WAPP is working with external consultants to finalize the organisation structure of Department of Information and Coordination Centre which has been given the responsibility to establish and manage the market trading WAPP.

The **Information and Coordination Committee (ICC)** is responsible to act as System and Market Operator for the WAPP. Proper functioning of Regional Electricity Market in West African Region is based on three requirements:

- Payment of bills as and when due
- Free access to the regional transmission network
- Monitoring and control of cross-border electricity exchanges

Role and responsibility of the committee responsible for managing the operations were set by the Regulatory Council in August 2015. These rules govern the commercial transactions pertaining to cross border flows of electricity that utilize transmission lines and associated assets of the interconnected system of the WAPP.

It is the responsibility of the System and Market Operator (SMO) to establish and govern an efficient, competitive, transparent, and reliable market for the sale and purchase of wholesale electricity and Ancillary Services in the WAPP region and to ensure that Operating Manual and the market rules work together to secure efficient co-ordination and adequate participation.

ICC has the following responsibilities:

- Collect analyze and disseminate the information needed considering WAPP's current situation and its future development
- Monitor development of the national electric power sector in ECOWAS Member states in order to forewarn the risks of performance deficiencies and to provide them with corrective measures
- Periodically analyze the economic and technical viability of cross-border electricity trading arrangements among Transmission Using Members
- Collaborating with other regional institutions like WAPP General Secretariat and ECOWAS Regional Electricity Regulatory Authority (ERERA). ERERA frames regulations of cross border connections, tariff setting methodology, technical regulations, dispute resolution methods and supervises various activities of the power pool. WAPP advises ERERA while framing the rules of the market.
- Credit Limits: ICC is responsible for determining and monitoring credit limit of the market participants. These limits are reviewed one every year and can be revised based on historical payments, future payments expected, expected sales and purchases.
- Information Exchange Protocols: ICC is mandated to maintain the data record of the trades carried out for a minimum period of 5 years. The market participants are also required to main the record of all transactions. It is also responsible for market confidentiality and to ensure that no participant gains from material non-public information.
- Monitoring of transaction settlement, Invoicing and Payment along with documentation for the entire settlement process including the taxes and interest.
- Support and monitor the technical performance of power utilities
- Coordinating among all market participants for formulation and implementation of market policies
- Market monitoring and surveillance
- Administration of contracts
- Dispute management between participants
- Administration of commercial data bases

In its effort to implement the regional electricity market, the ICC Department is undertaking various activities primarily focused on the following strategic projects like WAPP ICC Project, WAPP Market Road Map, Synchronization Project and Performance Improvement project.

Key Achievements

- The European Union and World Bank, the two Technical and Financial Partners (TFPs) that are supporting WAPP towards the implementation of the Regional Electricity Market, have funded technical assistance programs to assist in the transformation of the ICC Department into the System and Market Operator (SMO) including its initial operationalization.
  The assistance is intended to assist the ICC Department in organizing itself adequately enough to assume its new responsibilities under the Regional Market, in training the ICC staff, in operating the WAPP interconnected power system control equipment and administering the Regional Market.
- Following the Finance and Engineering & Operating Committee Market Taskforce Meetings, the Settlement Bank Agreement, the WAPP Day Ahead Market Book of Rules were drafted and validated. They were approved by WAPP Executive Board on 05th October 2019.
- Synchronization of WAPP Interconnected System Project: Activities under phase 1 included: site visits, trainings, upgradation of equipment for facilitating trade in the WAPP region
- ICC is working with consultants for finalization and adoption of Regional Transmission Pricing Model based on Regional Transmission Pricing Methodology approved by ERERA. A final model was disseminated to all the participants in 2019.

- Secured funding from The World Bank and European Union for appointing Power Pool Advisor for technical advisory to achieve the vision of establishing a WAPP Regional Market. ICC along with the consultants is reviewing WAPP power situation, finalizing ICC organizational structure, training ICC operation staff, reviewing and updating WAPP operation manual, setting up digital document management system and assisting WAPP member companies.
- ICC Undertook Distribution Loss Reduction Project aimed at improving the performance of distribution utilities. A training course on calculation of distribution loss was also organized for the staff of member utilities.
- Promoting a Climate Friendly Electricity Market in ECOWAS: ICC is working with giz to reduce greenhouse gases in the region. Objectives of this assignment are to promote use of renewable energy in the region, promote energy efficiency and efficient functioning of the power market.

Key learnings for SAFEM

- **Timely Implementation:** ECOWAS member countries have a total population of 340 million and only 42% of the population have access to electricity. Continuous delay in electricity access projects have tremendously limited the economic development of the region. The reason for this delay in implementation is lack of funding to pursue the activities required to be completed to successfully implement the project.

  SAFEM shall ensure availability of funds in order to establish an efficient power market within defined timelines

- **Timely payment for power producers:** In a number of trades in the region there has been an issue of partial payment or delay in payment to the power producer. This hamper the capabilities of power producers and also lowers the confidence of power market participants in the market structure.

  SAFEM can prospectively draft rules to ensure timely and complete payments to the power producers in order to increase participants confidence in the market trade activities

- **Synchronization:** Member countries of the WAPP undertook activities to synchronize the grid to facilitate power trading.

  SAFEM can take steps to encourage synchronization activities for seamless power trading with member countries

- **Reducing Greenhouse Gases:** ICC is working with GiZ on projects to reduce greenhouse gases in the long term by use of renewable sources to produce power and promoting energy efficiency.

  SAFEM can act as a body which can encourage member countries to take initiatives to reduce greenhouse gases in the region and incentivize power production using renewable sources

4.4. Greater Mekong Sub Region (GMS)

The Energy cooperation in the GMS was a joint initiative of the six nations centered in the South East Asian region and market its commencement after intergovernmental agreement (IGA) on regional power trade in 1992. The region participation entails the involvement of the nation's viz. Cambodia, People's Republic of China (PRC), Lao PDR, Myanmar, Thailand and Vietnam.

The GMS region is endowed with myriad of resources with the diverse resource mix in the different member nation. The estimated resource potential of the region, as a whole is ~229 GW hydropower, 1.2 trillion cubic mt. natural gas and 0.82 billion ton of oil. Hence, the overarching aim of the GMS Regional Power Trade (RPT) was the benefit sharing of the resources across the region and support the gradual evolution of the regional market trade from bilateral contracts to more sophisticated and centralized regional power trade setup. In,2010 total power trade in GMS was of the order of ~34,139 GWh with Lao PDR being major exporter and Thailand being major Importer. The power trade in GMS is exhibited as mentioned below:

Table 21: Power Trade in GMS, 2010 (GWh)

	Imports	Exports	Total Trade
Cambodia	1546	-	1546
Lao PDR	1265	6944	8210
Myanmar	-	1720	1720
Thailand	6938	1427	8366
Vietnam	5599	1318	6917
PRC	1720	5659	7379
Total	17069	17069	34139

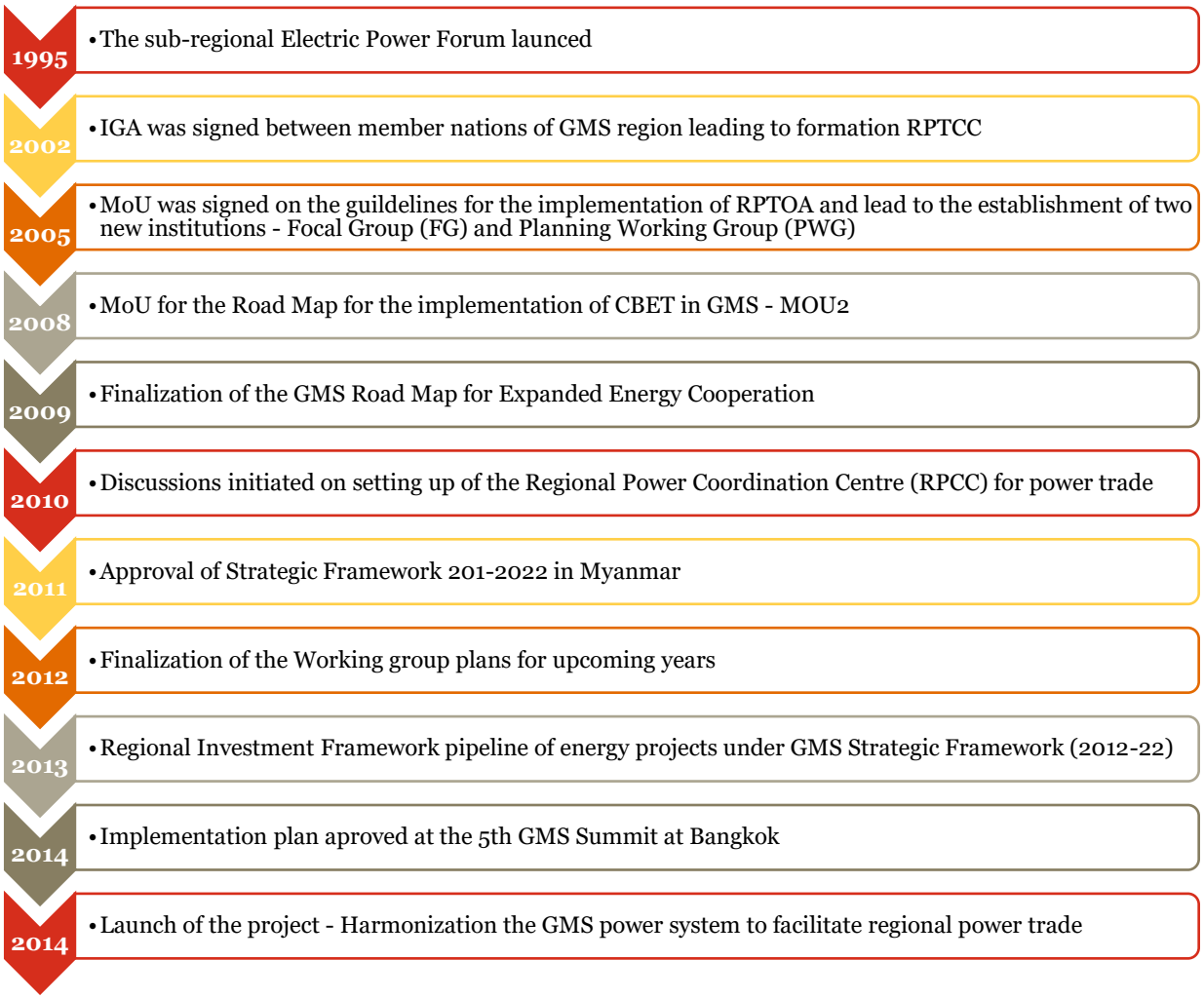
SOURCE – ADB Study, 2012

The power development in the region is envisaged to be developed under four stages, being elucidated as below:

Stage - 1	• Bilateral trade through surplus capacity available in existing CBET system
Stage- 2	• Enabling trading between any pair of GMS nations using transmission facilities of third region
Stage - 3	• Third parties other than national power utilities will be permitted to begin trading over the interconnectors
Stage - 4	• Establishment of multi-buyer and multi-seller regional market

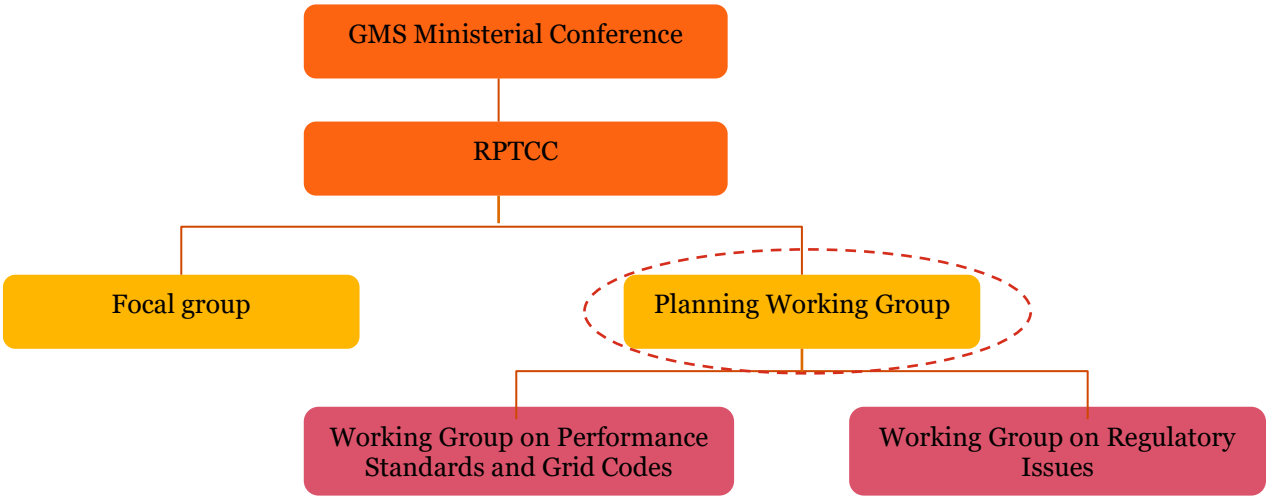
Evolution of GMS

RPTCC has played a vital role in transformation of the regional trade outlook in the GMS region, which has promoted the regional cooperation, cross-border power trade development, access to cost-effective generators, economic growth and development of the region. The chronological evolution of RPTCC is illustrated as follow:



Organizational Structure

The inception of GMS cooperation delineated nine thematic areas to nurture regional cooperation with energy being one of the thematic areas. In the same vein, Inter Government Agreement (IGA), 2002 was signed between member nations to implement the Policy Statement on Regional Power Trade endorsed in 2000, and to establish a framework for the advancement of regional power trade. Hence, a high-level regional body viz. Regional Power Trading Coordination Committee (RPTCC) was established as a fallout of IGA, 2002 and was endowed the responsibility of development and transformation of the regional trade. The structure of the regional power trade and concomitant committees are illustrated as below:



RPTCC is the high-level body and an apex body responsible for the responsibility of coordination and navigation of the development of regional market trade with the gradual, stepwise transition from bilateral to trilateral to an envisaged multi-buyer and multi – seller power trade. The operations of the RPTCC are supplemented by the Focal Group and the Planning Working Groups – observing representation from the national government and utilities – helping in aligning the activities of the regional priorities with the national objectives.

- **Focal Group (FG)** – FG is endowed with the responsibility of coordination of the implementation activities undertaken by the RPTCC and subsequently – by virtue of assumption of higher responsibilities – evolve into a Technical Secretariat.
- **Planning Working Group (PWG)** – Planning working groups are endowed with the responsibility of fulfilling the operational and planning needs of the system by:
    - Identification of the priority interconnection projects;
    - Regional performance standards and database;
    - Analysis of technical performance standards and grid code;
    - Study on regulatory issues.

There are further two working groups, established to aid the operations and responsibilities of Planning Working Groups – Working group on performance Standards and Grid Code (WGPSGC) and Working Group on Regulatory Issues (WGRI). The roles and responsibilities the working groups are explained in the later sections.

Roles and Responsibilities

RPTCC has been actively operating for the advancement of the regional integration of the power across the GMS region, and progress GMS towards fully functioning regional power poll. With respect to the SAFEM, operation of the two working groups viz. WGPG and WGRI, and one planning working group viz. PWG is critical. The roles of responsibilities of these groups is elaborated below:

Planning Working Group (PWG) – PWG was established with an overarching aim of fulfilling the operational and system planning working groups. The roles and responsibilities are as follows:

- Responsibility for overall transmission system planning.
- Identification in the priority interconnection projects in the region
- Establishment of the common regional performance standards and database.

Working Groups (WG) – Roles and responsibilities of the 2 working groups are elucidated as follows:

Table 22: Working groups in GMS

	Working Group on Performance Standards and Grid Code (WGPG)	Working Group on Regulatory Issues (WGRI)

Roles and Responsibilities	• Analysis of technical performance standards and grid codes across all the GMS countries
	• Preparation of implementation plan for harmonization of performance standards and grid code into a regional standard
	• Study of power transmission regulation
	  ○ Policy on scheduling and accounting
	  ○ Coordinated operational planning
	  ○ Communication infrastructure
		• Study on regulatory barriers to power trade development
		• Study on transmission regulations related to 3rdparty access to interconnections, prioritizing contracts/ PPAs, dispute resolution mechanism
		• Task force for transmission pricing mechanism, including wheeling charges for 3rdparty access.

Key Achievements

The working groups have undertaken gamut of activities to advance the power trade activities in GMS. Some key activities which have been undertaken recently by the working groups and have emerged as critical activities are enlisted as follows:

Table 23: Key Achievements by WG in GMS

	Working Group on Performance Standards and Grid Code (WGPG)	Working Group on Regulatory Issues (WGRI)
Key Achievements	• GMS performance standards adopted as a reference document in June 2016 • Regional transmission regulations adopted as reference document in Dec 2017 • WGPG continues to make progress in establishing common technical performance standards for GMS. • Standard regional metering and communication arrangements –under progress and to be finalized soon • GMS Grid Code target finalization by Dec 2018 (including gap assessment) • Other ongoing activities: Regional master plan (by June 2019) and FS for priority interconnectors (by June 2020) • Allocating resources for conducting the feasibility studies of regional projects • WGPG has been renamed as "Working Group for Planning and Operations" (WGPO) and has been endowed the responsibility of the regional synchronous operation and GMS grid code activities.	• Develop a roadmap for GMS countries on transmission pricing methodologies based on current principle and international examples • Technical assistance to countries on regulatory issues, i.e. transmission company, system operation, wheeling charges, etc. • Review of interconnectors and commercial arrangements –migration towards Stage 2 • WGRI has been playing a role in GMS regulatory harmonization – third party access and methodology of wheeling charges. • Study and gap analysis on existing policies on electricity subsidies and taxation rules for power imports and exports in member states • Proposition of a concept of benchmarking transmission charges.

Key Lessons for SAFEM

- **Phased transformation of trade from bilateral to prospective multilateral** - Since the inception of power trade in GMS region, it has undergone a drastic progress. The system has transitioned from a single circuit line between Lao PDR and Thailand to a tripartite power trading setup between nations like Lao PDR, Thailand to Malaysia, Malaysia purchases power from Lao PDR under a predefined set of terms regarding price and quantity, and Thailand acts as the transit transmission provider - EDL, Laos is connected to EGAT by 115KV AC transmission interconnections, Thailand – Malaysia by 300KV HVDC. The system subsumes numerous 230 KV and 500 KV lines, installed and upcoming lines to develop regional trade. The development is divided in the form of roadmap (consisting 4 stages) in GMS region and currently the region is progressing towards Stage-3, soon to graduate to the market pool.

  SAFEM can draft a guiding roadmap to aid phased transformation of the emerging SA Regional power market

- **Harmonization of Grid Code** – GMS is actively working towards development of GMS grid codes/Regional power trade operating agreement which will entail harmonized technical standards and operational procedures. These grid codes will play a vital role in ensuring a uniformity in the minimum set of technical, design and operational criteria to ensure secure and reliable supply. This will also improve the co-ordination of the cross-border power trade in the system.

  SAFEM can assist in development of grid code which shall be important for ensuring standardization across the region

- **Progressively creating Dedicated Groups** – Post the signing of IGA, 2002 – the plinth for the establishment of RPTCC was established with an aim to mutually transform the power sector and ensure cooperation, harmonized development and environmental sustainability. RPTCC is responsible for elaborating on rules and regulations for regional electricity trade. As the responsibility was growing and trade development was progressing, MOU was signed by the member nations for the establishment of new institutions, to supplement the works of RPTCC and share the responsibilities – to progress from Stage 1 to Stage 2. Subsequently, two working groups were formed to expedite the development, implementation and revision of standards, grid codes and regulatory issues – WGPG and WGRI. Gradual conception of RPCC as a platform for knowledge sharing and deliberating on regional issue. Recently, in order to undertake implementation of planning, operations and technical standards, WGPG has morphed to WGPO to propel the growth from Stage-2 to Stage-3.

  The gradual course of transition of the working groups and bodies of RPTCC can be taken as an analogy for defining the transition of working groups and bodies under SAFEM

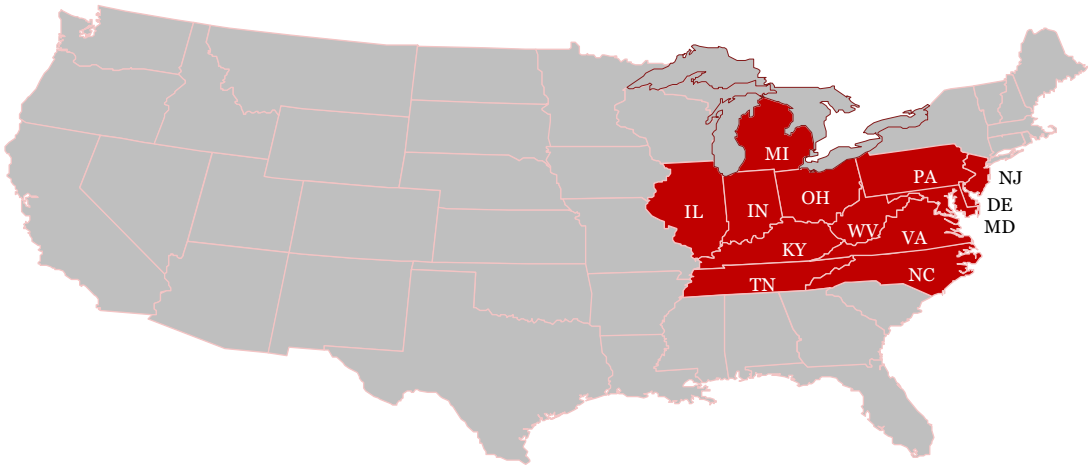
- **Headquarter Hosting** – Post conception of RPCC, extended debates and deliberations were undertaken to shortlist a host nation for housing the headquarters of RPTCC. This is not an impasse, per se but such situations impede the progress.

  SAFEM can take learning from this case, and this can emerge in case of a regional body like SAFEM

4.5. PJM Interconnection

Introduction

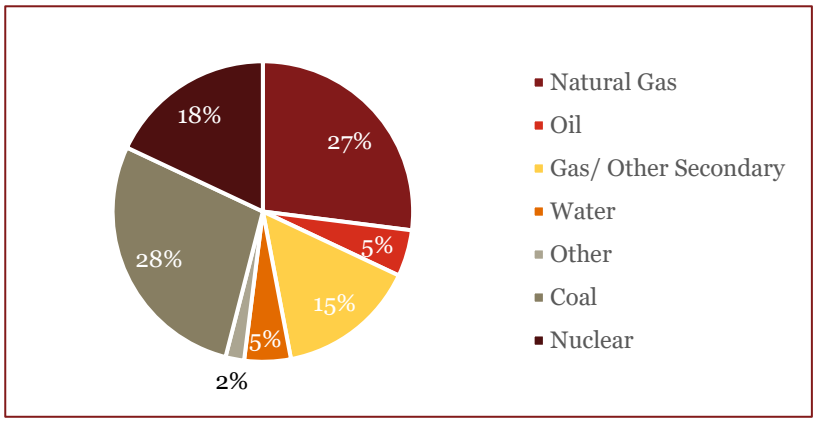
Pennsylvania-New Jersey-Maryland (PJM) Interconnection is a Regional Transmission Operator (RTO) in USA which started its operations in 1927 where three utilities from east came together and formed world's first continuing power pool for realizing the benefits and efficiencies possible by interconnecting to share their generating resources. Subsequently new members joined in the year 1956, 1965 and 1981 and currently PJM has a participation of 14 members states namely Delaware, Illinois, Indiana, Kentucky, Ohio, Tennessee, Columbia, Maryland, Michigan, New Jersey, North Carolina, Pennsylvania, Virginia and West Virginia. PJM consists of 1066 member across five sectors.



As on 2019,PJM has a generation capacity of 186.8 GW, peak demand of 165 GW, transmission line length of 84,236 miles, served 65 million people across 369,089 square miles of territory. Since its formation in 1927, PJM kept integrating a number of utilities into its operations which helped in expansion of resources available to meet consumer demand for electricity and increased the benefits of PJM's wholesale electricity market. PJMs current functioning can be broadly described as:

- Operating a competitive wholesale electricity market and managing the high voltage electricity grid to ensure reliability of customers.
- Prepare long term plan for the region providing a broad, interstate perspective to identify most effective and cost-efficient improvements to the grid to ensure reliability and economic benefits on system-wide basis.

Figure 36: Generation Mix (in 2019)



Source: PJM Reports, 2019

Membership: PJM members sign an operating agreement which gives them certain rights and Obligations. Membership fee for different categories ranges from $ 500 per year to $ 5000 per year. The operating agreement establishes five industry sectors to facilitate voting and other activities of members in the PJM stakeholder process. Membership is provided across the following five categories:

- Transmission owner
- Generation owner
- Electric distributor
- End-Use customer
- Other supplier

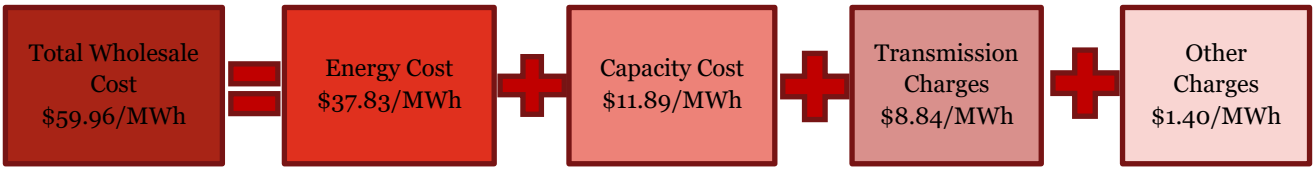
Evolution of PJM

During the tail-end of 1990s, Federal Energy Regulatory Commission (FERC) issued various orders in an incremental manner to transform the power ecosystem in USA. In USA power market, vertically integrated electrical utilities were monopolizing the market operations and control by managing the generation, transmission and distribution segments of the power sector value chain. The underlying reasons which lead to the development of the PJM as an RTO are enumerated as below:

- PJM started its transition into an independent, neutral organization in 1993 when the PJM interconnection Association was formed to administer the power pool.
- In 1997, PJM became a fully independent organization when membership was opened to non-utilities, and an independent Board of Managers was elected.
- PJM launched its bid-based market on April 1, 1997. Later in 1997, Federal Energy Regulatory Commission (FERC) approved PJM as the country's first fully functioning independent system operator (ISO).
- FERC Order 2000 issued in December 1999 established the concept of the regional transmission operator (RTO) and requires transmission operators to make provisions to form and participate in these organizations in multi-state area to advance the development of competitive wholesale power markets.
- Owing to these developments, in 2002, PJM emerged as an RTO in the Eastern Region of USA to ensure safety, security and reliability of the power market system**.**

Market Products by PJM

PJM operates several kinds of wholesale electricity markets with an objective to provide reliable electricity supply at the lowest possible cost determined through market competition. The relative size of the components determining the wholesale cost is presented in the diagram below:



The total price of wholesale power is the total price per MWh of purchasing wholesale electricity from PJM markets. The total price is an average price and actual prices vary by location and time period. The total price includes the price of energy, capacity, ancillary services, and transmission service, administrative fees, regulatory support fees and uplift charges billed through PJM systems.

PJM has a catalogue of products which are available under different categories of energy market setups. In this sub-section, various product offerings by the PJM as an RTO are exhibited as below:

Source: PJM Report

The existing market products as on date are described in the exhibit below:

Table 24: Trading Instruments in PJM

Trading Instrument	Description	Trading Details
Day Ahead Market	• PJM's Day-Ahead Market is a forward market in which hourly locational marginal prices are calculated for the next day based on the amount of energy generators offered to produce, the amount of energy needed by consumers and scheduled transactions between buyers and sellers of energy.	• Hourly prices are calculated based on generator offers, bids from power consumers such as utility companies and market-related financial transactions.
Real Time Market	• PJM's Real-Time Market is a spot market – meaning that the product is procured for immediate delivery - in which current prices (called locational marginal prices) are calculated at five-minute intervals based on actual grid operating conditions.	• Transactions between buyers and sellers are settled hourly; invoices are issued to market participants weekly.
Capacity Market	• PJM's capacity market, called the Reliability Pricing Model, ensures long-term grid reliability by procuring the appropriate amount of power supply resources needed to meet predicted energy demand three years in the future.	The essential elements of the capacity market are: • Procurement of capacity three years before it is needed through a competitive auction • Locational pricing for capacity that varies to reflect limitations on the transmission system • A variable resource requirement curve, which is the demand formula used to set the price paid to market

Trading Instrument	Description	Trading Details
		participants for capacity and the amount of capacity • Contract is for one delivery year.
Ancillary Services Market	• Ancillary services help balance the transmission system as it moves electricity from generating sources to retail consumers. Throughout the day, PJM operates markets to procure two important ancillary services: regulation and reserves.	• Regulation is used to control small mismatches between load (the electricity being consumed) and generation (the electricity being produced), adjusting for small tips to either side of the scale. • Reserves help to recover system balance by making up for generation deficiencies if there is loss of a large generator, resulting in a large tip in the scale.

The detailed representation of the total volume of capacity transacted and the total cost of transactions over the wholesale market of PJM is exhibited as mentioned below:

The Table below provides the price of electricity for different categories:

Table 25: Price of Electricity (USD)

Category	2015 $/MWh	2016 $/MWh	2017 $/MWh	2018 $/MWh	2019 $/MWh
Load Weighted Energy	$36.16	$29.23	$30.99	$38.24	$27.32
Capacity	$11.25	$10.96	$11.27	$13.02	$11.27
Capacity	$11.12	$10.96	$11.23	$12.97	$11.25
Capacity (FRR)	$0.13	$0.00	$0.00	$0.00	$0.00
Capacity (RMR)	$0.00	$0.00	$0.04	$0.05	$0.02
Transmission	$7.69	$8.42	$9.54	$9.47	$10.39
Transmission Service Charges	$7.09	$7.81	$8.83	$8.81	$9.75
Transmission Enhancement Cost Recovery	$0.51	$0.52	$0.64	$0.57	$0.55
Transmission Owner (Schedule 1A)	$0.09	$0.09	$0.10	$0.09	$0.09
Transmission Seams Elimination Cost Assignment (SECA)	$0.00	$0.00	($0.03)	$0.00	$0.00
Transmission Facility Charges	$0.00	$0.00	$0.00	$0.00	$0.00
Ancillary	$0.91	$0.71	$0.76	$0.80	$0.72
Reactive	$0.37	$0.38	$0.42	$0.41	$0.44
Regulation	$0.23	$0.11	$0.14	$0.18	$0.12
Black Start	$0.08	$0.09	$0.09	$0.08	$0.08
Synchronized Reserves	$0.11	$0.05	$0.06	$0.06	$0.04
Non-Synchronized Reserves	$0.02	$0.01	$0.01	$0.02	$0.02

Day Ahead Scheduling Reserve (DASR)	$0.10	$0.07	$0.05	$0.05	$0.02
Administration	$0.47	$0.46	$0.52	$0.50	$0.51
PJM Administrative Fees	$0.43	$0.43	$0.48	$0.47	$0.47
NERC/RFC	$0.03	$0.03	$0.03	$0.03	$0.03
RTO Startup and Expansion	$0.01	$0.00	$0.00	$0.00	$0.00
Energy Uplift (Operating Reserves)	$0.38	$0.17	$0.14	$0.23	$0.11
Demand Response	$0.02	$0.01	$0.01	$0.01	$0.00
Load Response	$0.02	$0.01	$0.01	$0.01	$0.00
Emergency Load Response	$0.00	$0.00	$0.00	$0.00	$0.00
Emergency Energy	$0.00	$0.00	$0.00	$0.00	$0.00
Total Price ($/MWh)	$56.87	$49.97	$53.23	$62.27	$50.33
Total Load (GWh)	776,093	778,269	758,775	791,094	771,929
Total Billing ($ Billions)	$44.14	$38.89	$40.39	$49.27	$38.85

SOURCE: PJM Annual Report, 2020

Energy Market

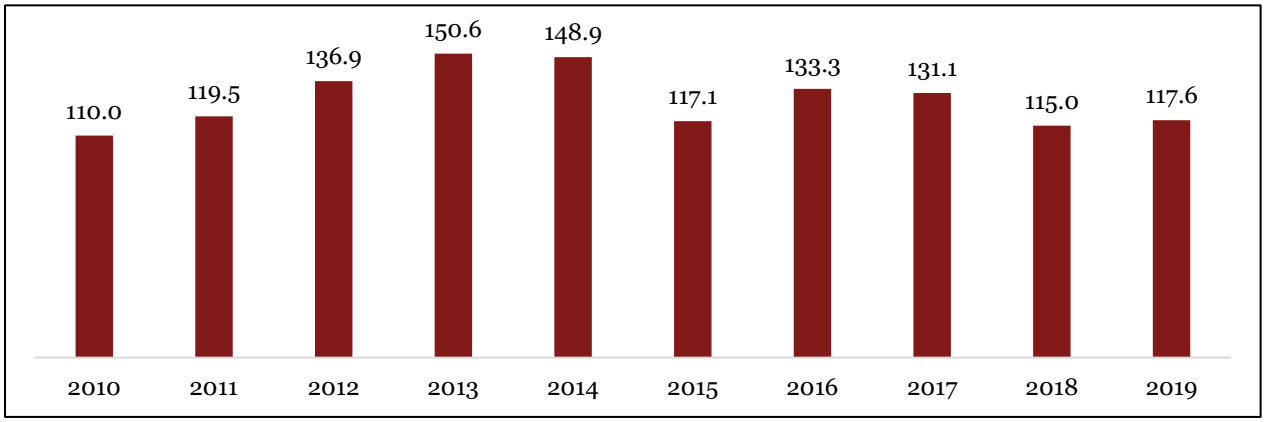
Energy market is the largest component in the PJM accounting for almost 63% of the wholesale electricity cost. The PJM energy market comprises of all types of energy transactions including the sale and purchase of energy in:

- **Day-Ahead Market** - PJM day-ahead market is a forward market in which hourly clearing prices are calculated for each hour of the next Operating Day based on generation offers, demand bids, and bilateral transaction schedules submitted into the day-ahead market. The day-ahead schedule is developed using least cost security constrained unit commitment and security constrained economic dispatch programs.

Benefits of DAM

DAM provides market signals to demand-side management providers, encouraging greater participation, and provide the benefits of enhanced system reliability, cost reduction, improved market efficiency, better risk management, environmental benefits, customer service improvements, and market power mitigation.

Figure 37: Day Time Supply (GWh)



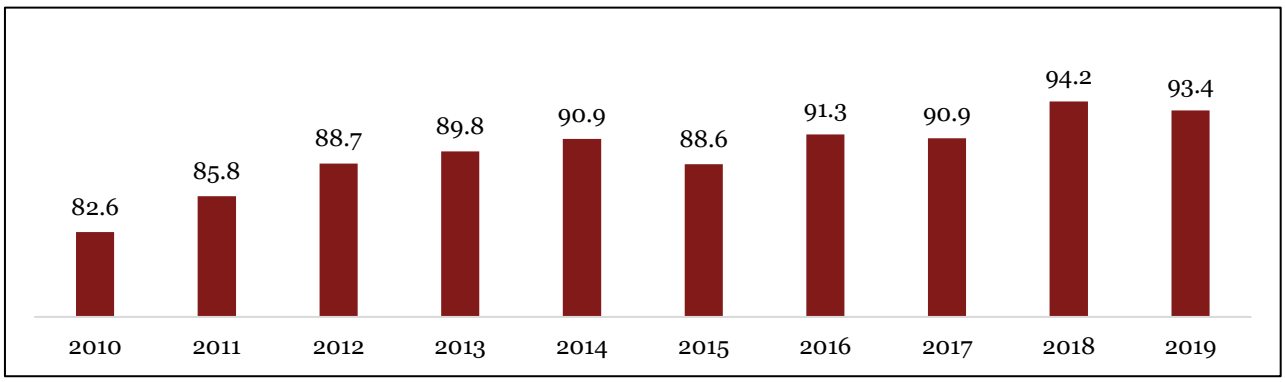
Source: PJM Factsheets, 2020

- **Real-Time Market** - PJM operates a real -time balancing market that is open to participants. The generation of imbalance service providers can be adjusted on a second-by-second basis by PJM dispatches. The real-time market is the real-time energy market during which hourly clearing prices are determined by the actual system operations security-constrained economic dispatch in which current LMPs are calculated at five-minute intervals based on actual grid operating conditions and transactions are settled hourly and issues invoices to market participants monthly.

Benefits of RTM

RTM proposes an opportunity of transacting wholesale electricity in real term and bring the required flexibility to provide real-time balance while ensuring optimal utilization of the available surplus regional capacity in the system

Figure 38: Real Time Supply (GWh)



Source: PJM Factsheets, 2020

- **Capacity Market –** Capacity market accounts for around 20% of the wholesale electricity cost in the PJM. While the energy market operates to meet the demand in real time/near real time, the capacity market is based on outlook. Capacity market is designed to secure power supply three years ahead in the timeline to ensure sufficient capacity is available for meeting future peak demand.

Benefits of Capacity Market

Capacity Market ensures reliability and certainty of the supply on the forward basis which shall ensure that the end tariff reflects the relative value of excess supply w.r.t power shortage. Moreover, capacity market also triggers market signals to retire the uneconomic capacity.

- **Long-Term FTR Market** – PJM also operates a market for financial transmission rights (FTRs) to assist market participants in hedging price risk when delivering energy on the grid. FTRs are financial contracts; they do not create a physical right to energy delivery. The FTRs are for hedging against nodal price differentials that are caused by transmission constraints but with implicit flows between nodes on unconstrained pathways. They operate independently of actual energy deliveries. The TSOs providers are also commercial participants in the reliability markets. Trades between parties at different nodes can be done through financial contracts (Financial Transmission Rights – FTRs) that are similar to CfDs but offered by the market operator, essentially on behalf of the transmission providers. Such financial instruments entitle the holder to a stream of revenues (or charges) based on the hourly congestion price differences across a transmission path in the Day-Ahead Market.

Benefits of FTRs

FTRs allow market participants to offset or bypass the congestion charges that result from the use of locational marginal prices (LMP) in the PJM market. The availability of FTRs can reduce risk and provide price certainty

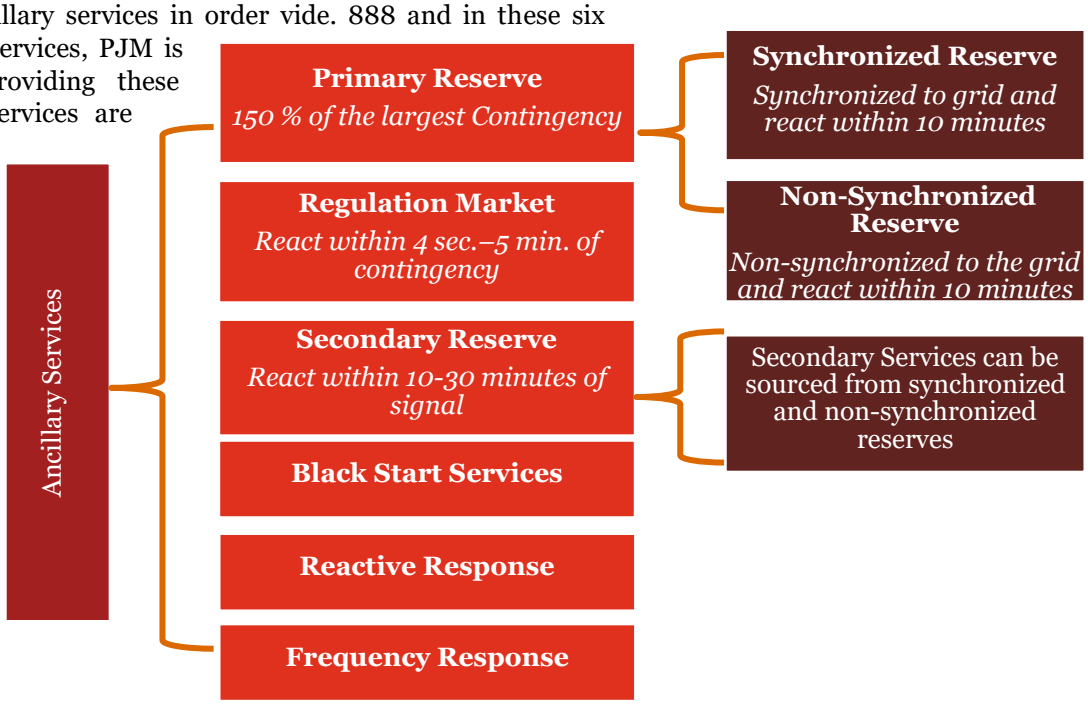
Table 26: FTR Revenue

Date	Total FTR Revenue ($Millions)	FTR Payout Ratio (%)	Day-Ahead Congestion ($Millions)
OCT2017	53.2	77%	50.8
NOV2017	61.2	100%	59.9
DEC2017	142.7	100%	138.8

Date	Total FTR Revenue ($Millions)	FTR Payout Ratio (%)	Day-Ahead Congestion ($Millions)
JAN2018	520.2	100%	517.6
FEB2018	46.9	100%	43.8
MAR2018	85.2	100%	80.2
APR2018	62.5	100%	57.4
MAY2018	125.9	100%	122.1
JUN2018	106.8	100%	95.2
JUL2018	84.2	100%	70.8
AUG2018	85.0	100%	69.2
SEP2018	107.3	100%	95.1
OCT2018	109.1	96%	95.0
NOV2018	83.1	100%	69.2
DEC2018	79.8	97%	63.0
JAN2019	138.7	100%	119.9
FEB2019	53.3	100%	36.4
MAR2019	61.9	100%	45.0
APR2019	41.8	100%	25.4
MAY2019	63.9	100%	47.5
JUN2019	52.1	100%	36.4
JUL2019	91.9	100%	75.1
AUG2019	57.1	100%	40.2
SEP2019	101.8	100%	84.6
OCT2019	91.1	100%	72.5

Source: PJM Factsheets, 2020

Ancillary Market – Ancillary services support the reliable operation of the transmission system as it moves electricity from generating sources to retail customers. Federal Energy Regulatory Commission (FERC) has identified six ancillary services in order vide. 888 and in these six FERC identified services, PJM is active and is providing these services. These services are represented in a schematic as below:



Benefits of Ancillary Services

Power market ancillary services maintaining the secure and stable operation of the power system or recovering system security, ensuring power supply, and meeting voltage, frequency quality, and other requirements.

The detailed trend of the market clearing prices of various uplift services which are transacted across the operational jurisdiction of PJM is exhibited below:

Table 27: MCP of the Ancillary Market Products (USD)

Period	Day-Ahead Operating Reserve ($/MWh)	Balancing Operating Reserve ($/MWh)	Reactive ($/MWh)	Black start ($/MWh)	Lost Opportunity Cost ($/MWh)	Total Uplift ($/MWh)
OCT17	0.03	0.12	0.04	0	0.02	*0.2*
NOV17	0.04	0.12	0.03	0	0.01	*0.19*
DEC17	0.06	0.14	0.03	0	0.04	*0.27*
JAN18	0.06	0.43	0.03	0	0.28	*0.8*
FEB18	0.06	0.03	0.04	0	0	*0.13*
MAR18	0.07	0.05	0.03	0	0.05	*0.2*
APR18	0.04	0.1	0.02	0	0.04	*0.2*
MAY18	0.11	0.14	0.04	0	0.11	*0.39*
JUN18	0.09	0.19	0.02	0	0.06	*0.35*
JUL18	0.03	0.1	0.01	0	0.03	*0.16*
AUG18	0.01	0.09	0	0	0.02	*0.13*
SEP18	0.02	0.15	0.02	0	0.04	*0.23*
OCT18	0.02	0.11	0.01	0	0.04	*0.17*
NOV18	0.01	0.1	0	0	0.01	*0.12*
DEC18	0.01	0.03	0	0	0.01	*0.05*
JAN19	0.01	0.08	0	0	0.01	*0.1*
FEB19	0.01	0.06	0	0	0	*0.07*
MAR19	0.04	0.06	0	0	0.01	*0.11*
APR19	0	0.06	0	0	0.01	*0.08*
MAY19	0.02	0.04	0	0	0.03	*0.1*
JUN19	0.04	0.06	0	0	0.01	*0.12*
JUL19	0.02	0.11	0	0	0.03	*0.15*
AUG19	0.04	0.07	0	0	0.02	*0.13*
SEP19	0.03	0.09	0	0	0.08	*0.19*
OCT19	0.01	0.1	0	0	0.04	*0.16*

Source: PJM Factsheets, 2020

The details of the overall transaction value undertaken by PJM in various product segments under the ancillary or uplift services is exhibited as below:

Table 28: Overall transactions under PJM (USD Mn)

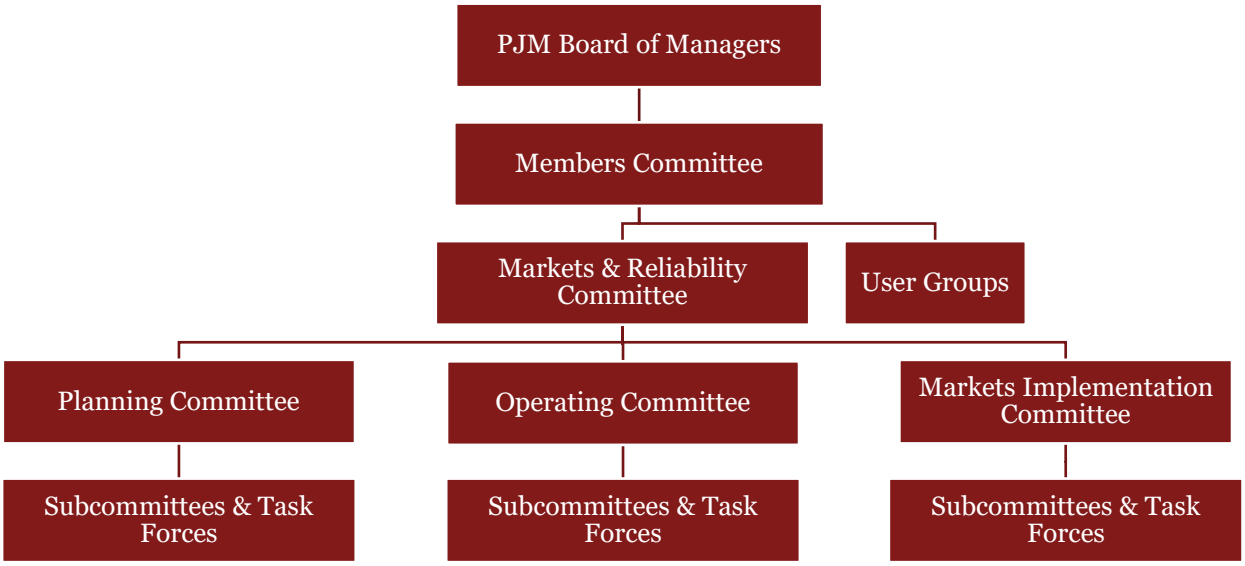
Period	Day-Ahead Operating Reserve ($ Millions)	Balancing Operating Reserve ($ Millions)	Reactive ($ Millions)	Black start ($ Millions)	Lost Opportunity Cost ($ Millions)	Total Uplift ($ Millions)
OCT17	55.0	58.2	55.0	0.0	45.0	58.7
NOV17	53.5	58.9	61.7	0.0	70.0	61.9
DEC17	67.0	70.0	76.0	0.0	75.5	70.8
JAN18	79.7	77.7	64.3	0.0	77.0	77.1
FEB18	60.7	59.0	55.8	0.0	0.0	59.9
MAR18	65.4	60.8	63.0	0.0	68.2	64.6
APR18	52.0	58.3	58.0	0.0	62.5	57.9
MAY18	64.1	61.3	55.8	0.0	61.6	63.2
JUN18	64.4	69.1	64.0	0.0	62.5	68.5
JUL18	68.3	74.5	52.0	0.0	74.0	76.5
AUG18	75.0	81.3	0.0	0.0	96.5	78.3
SEP18	67.5	67.7	50.0	0.0	71.0	66.7
OCT18	51.5	59.0	51.0	0.0	62.8	61.9
NOV18	63.0	63.4	0.0	0.0	70.0	65.4
DEC18	55.0	65.7	0.0	0.0	76.0	66.0
JAN19	103.0	73.0	0.0	0.0	75.0	77.0
FEB19	79.0	62.7	0.0	0.0	0.0	67.9
MAR19	57.5	68.8	0.0	0.0	49.0	62.9
APR19	0.0	58.3	0.0	0.0	55.0	51.9
MAY19	71.5	67.3	0.0	0.0	54.3	58.9
JUN19	65.0	68.0	0.0	0.0	68.0	62.8
JUL19	69.5	79.8	0.0	0.0	66.7	81.1
AUG19	66.8	72.7	0.0	0.0	86.5	73.0
SEP19	55.3	63.4	0.0	0.0	61.5	64.7
OCT19	87.0	60.0	0.0	0.0	58.5	57.5

Source: PJM Factsheets, 2020

Organizational Structure

PJM Interconnection committees are a forum for the members to actively deliberate on PJM's rules, policies and processes with an objective to further improve them. The apex decision making body in the PJM structure is the PJM Board of Managers. It is responsible for maintaining PJM's independence and ensuring that PJM fulfills its business and regulatory requirements.

The board consists of 10 members and is also responsible for ensuring that PJM maintains the reliability of power grid and operates a robust, competitive and non-discriminatory electric power market. President of the Board is a non-voting member and the nine other members have voting rights. Nominations for representation on the board is made by made by an independent consultant on the basis of qualifications and willingness of persons to serve on the board. The Nominating Committee distributes the list prepared by independent consultant to Members Committee for the election of member.



Members Committee

The Members Committee (MC) reviews and decides upon major changes and initiatives proposed by committees and user groups. The MC provides advice and recommendations to PJM on all matters relating to:

- The safe and reliable operation of PJM grid
- Creation and operation of a robust, competitive and non-discriminatory electric power market
- Ensuring there is no undue influence over PJM's operation by any member or group of members

Markets & Reliability Committee (MRC)

The Markets & Reliability Committee (MRC) is established by the Members Committee as the Senior Standing Committee. MRC ensures the continuing viability and fairness of the PJM markets as well as the reliable operation and planning of the PJM grid. The MRC has following objectives:

- Ensuring reliable and secure operation of the PJM system with the help of other committees of PJM
- Assuring continuous ability of member organizations to operate reliably and economically
- Ensuring fairness of PJM markets
- Reviewing proposed changes to the rules and procedures of the Operating Agreement and Manuals

The responsibilities of MRC include but is not limited to the following:

1) Development and approval of MRC Annual Plan including prioritization of planned activities and initiation of activities supporting the approved plan.
2) Providing advice and recommendations on issues pertaining to the operation and administration of the PJM markets, Operating Agreement, Tariff, or market rules and procedures.
3) Provide advice and recommendations to assure a high level of economy of service in the operation of the PJM Interchange Energy Market and other markets in accordance with established rules and regulations.
4) Provide advice and recommendations concerning studies and analyses relating to the overall efficacy of the PJM Interchange Energy Market.
5) Provide advice and recommendations concerning revisions to the Operating Agreement, the Reliability Assurance Agreement, and the PJM Tariff.
6) Recommendations concerning the generating capacity reserve requirement and related demand-side valuation factors for consideration by the Members Committee.

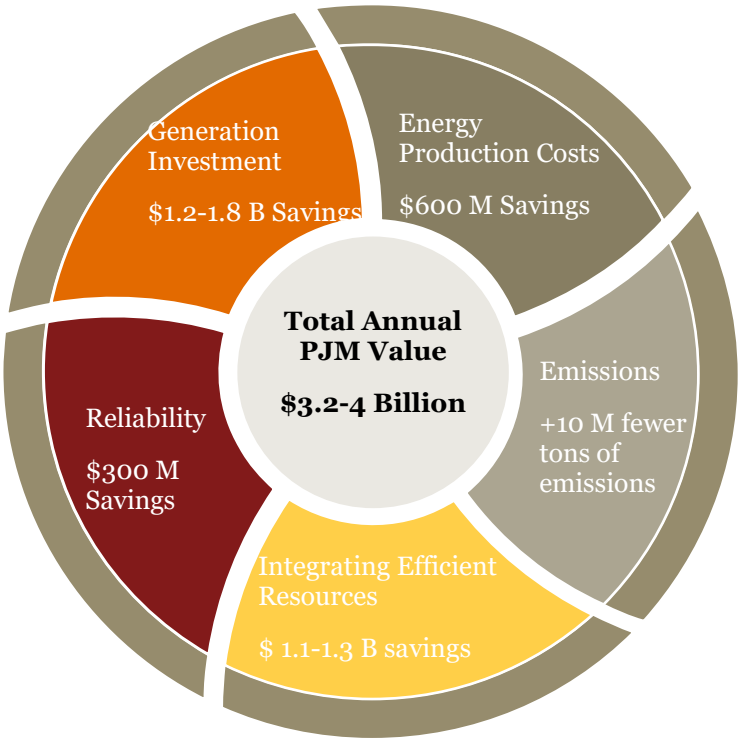
7) Create subcommittees, working groups or task forces when needed to assist in carrying out the duties and responsibilities of the MRC.

MRC is supported by the following committees:

- Operating Committee- The Operating Committee (OC) reviews system operations from season to season, identifying emerging demand, supply and operating issues. OC shall advise the Markets and Reliability Committee and PJM on matters pertaining to the reliable and secure operation of the PJM Region and the PJM Interchange Energy Market.
- Planning Committee- The Planning Committee (PC) is established under the Operating Agreement and shall advise the Markets and Reliability Committee and PJM on matters pertaining to system reliability, security, economy of service, and planning strategies and policies. It also makes recommendations regarding generating capacity reserve requirement and demand-side valuation factors.
- Market Implementation Committee- The Market Implementation Committee shall provide advice and recommendations to the Markets and Reliability Committee directed to the advancement and promotion of competitive wholesale electricity markets in the PJM Region.
- Subcommittees and Task Forces- Apart from the above-mentioned committees MRC is also supported by Subcommittees and task forces on Generation modelling, governing documents, price determination, fuel security, carbon pricing and financial risk mitigation.

Achievements of MRC

PJM Interconnection's operation of the high voltage power grid, wholesale electricity markets and its long-term planning process have made significant impact in the life of 65 million people in the region it serves. PJM operations, markets and planning results in annual savings of $ 3.2 – 4 billion. These savings represent the vital functions that PJM provides.



- **Reliability:** Planning processes under MRC assessed an opportunity by considering the region as a whole rather than by individual states or separate transmission-owner territories in determining transmission needs. Increase in capacity of transmission network has increased reliability of entire system.
- **Generation Investment**: Achieving lower reserve margins and competition from alternative sources through better planning for entire region helped in total saving of $1.2-1.8 billion.
- **Integrating More Efficient Resources**: The competitive market scenario has enabled replacement of less efficient generation resources with more efficient resources. Simulation of increased cost that would be associated with continuing to operate the retired resources instead of the new, more efficient resources demonstrate a savings of $1.1- 1.3 billion a year.
- **Energy Production Costs**: Unlike prior periods when energy was exchanged only when sales transactions were scheduled today PJM's dispatch process enables energy to be exchanged economically and automatically when less expensive resources in one area can be used to meet customer demand in another area.

- **Emissions Savings**: PJM contributes to climate policy goals while maintaining reliability through the efficient operation of the wholesale power markets. Competition in organized markets results in greater energy efficiency. Since 2005, overall reduction in emissions have been approximately 30 percent as a result of addition on renewables and shale gas in the PJM region.
- **Strengthening cross functional team efforts**: Cut-In Process was initiated in the year 2016 to strengthen the cross-functional coordination among different team members to ensure that critical tasks are completed prior to placing new equipment in service. This system also provides a 'go/no-go', status to energize equipment.
- **Interregional connections**: PJM has been actively participating with all neighboring system operators to improve energy security and power supply quality in the region. The planning exercise has been going out with New York Independent System Operator (NYISO) and ISO New England in the Northeast region, Midcontinent Independent System Operator (MISO) in the Western region, Southeastern Regional Transmission Planning (SERTP) and North Carolina Transmission Planning Collaborative (NCTPC) in the Southeast region. Transmission Expansion Advisory Committee is also extensively involved in these exercises.

Key Learnings for SAFEM

Extensive skill development program: MRC is a source of neutral, independent data, analysis, knowledge and expertise for the industry, lawmakers and regulators. In this role, MRC facilitates information sharing and informs decisions that help strengthen the grid and drive the power industry forward. PJM offers more than 160 training days a year, attended by 7000 trainees from all member companies. It also makes available a large number training material online.

Considering the large geographical spread of in SA Region SAFEM can conduct online training for all the delegated representatives from member nations

Building Resilience: Generation capabilities of resources in area of operation of MRC is very diversified and is seeing an increasing contribution from renewable power generators. The generation resources are also widely spread throughout the geographical area served by MRC. A contingency plan has also been put inti place in order to recuperate after any disaster.

SAFEM can assist in diversify its generation capabilities of the member nations, both geographically and in terms of input energy required for producing powe

Greater impetus on RE: Most of the PJM current power supply comes from the traditional sources of energy. However, MRC has been encouraging participants to increase the share of renewables. Currently the renewables contribution consists of biomass, solar, hydro and wind energy.

SAFEM can conduct various region level studies and assist the member nations in integrating renewable sources of power production to reduce pollution and carbon footprint in the region

Ancillary services: Ancillary services help balance the transmission system as it moves electricity from generating sources to retail consumers. MRC facilitates functioning of two important ancillary services: regulation and reserves. Operation of the Synchronized Reserve Market, the Non-Synchronized Reserve market and the Day Ahead Scheduling Reserve Market and the Regulation Market.

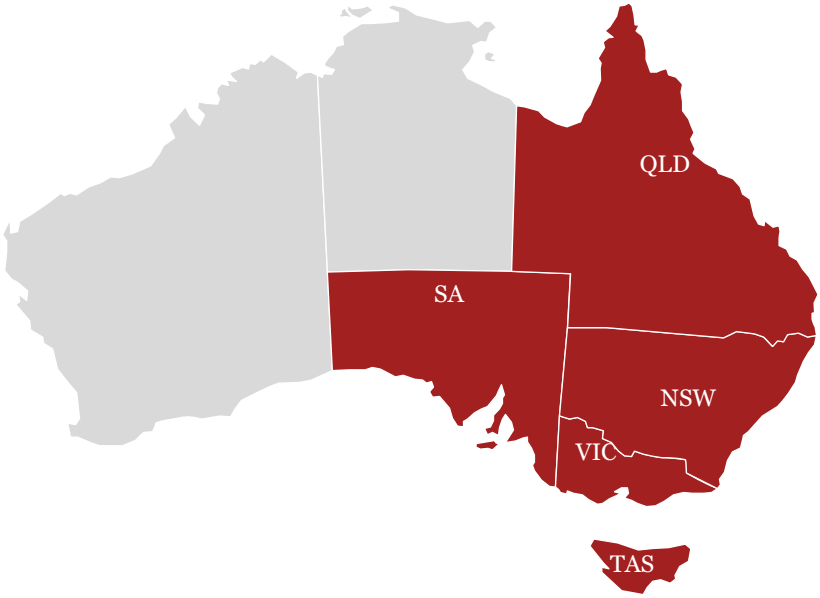
SAFEM can assist in facilitation and implementation of similar grid balancing services to equip the grid with better balancing capabilities

Increasing resilience: Power supply to the consumers faces threat from natural, technical and human caused disruptions, a resilient grid ensures reliable, secure and affordable electricity supply to all the consumers. MRC ensures a resilient power supply system by taking measures after mapping the threats to the system, impacts if the threat event occurs and the inherent vulnerabilities in the system.

SAFEM can conduct region level grid planning studies that will ensure uninterrupted power supply in the SA region

4.6. Australian Energy Market Operator (AEMO)

Introduction



AEMO is a not-for profit, independent, member-based organization which was created in 2009 by the consortium of industry bodies spanning across the electricity and gas market. It has an ownership structure split between government and industry representatives with the membership assumed by electricity generators, gas-based generators, transmission companies, distribution companies, retailers, resources companies and investment companies.

AEMO acts as an independent system and market operator for the National Electricity Market (NEM), the Western Australian (WA) Wholesale Electricity Market (WEM), wholesale and retail gas markets and supply hubs, and gas systems. It plays a pivotal role in strengthening the energy sector in Australian ecosystem by ensuring integrated, quality, safety, cost-effectiveness and security of electricity and gas supply in all the states.

Since the inception of the operation of the AEMO the total capacity across the NEM and WEM, supported by the AEMO has increased manifolds with shifting of demand trend by virtue of huge RE capacity augmentation, exponential rise in behind the meter infrastructure viz. solar rooftop installations, change in consumption patterns, grid supply etc. The transformation of the electricity system under AEMO is exhibited as below:

Table 29: Salient features of AEMO

Feature	2009	2019	Change
Capacity (GW)	52.01	61.08	↑ 17%
Maximum Demand (GW)	39.01	35.65	↓ -9%
Grid Supplied Electricity (GWh)	224,630	213,360	↓ -5%
Rooftop Solar PV System (Thousand)	35.6	2290	↑ 6333%
Variable RE Capacity (GW)	1.89	6.16	↑ 226%
Customer (Million)	9.73	11.19	↑ 15%
Registered Participation	298	463	↑ 55%

Source: AEMO Annual Reports, 2020

AEMO is responsible for managing a combined 48,000 km of electricity transmission infrastructure in both the National Electricity Market (NEM) and the South West Interconnected System (SWIS) in Western Australia and more than 2,000 kms of high-pressure gas transmission infrastructure as part of the Victorian Declared Transmission System, as well as the Victorian Declared Wholesale Gas Market, the Wallumbilla gas supply hub, Short Term Trading Market hubs in Adelaide, Sydney and Brisbane, and Retail Gas Markets in all states.

The broad areas of AEMO's strategic plan is built across the core operations and focus areas illustrated as below:

1. Maintain high-reliability operation of energy systems while adapting to anticipated changes in generation, and improve our forecasting services
2. Facilitate among stakeholders an orderly transition to a fit-for-purpose future system.
3. Implement new approved market requirements, adapt rules and markets to emerging needs within current regulatory framework.
4. Empower individuals to exercise choice in the energy market, improving access to data and decision tools, and reducing friction in sharing data and implementing decisions.
5. Deliver a modern digital platform that will unlock new value for consumers, improve data access, choice and user experience, and enable flexibility and new services.
6. Broadening the technical skills and evolution of innovation and collaborative environment

Membership: AEMO has two classes of members viz. government members and industry members and the specific eligibility criteria pertinent to them are discussed as below:

- **Government Member** - An applicant will meet the membership eligibility criteria for admission as a government member of AEMO if - (a) the applicant is the Crown in the right of the Commonwealth of Australia, a State of Australia, the Australian Capital Territory or the Northern Territory; and (b) the applicant has conferred on AEMO at least one function relating to the objects of AEMO.
- **Industry members** - An applicant will meet the membership eligibility criteria for admission as an industry member of AEMO if the applicant is registered with AEMO pursuant to a requirement or entitlement in a statute or legislative instrument (or in an agreement or rules contemplated by statute or legislative instrument), as a participant in an energy market or information service that AEMO operates.

Fees and charges: The National Electricity Rules (the Rules) set a maximum spot price, also known as the maximum Price Cap. From 1 July 2020, this cap is set at USD 15,000 per megawatt hour, and is adjusted annually for inflation. The Rules also set a minimum spot price, called the market floor price. The market floor price is USD 1,000 per megawatt hour.

Table 30: Fees and Charges

Particulars	Fee		Unit
	2019-20 (actual)	2020-21	
NEM	0.50	0.54	USD/MWh
WEM	1.722	1.788	USD/MWh
DWGM energy tariff	0.08713	0.08887	USD/GJ
DWGM distribution Meter	1.36970	1.28580	USD/day/meter
STTM	0.04258	0.03682	USD/GJ withdrawn
GSH			

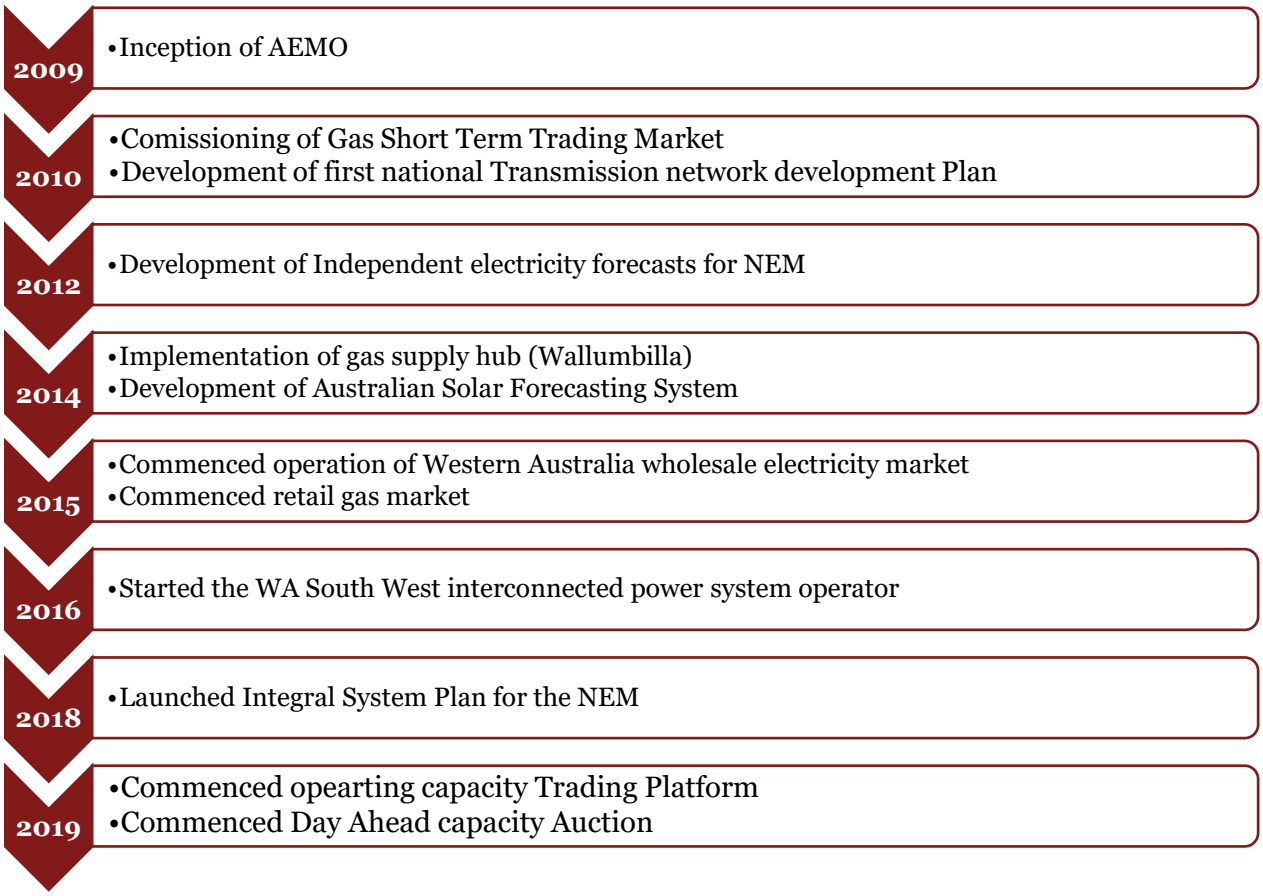
Particulars	Fee 2019-20 (actual)	2020-21	Unit
Fixed Fee - one license per annum	12,000	12,000	-
Fixed Fee - additional license per annum	12,000	12,000	-
Daily product fee	0.03	0.03	USD/GJ
Weekly product fee	0.02	0.02	USD/GJ
Monthly product fee	0.01	0.01	USD/GJ
Reallocation participants fixed fee per annum	9,000	9,000	-
Viewing participants fixed fee per annum	3,600	3,600	-
CTP			-
Fixed Fee - one license per annum (commodity & capacity)	12,000	12,000	-
Fixed Fee - one license per annum (capacity only)	7,000	7,000	-
Daily product fee	0.044	0.045	USD/GJ
Weekly product fee	0.034	0.035	USD/GJ
Monthly product fee	0.024	0.025	USD/GJ
Initial Registration Fee – Facility Operators	15,000	15,450	USD/participant

Source: Report on Budget and fees final by AEMO

The list of members participating and engaging with AEMO is attached as an **Annexure – A.7**

Evolution of AEMO

AEMO has been actively played a vital role in defining the outlook of the Australian energy landscape, where it has designed short term trading market, development of transmission plans, concoction of forecasts, streamlining RE integration, designing gas supply hub, operation of wholesale and retail market, capacity trading platform and day ahead capacity auctions. The chronological representation of the milestones achieved by AEMO are represented as follows:



AEMO is responsible for operating various market in Australia and has successfully brough electricity and gas markets under its aegis. The portfolio of AEMO subsumes the responsibility of markets from energy market viz. National Electricity Market, Wholesale Market, Short-term Trading Market, Gas Market, Wholesale gas market, pipeline capacity, gas retail. These markets are briefly

National Electricity market (NEM)

The NEM commenced operation as wholesale spot market in December 1998. It interconnects five regional market jurisdictions – Queensland, New South Wales (including the Australian Capital Territory), Victoria, South Australia, and Tasmania.

- The National Electricity Market (NEM) incorporates around 40,000 km of transmission lines and cables.
- It supplies about 200 terawatt hours of electricity to businesses and households each year.
- It supplies around 9 million customers.
- It has a total electricity generating capacity of almost 54,421 MW (as at December 2017).
- USD 16.6 billion was traded in the NEM in the financial year 2016–17.
- Strategic reserves of demand and generation resources of more than 1000 MW for 2017-18.

The NEM involves wholesale generation that is transported via high voltage transmission lines from generators to large industrial energy users and to local electricity distributors in each region, which deliver it to homes and businesses. The transport of electricity from generators to consumers is facilitated through a 'pool', or spot market, where the output from all generators is aggregated and scheduled at five-minute intervals to meet demand.

Wholesale electricity market (WEM)

The Wholesale Electricity Market (WEM) for the South West Interconnected System of Western Australia (SWIS) commenced operation on 21 September 2006. The WEM aims to facilitate competition and private investment

and allow generators and wholesale purchasers of electricity (such as retailers) greater flexibility as to how they sell or procure electricity, and who they transact with.

AEMO is responsible for operating the WEM in accordance with the Wholesale Electricity Market Rules (WEM Rules) and the related WEM Market Procedures.

- The South West Interconnected System (SWIS) incorporates over 7,800 km of transmission lines.
- The WEM supplies about 18 terawatt hours of electricity each year.
- A total of USD 500 million was transacted in 2014-15.
- There are more than one million customers in the WEM.
- 5,798MW of registered generation capacity, including 513 MW of non-scheduled generation.

Declared wholesale gas market (DWGM)

A Victorian declared wholesale gas market (DWGM) was established in 1999 to enable competitive, dynamic trading based on injections into, and withdrawals from, the transmission system that links multiple producers, major users and retailers. In 2007, intra-day trading intervals were introduced.

This market is unique, as most Australian gas markets are based on bilateral arrangements between producers, major users, and retailers, linked together through pipeline hubs connecting gas fields to gas consumers.

Short term trading market (STTM)

The Short-term trading market (STTM) is a market-based wholesale gas balancing mechanism established at defined gas hubs in Sydney, Adelaide and Brisbane.

- The market itself runs once a day, on the day ahead, for each hub.
- It uses bids, offers, and forecasts submitted by participants, and pipeline capacities, to determine schedules for deliveries from the pipelines which ship gas from producers to transmission users and the hubs. These hubs are nominally the low pressure networks in Adelaide and Sydney.
- The market sets a daily market price at each hub and settles each hub based on the schedules and deviations from schedules.
- Participants' daily transactions (scheduled trades and unscheduled deviations or variations) are settled at market prices and billed regularly (monthly). Suitable credit management arrangements have been put in place to manage credit requirements.
- AEMO operates the STTM but does not operate the physical pipeline or network assets.

Gas Supply hub (GSH)

AEMO implemented a Gas Supply Hub (GSH) at Wallumbilla in March 2014, at the request of the Council (the then Standing Council on Energy and Resources).

- The GSH, which is an exchange for the wholesale trading of natural gas, was introduced to enable improved wholesale trading for an east coast gas market affected by significant liquefied natural gas (LNG) exports in Queensland.
- Through an electronic platform, GSH participants can trade standardised, short-term physical gas products at each of the three foundation pipelines connecting at Wallumbilla.
- AEMO centrally settles transactions, manages prudential requirements and provides reports to assist participants in managing their portfolio and gas delivery obligations.

In June 2016 a trading location at Moomba was established, enabling participants in southern markets to trade under the same market framework and rules as at Wallumbilla.

In March 2017 the three trading locations at Wallumbilla were replaced with a single Wallumbilla location, through what is known as the Optional Hub Services (OHS) model. A single trading location at Wallumbilla improves market liquidity allowing trading participants across different pipelines to more easily trade with each other.

Pipeline capacity trading (PCT):

Pipeline capacity refers to the right to transport gas through a transmission pipeline. PCT, therefore, allows participants to trade spare pipeline capacity, including firm park services, firm forward haul services and firm compression services. It applies to gas transmission pipeline and compression services (which are jointly referred to as 'transportation services') outside of the Victorian Declared Transmission Service (DTS).

PCT includes the following features:

Capacity Trading Platform (CTP): An online platform that shippers can use to trade secondary capacity ahead of the nomination cut-off time. It provides for exchange-based trading of commonly traded products and a listing service for more-bespoke products. The CTP forms part of the Gas Supply Hub exchange.

Day-Ahead Auction (DAA): An auction of contracted but un-nominated capacity. It is conducted after nomination cut-off and is subject to a reserve price of zero. Compressor fuel is provided in-kind by shippers.

Standards for key contract terms: By providing standards for key contract terms in primary, secondary and operational transport agreements, we help to make capacity products more fungible. In doing so, we facilitate increased levels of secondary capacity trading.

Reporting framework: A reporting framework for secondary capacity trades that provides for the publication of price and other related information on secondary trades. It also provides other market transparency measures, including information relating to allocation agreements.

Gas retail markets:

AEMO facilitates gas retail markets in New South Wales and the Australian Capital Territory, Queensland, South Australia, Victoria, and Western Australia. AEMO provides retail market services to gas industry participants and delivers the infrastructure that provides over 5 million gas consumers with the ability to contract for the supply of gas with any licensed retailer of their choice, and facilitates the interactions between industry participants required to support efficient operation of the markets.

Market Products

AEMO currently offers the following trading instruments to its participants:

Table 31: Trading Instruments in AEMO

Trading Instrument	Description	Trading Details
Bilateral Contracts	• Bilateral Contracts are agreements formed between wholesale market suppliers (i.e. generators) and wholesale market consumers (i.e. retailers and directly connected loads) for the provision of energy. • These Bilateral Contracts are formed on a purely commercial basis, and the market has no role or interest in how they are formed, or in the conditions they impose on the parties subject to those contracts. The market operator does not operate any secondary trading market for Bilateral Contracts.	• Trading duration and terms of the contract depends upon the signatories of the contract.

Trading Instrument	Description	Trading Details
The Short Term Energy Market (STEM)	• The Short Term Energy Market (STEM) is an energy-only forward market operated on the Scheduling Day to facilitate trading around Bilateral Contract positions. • The STEM schedules are contracts between suppliers and the market operator and between the market operator and consumers.	• The STEM is run for every Trading Interval of the Trading Day and determines a single clearing price for each Trading Interval as well as the quantities that participants have been cleared to sell to or purchase from the market operator. • The auction is designed so that the market operator purchases the same amount of energy it sells, so that it has no net exposure. • STEM Submissions are made to the market operator between 9:00 AM and 9:50 AM of each Scheduling Day. Accepted submissions will be used in the STEM auctions run between 10:00 AM and 10:30 AM.

The Balancing Markets	• The Balancing Market accounts for differences between day-ahead Net Contract Positions, established after the STEM process, and actual outcomes. This is achieved through:
	  • Price-based dispatch of Facilities to match supply to demand; and
	  • Settling participant' differences from their Net Contract Positions at a common Balancing Price.
	• Only participants that deviate from their Net Contract Position are exposed to the Balancing Price. Deviations can occur for physical reasons (higher or lower than expected demand, generator outages etc) or for market reasons (lower priced generation being dispatched in preference to higher priced generation).
		• Participation via price-based dispatch in the Balancing Market is mandatory for generating Facilities with a sent-out capacity of 10 MW or more.
		• The first step in the operation of the Balancing Market is the submission of Resource Plans. Resource Plans must be submitted to the market operator by 12:50 PM on the Scheduling Day.

Load Following Ancillary Services	• The LFAS Market operates in parallel with the Balancing Market.	• The first step in the LFAS Market cycle is the provision by 12:00 PM each Scheduling Day by System Management to the IMO of forecast LFAS requirements for each Trading Interval of the following Trading Day.

Trading Instrument	Description	Trading Details
		• The market operator creates Forecast Upwards and Downwards LFAS Merit Orders by stacking the quantities in respective Upwards and Downwards LFAS Submissions in price order.
Contracts	• Alongside generators and retailers, participants in electricity contract markets include financial intermediaries and speculators, such as investment banks. Brokers often facilitate contracts between parties in these markets.	In Australia, two distinct financial markets support the wholesale electricity market: • **Over the counter (OTC) markets**, in which two parties contract with each other directly (often assisted by a broker). The terms of OTC trades are usually set out in International Swaps and Derivatives Association (ISDA) agreements. • **The exchange traded market,** in which electricity futures products are traded on the Australian Securities Exchange (ASX). Participants include generators, retailers, speculators, banks and other financial intermediaries. Electricity futures products are available for Queensland, NSW, Victoria and South Australia

As discussed, AEMO operates multiple markets in energy and gas domain. An overview of the total trade and volume in the portfolio of AEMO is exhibited as below:

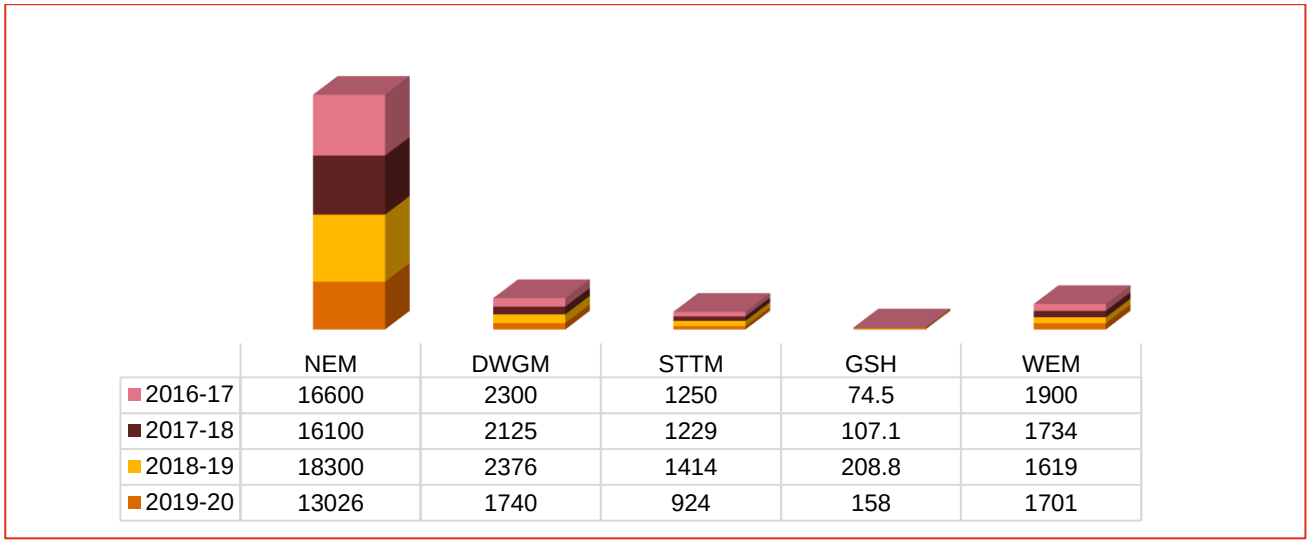
Table 32: Trade and volume summary (2019-20)

Products	Energy purchased (GWh)	Purchase value (AUD mn.)	Wholesale gas withdrawal (PJ)	Wholesale gas purchased (USD mn.)
NEM	182,108	13,026	-	-
DWGM	-	-	220	1,740
STTM	-	-	146.9	924
GSH	-	-	25.2	158
WEM	17,665	1,701	-	-

Source: AEMO annual report 2019-20

As in 2019, AEMO registered a consolidated purchase value of AUD 17.5 Bn with nearly 89% of the transactions taking place in electricity segment, with remaining 11% contribution by gas segment. The major contributor in electricity segment is NEM with registered 74% to the overall purchase value under AEMO. The remaining 15% is contributed by WEM (10%) and STTM (5%) respectively. Under the gas segment, the majority of the transactions have happened in DWGM and remaining 1% in GSH segment. The year-wise details of the total purchase quantum under different market setups has been exhibited in the following graphical.

Figure 39: Market trade trend (Mn USD)



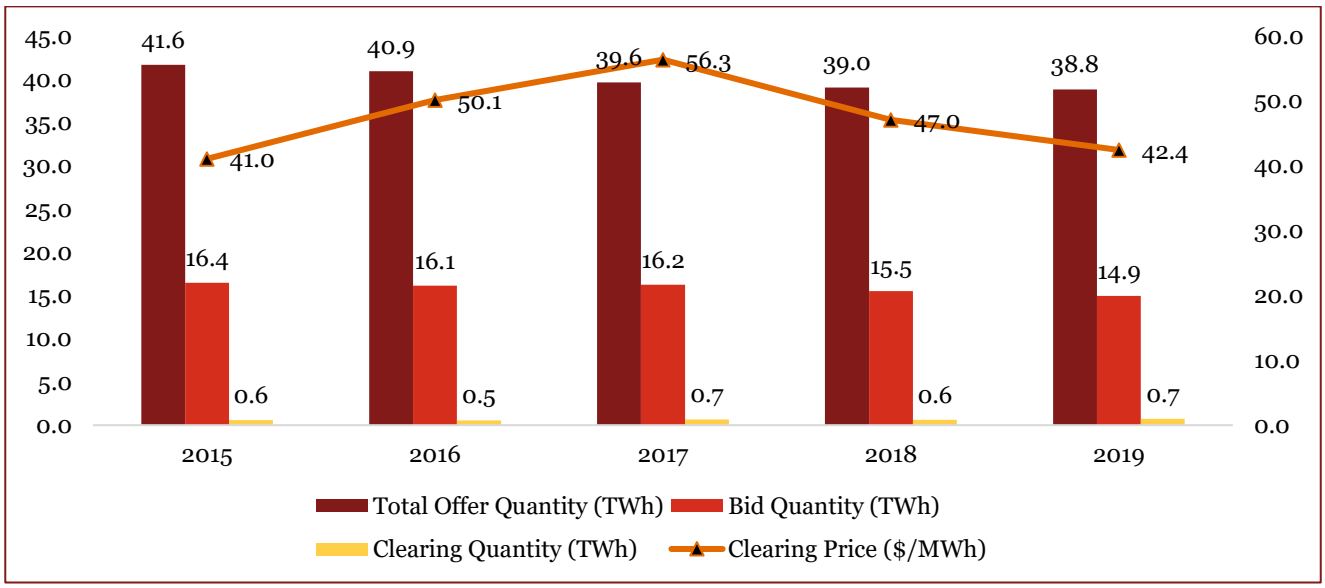
	NEM	DWGM	STTM	GSH	WEM
2016-17	16600	2300	1250	74.5	1900
2017-18	16100	2125	1229	107.1	1734
2018-19	18300	2376	1414	208.8	1619
2019-20	13026	1740	924	158	1701

Source: AEMO annual report, 2017-2020

Short-Term Energy Market (STEM)

Within the Short-Term Energy Market (STEM), participants can offer to increase the net supply of energy beyond the net bilateral position and bid to decrease the net supply of energy relative to that position.

Figure 40: STEM Trading Data

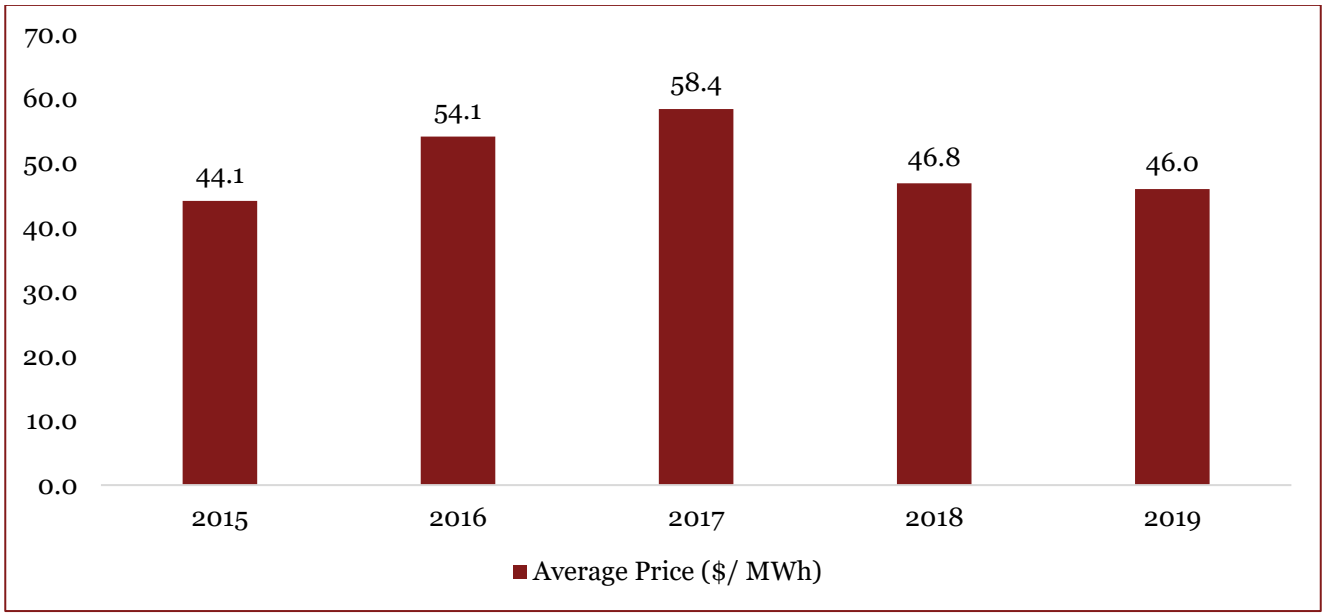


SOURCE: AEMO Annual Report, 2020

Balancing Market

As in 2019, the average price of the power in balancing market is 46 AUD/MWh. The price trajectory of power traded in the balancing market has been detailed out given in the graphical representation as below::

Figure 41: Average Price in Balancing Market ($/ MWh)

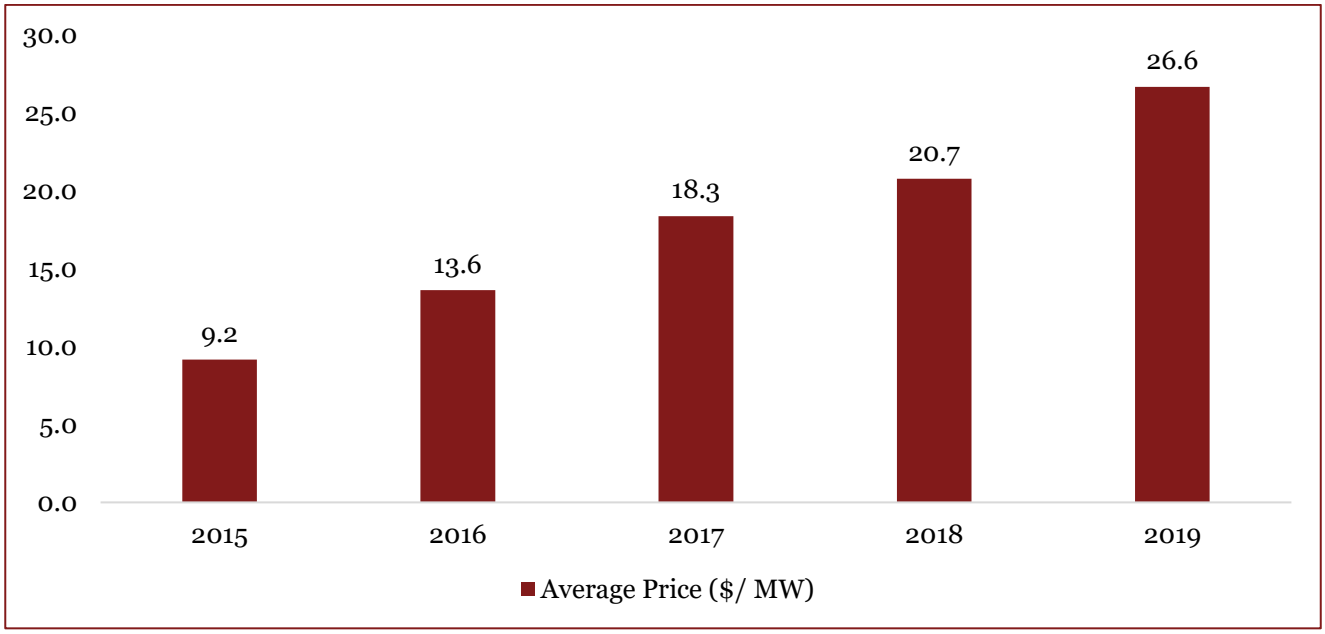


SOURCE: AEMO Annual Report, 2020

Load Following Ancillary Services

As in 2019, the average price of the load balancing ancillary market is 26.6 AUD/MWh. The price trajectory of power traded in this market has been detailed out given in the graphical representation as below:

Figure 42: Average Price ($/ MW)



SOURCE: AEMO Annual Report, 2020

Spot Market

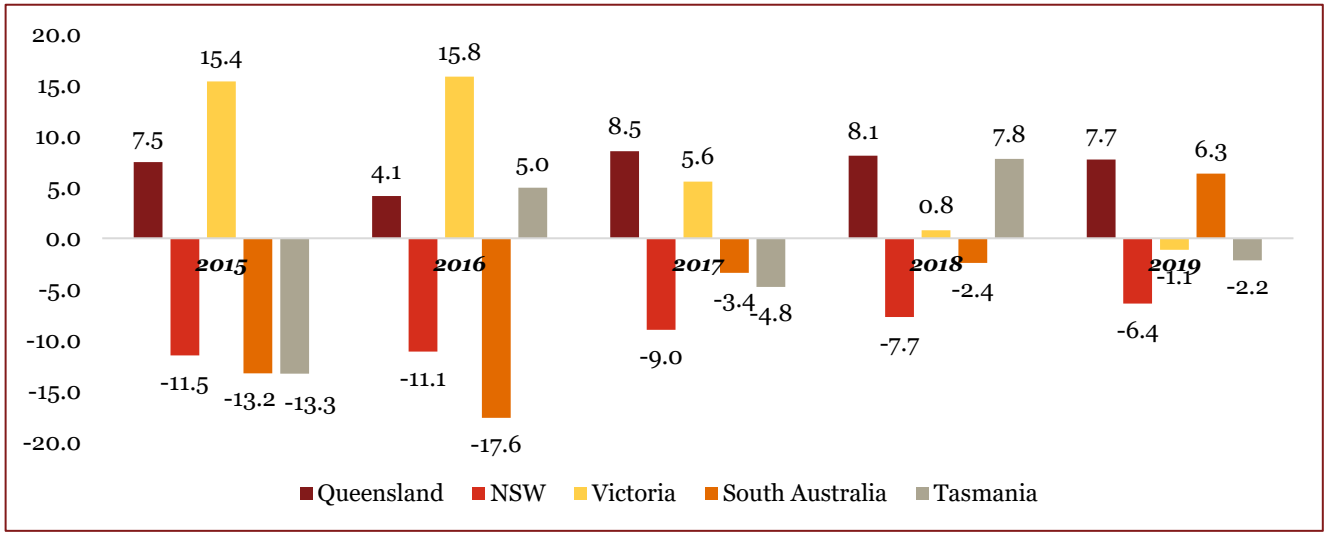
Spot Pool Market is operated by AEMO and operates across the eastern states of the mainland, and includes the state grids of (QLD), New South Wales (NSW), Victoria (VIC) and South Australia (SA). Tasmania (TAS) is

connected to the other NEM regions via an undersea inter-connector to Victoria. Futures and options contracts are listed on the 4 major regions (VIC, SA, QLD and NSW).

AEMO publishes a half-hourly spot pool price for electricity in each region based on a gross pool merit order dispatch system. All retailers and market customers purchase their power from the spot pool market in their relevant region and pay the spot market price to AEMO (i.e. the spot price determines the retailer's supply cost). All generators that supply power to the regional pool market during this time receive the spot market price from AEMO (i.e. the spot price determines the generator's revenue).

The spot price (and the price of futures contracts used to "lock in" long term revenues or costs at a fixed rate) provide the market signals for investment in new generation and competitive responses from new entrant retail suppliers. The inter-regional trade in the spot market under AEMO is exhibited as below:

Figure 43: Interregional Trade as a percentage of Demand



Source: State of Energy Market Report by AER, 2020

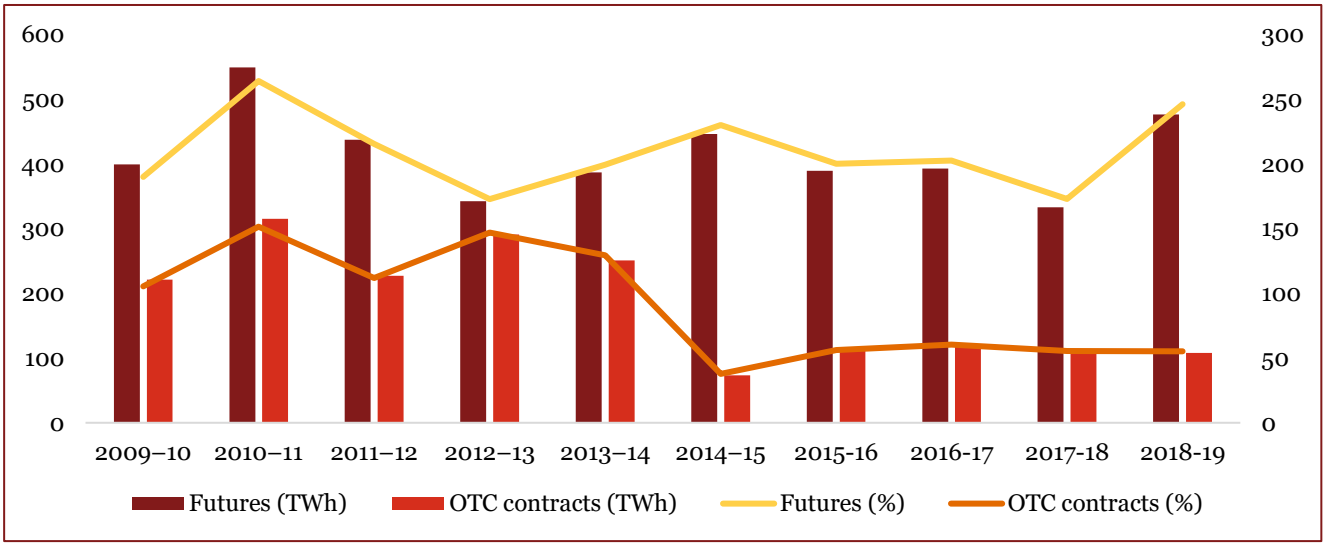
Queensland has surplus generation capacity, making it a net electricity exporter (figure 2.15). Victoria's abundant supplies of low-priced brown coal generation also traditionally made it a net exporter of electricity. But Hazelwood's closure in 2017 eliminated Victoria's trade surplus, with Victoria becoming a net importer for the first time in 2019.NSW has relatively high fuel costs, typically making it a net importer of electricity. Its trading position tends to be relatively stable, although declining imports from Victoria led to its net imports recording a historic low in 2019.

Electricity Contract Markets

Futures (contract or derivatives) markets operate parallel to the wholesale electricity market. Prices in the wholesale market can be volatile, posing risks for market participants. Generators face the risk of low settlement prices reducing their earnings, while retailers risk paying high wholesale prices that they cannot pass on to their customers. A retailer may expand its operation and sign up a significant number of new customers at a particular price, only to then incur unexpectedly high prices in the wholesale market, ultimately leaving the retailer substantially out of pocket.

While prices are publicly reported for ASX trades, activity in OTC markets is confidential and not disclosed publicly. The Australian Financial Markets Association (AFMA) reports data on OTC markets through voluntary surveys of market participants, providing some information on the trade of standard (or vanilla) OTC products such as swaps, caps and options. The graph below gives the details of future prices for the year 2020:

Figure 44: Future prices for year 2020



Source: State of Energy Market Report, AER

Various products are traded in electricity contract markets. Similar products are available in each market, but the names of the instruments differ. And while ASX products are standardized to encourage liquidity, OTC products can be uniquely sculpted to suit the requirements of the counterparties:

- **ASX futures** contracts allow a party to lock in a fixed price (strike price) to buy or sell a given quantity of electricity at a specified time in the future. Each contract relates to a nominated time of day in a particular region. Available products include quarterly base contracts (covering all trading intervals) and peak contracts (covering specified times of generally high energy demand).
- **Caps** are contracts setting an upper limit on the price that a holder will pay for electricity in the future. Cap contracts on the ASX have a strike price of $300 per MWh. When the spot price exceeds the strike price, the seller of the cap (typically a generator) must pay the buyer (typically a retailer) the difference between the strike price and the spot price.
- **Floors** are contracts that operate on the opposite principle of a cap contract, because they set a lower price limit. They are typically purchased by generators to ensure a minimum level of revenue for output.
- **Options** are contracts that give the holder the right— without obligation—to enter a contract at an agreed price, volume and term in the future. The buyer pays a premium for this added flexibility. An option can be either a call option (giving the holder the right to buy the underlying financial product) or a put option (giving the holder the right to sell the underlying financial product). Options are available on futures and cap products.

ASX traded contracts are settled through a centralized clearing house, which acts as a counterparty to all transactions and requires daily cash margining to manage credit default risk. In OTC trading, parties rely on the creditworthiness of their counterparties. Electricity derivatives markets are regulated under the Corporations Act 2001 (Cth) and the Financial Services Reform Act 2001 (Cth). The Australian Securities and Investments Commission is the principal regulatory agency.

Future system design

- Integrated energy roadmap.
- 2020 integrated system plan (ISP).
- Integration of renewable energy resources.
- Victorian network planning.
- Grid connection.

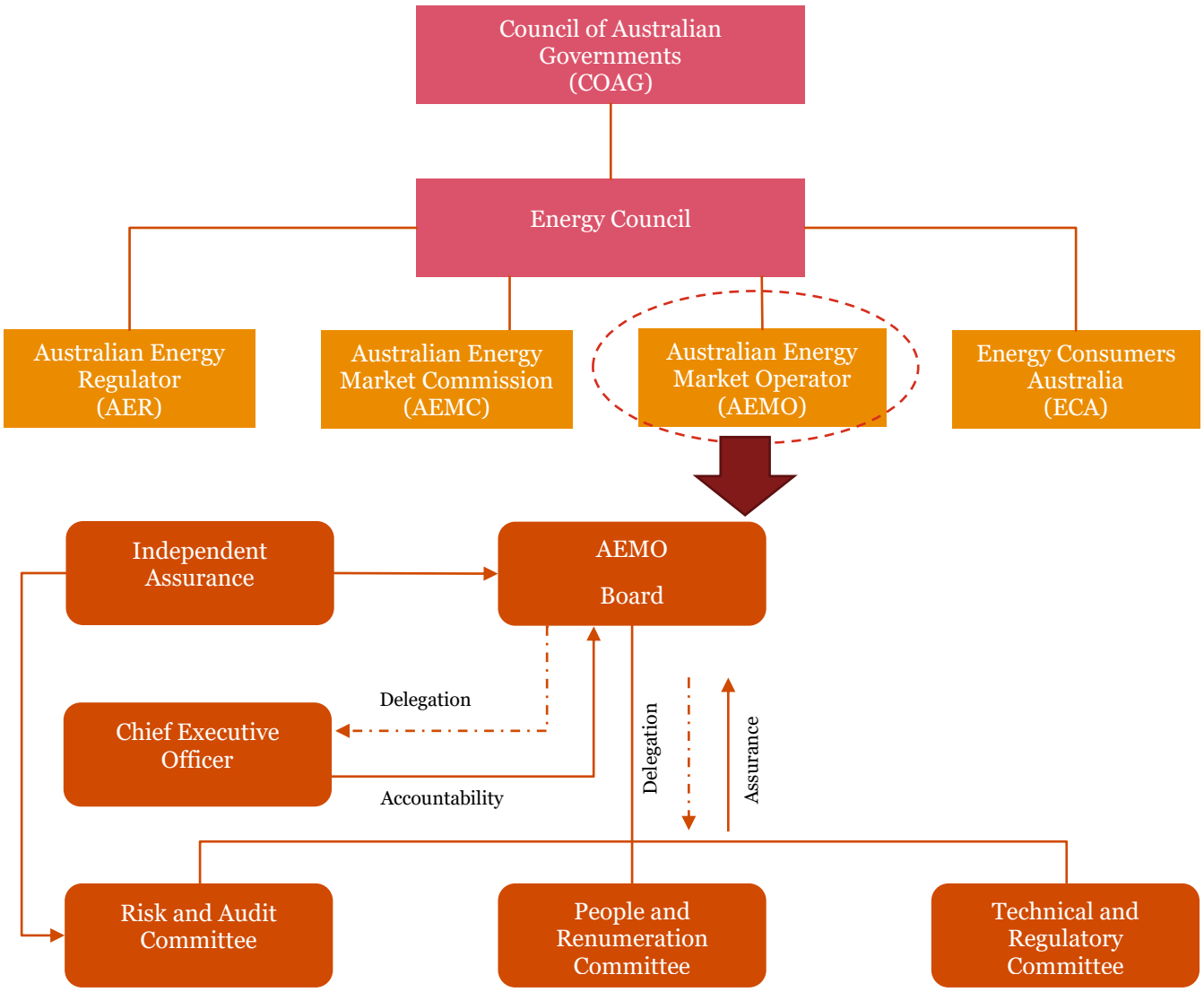
Market settlement- AEMO continues to progress the implementation of 5MS and GS, key market reforms endorsed by the AEMC in November 2017 and December 2018 respectively.

- The 5MS rule will reduce the wholesale electricity spot market settlement period from 30 minutes to five minutes. This change aims to provide a better price signal for investment in faster response technologies (e.g. batteries, gas peaking generation) and to enable more efficient bidding, operational decisions and investments, aligned to smaller interval dispatch and financial settlement periods.
- The GS rule will change the way AEMO recovers the cost of unaccounted-for energy (UFE) by moving from settlements by difference (where the local retailer in a market area is financially responsible for UFE) to global settlements, where UFE is assigned to all retailers in a market area on a pro-rata basis.
- In July 2020, due to COVID-19, the AEMC announced the deferred commencement of 5MS (to October 2021) and GS (until May 2022). Despite the delay, AEMO will deploy the required systems changes in March and April 2021, which will allow market participants that choose to progress according to the original timeline to begin bidding and submitting meter reads at five-minute intervals. During this "transition period", the market will continue to be settled at 30-minute intervals.

Organizational Structure

AEMO is a part of the overall Australian Energy Market Governance Structure, which is headed by the apex body Council of Australian Governments (COAG). In this structure AEM acts as the overall regulator, Australian Energy Market Commission (AEMC) which makes the rules governing the regulation of the energy markets, Energy Council (EC) responsible for national co-operation and energy market policy making, Energy Consumers Australia (ECA) responsible for consumer advocacy and research and finally the AEMO is the market operator.

Fig. Australian Energy Market Structure



AEMO is governed by a Board comprising a group of non-Executive Directors who are further supported by the Managing Director/Chief Executive Officer. The day-to-day management of the company is delegated to the Managing Director and Chief Executive Officer with support from Board Committees as appropriate. The bifurcation of the responsibilities is broadly allocated amongst three committees which address corresponding subject related activities and responsibilities. The functions of these committees and AEMO as a whole is elaborated in the following section.

Roles and Responsibility

AEMO plays the role of the energy market operator and planner positions for electricity and gas market, where it works under the aegis, and abides by rules and regulations set by National Electricity Law and Rules and the National Gas Law and Rules. It operates within the energy market setup and closely collaborates with AER and AEMC. The roles and responsibilities undertaken by the AEMO are enlisted as follows:

- **Market Operations–** AEMO is responsible for the operation of wholesale and retail gas and electricity market spanning from the eastern to the south-eastern Australian region. The responsibility entails lowest cost scheduling, trades settlement, enabling transparency in data flow and information register. AEMO assumes the operations and management of the following:
    - **Electricity –** National Electricity Market, Wholesale Electricity Market, Short Term Energy Market (STEM)
    - **Gas -** Declared Wholesale Gas Market (DWGM) in Victoria, Gas Short Term Trading Market (STTM) in Sydney, Brisbane and Adelaide, the Gas Supply Hub (GSH) in Wallumbilla and Moomba and, a pipeline capacity auction and trading platform.
- **System Operations -** AEMO has a pivotal role to play with the endowed responsibility for the oversight of operations and security of the NEM power system, Western Australia's South West Interconnected System (SWIS) and the Victorian Gas Declared Transmission System, by virtue of unremitting and uninterrupted operations of control rooms, to ensure safe, secure and reliable supply to the residential, commercial and industrial consumers**.** The catalogue of services extended by the AEMO involves systems operation, metering and settlements, and market performance reporting
- **System Planning –** AEMO is responsible for developing regular publishing of independent energy forecasting and planning information to facilitate strategic gas and electricity planning advices and navigate the efficient long-term investment plans across the NEM and the eastern and south-eastern Australian gas network. AEMO provides independent modelling of possible future scenarios, advice on how markets might develop under those scenarios and leadership in developing markets to meet forecast energy requirements. Few of the initiatives on the same line - National integrated electricity system planning (National Transmission Planning) including the Integrated System Plan (ISP).
- **Transmission Service Procurements -** AEMO is responsible for planning and procuring new transmission capacity and for connecting generators and customers to the electricity transmission network. AEMO assumes the responsibility as the Victorian electricity Transmission Network Service Provider (TNSP), which includes extending transmission network connections, transmission network expansion needs, procurement of the services from the network asset owners.
- **Regulatory Aspects –** AEMO operates collaboratively with regulatory and central authorities like AER, AEMC and COAG Energy Council, and provide expert technical support for reform initiatives with an aim to create a level playing field for the market players, promote competition, garner innovation, enhance system efficiency and augment productivity of the energy ecosystem.

There are broadly 3 internal committees in AEMO which are responsible for the running the operation of the AEMO, however, with the respect to the SAFEM, the committees which can be prominent for the case are elucidated below.

Table 33: Select AEMO Committees (as in 2019)

Features	Risk and Audit Committee	Technical and Regulatory Committee
Meeting Frequency	4 times in a year	4 times in a year
Function	The committee assists the Board to fulfil its responsibilities for oversight and governance of financial, risk, audit, corporate governance, and compliance matters	The committee assists the Board to fulfil its responsibilities for the oversight and governance of technical matters, including information technology, technical publications, emergency preparedness, and regulatory matters
Activities	• Assisting the Board by reviewing the risks facing AEMO, risk management strategy and reporting, strategic and key operational risks. • Reviewing the annual financial report and the appropriateness of AEMO's material accounting policies and procedures. • Approving the internal audit plan, reviewing the findings of the internal auditor. • Reviewing the approach for the external market audits conducted for all markets and systems operated by AEMO • Reviewing the findings of the market auditors and the effectiveness of the market audit functions • Monitoring compliance reporting and analysis and review of appropriate regulatory compliance programs.	• Review of information technology performance. • Oversight of the strategic direction and high-level structure and content of key AEMO forecasting and planning publications - the first Integrated System Plan, the Electricity and Gas Statement of Opportunities. • Implications for future power system operations and functioning modalities • Reviewing energy market performance • Consideration of regulatory reforms and proposals for regulatory reform

Key Achievements

Since the inception of AEMO, the energy outlook of Australia has undergone drastic transformation enabled by the introduction of planning tools, trading platforms, network development plans, gas hubs, RE integration, strengthening of retail and wholesale markets, transmission capacity augmentation and regulatory interventions. The key achievements of the AEMO are enlisted as below:

Table 34: Key Achievements AEMO

	Electricity Market	Gas Market
Achievement	• Development of National Energy Customer Framework (NECF) arrangements • Expansion of the wholesale electricity market by undertaking regions (like West Australia) under its wing and bringing all the regions on common platform to promote low cost production • Development of National Transmission Network Development Plan (NTNDP), which is a strategic document that provides a 20-year projection of development	• Development of Short-Term Trading Market in 2010 which fast-tracked the trading of gas on daily price basis to facilitate short-term trading of gas to balance supply and demand variations. • Integration of the jurisdictionally based gas retail markets for developing a nationally consistent procedure development mechanism. • Development of Gas Supply Hub in regions like Wallumbilla, Queensland and Moomba with an aim to increase liquidity, transparency and competition in the market.

	Electricity Market	Gas Market
	requirements for the NEM interconnected electricity grid. • Development of National Electricity Forecasting Report as independent electricity forecasts for all NEM regions, using a nationally consistent forecasting framework to strategically plan the capacity expansion plan • Development of solar forecasting to integrate small and medium scale RE capacity into the grid. • AEMO streamlined the balancing market by agreement for the provision of network support and control ancillary services (NSCAS) and contracted a new NSCAS provider. • Promotion of seamless integration of RE, EV, Battery storage, rooftop PV and behind-the-meter aspects by launching Integrated System Plan (ISP) – a progressive projection report to meet the transforming demand trends and morphing energy mix.	• Development of the national gas bulletin – a platform covering all major gas production fields, storage facilities, major demand centers and natural gas transmission pipeline systems • AEMO released National Gas Forecasting Report (NGFR) which forecasts gas consumption and maximum demand in Australia's eastern and south-eastern gas markets. • Harmonization of B2B and B2M procedures across New South Wales and Australian Capital Territory retail gas markets. • Harmonization of the retail gas markets of New South Wales region with Australian Capital Territory to promote efficiency, cost-effectiveness of the participants. • Development of a new pipeline capacity trading platform and developing a capacity trading and day ahead auction market mechanisms to improve trading capabilities and greater liquidity in secondary capacity trading

Key Learnings for SAFEM

Development of electricity market – AEMO is responsible for the operation of the two electricity markets in Australia and has played a vital role in expanding the span of the markets by progressively undertaking charge of newer regions and expanding the existing portfolio of regions like New South Wales, the Australian Capital Territory, Queensland, South Australia, Victoria and Tasmania (excluding Western Australia and the Northern Territory which are not connected to the NEM). There are nearly 300 registered participants in the NEM and approximately 88 WEM Participants and cumulatively they cater to customer base of ~ 11.2 million and transaction quantum of ~ AUD 20 billion. Under the ambit of progressive and advanced market setups, short term power market (STEM), Reserve Capacity Mechanism (RCM) etc. are integrated under the patronage of electricity market. All these efforts have resulted in greater competition and investment in the electricity industry, greater flexibility in transacting for generators and wholesale purchasers, and final transfer of benefit to the customers.

The market operations and mechanism of integration of regions under market regime can emerge as a learning for SAFEM and can be used as blueprints for market development activity

Defining Future Supply Outlook – AEMO has undertaken the responsibility of enabling sustainable long-term infrastructure investment, development of energy resources, efficiently meet the growing demand, guide the augmentation of transmission capacity building and navigating capacity addition. Under this initiative, National Electricity Forecast Report etc. are being developed. Such forecasting and planning initiatives have enabled data analysis and insights that have helped in steering the efficient development of energy supply and transmission to meet Australia's future energy needs over the next five, 10 and 20 years.

The planning and forecasting mechanism can emerge as a learning for the SAFEM

Development of Transmission Network – AEMO has also subsumed the responsibility of the development of transmission network by undertaking planning activities like - National Transmission Network Development Plan. Such plans outline the changes emerging over the next two decades, such as Australia's transition to a low

carbon economy and the integration of renewable energy sources, rising prices and consumers adopting energy efficient behaviors and technologies, new policies, technologies and changing consumption patterns.

This can emerge as a profound learning for SAFEM for planning the development of transmission lines across member states

Transformation of Gas Market – AEMO has played a pivotal role in redefining the outlook of the gas market in Australia by development and expansion of different market setups - The STTM i.e. the hub-based wholesale gas markets that support short-term trading between procurers and retailers; Gas Supply Hub to support wholesale trade of gas between regions by trading short-term physical gas products and Gas Retail Market to facilitate the sale of gas from retailers to residential customers. In 2019 cumulatively, these market setups supported the business transaction of the worth ~ AUD 4 billion. Over and above these, the systems are augmented by the launch of modern market modalities viz. Capacity Trading Platform (CTP) and Day Ahead Auction (DAA) market mechanisms. All these initiatives delivering improved trading capabilities and more liquid secondary capacity trading to Australia's east coast gas markets.

The market design aspects, the market variety and modern modalities like platform and mechanisms can emerge as a lesson for gas aspect of SAFEM

Harmonization of Gas Market – AEMO has undertaken active initiatives to streamline the gas market operation by harmonizing across the markets in the regions. Under this, business-to-business (B2B) and business-to-market (B2M) procedures across the New South Wales and Australian Capital Territory were harmonized with those operating in Victoria, Queensland, and South Australia retail gas markets were aligned in order to induce commonality in standards, elimination of barriers to entry, improving competition and transparency.

The harmonization mechanism and procedure can emerge as a learning for SAFEM

Facilitation of demand-side activities – With the advent of Electric Vehicles, Battery Storage Solutions, RE penetration, embedded generators response and solar rooftop integration the demand trends are shifting, and the focus is migrating towards demand-side participation. In order to facilitate this AEMO designed a strategic system plans like Integrated System Plan (ISP) with an aim to meet current and future needs of our changing energy mix, guided by projections conducted by advanced analytics. The ISP proved to be a widely accepted approach towards the development of the power system which has maximized value to consumers by designing the lowest cost, secure and reliable energy system.

SAFEM can conduct various strategic system studies and regional plans to incorporate the changing demand trends in the diverse regional power markets

4.7. SIEPAC (Central America Regional Electricity Market)

Introduction

Central American countries, namely, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama, signed the framework agreement, the Marco Treaty of the Electrical Market of Central America in 1996, setting the common electricity market *Mercado Regional de Electricidad* (MER) and launching SIEPAC line project.

The treaty was validated in 1998 and came into force in 1999. It implied the creation of the regional electricity market based on the standard set of trading rules at the supranational level: Free access to infrastructure for all parties, bilateral contracts, and gradual market development.

Table 35: Salient Features (2019)

Particulars	Description
Installed Capacity (MW) - 2015	15046 MW
Energy Generated (BU)	47.6
No of participants	6
Energy Export (GWh) - 2015	1.34 BUs

SIEPAC consists of two independent projects:

- **Regional Electricity Market (MER)** development based on a standard set of trading rules at the regional (supranational) level. Part of the MER initiative is the creation of a regional institutional structure, including regional regulator and a regional transmission operator.

- **International Transmission Line** (1800km) development and completion, running from Panama in the south to Guatemala in the north, to increase transfer capacity at all borders in the region to 300 MW.

Table 36: Energy Trade in SIEPAC

Particulars	Description
Installed Capacity (MW) - 2015	15046 MW
Energy Generated (BU)	47.6
No of participants	6
Energy Export (GWh) - 2015	1.34 BUs

The amounts of electricity traded among the various markets that make up the MER has grown. Total installed capacity of the generators in MER region tapped 15.05 GW with energy generated in range of ~47.6 Billion Units (BU). The total amount of energy traded over the Central American Markets in Exchange has remained same from 2014 and marked 1.34 GWh quantum in 2015. A comparison of the exchanges during the seven months corresponding to 2013 with their counterparts in 2014 and 2015 shows that the traded volume was lower in 2013, largely due to implementation in June 2013 of the new operating rules derived from implementation of the MER Regulations (RMER), a situation that required a period of accommodation of the markets.

Evolution of the SIEPAC

SIEPAC has been actively played a vital role in defining the outlook of the South American energy landscape. The chronological representation of the milestones achieved by SIEPAC are represented as follows:

1976	• First interconnection in the region built between Honduras and Nicaragua.
1979	• The governments and state utilities of the six countries agree to create the Central American Electrification Council (CEAC)
1989	• CEAC is formally established following ratification of its Constituent Agreement.
1990	• Costa Rica is the first country in the region to begin reform of its electricity sector. • Establishes a single-buyer model. Guatemala follows in 1991.
1993	• Protocol Treaty on Economic Integration of Central America agreed to at summit of Central American Presidents.
1996	• Peace accords signed. All six countries reformed at least to the stage of introducing single buyer. • Six countries sign the Marco Treaty.
1997	• IADB and the government of Spain approve loans to the SIEPAC project.
1998	• Marco Treaty ratified.
1999	• Marco Treaty comes into effect.
2000	• MER design approved. • CRIE established.
2001	• Regional electricity system and market operator (EOR) established. • Plan Puebla-Panama (PPP) proposed by Mexico to support regional development and integration.
2002	• Transitional Regulations for the Regional Electricity Market (MER) finalized by CRIE and signed by the governments.
2003	• Environmental impact assessments for the SIEPAC line completed for each of the six countries.
2004	• Plan Puebla-Panama institutionalized. Technical studies.
2005	• Transitional MER regulations replaced by updated code approved by CRIE.
2006	• Construction of the SIEPAC transmission line begins.
2008	• Plan Puebla- Panama changes name to The Mesoamerican Project.
2009	• La Corporación Andina de Fomento (CAF) signs a loan agreement with EPR.
2014	• Construction and development of transmission line finally completed.

- The region contained untapped energy reserves, particularly in hydropower. However, largescale development was restricted by small markets at the individual country level and a lack of enough market integration. Economies of scale in generation could be achieved in the context of a multinational market. Trade at the regional level was envisaged to open the potential for trade with large neighboring systems in Mexico and Colombia and enable the potential gains from integration.

- Moreover, in Central America, there were no countries with developed centralized thermal generation that could backup renewables when there is a draught. Fuel and diesel oil capacities had extremely high fuel costs. In addition, there was a limited resource endowment of the countries, determining a critical dependency of the countries on imported energy. Consequently, almost all countries in the region characterized striking electricity supply deficit.

- Poor electrification hindered industrial development in the area, and SIEPAC project was expected to provide a solution to resolve such qualms and the project was initiated in 1987.

- The first technical-economic studies of the proposed transmission project were completed in 1989 and was in favour of the Transmission line.

- In 1997, the economic study considered various electricity sector future scenarios, and came to the conclusion that the 230 kV line was the lowest risk option.

- The Transmissions Investment Task Force within the CEAC identified instruments required to strengthen the national transmission networks to allow secure interconnection with the SIEPAC system.

During the SIEPAC market development, numerous challenges were faced which have been discussed as below:

Measures taken against Environmental Issues:

- Environmental impact assessments (EIAs) were carried out for each of the six countries by private firms selected through competitive bidding. The final reports were presented in 2003.
- The project financing concessions were conditional on the EIAs being approved by IADB and the environmental agencies of each country.
- EPR was required to submit environmental management plans (EMPs) to each government along with the EIAs. These would include plans to mitigate direct and indirect impacts, resettlement plans,
- emergency plans, plans for monitoring during the construction and operation of the line, and a plan to provide the necessary environmental management capacity in each national utility.
- A geological and geotechnical study and ground classification was carried out for the route in 2004. The construction design incorporates protections against seismic risk.

Measures taken against Market Structure Differences:

- The six countries underwent Electric Sector reforms.
- In 1990, Costa Rica was the first to move away from the state-owned, vertically integrated utility model to a single-buyer model followed by Guatemala in 1991.
- By 1996 all six countries had reformed to at least the level of a single-buyer model.
- In 1996 Guatemala implemented regulated wholesale competition (a cost-based pool). El Salvador also introduced a wholesale market and passed a law to begin the implementation of retail competition.
- During the second half of the 1990s Nicaragua and Panama took steps toward introducing wholesale competition. In 2000 Nicaragua launched its electricity market.

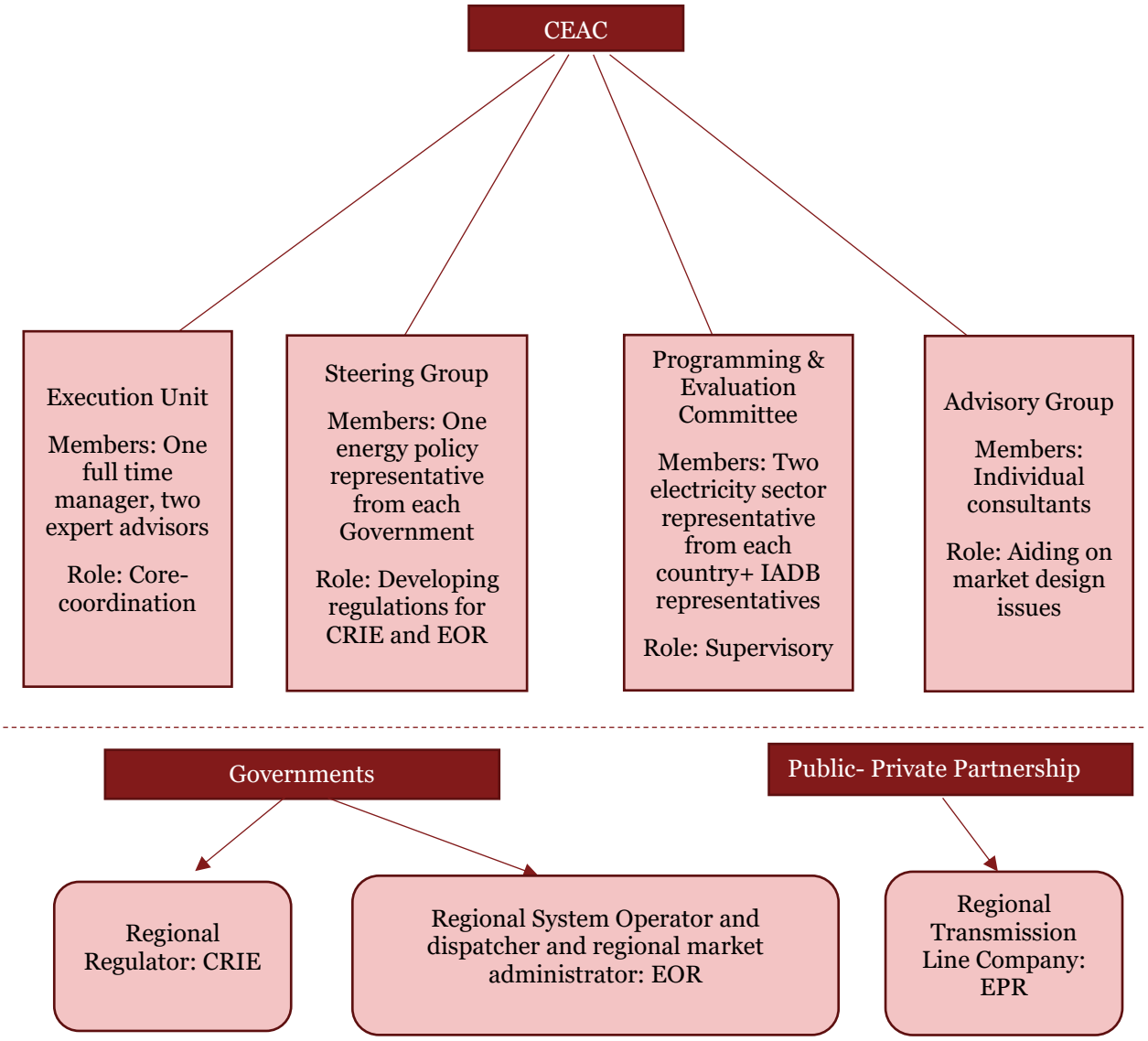
Cost Structure Scheme Implemented:

- Prices at the MER are set as a result of iterative process at the national and region levels.
- The regional market operator EOR gathers pre-dispatch information from national market operators, combines it with bids and offers to determine the reasonable regional nodal prices on hourly basis.
- Honduras and Costa Rica have no competitive national electricity markets and associate the MER prices with those set internally.
- Basing on the MER nodal prices the other countries agree with them or carry out customization.
- All the countries in the region conducted the liberalization reforms in 1990s, but the process was hindered by low welfare of end users who could not cope with tariff increase.
- This situation gave way to multiple governmental interventions into the markets in all countries by means of subsidies and price control.

Organizational Structure

The Central American Electrification Council (CEAC), as the regional planning body representing each state-owned utility, took the role of coordinating the overall development of the project. The technical assistance grants for SIEPAC were mostly made to CEAC as executing agency. This entity has facilitated the coordination of the different levels of the electricity sector and has channeled significant support for international technical collaboration toward the countries of the region, and has had a significant influence on the subsequent development of SIEPAC

Committees and groups were formed in CEAC to coordinate the design and implementation phase of the MER. This was a requirement of the IADB loan and technical assistance conditions. However, later these groups were phased out and permanent institutions were set up to take their roles.



Role of CRIE:

- Approving regulations for the market and coordinating these with the country level regulators,
- Setting tariffs for use of the transmission system,
- Progressing the market through increasing stages of competition and to
- Guard against the exercise of a dominant position,
- Imposing penalties for noncompliance with market rules, and
- Settling disputes among participants.

Role of EOR:

- Proposing rules for MER and transmission system use for approval by CRIE,
- Ensuring quality and security of supply in the electricity system,
- Carrying out the market operation function in an efficient manner, and
- Settling market transactions among participants.

Role of EPR:

- EPR is a public-private joint venture between the governments of six countries.
- EPR is responsible for developing and maintaining the line on a build, own, operate (BOO) basis.

Role of National Regulators:

- Each of the six countries has an electricity regulatory agency.
- The role of the national regulators with respect to the regional market is to monitor and approve firm contracts for international trade to ensure there is a corresponding firm transmission right.
- These approvals are to be made by regulators in both buyer and seller countries.

Table 37: List of National Regulators across member countries

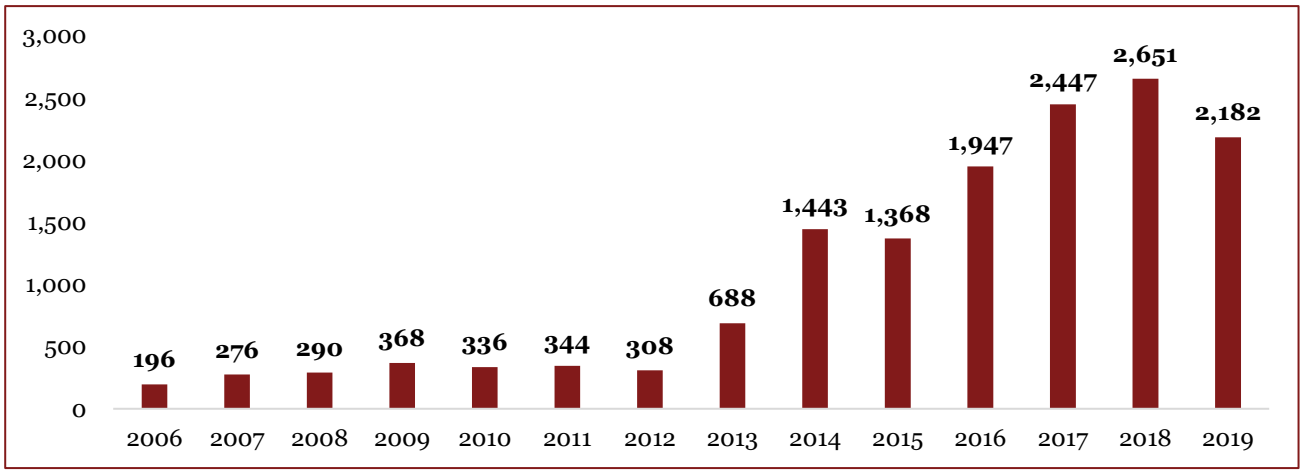
Country	Regulator	Year of Inception (Operation)
Costa Rica	Public Services Regulatory Authority (ARESEP)	1996
Panama	Regulatory Authority for Public Services (ASEP)	1996
El Salvador	General Superintendency of Electricity and Telecommunications (SIGET)	1996 (1997)
Guatemala	National Electricity Commission (CNEE)	1996
Honduras	National Energy Commission (CNE)	1998 (1999)
Nicaragua	Nicaraguan Institute of Energy (INE)	1999

Source: Comisión Regional de Interconexión Eléctrica (CRIE)

Market Products and Structure

In this term of operation of SEIPEC, various feats have been achieved and overall energy situation has progressed substantially. As it can been seen in the graphical representation below, electrical energy input has grown by over 10 times in 2019 to mark 2182 GWh as against 196 GWh in 2006. Electrical energy input doubled between 2013 and 2014, rising from 688GWh to 1,445 GWh, following the entry into operation of MER.

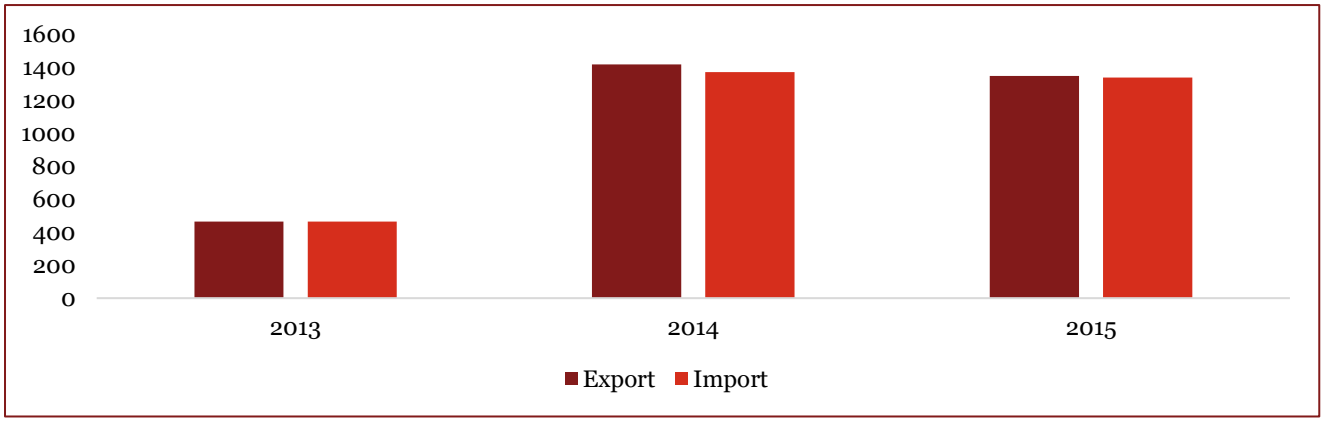
Figure 45:Trade in SIEPAC



Source: CDMER

As per 2019, nearly 34% of the transaction was through electricity exchange or opportunity market (short term) and remaining 66% capacity traded though OTC contracts. The participation of the various Central American markets in the exchanges in the MER has certain characteristics, as the Guatemalan market is the main exporter, while the El Salvador market is the leading importer.

Figure 46: Volume of Energy Traded over the SEIPAC (GWh)



Source: CDMER

Key Learnings for SAFEM

- ***Adequate feasibility studies:*** Pre- feasibility study, Technical- economic studies, Economic study of 1997, Environment Impact Assessments, Geological and geotechnical study and ground classification and such feasibility studies were carried out by SIEPAC to understand the potential risk factors.

SAFEM can act as body to conduct feasibility studies in the SA Region

- ***Extra- Regional Connections:*** SIEPAC's main infrastructure is also connected to neighboring countries through extra- regional links, such as the Mexico- Guatemala link. The extra-regional interconnection aimed to establish a 98.6 km-long transmission line, with a generation capacity of 400 KW, 72% of which was on the Guatemalan side of the border. This also involved the expansion of two substations in Tapachula, Mexico and Los Brillantes, Guatemala.

SAFEM can conduct regional capacity planning studies for enhancing transmission capacity in the SA Region

- ***Monitoring Studies for Environmental Impact:*** Regular monitoring studies are conducted to evaluate the strength and potential influence of electromagnetic fields and noise generated by the towers. If issues are identified, EPR works with SIEPAC to ensure any social or environmental impacts are mitigated. For example, At the outset of the project, the environmental impact assessment recognized that the tall, powerful transmission lines that constitute SIEPAC might influence the migratory patterns of some birds. As a result, a device (bird- saver) was deployed every 30 meters along the affected portions of the transmission line, to offset the measurable impact in migratory patterns.

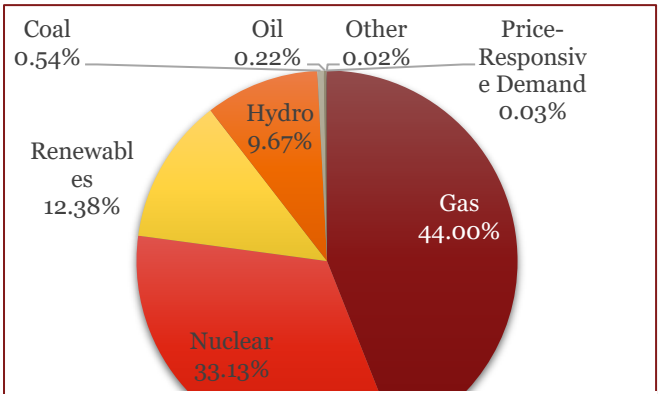
SAFEM can also take initiative for the development of environmental studies for SA region to promote responsible development

4.8. Independent System Operator – New England (ISO- NE)

Introduction

ISO-NE is a non-profit corporation that operates the regional bulk power generation and transmission system, administers New England's wholesale electricity marketplace, and plans for the region's electric future.

Figure 47: % Resource Mix



Source: ISO-NE Annual Report, 2019

Table 38: Salient features of ISO-NE

Particulars	Description
Installed Capacity (GW)	31
Peak Load (GW)	28
Energy Exchanged (BU)	119
No of traders	500
Market Size ($ bn)	9.8
# of households (millions)	6.5
Tariff ($/MWh)	30.7

Source: ISO-NE Annual Report, 2019

It was created by the Federal Electricity Regulatory Commission (FERC) in 1997 as a successor to New England Power Pool, which had been formed in 1971. In 2005, ISO New England was designated as the regional transmission organization. ISO New England covers the six states of Connecticut, Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont. The total installed capacity is 31 GW.70% of the generation mix comes from gas and nuclear. In 2019, natural-gas-fired generation, nuclear, other low- or no-emission sources, and imported electricity provided roughly 99.5% of the region's electricity.

Key responsibilities of ISO New England as an RTO

Operating the Power System
Balancing electric supply and demand every minute of the day

Administering wholesale electricity markets
Pricing electricity competitively and promoting investment in the power system

Power System Planning
Ensuring the Power System evolves to meet future electricity needs

Evolution

The evolution of the New England ISO is described in the exhibit below:

1965	•Great Northeastern Blackout acts as an eyeopener to the vulnerability of interconnected networks to power failures
1971	•New England Power Pool (NEPOOL) created
1977	•Congress reorganizes Federal Power Commission as Federal Energy Regulatory Commission (FERC)
1970s-1990s	•The vertically integrated utility model leads to lack of competition within the industry
1992	•Energy Policy Act creates new category of electricity producer, opening door for greater number of power producers
1996	•Deregulation("market restructuring") begins that open transmission systems to fair and non-discriminatory access and remove obstacles to competition in wholesale trade of electricity
1997	•ISO- New England created to implement wholesale markets, operate regional power system
2003	•New England largely spared from Blackout that affected 50 million in Midwestern & Northeastern USA and Canada, sound operation practices credited
2005	•ISO begins operation as Regional Transmission Organization (RTO)

Markets and Products:

The New England system integrates resources with the transmission system to serve all regional load regardless of state boundaries. In New England, electricity is bought and sold two ways:

- Through contracts between individual buyers and sellers
- In markets managed by the ISO that establish prices for wholesale electricity products and services through competitive bids

Further division in terms of market products on the ISO trading platform are shown in the exhibit below:

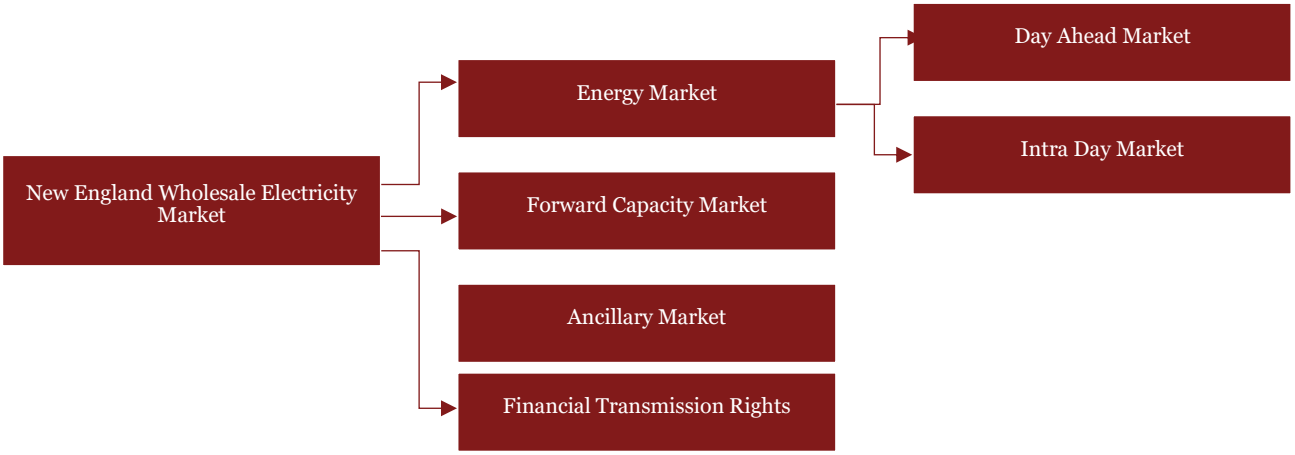


Table 39: Market Products in New England-ISO

Particulars	Description	Trading Time
Day Ahead Market	An open and competitive sub-market traded on a day-ahead basis	Day-Ahead Energy Market submission period closes for Supply Offers, Demand Reduction Offers, Increment Offers, Demand Bids and External Transaction at 12:00 hours of previous day Result of Day Ahead Bids obtained at 16:00 hours
Real Time Market	The Real-Time Energy Market lets market participants buy and sell wholesale electricity during the course of the operating day.	• Bids can be submitted from 16 :00 hrs of previous day • Can be submitted till 1 hr before the operating time
Capacity Market	The Forward Capacity Market (FCM) ensures that the New England power system will have sufficient resources to meet the future demand for electricity.	FCM operates via an annual forward capacity auction (FCA) Held three years in advance of the delivery year, which runs from June 1 to May 31
Ancillary Market	– Regulation: Regulation services are used against second-to-second variations in demand against supply – Forward Reserve Market: forward reserves are procured through an auction process. This ensures that resources are available in the event of system capacity shortages – Real Time Reserve Market: The real-time reserve market is operated by ISO to provide compensation to resources providing reserves in real-time Demand Response Program: Demand Response Program allow demand response assets to participate in the energy markets and to be dispatched during a capacity deficiency based on real-time system conditions	Regulation Reserves: Must respond within 0- 5 seconds d. Forward Reserve: – Non-Synchronized reserves: must respond within 10 mins – Operating Reserve: must respond within 30 mins Real Time Reserve: – Synchronized reserves: must respond within 10 mins – Zonal Forward Reserve - must provide 30 min contingency response
Financial Transmission Rights (FTR)	FTR auctions allow market participants to HEDGE risk	The ISO conducts **annual and monthly auctions** to allow eligible bidders to acquire annual

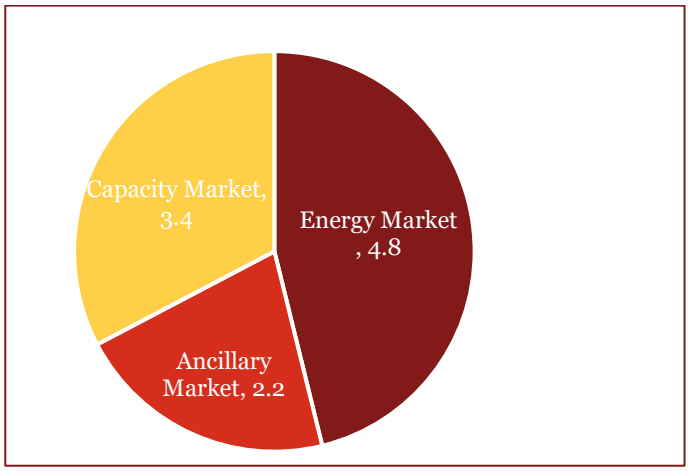
	Also known as "Congestion Revenue Rights" – These can only be used to hedge the portion of basis risk due to Congestion	or monthly FTRs, and to allow FTR holders to sell FTRs.

Source: ISO NE Reports

Internal Bilateral Contracts: According to the Federal Energy Regulatory Commission's (FERC), bilateral trade can occur through direct contact and negotiation, a voice broker, or an electronic brokerage platform and can range from standardized contract packages to customized complex contracts known as structured transactions. Some features of Internal Bilateral Markets are as follows:

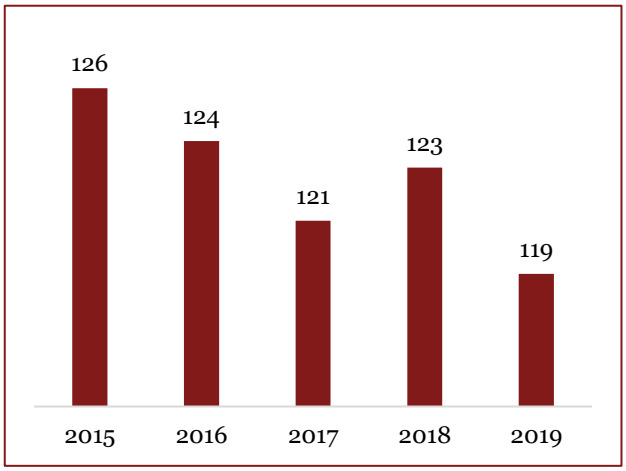
- Transactions between participants at any point on the grid
- Can be settled against the generator pricing node
- Can be settled against the load zone, such as CT Zone
- Schedule in the Day Ahead or Real Time markets

Figure 49: Volume in Wholesale Market ($ Bn) in 2019



Source: ISO-NE Annual Report, 2020

Figure 48: Energy Trade (BU)

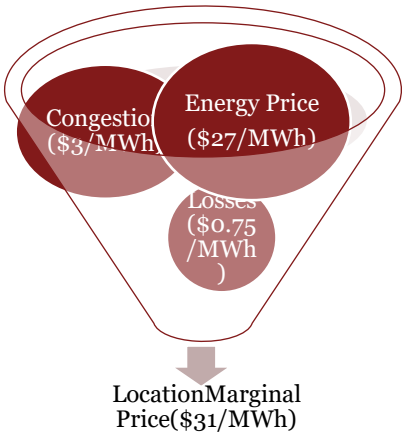


Source: ISO-NE Annual Report, 2020

There are about 500 buyers and sellers in the wholesale electricity market. The market size of the whole sale electricity market in 2019 was 9.8 billion USD which was 19% less than 2018. The demand (119 MWH) has also decreased slightly compared to previous year due to combination of milder weather and increases in energy efficiency and photovoltaic generation.

Pricing of Products in New England ISO Market

Hundreds of regional price points help establish wholesale prices. Since 2003, the Energy Market features locational marginal pricing (LMP). Prices are made up of energy, congestion, and losses.



Essential features of Pricing of Energy Markets in New England ISO

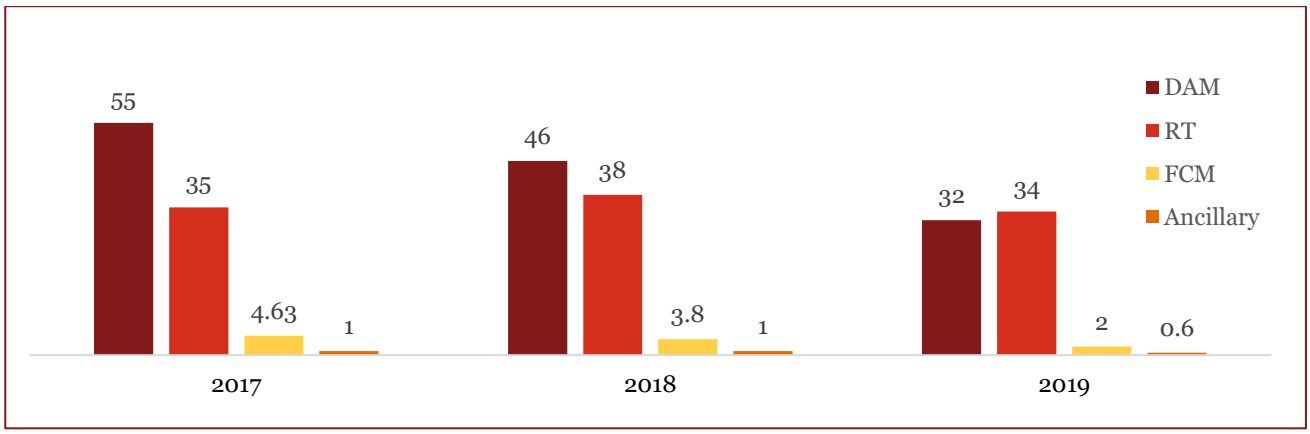
Particulars	
Nodes	– 900+ specific pricing locations across New England – Generators are paid at their individual nodal price, which is unique for each modeled generator
Zones	– Eight load zones – Vast majority of load settles at zonal price – Zonal price is load-weighted average of nodal prices within a zone – 19 Dispatch zones for dispatching active Demand Resources
Hub	– Predefined node; straight average of 32 nodal prices – Hub was created to support bilateral trading

Source: Market Performance Report

In 2019, New England experienced a lessened electricity demand from the grid and lesser average wholesale electricity price due to mild winter that moderated natural gas prices, a cool summer and surging amounts of solar power and energy efficiency.

Price by category of products

Figure 50: Product wise electricity price in New England -ISO



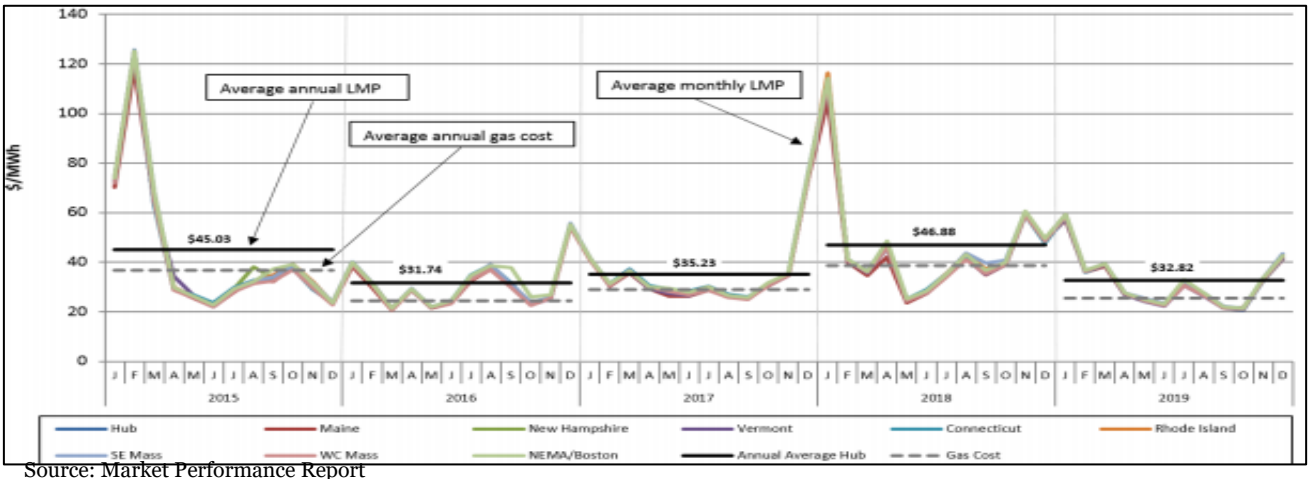
Source: Market Performance Reports

Each of the product segments are discussed further in the subsequent sections

1. Day Ahead Market: ISO follows zonal pricing in pricing of Day Ahead Market. However the graph illustrates a pattern in prices that varies considerably by year and by month and not by zones. For winter months in 2015 and 2018 constraints on the natural gas system resulted in large price spikes in natural gas and electricity prices. The highest prices in 2019 were in January, with prices of $59/MWh.

e.

Figure 51: Day Ahead Price ($/MWh)

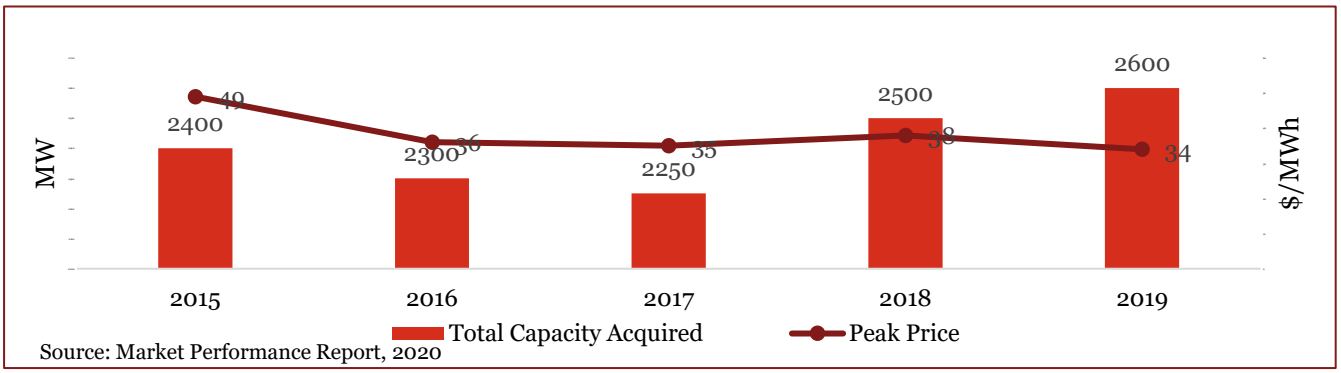


Source: Market Performance Report

f.

2. **Real Time Market**: Real Time Market Pricing has decreased by 29% since 2018 with the volume standing at 2600 MW

Figure 52: Energy Traded and Price in RTM

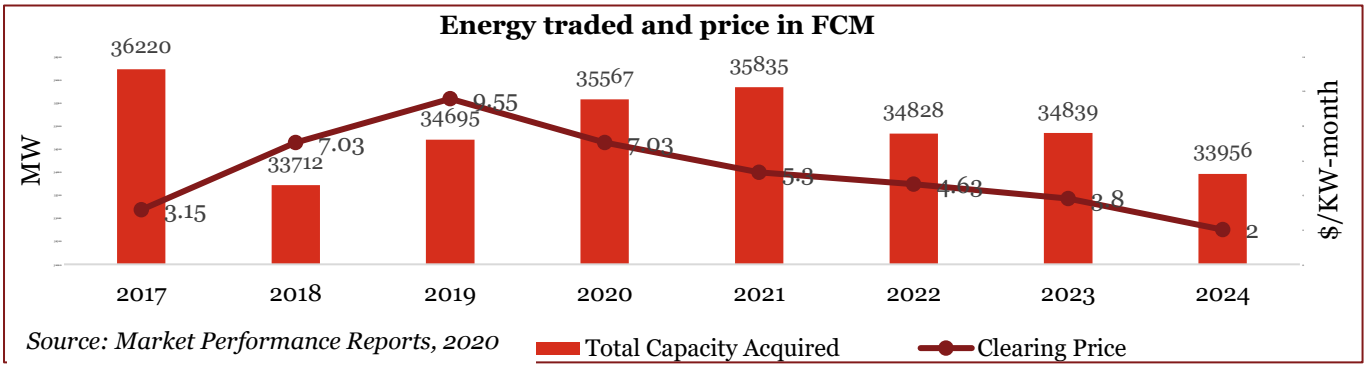


Source: Market Performance Report, 2020

3. **Capacity Market:** Capacity prices are determined by Forward Capacity Auctions and have fluctuated with the change in the number of resources competing and clearing in the auctions and the region's capacity surplus have changed.

The clearing price in FCA (2019) of $2/kW-month was the lowest price since the inception of the FCM.

Figure 53: Energy Traded and Price in FCM



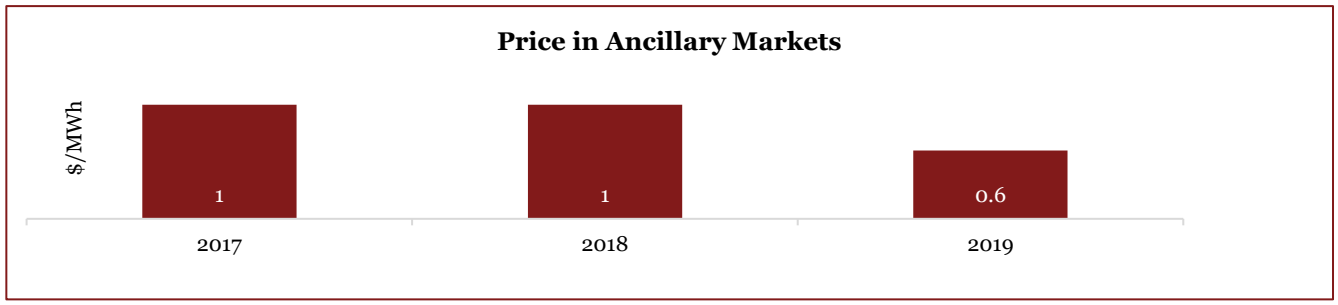
Source: Market Performance Reports, 2020

4. Ancillary Market

g. In 2019, ancillary services costs totaled about $114 million. In 2019, the costs($/MWh) of ancillary services decreased by 29%, driven by the reduction in energy prices and the end of the winter reliability. program after Winter 2018.

h.

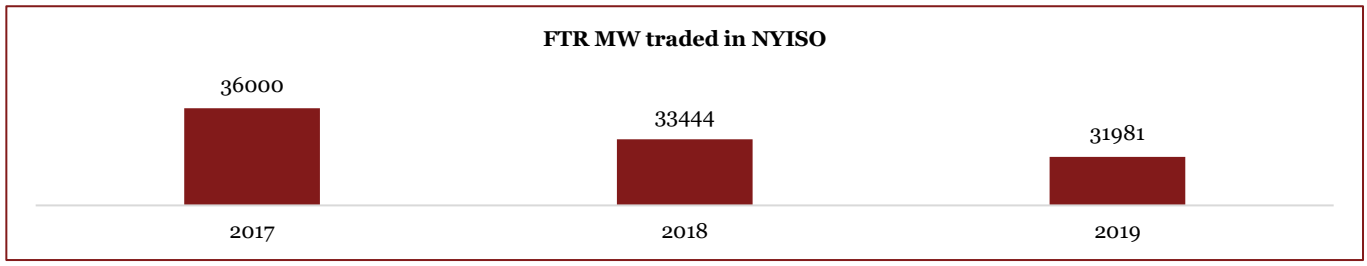
Figure 54: Price in Ancillary Market (USD/MWh)



Source: Market Performance Reports, 2020

5. Financial Transmission Rights:

Figure 55: FTR (MW) Traded in NYISO



Source: Market Performance Reports, 2020

FTRs are instruments to hedge or speculate on transmission congestion in New England's day-ahead energy market. Market participants had an average of 31,981 MWs of FTRs in effect per hour in 2019.

Over the past 20 years, the ISO's continuous study of the transmission system has helped guide cooperative regional investment that not only improves reliability but enables the competitive markets to work as designed. Transmission system upgrades allow the ISO to dispatch the most economic resources throughout the region, allow less-efficient resources to retire, and enable the interconnection of power plants with lower emissions. Upgrades have nearly eliminated congestion costs in the New England energy market and, with the aid of low natural gas prices and other factors, have helped drive down and mitigate "uplift" payments to run specific generators to meet local reliability needs.

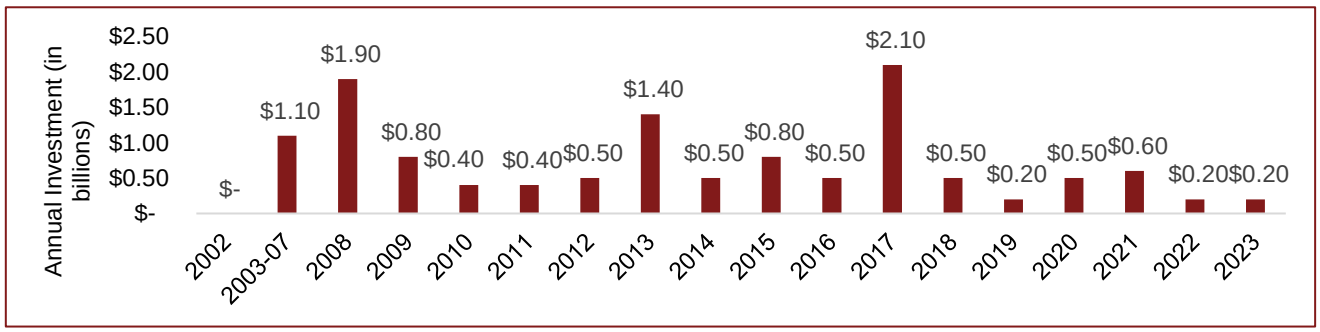
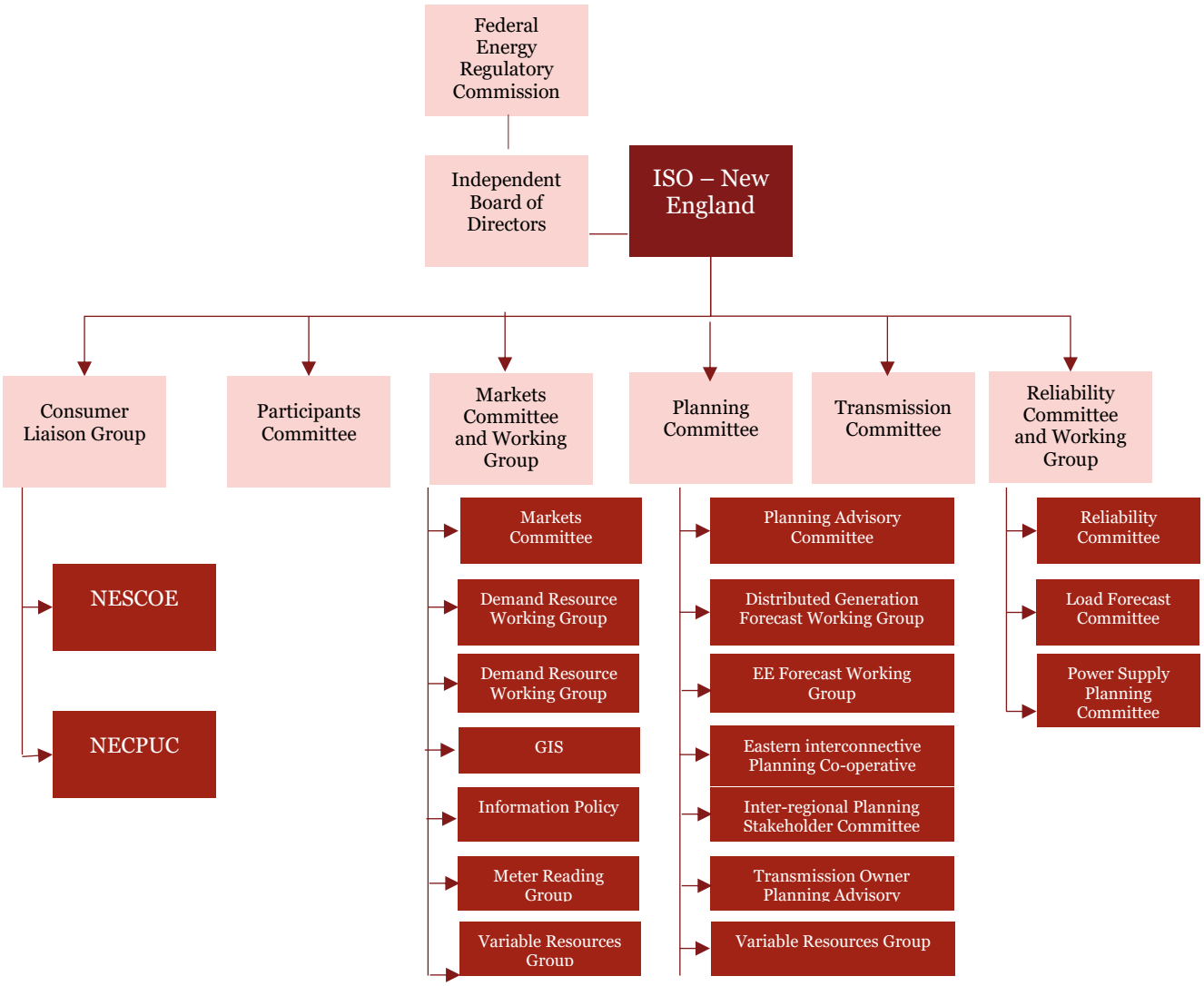


Figure 56: Average Investment (USD Bn)

Transmission system upgrades have nearly eliminated congestion costs in the New England energy market and, with the aid of low natural gas prices and other factors, have helped drive down and mitigate "uplift" payments to run specific generators to meet local reliability needs.

Organizational Structure

Below is the schematic of the organizational structure of ISO-NE



Below is a description of the functions of each of the Committees and Groups:

Federal Regulatory Energy Commission: FERC is the federal agency that regulates the transmission and wholesale sale of electricity and natural gas. It regulates regarding tariffs, agreements and operations

Board of Directors: An independent group of leaders that helps guide the ISO in fulfilling its mission.

Various stakeholder committees, working groups and forums collaborate with ISO. For example:

Consumer Liaison Group: It is a forum of consumers and consumer representatives (including state consumer and ratepayer advocates), state business and industry associations, chambers of commerce, individual businesses, trade groups, nonprofit organizations, and other end users. The CLG meets four times a year to exchange information with the ISO.

In its collaboration with the states, are two organizations that advise the ISO on regional electricity matters:

- NESCOE: the organization representing the collective interests of the New England states, which is directed by managers appointed by the six New England governors
- NECPUC: the organization representing the utility regulatory bodies of the New England states

Participants' Committee: It is the principal governing body through which the members of the NEPOOL act as a stakeholder organization. This key committee seeks to ensure the representation of all market participants, coordinate and clarify input to ISO New England, and facilitate the formation of consensus positions that have both practical and legal significance to the administration of New England's wholesale electricity markets and power system.

Markets Committee and Working Group: This is a standing technical committee of the New England Power Pool (NEPOOL) and one of NEPOOL's principal committees. Its major function is to advise ISO New England on the rules and procedures.

Planning Committee: This committee provide valuable input regarding the resources and transmission facilities needed to maintain the reliable and economic operation of New England's power system. The functions of some of the sub-groups are described below:

- Planning Advisory Committee: This is an open stakeholder forum that provides input and feedback to ISO New England on the regional system planning process
- Generation Forecast Working Group (DGFWG): This is a regional forum for interested parties, including state policymakers, distributed generation (DG) program administrators, and distribution companies, to provide input on ISO New England's long-term DG forecast
- Eastern Interconnection Planning Collaborative (EIPC) :This is a collaborative made up of the major transmission planning coordinators responsible for the planning of the bulk power grid throughout the Eastern Interconnection,
- The Energy-Efficiency Forecast Working Group (EEFWG): This Group provides ongoing input to ISO New England's annual energy-efficiency (EE) forecast process,
- Environmental Advisory Group (EAG): This is an open stakeholder forum that provides input and feedback to ISO New England on the environmental consequences of regional system planning and operations
- Interregional Planning Stakeholder Advisory Committee (IPSAC): This is an open stakeholder group that provides input for the development of the Northeastern Coordinated System Plan (NCSP).
- Transmission Owner Planning Advisory Committee (TOPAC): This is a transmission owner-led forum which discusses and solicits input on each company's Local System Plan (LSP) and upcoming transmission projects within their areas.

Transmission Committee:

The Transmission Committee (TC) is a standing technical committee of New England Power Pool (NEPOOL). The main responsibility of this committee is to advise the Participants Committee, ISO New England, and transmission owners on the reliable and efficient operation of the regional transmission system. Major functions are as follows:

- Amendments to transmission-related provisions of the ISO Tariff and related rules
- Transmission and ancillary services billing procedures
- Proposed amendments of the Transmission Operating Agreement (TOA)

Reliability Committee and Working Group

The Reliability Committee is a standing technical committee of the New England Power Pool (NEPOOL) and one of NEPOOL's principal committees. Various sub-groups with their function are described below:

- The Reliability Committee (RC): Advises on the design and oversight of reliability standards for the New England power system.
- Load Forecasting Committee (LFC): Review ISO New England's methodologies for developing the long-term load forecast for the region
- Power Supply Planning Committee: This sub-committee examines issues related to the ability of New England's generation, transmission, and other resources to meet reliability requirements, locational capacity requirements, and tie reliability benefits.

Key Learnings for SAFEM

Comprehensive Planning: ISO New England maintains an ongoing 10-year plan for the region to ensure the power grid will continue to meet New England's evolving needs. Careful analyses and planning are done to evaluate the projects' feasibility. The plans are further finalized through an open and collaborative process with the region's stakeholders, including generator and transmission-owning entities, and state representatives.

SAFEM can assist in the comprehensive planning in the SA Region by undertaking studies like transmission study, interconnection studies, capacity planning etc.

Standard Market Design: ISO-NE redesigned the wholesale power market, replacing the initial market system with a new method for buying and selling wholesale power in the region, called Standard Market Design (SMD). The features included:

- Providing clear economic signals indicating where investment in the bulk power system is needed, including the location of new generating units, expansion of transmission facilities and participation in demand-side management programs—elements needed in a well-functioning market to alleviate constraints, increase competition, and improve the system's ability to meet power demand.
- Providing the correct price signals to influence economic and efficient real-time market behavior and expand the options for energy transactions, making the market more liquid, more competitive, and more economically efficient.
- Providing mechanisms to hedge against volatility and uncertainty of real-time prices and to hedge against higher wholesale prices caused by congestion costs.
- Reducing trading barriers across electricity markets in the Northeast that will increase competition and trading choices offered to wholesale market participants.

SAFEM can assist in outlining the standard market design in the SA Region

Smart Grid Development: The ISO participated in the development of national smart grid interoperability standards, led by NIST, to establish protocols that provide common interfaces for smart grid equipment. ISO staff are also active in the Institute of Electrical and Electronics Engineers (IEEE), a professional society that, among its many activities, helps develop standards for the interconnection and operation of smart grid technologies. Phasor Measurement Units (PMUs) were installed across the region for collecting Power System data. PMUs measure grid conditions 30 times per second, painting a much more accurate picture of what's happening on the power system than traditional SCADA systems that measure grid conditions every 2 to 10 seconds.

SAFEM can undertake initiatives to aid the development of the Smart Grid in the region

4.9. Key Learning from the international market forums

The comprehensive study and assessment conducted in the preceding section bring out the key learning which can be useful for the development of SAFEM. The learnings have been segregated under the design based and learnings and good practices which can be vital for the SAFEM design, and such learning have been exhibited as mentioned below:

Table 40: Key Takeaways from International Cases

	SAPP	ENTSO-E	WAPP	GMS	PJM	AEMO	SIEPAC	ISO-England
Participation	Net Pool	Gross Pool	Gross Pool	-	Net Pool (DAM)	Gross Pool	Gross Pool	Gross Pool
Products Offered	Bilateral Contracts, DAM, IDAM, FPM (monthly), FPM (weekly)	Bilateral Contracts, Forwards, DA, Intra Day	Bilateral	Bilateral Contracts	Bilateral Contracts, DA Spot, Real-Time, Capacity Market	DA Spot, Short Term, Forwards, Futures on ASX	Short Term, Bilateral Contracts	Bilateral, DA Spot, Real Time, Capacity market
Bidding Mechanism	Double Sided Auction Process	Double Sided Auction Process	-	-	Double Sided Auction	Double Sided Auction	Double Sided Auction	Double Sided Auction
Balancing Market	Bilateral Contract	Purchase of Ancillary Services	-	-	Deviations Traded in Real Time	Purchase of Ancillary Services and Reserve Capacity	-	Deviations Traded in Real Time and Forward Reserves
Pricing	Zonal	Zonal	Zonal	Zonal	Nodal	Zonal	Zonal	Nodal + Zonal
Risk Management (Financial Derivative Market)	Bilateral OTC, Forwards	Bilateral OTC, Forwards, Bidding on virtual platform (XBID)	Bilateral OTC	Bilateral OTC	FTRs-ARRs, Bilateral OTC, Financial Trading, Virtual Bidding	Bilateral OTC, Derivatives, Options, ASX Futures, Floors	Bilateral OTC, PX	FTRs, Bilateral OTC, Forwards, Financial Trading
Capacity Market	-	Forwards	-	-	Capacity (FRR), Capacity (RMR)	Capacity Credits (Contracts), Forward Capacity Auctions	-	Forward Capacity Auctions

Table 41: Good Practices and Developmental Activities

	Technical and Operational Aspects	Policy, Planning and Strategy Aspects	Organizational and Commercial Aspects	Sustainability and Diversification Aspects
SAPP	• Extensive portfolio of products along the years catering to the changing demands of the market participants and make the market participation lucrative.	• Established Transmission Infrastructure Financing Facility (TIFF) to raise funds for development of transmission infrastructure in the region. • Seeking support from foreign bodies like - Government of Norway and Swedish International Development Cooperation Agency - for carrying out reforms for the development of market	• Extensive trainings to all the market participants along with introducing new products to ensure enthusiastic participation from all members which contributed to the success of newly launched products	• Anti-discriminatory rules and regulations developed by SAPP ensures ethical treatment and equal representation of all member countries to ensure ethical treatment and equal representation of all member countries • Markets sub-committee in SAPP plays role of an advisor by providing suggestions to all its member countries to meet energy needs along with adhering to long term environmental and economic commitments
ENTSO-E	• Design of EU Member harmonized tariff network codes has emerged as an opportunity to improve tariff methodologies to help promote trading, such as the transfer of variable charges (CVs) from the entry to the exit points	• Developing electricity Balancing Guidelines which help create a marketplace where countries can share the resources used by their transmission system operators to make generation equal demand	• Developed market products like SADC which allocates scarce cross-border transmission capacity in the most efficient way by coupling wholesale electricity markets from different regions through a common algorithm, simultaneously taking into account cross-border transmission constraints	• Enhanced integration of RE sources in the power market and provision a level playing field to all the generators. Established Clean Energy Package (CEP) which shall enhance framework for regional cooperation through the establishment of Regional Coordination Centres (RCCs).
WAPP	• Initiatives to synchronize power transmission infrastructure to facilitate power trading	• Presence of independent regulator viz. ERERA to frame policies and supervise various activities of the power pool	• Partial and delayed payments emerged as a learning for the pool as it hampers the capabilities of power producers and lowers the confidence of power market participants in the market structure	• Undertaking initiatives to reduce the GHG emissions in the long term by use of renewable sources to produce power and promoting energy efficiency viz. project with GIZ to reduce GHG
GMS	• Developing GMS grid codes/Regional power trade operating	• Development of a roadmap (consisting 4 stages) in GMS region which has acted as a	• The gradual process of creation of the dedicated groups, based on the emerging diverse set of	• Post conception of RPCC, extended debates and deliberations were undertaken to shortlist a host

	agreement which will entail harmonized technical standards and operational procedures and ensure uniformity in the minimum set of technical, design and operational criteria to ensure secure and reliable supply	guiding tool in governing the phased progress of the GMS region and can emerge as a vital learning for SAFEM to define the roadmap of SA region.	requirements can be taken as a analogy for defining the transitional growth of structure	nation for housing the headquarters of RPCC. This can emerge as a case study for SA region.
PJM	• Diverse set of balancing services available in the portfolio of PJM viz. Synchronized Reserve Market, Non-Synchronized Reserve market, Day Ahead Scheduling Reserve Market and the Regulation Market	• Undertaking activities of resilience planning by taking measures to map the threats to the system, impacts if the threat event occurs and the inherent vulnerabilities in the system to provide uninterrupted power supply in the region.	• Sub-committees of PJM facilitate information sharing and informs decisions that help strengthen the grid and drive the power industry forward, and by making large number training material online. This practice can be adapted by SAFEM to provide online training for all the participants in cost effective manner	• PJM has a resilient generation system as the capacity capabilities of resources is very diversified and is seeing an increasing contribution from RE generators. Also, the generation resources are widely spread throughout the geographical area with a contingency plan into place. • Encouraging participants to increase the share of renewable energy resources – existing RE fleet consists biomass, solar, hydro and wind energy
AEMO	• Undertaken active initiatives to streamline the gas market operation by harmonizing across the markets in the regions viz. business-to-business (B2B) and business-to-market (B2M) procedures to • Played a pivotal role in redefining the outlook of the gas market in Australia by development and expansion of different market setups -	• Focus on demand-side management by designed a strategic system plans like Integrated System Plan (ISP) with an aim to meet current and future needs of our changing energy mix, guided by projections conducted by advanced analytics • Subsumed the responsibility of the development of transmission network by undertaking planning activities like - National Transmission Network Development Plan	• AEMO has taken steps to enhance the liquidity in the market by expanding the span of the markets viz. progressively undertaking charge of newer regions and expanding the existing portfolio which has resulted in greater competition and investment in the electricity industry, greater flexibility in transacting for generators and for wholesale purchasers	• AEMO has undertaken the responsibility of enabling sustainable long-term infrastructure investment, development of energy resources, efficiently meet the growing demand, guide the augmentation of transmission capacity building and navigating capacity addition e.g. development of National Electricity Forecast Report etc. to enable data analysis and insights that have helped in steering the efficient development of energy supply and transmission

	The STTM i.e. the hub-based wholesale gas markets that support short-term trading between procurers and retailers etc. which have improved trading capabilities and more liquid secondary capacity trading to Australia's east coast gas markets	entailing critical aspects like Australia's transition to a low carbon economy integration of RE, rising prices and consumers adopting energy efficient behaviors and technologies, new policies, technologies and changing consumption patterns.		
AEMO	• Undertaken active initiatives to streamline the gas market operation by harmonizing across the markets in the regions viz. business-to-business (B2B) and business-to-market (B2M) procedures to • Played a pivotal role in redefining the outlook of the gas market in Australia by development and expansion of different market setups - The STTM i.e. the hub-based wholesale gas markets that support short-term trading between procurers and retailers etc. which have improved trading capabilities and more liquid secondary capacity trading to Australia's east coast gas markets	• Focus on demand-side management by designed a strategic system plans like Integrated System Plan (ISP) with an aim to meet current and future needs of our changing energy mix, guided by projections conducted by advanced analytics • Subsumed the responsibility of the development of transmission network by undertaking planning activities like - National Transmission Network Development Plan entailing critical aspects like Australia's transition to a low carbon economy integration of RE, rising prices and consumers adopting energy efficient behaviors and technologies, new policies, technologies and changing consumption patterns.	• AEMO has taken steps to enhance the liquidity in the market by expanding the span of the markets viz. progressively undertaking charge of newer regions and expanding the existing portfolio which has resulted in greater competition and investment in the electricity industry, greater flexibility in transacting for generators and for wholesale purchasers.	• AEMO has undertaken the responsibility of enabling sustainable long-term infrastructure investment, development of energy resources, efficiently meet the growing demand, guide the augmentation of transmission capacity building and navigating capacity addition e.g. development of National Electricity Forecast Report etc. to enable data analysis and insights that have helped in steering the efficient development of energy supply and transmission
SIEPAC	• Pre- feasibility study, Technical- economic studies, Economic study	SIEPAC's main infrastructure is also connected to neighboring countries through	Implementation of a financing scheme with considerable leveraging and long terms of	Regular monitoring studies are conducted to evaluate the strength and potential influence of

	of 1997, Environment Impact Assessments, Geological and geotechnical study and ground classification and such feasibility studies were carried out by SIEPAC to understand the potential risk factors	extra- regional links, such as the Mexico- Guatemala link. The grid integration practices can be taken as a learning for planning support activities by SAFEM.	payment for services, which, taking into account the limited resources immediately available and the potential for future gains for the countries, effectively adapted international models to the local market.	electromagnetic fields and noise generated by the towers. If issues are identified, EPR works with SIEPAC to ensure any social or environmental impacts are mitigated
ISO-New England	• Grid Operation- Coordinate and direct the flow of electricity in the grid • Market Administration: Design and oversee the functioning of wholesale power market. Consist of **Energy Market, Forward Capacity Market and Ancillary Markets** • Power System Planning- Study, analyze and system planning to ensure reliability of supply	• Focus on non-carbon emitting resources, demand response management and capacity development • Transmission system upgrades allow the ISO to dispatch the most economic resources throughout the region, allow less-efficient resources to retire, and enable the interconnection of power plants with lower emissions.	• Wholesale market and state policy initiative of ISO-New England facilitate collaborative process in the administration of New England's wholesale electricity markets and power system in tandem with state policies This practice can be adapted by SAFEM to provide/ discuss potential wholesale market design changes that would enable competitive markets to better accommodate state public policy objectives	• Upward trend in Renewable Energy and Energy Efficiency Forward Capacity Market has enabled the entry of nearly 12 GW from energy efficiency, demand response, renewable resources and natural gas plants. • Air emissions from generators has decreased dramatically. From 2001 to 2017, annual emissions for sulfur dioxide (SO_2), nitrogen oxides (NOX), and carbon dioxide (CO_2) declined by **98%, 74%,** and **34%**, respectively.

In the South Asian region, there are existing regional/sub-regional groups which are operating to strengthen collaboration in promoting regional cross border power trade. A prime focus area for these organizations is to facilitate regional electricity sector cooperation, CBET, transmission connectivity, regional power market development etc. The salient points of these regional organizations are as given below:

Table 42: Institutional Structure of Regional Forums in South Asia

Regional Institution	**Member Countries**	**Focus Areas**	**Institutional Structure and Functioning**
The South Asian Association for Regional Cooperation (SAARC)[4]	- Afghanistan - Bangladesh - Bhutan - India - Maldives - Nepal - Pakistan - Sri Lanka	- Energy, Transport, Science & Technology - Human Resource Development and Tourism - Agriculture and Rural Development - Environment, Natural disaster and Biotechnology - Economic, Trade and Finance - Social Affairs - Information and Poverty Alleviation - Education, Security and Culture	• **Governance and Operating Structure** - **Summits:** Government of the member states is the highest decision-making authority **(Prime Minister/ President)** and head the biennial summits. - The Summit Declaration contains decisions and directives of the leaders to strengthen and consolidate regional cooperation in different areas. - **Council of Ministers (CoM)** comprises **Ministers of Foreign / External affairs** of member states. - CoM undertakes formulation of policies, review of progress, decision on new areas of cooperation and establishment of additional mechanism. The Council also reviews the progress of implementation of decisions taken by Summits. Council meets once every year. - **Standing Committee** comprises **Foreign Secretaries** of the SAARC Member States. - Standing committee take measures /decisions relating to overall monitoring and coordination of Programme of cooperation under different areas; approval of projects and programmes, including modalities of their financing; determination of inter-sectoral priorities; mobilization of regional and external resources; and identification of new areas of cooperation based on appropriate studies. Standing committee meets at least once every year.

[4] https://www.saarc-sec.org/

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
			- **The Programming Committee** comprising the Heads **(Joint Secretary/ Director General /Director)** of SAARC division of member countries assists the Standing Committee. - The Programming Committee considers the Calendar of Activities; Administrative and Financial Matters of the Secretariat and Regional Centers, Technical Committees, Working Groups, and Specialized Bodies. The committee meets at least twice every year. - **Technical Committees** comprising representatives of Member States are responsible for implementation, coordination and monitoring of the programs in their respective areas. - In addition to determining the potential and the scope of regional cooperation in agreed areas, Technical Committees are involved in formulation of programmes and preparation of projects. They also coordinate the implementation of sectoral programmes and assess the implementation regularly. - **Working Groups (WG)** formulate and oversee program activities in their respective areas. The WGs coordinate, monitor and evaluate programmes. - The Standing Committee sets up **Action Committees** comprising Member states concerned with the implementation of projects involving more than two but not all member states. - SAARC Council of Experts of Energy Regulators (CEERE) serves as a regional forum to discuss, share knowledge, and achieve consensus on harmonized rules to enable bilateral and multilateral power trade in the SAARC region. It started functioning in 2016 and is run with the technical and financial support of ADB. - **Agreement for Energy Cooperation**

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
			- "SAARC Framework Agreement for Energy Cooperation (Electricity)" was signed by all Member States of SAARC including India on 27.11.2014 in 18th SAARC Summit held in Nepal on 26th-27th November, 2014. **Financial Arrangement** - The contribution of each Member State towards financing of the activities of the association is voluntary. - Each Technical Committee makes recommendations for the apportionment of costs of implementing the programmes proposed. - In case sufficient financial resources cannot be mobilised within the region for funding activities of the association, external financing from appropriate sources may be mobilized with the approval of or by the Standing Committee. **Headquarter Details** - **The Secretariat** of SAARC is based in **Kathmandu**
The South Asian Sub-regional Economic Cooperation (SASEC)[5]	- Bangladesh - Bhutan - India - Maldives - Myanmar - Nepal - Sri Lanka	- Energy - Transport - Trade facilitation - Economic corridor development	• **Governance and Operating Structure** - The SASEC program was formed in 2001 in response to the request of the four countries of South Asia – Bangladesh, Bhutan, India and Nepal – from ADB to assist in facilitating economic cooperation among them. ADB launched the SASEC program and supported it through several regional technical assistance projects. - **SASEC Nodal Officials:** Represented by the **Secretaries and Joint Secretaries** of **Ministry of Finance** of SASEC countries. - The Nodal Officials meeting reviews existing projects and provides strategic direction and guidance for cooperation under SASEC. The meeting occurs on the sidelines of ADB's Annual Meeting.

[5] https://www.sasec.asia/index.php

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
			- **Agreement for Energy Cooperation** - SASEC Vision document and SASEC Operational Plan identifies cooperation in energy sector as an strategic objective of the member countries. - **SASEC Technical Working Groups:** The SASEC Working Groups are represented by **Joint Secretary or Director General** of member countries. Different groups for trade facilitation and transport, energy and ICT. - The working group reviews strategic priorities and project-based progress. The Working Group typically meets once or twice annually. - **Technical sub-committees:** Carry out the agreed actions of working groups. - **The SASEC Electricity Transmission Subgroup (SETUF)** has been formed with an objective to develop cross-border power transmission connectivity and promotion of power trade between SASEC subregion and Sri Lanka. - **SASEC Power Trade Working Group (SPT-WG) (Senior officials and representatives from MoP and utilities from SASEC countries)-** Working group has been formed to promote regional power trade between member countries. • **Financial Arrangement** - SASEC is funded by ADB. • **Headquarter Details** - SASEC **Secretariat** is based at ADB headquarters in Manila, **Philippines.**

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
The Bay of Bengal Initiative for Multi-Sectoral Technical and Economic Cooperation (BIMSTEC)[6]	- Bangladesh - Bhutan - India - Nepal - Sri Lanka - Myanmar - Thailand	- Energy - Trade - Technology - Transport - Tourism - Fisheries - Agriculture - Public Health - Poverty Alleviation - Counter terrorism - Environment - Culture - People to people contact - Climate Change	• **Governance and Operating Structure** - **Summits** are the apex decision making event for BIMSTEC. They are planned to be held every two years. The summits are attended by the head of the governments **(Prime Minister/ President)** of member countries. - **Foreign Ministerial Meetings** attended by **External Affairs Minister/ Foreign Minister** determines the overall policy for the forum and as well as recommendations for the Leaders' Summit. - **The Trade/ Economic Ministerial Meetings (TEMM)** are attended by **Trade/Economic Ministers** of the Member states monitors the progress in the Trade and Investment Sector as well as FTA policy. - **Senior Officials Meeting** (comprising **Foreign Secretaries**) helps the Ministerial Meeting in monitoring and providing overall direction to the BIMSTEC activities. - **Senior Trade/ Economic Officials Meeting (STEOM**) is attended by **Senior Officials of the Trade/ Commerce Ministry** of the member states and representatives from **Ministry of Foreign Affairs** and assists the Ministers of trade - **Business Forum and Economic Forum** under the STEOM allow active participation of the **private sector**. In the Business Forum, private sector representatives from the BIMSTEC Member States meet and discuss various issues. Results from the Business Forum will be forwarded to Economic Forum where the private sector has an opportunity to discuss freely with representatives from member

[6] https://bimstec.org/

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
			States. The Economic Forum will then report outcomes of its meetings to the STEOM. - **BIMSTEC working group** comprising of **Ambassadors/ Representatives** from member states ensures progress of work agreed during annual meetings. - **Specialized Task Forces** and other mechanisms as deemed necessary by Senior Officials are coordinated by member states. - **Agreement for Energy Cooperation** - Memorandum of Understanding (MoU) for Establishment of the BIMSTEC Grid Interconnection was signed in Kathmandu, Nepal on 31 August 2018. - Memorandum of Association (MoA) for Establishment of BIMSTEC Energy Centre was signed in Nay Pyi Taw, Myanmar on 22 January 2011 • **Financial Arrangements** - BIMSTEC is financed by contribution from member nations. • **Headquarter Details** - **BIMSTEC secretariat** has been established in **Dhaka, Bangladesh**. - **BIMSTEC Energy Centre (BEC)** has been agreed to be set up in **Bengaluru, India**. Rules to govern the structure, functioning, financing and reporting of the Centre is being worked out by the member nations.

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
South Asia Forum for Infrastructure Regulation (SAFIR)[7]	- Bangladesh - Bhutan - India - Maldives - Nepal - Pakistan - Sri Lanka	- Power - Telecommunication - Water - Transport	• **Governance and Operating Structure** - SAFIR aims at providing high quality capacity building and training on infrastructure regulation & related topics. - The **Chairperson and Vice- Chairperson** of SAFIR hold the office in ex-officio capacity. Each annual conference of SAFIR shall elect a Chairperson (from **Chairman of regulatory bodies of member countries**) and Vice Chairperson on rotation basis. - The **Steering Committee** is the policy making body of SAFIR and consists of **Chairperson / Board level member / Governing body member** of regulatory commissions, regulatory association, Co-operative societies, corporate bodies, infrastructure service providers, consumer advocacy groups, Non-Governmental Organizations and academic institutions. The steering committee meets at least once a year for AGM. - The **Executive Committee** consists of **Chairman of regulatory bodies** from member countries. The members of the Steering Committee shall nominate the members of the Executive Committee. Chairperson of SAFIR shall be the ex-officio **Chairperson of the Executive Committee**. - The Executive Committee has the responsibility of operationalizing the strategic direction provided by the steering committee. - **Agreement for Energy Cooperation** - Memorandum of Understanding signed between the member countries identifies cooperation in power sector as one the objectives of the forum.

[7] https://www.safirasia.org/

Regional Institution	Member Countries	Focus Areas	Institutional Structure and Functioning
			• **Financial Arrangement** - SAFIR is funded by annual subscription fees from members of the steering committee. • **Headquarter Location** - **Secretariat:** One person of the steering committee is entrusted with the responsibility of operating the **Secretariat** of SAFIR for a period as may be decided by the steering committee. - The **Secretariat** of SAFIR is housed within Central Electricity Regulatory Commission (CERC) office, **New Delhi, India**.

4.10. Institutional Structure of Regional Power Markets

This sub-section envisages to illustrate the key institutional aspects of the regional power markets across the globe. The broad aim of this section is to gain insights from the international experience which can be useful for the development of SAFEM:

Table 43: Institutional Structure of Regional Power Pools

Regional Institution for Power Trade	**Member Countries/ States**	**Roles and Responsibilities**	**Institutional Structure and Functioning**
South African Power Pool (SAPP)[8]	- Angola - DRC - Tanzania - Malawi - Zambia - Mozambique - Namibia - Zimbabwe - Botswana - Swaziland - Lesotho - South Africa	- Facilitate development of competitive power market - Develop guidelines for power trading and launching diverse products - Capacity building of market participants - Future infrastructure planning - Providing technical advice to member countries - Increase investment attractiveness of South African region power sector - Risk management, research and benchmarking for energy trading	• **Governance and Operating Structure** - Formed by **South African Development Community (SADC) in 1995, represented by the Heads of State and Government or their representatives,** by signing an Inter-Governmental Memorandum of Understanding. - Membership to SAPP is given across three broad categories: National Power Utility Member, Operating Member and Market Participant. - **SADC Directorate of Infrastructure and Services** (headed by **Executive Secretary**) is the highest decision-making body. - **Executive Committee:** It consists of **Chief Executives of the various power utilities**. They address major policy issues of SAPP. - **Management Committee:** It is headed by **Director of Utility** and consists of officials from member utilities and oversees the management of SAPP. - There are four **sub-committees**: Environmental sub-committee, Markets Sub-committee, Operating Sub-committee, Planning Sub-committee.

[8] http://www.sapp.co.zw/

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			- **Coordination Centre Board** (headed by **Executive Director** and consists of **officials from member utilities**) is supported by Coordination Centre and monitors operation of the power pool. - Coordination Centre is supported by Project Advisory Unit. - **Markets sub-committee** (headed by **Executive (Market) of Member Utility)** is responsible for framing policies, implementing new initiatives and ensuring compliance to the rules and regulations of energy trading in SAPP. • **Financial Arrangement** - SAPP is financed by fees from member the member utilities. • **Headquarter Location** - SAPP has its headquarters in Harare, Zimbabwe.
European Network of Transmission System Operators for Electricity (ENTSO-E)[9]	- Austria - Albania - Bosnia and Herzegovina - Belgium - Bulgaria - Switzerland - Cyprus - Czech Republic - Germany - Denmark	- Coordinating the development of an economic, secure and environmentally sustainable transmission systems - Coordination of cross border investments and meeting the European security and quality of supply requirements - Developing network codes for interoperability and coordination of system operation	• **Governance and Operating Structure** **ENTSO-E was established and given legal mandate by European Union's Third Energy Package in 2009,** a legislative package for an internal gas and electricity market in the European Union. Its purpose is to further open up the gas and electricity markets in the European Union. The package was proposed by the European Commission in September 2007, and adopted by the European Parliament and the Council of the European Union in July 2009.

[9] https://www.entsoe.eu/

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
	- Estonia - Spain - Finland - France - United Kingdom - Greece - Croatia - Hungary - Ireland - Iceland - Italy - Lithuania - Luxembourg - Latvia - Montenegro - Republic of North Macedonia - Netherlands - Norway - Poland - Portugal - Romania - Serbia - Sweden - Slovenia - Slovak Republic	- Develop market related codes to ensure non-discriminatory access to transmission system and ensure regional integration - Monitor and, where possible, enforce compliance of the implementation codes - Monitor network development - Promote R&D activities relevant for TSO industry	- ENTSO-E is governed by an **Assembly** (comprising of **CEO of member utilities**) representing the Transmission System Operators and by a Board consisting of 12 elected members. - The assembly is responsible for the adoption of annual work program, on the proposal of the board. - The assembly is responsible for establishment and dissolution of committees and regional groups - It seeks approval and guidance from European Union (EU), Council of European Energy Regulators (CEER) and Agency for the Cooperation of Energy Regulators (ACER). - **The Board** (elected by the assembly for two years consists of **Director rank officials** of member utilities) is responsible for coordination of work between various committees and groups - The Board is supported by the following **Committees** (headed by officials of the rank of **Executive Vice President** of member utilities): • Research Development & Innovation Committee • System Development Committee • Systems Operation Committee • Market Committee - The Committees can establish and dissolve functional, temporary sub-committees, called Working Groups. The composition and tasks of the working groups are defined by the committee concerned. - The Legal and Regulatory Group is responsible for providing advice on legal issues to The Assembly, The Board, The Committees and The Secretariat. It also ensures legal and regulatory compliance of the Associations activities.

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			- **The Regional Groups and The Voluntary Regional Groups**: Two or more countries can propose the creation of a regional group. The proposal is assessed by the Committee concerned on the basis of terms of reference which includes proposed members, purpose, working structure and the decision-making process of the group. - **The Secretariat** performs the following functions: •Assisting and supporting the bodies of the association •Communicating with external stakeholders •Drafting proposals for decision making •Informing the bodies, members, associated members and observer members on the association activities •Proposing to the Board the establishment and dissolution of Expert Groups and their Terms of Reference •Ensure coherence and alignment between Association strategy and the work of Committees • **Financial Arrangement** - *ENTSO is financed by fees from members* • **Headquarter Location** - *ENTSO is headquartered in Brussels, Belgium*
West African Power Pool (WAPP)[10]	- Senegal - Mali - Niger	- Monitor development of electricity sector in member countries	• **Governance and Operating Structure** In December 1999, the Heads of State and Government of member states of the Economic Community of West Africa States (ECOWAS) created the West African Power Pool (WAPP) with 14 out of 15 member states agreeing to pool together the efforts of

[10] https://www.ecowapp.org/en/

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
	- Gambia Guinea-Bissau - Sierra Leone - Liberia - Guinea - Cote d'Ivoire - Burkina Faso - Ghana - Togo - Benin - Nigeria	- Analyse technical and economic viability of cross-border electricity trading arrangement - Suggest regulatory interventions for promoting CBET - Monitor transactions for power trade - Monitor and support technical performance of the utilities - Coordinating among market participants for formulation and implementation of market policies - Market monitoring and surveillance - Administration of contracts - Dispute management - Administration of commercial databases	their various national electricity utilities. The goal is to create more robust regional power systems that will reduce capital investments expenditure, lower systems operational costs and increase electricity supply and access in the region. - The **General Assembly** (comprising of **CEO of all member utilities**) is the highest decision-making body of the WAPP and consists of representatives from all member utilities. - The **Executive Board** is composed of **Director Generals/ Managing Directors and Chief Executive Officers of the National Power Utilities**. - The Executive Board is responsible for implementing the decisions of the General Assembly. - **The Organizational Committees** provide support and expertise to the Executive Board on all matters. The five committees are: • The Engineering and Operations Committee • The Strategic Planning and Environment Committee • The Finance Committee • The Human Resource and Governance Committee • The Distribution and Commercial Committee - The **General Secretariat** is the administrative and technical body responsible for the management of activities of WAPP. - The General Secretariat is composed of three departments: • The Department of Information and Coordination Centre • The Department of Administration and Finance • The Department of Planning, Investment, Programming and Environmental Safeguards

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			- The Information and Coordination Committee is responsible to act as the System and Market Operator for the WAPP. • **Financial Arrangement** - Funded by African Development Bank and member countries • **Headquarter Location** - WAPP is headquartered in Republic of Benin.
Greater Mekong Sub Region (GMS)[11]	- Cambodia - China - Lao PDR - Myanmar - Thailand - Vietnam	- Enable trade involving more than two countries - Establish multi-buyer and multi-seller regional market - Identify the priority of interconnection projects - Suggest regulatory interventions to promote trade - Establish common regional performance standards and database - Preparation of implementation plan for harmonization of performance standards and grid code	• **Governance and Operating Structure** In 1992, six countries—Cambodia, the People's Republic of China (PRC) (Yunnan Province), the Lao People's Democratic Republic (Lao PDR), Myanmar, Thailand, and Viet Nam—established the Greater Mekong subregion Economic Cooperation Program (GMS Program) as an activity-based subregional economic cooperation program, and asked the Asian Development Bank (ADB) to be the program's secretariat - GMS **ministerial conference** (**comprising of Minister charge of GMS Cooperation**) is the highest policy making body. - Regional Power Trading Coordination Committee (RPTCC) (comprising representatives **of senior government officials from six GMS countries, Asian Development Bank (ADB), and other development partners**) implements the decisions made in ministerial conference and is responsible for promoting regional power trade. - RPTCC is supported by Focal Group and Planning Working Group.

[11] https://www.greatermekong.org/

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			- **Focal Group** (headed by an official of the rank of **Deputy Director of Utility**) is endowed with the responsibility of coordinating the implementation activities undertaken by RPTCC. - **Planning Working Group (PWG)** (led by official from **National Energy Administration**) has been entrusted with the following responsibilities: • Identification of priority interconnection projects • Regional performance standard and database • Analysis of technical performance standards and grid code • Study of regulatory issues - Working Group on Performance Standards and Grid Code (WGPSGC) and Working Group on Regulatory Issues (WGRI) aid the PWG. • **Financial Arrangement** - GMS is funded by Asian Development Bank • **Headquarter Location** - GMS has its secretariat in Manila, Philippines.
Pennsylvania-New Jersey-Maryland (PJM)[12]	- Delaware - Illinois - Indiana - Kentucky - Ohio - Tennessee - Columbia - Maryland	- Ensure reliable and secure operation of market - Review proposed changes to rules and procedures of the operating agreements and manuals - Increase market participation by providing multiple products for power trade.	• **Governance and Operating Structure** PJM began in 1927 when three utilities, realizing the benefits and efficiencies possible by interconnecting to share their generating resources, formed the world's first continuing power pool. - The apex decision making body in the PJM structure is the PJM **Board of Managers** (led by an official of the rank of **President of energy utility**).

[12] https://www.pjm.com/

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
	- Michigan - New Jersey - North Carolina - Pennsylvania - Virginia - West Virginia	- Operate ancillary market for grid balancing services. - Skill development program for all member utilities - Integrating RE - Create subcommittees, working groups and task forces to assist in carrying out the duties and responsibilities of committees - Promote participation of private players	- The Board consists of 10 members. The President of the Board is a non-voting member and the other nine members have voting rights. - PJM seeks approval from Federal Energy Regulatory Commission (FERC) on relevant matters. - **The members Committee** (MC) (headed by official of the rank of **Vice President of a Utility**) reviews and decides upon major challenges and initiatives proposed by committees and user groups. - **The Markets and Reliability Committee** (headed by official of the rank of **Senior Vice President)** is established by the Members committee ensures viability and fairness of the markets and reliable operation and panning of the PJM grid. - MRC is supported by the following committees • **Operating Committees** (headed by official of the rank of **Director)**: Advices MRC on the basis of demand, supply and operating issues for reliable and secure operation of the PJM grid. • **Planning Committee** (headed by official of the rank of **Director)**: Advices MRC on the matters pertaining to system reliability, security, economy of service and planning strategy and policies. • **Market Implementation Committee** (headed by official of the rank of **Director**): Provide advice for advancement and promotion of competitive wholesale electricity markets. - Subcommittees and Task Forces: Task forces on generation modelling, governing documents, price determination, fuel

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			security, carbon pricing and financial risk mitigation supports the MRC and other committees. • **Financial Arrangement** - PJM is financed by membership fees. • **Headquarter Location** - PJM is headquartered in Pennsylvania, United States
Australian Energy Market Operator (AEMO)	- Queensland - New South Wales - South Australia - Victoria - Tasmania	- Reliable market operations - Development of transmission plans - RE integration - Oversight of power system - Future infrastructure planning - Transmission service procurements - Collaborate with regulatory authorities for reform initiatives	• **Governance and Operating Structure** The Australian Energy Market Operator (AEMO) was created by Energy National Cabinet Reform Committee (ENCRC) in 2009 with responsibility for gas and electricity market operation roles. - **Energy National Cabinet Reform Committee (ENCRC)** and the **Energy Ministers' Meeting (EMM)** are Ministerial forums for the Commonwealth, states and territories. ENCRC and EMM are chaired by the Minister for Industry, Energy and Emissions Reduction. The Energy Ministers are responsible for energy matters for the Commonwealth, Australian state and territory jurisdictions, and New Zealand. Energy Ministers work closely with Energy Consumers Australia, and have oversight of the following energy market institutions responsible for the operation of national energy markets:: - **Australian Energy Regulator** – Regulates wholesale and retail energy markets in Australia - **Australian Energy Market Commission** – Responsible for making rules for market operation - **Australian Energy Market Operator** – Market Operator - **Energy Consumers Australia**- Consumer advocacy group - AEMO is governed by a **Board of Directors,** comprising a group of **non-Executive Directors, Executive Leadership**

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			team headed by the **Managing Director/ Chief Executive Officer** and other officers of the rank of Executive General Managers. - AEMO is supported by the following committees: • Information Exchange Committee (IEC) • Nomination Committee • People and Remuneration Committee • Risk and Audit Committee • Technical and Regulatory Committee • Financial Consultations Committee (FCC) • National Electricity Market Operations Committee (NEMOC) • Distribute Energy Integration Program (DEIP) Interoperability Steering Committee - Each committee is supported by working groups and forums having expertise and responsibility in different areas. • **Financial Arrangement** - AEMO is funded by fees from members • **Headquarter Location** - AEMO is headquartered in Melbourne, Australia.
Central America Regional Electricity Market (SIEPAC)	- Guatemala - El Salvador - Honduras - Nicaragua - Costa Rica - Panama	- Facilitate power trade between member countries - Carry out environmental impact assessment and prepare environmental management plan.	***Governance and Operating Structure*** Central American countries, namely, Guatemala, El Salvador, Honduras, Nicaragua, Costa Rica and Panama, signed the framework agreement, the Marco Treaty of the Electrical Market of Central America in 1996, setting the common electricity market *Mercado Regional de Electricidad* (MER) and launching SIEPAC

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
		- Conduct technical-economic study, geological and geotechnical study for the proposed projects. - Implement extra-regional connections	line project. The treaty was validated in 1998 and came into force in 1999. - The **Central American Electrification Council (CEAC)** comprising of public utilities of member countries and headed by highest executive authorities of the member institutions. - CEAC works as a regional planning body, has the role of coordinating the overall development of the project. - **Comision Regional de Interconexion Electrica (CRIE)** – It performs the following functions: • Approving regulations for the market and coordinating with the country level regulators • Setting tariffs for use of transmission system • Ensure compliance of market rules • Settle disputes among participants - **Ente Operador Regional (EOR**)- • Efficiently carry out market operation • Settling market transactions among participants • Suggesting market trading rules and policies to CRIE • Ensure quality and security of supply in the electricity system - **Empressa Propietaria de la Red (EPR**)- • EPR is an association of six countries. • It is responsible for developing and maintaining transmission infrastructure. - National Regulators monitor and approve firm contracts for international. **Financial Arrangement**

Regional Institution for Power Trade	Member Countries/ States	Roles and Responsibilities	Institutional Structure and Functioning
			- SIEPAC is funded by the member countries. **Headquarter Location** - SIEPAC is headquartered in Costa Rica.

4.11. Summary of Institutional Structure of Regional Power Market

	SAPP	ENTSO-E	WAPP	GMS	PJM	AEMO	SIEPAC
Legal Structure	- Inter-governmental MoU - Non-profit - Established as a Forum (for Cooperation between utilities)	- Inter-utility agreement - Aims to work on a non-profit basis to enhance co-operation between members. - Established as an Association	- Inter-governmental agreement. - Established as an Association of Public and Private Power entities.	- Inter-governmental agreement. - Sub-regional Economic Cooperation Plan •	- Inter-utility agreement - Not for profit organization - Established as an Association	- Agreement between Government and industry representatives - Non-profit organization - Established as a Company	- Inter-governmental agreement. - Non-profit organization - Established as an Association
Membership and Chairman	- Electricity enterprises from member countries - Chairmanship of the Executive Committee rotates among the member countries	- Transmission System Operators (TSOs) from member countries - President is appointed by the Assembly - Tenure of the President is two years	- Utilities from member countries can become members - Executive board is headed by the Chairperson - Chairperson is the CEO of national utility of one of the member countries	- Utilities from member countries are participants	- Utilities from the member states are members - PJM board is headed by the CEO - CEO is selected by the board	- Membership is open to government institutions and participants in the industry - AEMO board is headed by Managing Director - MD is appointed by the Board	- Comprises of Public Utilities of the member countries - CEAC meetings are chaired by the President
Governance	- Prime Minister/ President - Ministers of Foreign / External affairs - Foreign Secretaries - Joint Secretary/ Director General /Director -	- CEO of member utilities - Director of member utilities serve in the Board - Board is supported by committees which is headed by officials of the rank of Executive Vice President. -	- CEO of all member utilities - MD of the National Power Utilities serve on the executive board -	- Minister charge of GMS Cooperation - Senior government officials from six GMS countries, Asian Development Bank (ADB), and other	- President of energy utilities serve on PJM Board of Managers which is the apex decision making body - Members Committee comprises of Vice President	- Prime Minister - First Ministers - Local Government Association - Energy National Cabinet Reform Committee - Energy Ministers - AEMO is governed by a Board comprising a group of non-Executive	- CEO of Public Utilities - Comision Regional de Interconexion Electrica (CRIE) – Coordinating with country level regulators -

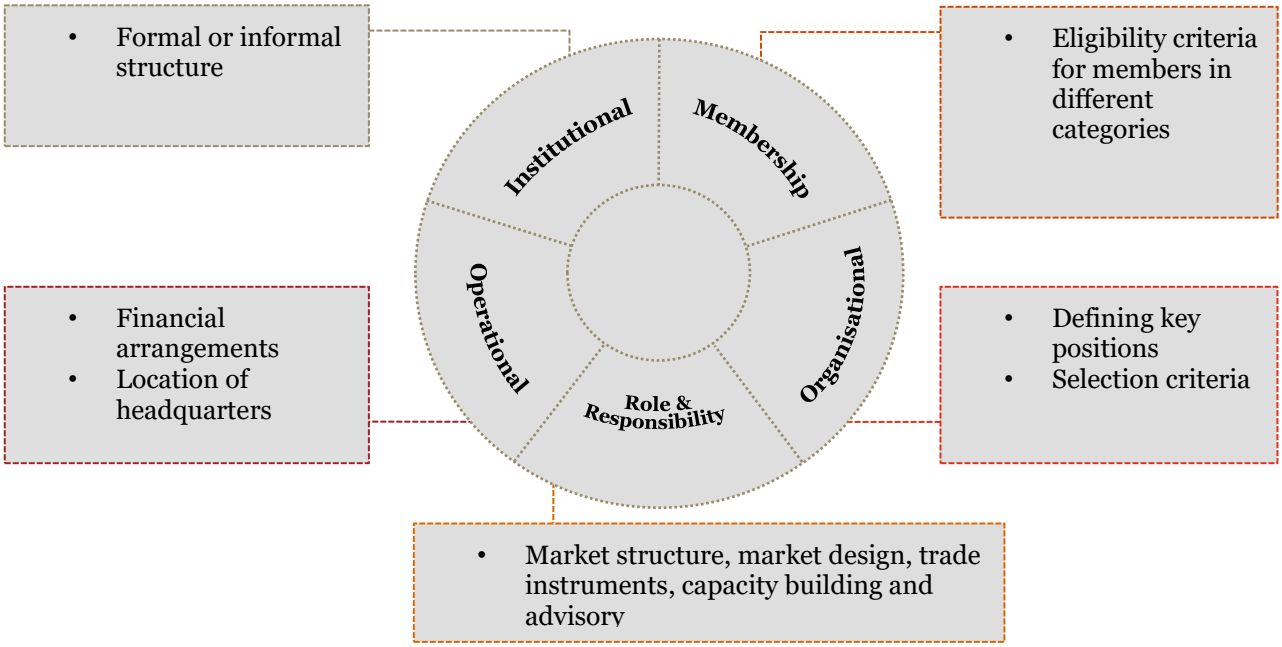
	SAPP	ENTSO-E	WAPP	GMS	PJM	AEMO	SIEPAC
				development partners serve on the Regional Power Trading Coordination Committee (RPTCC). -	of member Utility - Operating committees are headed by Director of member utility. -	Directors who are further supported by the Managing Director/ Chief Executive Officer -	
Operating Structure	- Technical Committees - Working Groups (WG) - Action Committees	- Research Development & Innovation Committee - System Development Committee - Systems Operation Committee - Market Committee - Legal and Regulatory Group - Regional Groups Groups	- Engineering and Operations Committee - Strategic Planning and Environment Committee - Finance Committee - Human Resource and Governance Committee - The Distribution and Commercial	- Regional Power Trading Coordination Committee (RPTCC) - Focal Group and Planning Working Group. - Planning Working Group (PWG)	- The Markets and Reliability Committee - Operating Committees - Planning Committee - Market Implementation Committee - Subcommittees and Task Forces	- Information Exchange Committee (IEC) - Nomination Committee - People and Remuneration Committee - Risk and Audit Committee - Technical and Regulatory Committee - Financial Consultations Committee (FCC) - National Electricity Market Operations Committee (NEMOC) - Distribute Energy Integration Program (DEIP)	- Ente Operador Regional (EOR)- Market Operator - Empressa Propietaria de la Red (EPR)- Maintaining Transmission Infrastructure -

	SAPP	ENTSO-E	WAPP	GMS	PJM	AEMO	SIEPAC
						Interoperability Steering Committee	
Financial Arrangement (Details of membership fees added in Section 2.5)	- Fees from the member utilities, equal contribution by each member	• Fees from members, contribution by each country is in the ratio of voting rights of the country	- Funded by African Development Bank and member countries	• Funded by Asian Development Bank	• Financed by membership fees, fees for different categories is added in section 2.5	• Funded by fees from members, fees for different categories is added in section 2.5	- Funded by the member countries, Inter-American Development Bank (IADB) and Central American Bank for Economic Integration (BCIE)
Headquarter Location	- Harare, Zimbabwe.	- Brussels, Belgium	- Republic of Benin	- Manila, Philippines	- Pennsylvania, United States	- Melbourne, Australia	Costa Rica

4.12. Factors Identified for Successful Implementation of SAFEM

SAFEM is envisaged to function as a regional forum of market players supporting the market-based electricity trade in the South Asian region which includes bilateral, trilateral, multilateral and collective electricity trade. Key areas of work of SAFEM shall include recommendations for market structure and products, market design and rules, payment mechanism of trade, conflict resolution mechanism, promoting knowledge exchange between member countries.

Based on the envisaged functions of SAFEM and the study of regional power markets in Africa, Europe, South East Asia, America and Australia the following factors have been identified as major contributors for efficient functioning of the regional power market:



Institutional Arrangement: South Asian Forum for Electricity Market (SAFEM) may be initially established as an informal body and in the future may be formalized with approval of the Government of member countries. SAFEM shall act as an advisory forum which makes detailed suggestions to the member countries for achieving mutually agreed goals

Membership Criteria: Membership to the forum may be limited to a few entities from the power sector based on mutually agreed criteria. Officials from stakeholders participating in the electricity markets from all member countries shall be part of the forum. Officials shall be nominated by the member countries for representation on the forum. The forum may also form collaborations with research organizations, academic institutions, trader association and consumer bodies for a deeper insight to the needs of all stakeholders.

Organization Structure: SAFEM shall provide fair representation to all the member countries and the decisions taken shall be based upon consensus between members of the forum. The organization structure may consist of an apex body (Governing Body/Board of Members) followed by Executive/Management Committee. Individual sub-committees may be established to deliberate issues/challenges on focused area such as policy, market products, RE and New Energy.

Roles and Responsibility: The forum shall also be responsible for reviewing the power market policies and rules/regulations for cross border Electricity trade in each of the South Asian countries in the Region. It will also be responsible for developing an understanding of the various products which may be introduced in the market. Besides these, the forum will help in understanding issues/challenges in existing CBET and help in facilitating RE trade.

Operational Aspects: The operational aspects of SAFEM will cover the funding structure to cover the day to day operation and conduct studies depending on the requirements and the proposed location of headquarters

Funding Structure: SAFEM may be initially funded by multilateral agencies. Later, to make it self-sufficient, annual budget for the forum may be met from the annual membership fees from all the members of the forum or a predetermined contribution made by the member countries.

Location of Headquarter: Location of headquarters for the functioning of forum may be selected on the basis adequate infrastructure facilities and manpower.

5. Proposed Institutional Mechanism of South Asian Forum for Electricity Markets (SAFEM)

In the South Asian context, USAID, ADB, the World Bank, and SAARC have played a vital role in highlighting the need for regional cooperation in the energy sector and have helped in the creation of various forums for undertaking studies to identify various issues, mobilizing support from stakeholders, and providing financing for the implementation of the identified projects.

5.1. Key Objectives

The SAFEM (South Asia Forum for electricity Markets) is proposed to be formed with the objective of taking regional trade a step forward by acting as a neutral body, facilitating regional electricity market development and creation. Key objectives of SAFEM shall include:

- Help member countries in adoption & implementation of market rules/regulations for CBET
- Suggest market structure & products such as day ahead market in the power exchange, short term contracts, medium term contracts, long term contracts, financial derivatives, ancillary services market, etc. for electricity trade.
- Suggest market opportunity for private sector participants in regional electricity market in South Asia.
- Facilitate in addressing Issues/challenges for regional electricity market development in the region
- Facilitating renewable electricity trade in South Asian regional market.
- Facilitate capacity building, sharing of experiences and best practices among member countries

5.2. Roles and Responsibilities

One of the major tasks of SAFEM will be to act as a neutral body and facilitate creation of electricity market in the South Asian Region. To perform this, SAFEM may review existing cross border electricity trade between the member countries, future demand supply scenario and, based on this analysis and consultations with the member countries, may suggest creation of products to meet the future needs. It will also leverage on the previous technical and non-technical studies done by the multiple organizations in South Asian Region.

Key focus areas with roles and responsibilities

Table 44: Roles and Responsibilities

Sl. no	Key issues to be considered for creation of electricity market	Roles and Responsibilities
1	Cross Border Regulations	Review the Power Market policies and rules/regulations for cross border Electricity trade in each of the South Asian countries in the Region
2	Market Structure with products	iii) SAFEM shall help the member countries in developing an understanding of the various products which may be introduced in the market. It may conduct detailed study upon receiving a request from the member countries. iv) Assist member nations towards its implementation
3	Type of Trading contracts	Examine the current contracts for CBET in operation, for example bilateral, trilateral, power exchange based contracts. Carry out studies to help member countries in suggesting new type of contracts and the rules, Agreements for the same.
4	Renewable Energy	Facilitate Renewable Electricity trade in South Asian regional market
5	Gas Market	Deliberate on potential of expanding the Electricity Market to include Gas

Method of Operation of SAFEM:

One of the functions SAFEM must play is to work towards building consensus among the member nations and act as the forum for exchanging multinational viewpoints, knowledge sharing and capacity building. This may include interactions with country level national Governments, regulatory authorities etc., either by SAFEM or by the respective country representatives of SAFEM.

5.3. Mechanism of Interaction with the national level participants

SAFEM shall coordinate with the national level participants to facilitate market-based electricity trade and creation of a common market for South Asia Region. Each committee of SAFEM- executive committee, working sub-committees and the governing body will have representations from each of the South Asian Nations. They will comprise of Utilities, TSOs, Research organizations etc. from each of the countries in South Asia as members which will help in deliberating various issues relating to electricity trade in each of the countries. Regular meeting between the various stakeholders shall help in building consensus among the member countries. The outcomes from the meeting may be deliberated by the member countries for further action at the forum.

Members of SAFEM may participate in meetings of other regional forum to understand the development and complexities existing in South Asian Region in power trading. They may also collaborate with other regional forums working in the areas of mutual interest.

5.4. Organization Structure

Membership Types:

Regional forums in the international market for electricity markets have different categories of memberships for participants of the forum. The forums described here address various aspects such as system operation, market development, maintaining reliability of the grid, future infrastructure planning etc. in the respective geographies. However, one of the major functions of many of these forums is the development of energy markets and hence an analysis of the members of the forum are presented below:

Table 45:Membership Types

	Membership types	Description
PJM	Affiliate Members	• Transmission owner • Generation owner • Electric distributor • End-Use customer (large industrial consumer, consumer advocacy groups) • Other supplier
	Associate Members	An entity that is not a member of the end-use customer sector and has not been a market participant over the past six months Associate members may attend stakeholder meetings but do not have voting privileges and may not transact in PJM's markets.
AEMO	Government (60%)	Federal and State Government members
	Industry (40%)	Market participants (eg: generation, distribution), service providers, industry members
ENTSOE	Founding Members	Transmission System Operator
	Associated Members	Transmission System Operator
	Observer Members	Transmission Corporations
SAPP	Full Membership	One per country as designated by the country's government.
	Other Members	Electricity Supply Enterprise (Power Utility, Independent Power Producer, Independent Transmission Company and/or a Service Provider)

SAFEM is proposed to be a forum of market players of the South Asian Countries which would work towards different facets for creation of a regional electricity market. The recommendations made by SAFEM shall be overseen by the power sector policy makers and regulators. Based on the current structure of power market in the countries we have identified buyers (Discoms), sellers (power generators), transmission utilities, system operators research institutions, officials from technical bodies of the Government in the field of electricity markets, mid-level officials from policy making bodies and regulatory authorities shallbe a part of the forum.

Some countries in the South Asian region have multiple distribution utilities. In order to have a fair representation of all the distribution utilities, SAFEM shall allow their participation on a rotating basis. The membership types as mentioned below is based on our learnings from other regional electricity market forums, as well as based on the roles and responsibilities of SAFEM.

The membership for SAFEM may be divided into the following two categories:

Direct Member: These members can be mainly of the following types:

- Power Market players like Generators (represented by generators from central, state and private sector on rotating basis), Exchanges and Power Traders
- National Transmission Utility of each country
- Distribution Utilities (represented by one or two distribution utilities from countries with multiple distribution utilities on rotating basis)
- National System Operator

Associate Members: These may be Research organizations and Academic Institutions.

Organization Structure

We have proposed two organizational structures for SAFEM that are in consonance with the various functions of SAFEM. These structures are based on our learnings from best practices from other regional forums both in South Asia and other global markets.

Option A:

SAFEM's role will be to act as a regional advisory forum in providing inputs to policies and regulations for facilitating cross border trade of electricity. SAFEM shall act as a forum for discussions to facilitate development of regional market. Discussions shall lead to identification of the areas where cooperation would lead to long term benefits in the power sector for all the member nations. It may carry out studies and provide recommendation for introduction of new products and assist member nations towards its implementation.

The structure in Option A is formulated in line with the organizational structure of SAPP, WAPP and ENTSO.

In each of the structure of the forums, there is a governing body/General Assembly or Directorate as the main decision-making body at the apex followed by an Executive body and then Organizational Committees or Working Groups /Sub Committees.

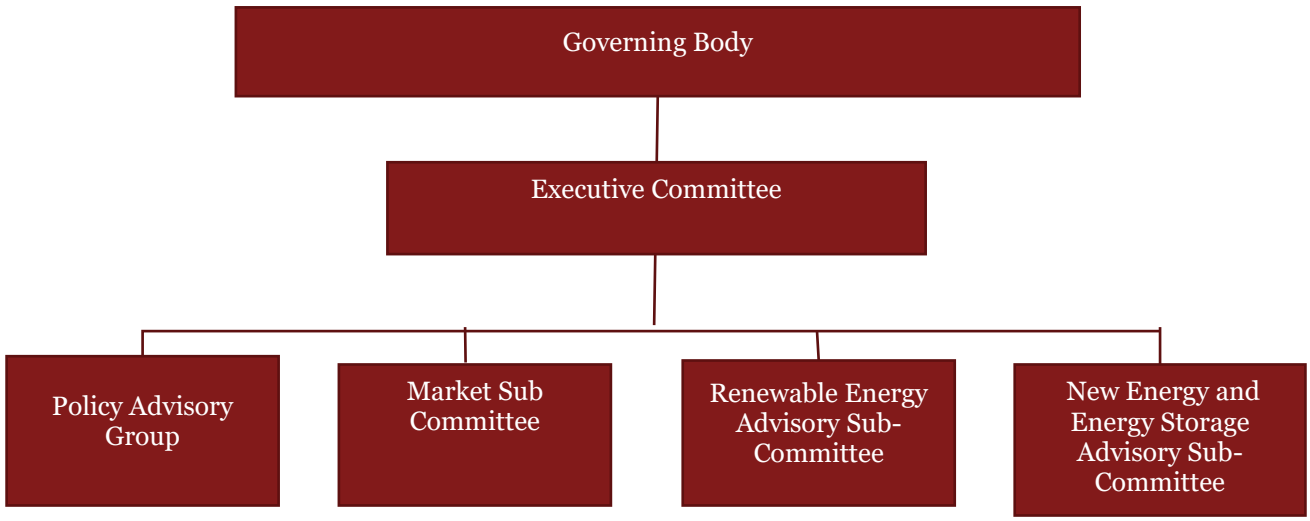
SAPP	WAPP	ENTSO

• Apex Body:Directorate, Industry and Infrastructure, SADC (SAPP, which was formed under the initiative of SADC)
• Executive Body: It consists of the chief executives of the various power utilities
• Sub Committes:
  • Operation
  • Planning
  • Market and
  • Environment
	• Apex Body: The General Assembly is the highest decision-making body of the WAPP
	• Executive Body:It consists of Director Generals/ Managing Directors/Chief Executive Officers of Power Utilities
	• Organisation Committees:
	  • Engineering and Operations
	  • Strategic Planning and Environment Committee,
	  • Finance Committee (FC)
	  • Human Resource and Governance Committee (HRGC) and
	  • Distribution and Commercial Committee (DCC)
		• Apex Body: ENTSO-E is governed by an Assembly comprising of CEO of member utilities
		• Executive Body:This is known as the Board. The is elected by the Assembly for two years and consists of Directors of the member utilities.
		• Working Groups:
		  • System Deveopment Committee
		  • System Operations Committee
		  • Market Committee
		  • Research and Development Committee

In some forums like SAPP, there is a Managing Committee to oversee the management of the forum. For other forums, such function is taken care of by the Executive Committee.

The executive committee works based on recommendation from Organizational Committees (OC), Working Groups (WG) or Sub Committees. The number of such committees for WAPP, SAPP and ENTSO are five, four and four respectively and the function of such committees are aligned with different roles and responsibilities of the respective forums.

For SAFEM, we have proposed a similar kind of structure with Governing Body as the apex body which will be responsible for coordination of work between various committees and groups. The Governing Body will comprise of one representative from each of the member nations of SAFEM preferably in the rank of Chief Executive Officer or an interested party nominated by the Chief Executive Officer.



This will be followed by an Executive Committee which will consist of officials of the power utilities in the rank of Directors from member nations. The Executive Committee will be responsible for implementing the decisions from the Governing Body. The executive committee shall consist of two members from each of the participating country. Next, there will be Sub-Committees which will be at the Working level and would be headed by Chief Engineers/Executive Directors officials from the member utilities.

Each sub-committee may consist of senior officials from power utilities, power advisory forums as well as members from research organizations and academic institutions. There will be at least one representation from each member nation for each of the sub committees. Sub-committees may also include middle level officials from policy making and regulatory bodies. Inclusion of members from regulatory and policy making bodies would ensure that the point of view of government stakeholders are also included in the discussions of SAFEM. Following Sub Committees may be positioned in SAFEM:

- Policy Advisory Group: Review issues /challenges in market rules/regulations for trade in electricity market
- Markets Sub-Committee: The Markets Sub-Committee is responsible for the design and continued development of the electricity market. It will deliberate on issues relating to new and upcoming market products such as financial derivatives, capacity markets, etc. for electricity trade
- Renewable Energy Advisory Sub-Committee: This group will enable review and assessing RE penetration in South Asia and help in addressing issues and challenges to facilitate RE trade.
- New Energy and Energy Storage Advisory sub-committee: This group will advise the members regarding upcoming energy generation sources and the energy storage technologies. This group shall also provide advisory support on analysis the potential of regional gas market in the SA region.

A use case of South African Power Pool has been extensively discussed as follows to shed light on the memberships[13]

Use Case – South African Power Pool (SAPP)

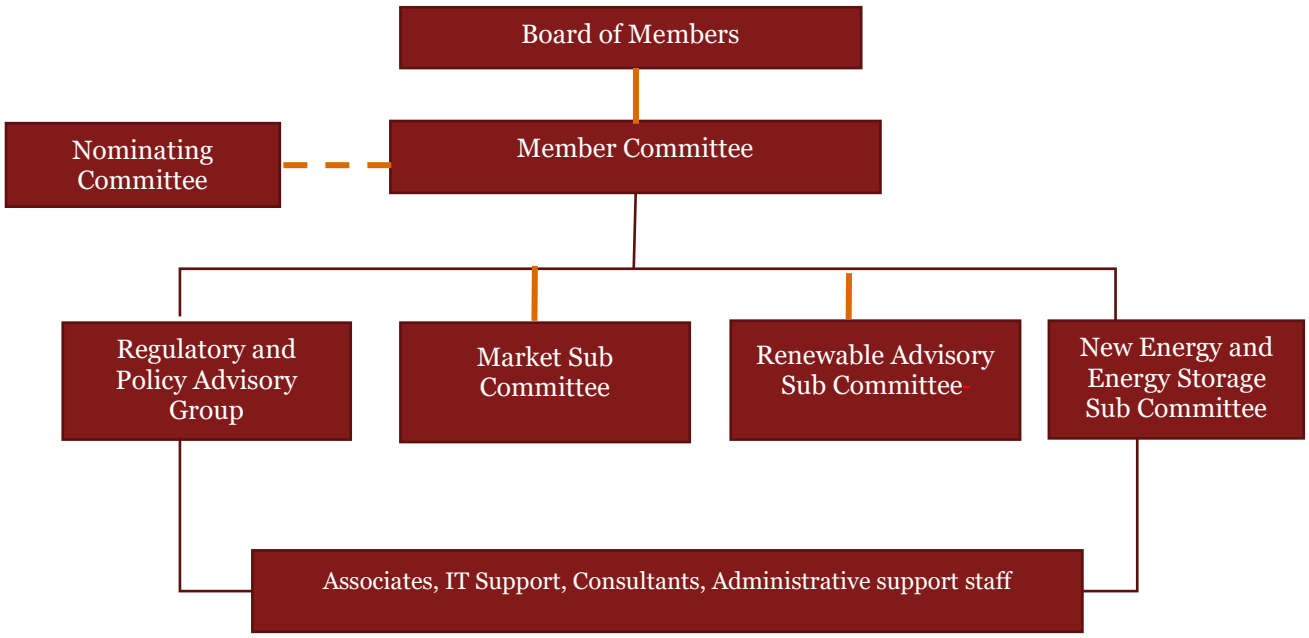
- SAPP has SADC Directorate as the apex body which has participation of the government ministers and officials from appointed by each nation to represent their nation on regional level and contribute towards policy matters.
- This is immediately followed by the executive committee which has representation from chief executives of representative power utilities and assist the SADC energy ministers in major issues related to policy matters
- This is followed by the management committee which has representation from the appointed members from the member utilities.
- There are four sub-committees which report to the management committee.
    - Operating committee – This committee has members/representatives from those utilities which already has interconnected and which exchange power on major scale e.g. South Africa, Zimbabwe, Zambia etc.
    - Planning Subcommittee consists of maximum two representatives from each participating member utilities
    - Environment Subcommittee also has appointed members from the participating member utilities
    - Markets Subcommittee also operates on the same line of the other sub-committees and has membership from each member utility

Option B: Under option B, a more mature model is proposed based on our understanding of markets in developed region in USA and Australia. Forums such as AEMO, SIEPAC and PJM are referred to while proposing this structure.

[13] https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_South%20African%20Power%20Pool-Transmission%20&%20Trading.pdf

AEMO	Central America Regional Electricity Market (SIEPAC)	PJM
•Apex Body:Board of Members.comprises of a group of non-Executive Directors and further supported by the **Managing Director/Chief Executive Officer** •Committees: 3 important committees: •Risk and Audit Committee People and Renumeration Committee and Technical and Regulatory Committee • Sub Committes: Several working groups and forums having expertise and responsibility in different areas support the Committees	•Apex Body: Central American Electrification Council (CEAC), This comprises of **public utilities of member countries** and headed by highest executive authorities of the member institutions •Committees: 4 important committees: •Steering Group:: One **energy policy representative** from each country •Programming & Evaluation Committee: Two **electricity sector representative** from each country+ IADB representatives •Advisory Group :Members: **Individual consultants** •Execution Unit: Expert Advisors from each country •Sub Committees: Several sub committees are created to support the committees	•Apex Body:Board of Managers (led by an official of the rank of President of energy utility). •Member Committte and Market Reliability Committee(MRC). (Headed by official of the rank of **Senior Vice President of energy utility)** •Committees: MRC has three committeesunder it-Planning Committee, Operating Committee and Markets Implementation Committee. These committees are headed by officials from energy utility of the rank of **Director** •Sub Committees: Sub Committees /Working Groups on generation modelling, governing documents, price determination etc are present

The organization structure will work through the interaction of the Member Committee and Sub Committee or Working Groups. The structure proposed here will have participation from utilities and their suggestions regarding conceptualization and implementation of the market related products shall be overseen by policymakers and regulators.



The proposed structure for SAFEM has Board of Members as its apex body. The Board of Members will be responsible for maintaining SAFEM's independence and ensuring that SAFEM fulfills its business requirements. The Board of Members will consist of one member from each participant country of SAFEM. The Board of

Members should comprise of members from each of these areas like generation, transmission, distribution, system operation, utility law and regulation, commercial markets and risk management.

The Member committee will initially be constituted which will consist of representatives in the rank of Managing Directors (MD)/CEOs from generation, transmission & distribution utility, system operators, power traders etc from each member nation. The members committee shall have two representatives from each member country. The decision regarding nomination of representatives to form part of member committee will be taken by the governments of the member countries

Following may be some of the functions of Member Committee:

- Reviews proposed changes to the rules and procedures in cross border electricity trade
- Facilitate introduction of new products for cross border power trade
- Assess opportunity for private sector participants in cross border power trade

The formation of the member committee will be followed by the formation of the Nominating Committee which would be comprised of representatives elected annually from the Member Committee. The Nominating committee will then further nominate prospective board members who would be consequently elected by the Member Committee by voting for a term of 3 years. The Board members may have no personal affiliation or ongoing professional relationship with, nor any financial stake in, any SAFEM member. The Board members will not consist any member from member/nominating committee or any of the sub committees.

There will be three Sub Committees to support the Member Committee. The Sub Committees will consist of representatives in the rank of Directors from generation utility, transmission utility, distribution utility, traders, System Operators and new energy markets from each member nation. Sub-committees may also include middle level officials from policy making and regulatory bodies. Inclusion of members from regulatory and policy making bodies would ensure that the point of view of government stakeholders are also included in the discussions of SAFEM.

- Regulatory and Policy Advisory Group: This Sub-Committee will review market rules/regulations for electricity trade in the member states and provide inputs and suggestions.
- Market Sub-Committee: The Markets Sub-Committee will be responsible for reviewing issues related to the continued development of the electricity market. It will deliberate on issues relating to new and upcoming market products such as financial derivatives, capacity markets, etc. for electricity trade.
- Renewable Energy Advisory Sub Committee: This subcommittee will discuss challenges and issues in renewable Energy penetration in South Asia and help in facilitating cross border RE trade among the SA countries.
- New Energy & Energy Storage Advisory Sub Committee: The Sub-Committee will also deliberate on issues related to upcoming New Energy and storage and review and assess its potential and penetration in South Asia. The Sub Committee will also deliberate on issues to promote development of an integrated Gas market in South Asia.

PJM

As mentioned earlier, the Option – 2 has been based on the international experiences from markets like AEMO and PJM. To exhibit the use case along which the Option – 2 has been designed, the structure of PJM has been discussed. In PJM there is an apex body which is called the "Board of Managers" and is being led by an official of the rank of President of energy utility. Members of the board have no affiliation with or financial stake in any PJM market participant

This is followed by the "Member Committee and Market Reliability Committee (MRC), which is headed by official of the rank of Senior Vice President of energy utility. The structure of PJM also has a special body viz. the "Nominating Committee (NC)" which is responsible for nomination of candidates to serve on the PJM Board of Managers and reports to the Members Committee.

All the committees and sub-committees will be supported by Associates, IT Support, Consultants, Administrative support staff.

A comparison of the two structures discussed above has been provided below:

Table 46:Salient Features of Organization Structure Options

Sl. no	Option A	Option B
Apex Body	Governing Body is formed by representatives from each member nations nominated from each country. Such a structure doesn't need additional committee like Nominating Committee.	The Apex Body that is Board of Members is selected by voting. Board of Members is an independent body without any affiliation to any SAFEM member and are appointed on the basis of recommendations made by the nominations committee and elected by the Member committee
Executive/Member Committee	Executive Committee will consist of officials of the power utilities in the rank of Directors from member nations, and it will be responsible for implementing the decisions from the Governing Body.	Member Committee will consist of representatives from each participant nation in the rank of Managing Directors (MD)/CEOs from generation utility, transmission utility, distribution utility, system operators, traders s from each member nation with two representatives from each member country.
Nominating Committee	A leaner structure, devoid of any nominating committee	A more complex structure wherein the Nominating Committee is comprised of representatives elected annually from the Member Committee which will be responsible for nominating the board members

5.5. Operating Structure

Financing for Administrative Costs

Regional forums use membership fees to cover the administrative costs of the host entity. The host entity will receive the fee and other funds on behalf of the regional forum and keep them in separate accounts subject to the budget allocations to various committees. The contribution to the forum by member countries shall be agreed upon by the member countries during the formulation of article of association for SAFEM.

Membership Fee (on Annual Payment Basis)

Membership to the forum may be provided across the following five categories:

- Power Market players like Generators, Exchanges/Power Pools, Transmission Utilities and distribution utilities
- Power Traders
- Any power advisory committees from any of the South Asian Countries
- Research organizations and Academic Institutions

Comparison of membership fee of other similar Forums

The annual Membership Fees of some of the forums in South Asia and across the global are given in the exhibit below:

Table 47: Membership Fees for Forums

Forum	Fees
SAARC	Institutional Members: US $ 10,000.00 Corporate Members: (a) US $ 10,000 Per Annum for Developed Countries (b) US $ 5,000 Per Annum for Non-Developed Countries Parton Member: US $ 8,000 For Five Years Only Life Members: (a) US $ 5,000 For Males (b) US $ 3,000 For Females
SASEC	Funded by Asian Development Bank (ADB)
BIMSTEC	Voluntarily funded by member countries
BBIN	Funded by Asian Development Bank (ADB)
SAFIR	Consumer bodies/NGOs – USD 500 Academic /Research institution – USD 2,000 Regulatory Bodies – USD 4,000 Corporates/Utilities – USD 5,000
SAPP	The SAPP Membership Application fees amounts to Two Thousand Five Hundred Dollars (USD 2,500)
ENTSOE	Associated Member Fee: 100 Euros per year Observer Members Fee: 10-70 Euros per year
WAPP	Funded by African Development Bank and Economic Community of West African States (ECOWAS)
GMS	Funded by Asian Development Bank (ADB)
PJM	Application fee: USD 2,000 for market participants Risk policy review fee: USD 1,500 for market participants Annual membership fee: USD 5,000 for voting members

AEMO	• Electricity Market:
	  • NEM fee: AUD 0.54/MWh
	  • Victorian Electricity Transmission Network Service Provider (TNSP) : AUD 591 mn
	  • Western Australia Wholesale Electricity Market (WEM): AUD 0.861/MWh
	• Gas Market
	  • Initial Registration Fee – member: AUD 13,163
	  • Initial Registration Fee – associate member: AUD 2,632
	  • Annual fee – members: AUD 20,649 per annum
	  • Annual fee – associate members: AUD 4,027 per annum

SIEPAC	Funding from Governments of member countries, Inter-American Development Bank (IADB) and Central American Bank for Economic Integration (BCIE)
ISO-New England	• Generation, Transmission and Supplier: USD 5,000 • Publicly owned entities with annual energy sales of less than 30,000 MWh in the preceding year: USD 500 • Alternative resources—5 MW or more: USD 5,000 • Fuels Industry Participant: USD 5,000

Source: website of respective forums

Funding requirements may also be met by:

i. **Governmental funding with pre-determined sharing ratios:** Example of such funding can be seen in SAARC Annual budget of secretariat. For many regional institutions, minimum 40% of cost is funded by host country and balance shared by member states through agreed formula. Since funding depends on member states, there are cases where delays happen. There may be also disagreements on funding proportion.
ii. **Funding by multilateral agencies:** Examples of such kind of funding include funding from multilateral agencies like USAID, ADB, World Bank etc.

A summary of the funding mechanism of multiple international markets is provided below.

- ENTSO-E being a non-for-profit organization (under Belgian law) was established in Brussels without capital contributions. The member entities contribute annually to the budget of the association by the payment of the "Member Subscription Fee" determined by their voting – with 30% of the budget financed by the members in proportion to the "First Part" of the voting power and 70% in proportion to the "Second Part" of the voting power. The details of the voting powers are elucidated as follows:
    - ✓ First Part of Voting Power – This concept is based on the "one country one vote' principle wherein each nation shall have an equal voting right.
    - ✓ Second Part of Voting Power – This concept is deriving the voting rights basis the population of the country
- The voting rights have been mutually decided and agreed upon by the member nations. The budget of ENTSO-E is entirely covered by the membership fee from the members and in 2019, ENTSO-E had 103 employees and the budget of ENTSO-E amounted to EUR 30.1 Mn funded by TSO member fee of EUR 28.7 Mn and other revenues for EUR 1.5 Mn[14]. Additionally, the Secretary-General shall monitor costs against budget and inform the Board about the financial situation of the Association. In case of an unforeseen deficit, the Assembly may decide on advance payments to be made by the Members, in proportion to their annual contribution to the budget.

- SAPP has also been operating on the basis of operational budget drawn from the annual subscription by the members. The SAPP capital budget is shared equally amongst all members, whilst projects are normally funded by cooperating partner. Funds income received is based on a set budget agreed upon by all members of the organization. Contributions made by members are based on set percentages and proportions based on "Usage Principle" based on the electricity usage by each of the member nation. The income is brought to account per issued invoice to each of the member countries. In 2018, SAPP had a revenue of USD 8.9 Mn with USD 1.045 Mn coming from membership contribution, USD 4.25 Mn from administration fee (from marketing platform), USD 3.5 Mn through Grants from World bank, ZIZABONA, Norad etc. and USD 12, 045 from other income sources[15]. Further to this SAPP raises grants and funds (on ad-hoc basis) from World Bank, Swedish International Development Agency, DFID etc.to fund the studies on regional cooperation, tariff studies etc.[16].

Drawing from the international cases, SAFEM can be established by funding from the multilateral agencies active in the SA region for the regional cooperation and CBET activities. However, the idea shall be making SAFEM self-sustaining where - in line with the international peers like SAPP, ENTSO-E etc. Additionally, grants and funding can be raised by SAFEM from multilateral agencies in the SA region to fund the studies and projects and further the objectives of regional cooperation.

Location of Headquarters

Headquarter is generally selected in the capital city of any of the member state. This must be mutually agreed or voted. Following are some of the ways to reach consensus by member states regarding location of headquarter.

Selection based on Competitive Bidding: In such a process, weightage is given on various parameters like office space, contribution to the budget, staff availability etc. However, such a process generally consumes a lot of time.

Mutually Discussed: In this process voting is process may be adopted to reach consensus.

Others: If the proposed forum is part of any existing forum in South Asia like SAARC, SASEC, BIMSTEC, BBIN or SAFIR, then the headquarter location may be situated in the existing headquarter location of the forum.

The advantages and disadvantages of each method of selecting a headquarter is described below:

[14] https://annualreport2019.entsoe.eu/wp-content/uploads/2020/07/entso-e_AR2019.pdf
[15] http://www.sapp.co.zw/sites/default/files/30955_Sapp%20Annual%20Report%202018.pdf
[16] https://www.esmap.org/sites/esmap.org/files/BN004-10_REISP-CD_South%20African%20Power%20Pool-Transmission%20&%20Trading.pdf

Table 48: Selection of Headquarter

Particulars	Advantages	Disadvantages
Selection based on Bidding	Transparent and fair process	Time consuming
Mutually Discussed	Everyone's views considered	Less time taking
Others (part of existing forum)	Saves time	May not have member consensus

Location of Headquarter for BIMSTEC

Though Sri Lanka (Colombo) was the initial choice for headquarter of BIMSTEC, however during voting, a few countries including India voted against it citing security concerns.

Finally, Dhaka in Bangladesh was selected as the location of Headquarter for BIMSTEC

The subsequent paragraphs list down the process followed for selection of headquarters of select international regional power market forums

- The electricity subcommittee under SADC met at the SADC energy ministers meeting held in Harare in 1990. The subcommittee continued its function of advising the energy officials and ministers on the issues of regional cooperation from Harare and subsequently when SAPP was formed, Harare continued acting as headquarter for the power pool.
- Operationalization of headquarters for a regional forum brings economic development to the headquarter location. Promoting economic development of Brussels was one of the reasons for selecting it to act as a headquarters of ENTSO. Brussels also acted as headquarters of European Union and selecting it as a headquarter of ENTSO was expected to facilitate frequent interactions with other bodies working in Europe to facilitate power trade.
- On the 5th of July 2006, ECOWAS countries reached a consensus on conferring diplomatic immunities to Republic of Benin, required to effectively operate WAPP headquarters within the entire ECOWAS Member States. After conferring diplomatic immunity, ECOWAS signed on behalf of WAPP a Headquarters Agreement with the Government of Benin. The headquarters of WAPP Secretariat is presently located at Cotonou in Republic of Benin.
- Cross Border Electricity Trade (CBET) in the GMS region started as a part of Greater Mekong Subregion Economic Cooperation Program established with the support of Asian Development Bank. ADB office in Manila was acting as a headquarters for the economic cooperation program and it was decided to continue energy cooperation program for GMS region from the same office.
- PJM evolved from the Pennsylvania – New Jersey interconnection formed in the year 1927. After its formation it operated from the office of a utility in Pennsylvania. PJM Interconnection Association was formed in 1993 and it continued to maintain Pennsylvania as its headquarters.

Selection of headquarters for SAFEM shall be done by a discussion between the member countries on the basis of cordial relationship with the country hosting the headquarters, opportunity for development of city hosting the headquarters, ease of coordination with other entities working to facilitate regional power trade, early operationalization with adequate manpower and infrastructure facilities. After reaching a consensus on the country for hosting the headquarter, member countries shall also commit resources for ensuring smooth functioning of the headquarters. Post this a permanent headquarters can be developed on the selected location, with a rotating chair to ensure equitable participation by all the member nations (in line with the methodology of SAPP with rotating chair and permanent headquarters in Harare, Zimbabwe)

5.6. Resources of Common Interest

Undertaking infrastructure projects to improve interconnection between countries will help in increasing energy trade between the countries. Having adequate power transmission capability will also facilitate introduction of multiple energy trading products in the markets. Categorizing an infrastructure project as resource for common interest shall lead to advantages in the following areas:

- Accelerated planning and permit granting
- A single national authority or Coordination between national authorities for obtaining permits
- Increased consultations
- Increased visibility to investors

South Asia Forum for Electricity Market (SAFEM) can act an advisor to the member countries for creation of infrastructure which benefits more than one country. SAFEM may be given the responsibility to carry out the feasibility study for the proposed projects and prioritization of the listed projects. The feasibility analysis shall include improvement in power trade, economic benefits, environmental impact and risks involved. The cost for building shared infrastructure projects may be equitably divided between the countries on the basis of benefits derived.

5.7. Institutional Arrangement

The institutional mechanism for any regional forum is crucial because it should enable commitment from each member nation and this forum should be such as it is possible to easily reach consensus.

The following are the two proposed institutional arrangements for SAFEM.

a) Regional Market Advisor which makes detailed suggestion to the member countries for achieving mutually agreed goals

b) Regional Market Authority which ensures adhesion to the agreed policy measures by all the member countries. Both the suggested structures can be compared based on following parameters:

SAFEM is currently envisaged to be working in advisory capacity. However, with gradual evolution and maturity of market in South Asian region, SAFEM's role as a regional market authority may be explored.

Parameter	Regional Market Advisor	Regional Market Authority
Participation of Members	Voluntary	Mandatory
Market Policies & Products **Market Products**	Review and advise on issues related to market policies Advise on new products or other issues and challenges for creation of electricity market	Ensure adhesion to the agreed policy measures
Uniformity in market related practices	Might lead to non-uniform practice in member countries	Uniform market practices in all member nations

The two options for the institutional set up of the forum as shown in the exhibit below:

Option 1 (Regional Market Advisor): The forum can act as an association of member nations. Following will be the functions of the body.

- May initially start as an association of member nations and later expand its role as the market becomes mature
- Provide advisory service to the member countries in addressing challenges and issues in creation of electricity market.
- Offer advice on matters relating to policies, market products, RE trade etc
- Act as a knowledge sharing platform in matters of electricity/gas trade among member nations

Option 2 (Regional Market Authority): The forum can just act as a Regional Market Authority which is empowered to ensure implementation and adoption of regional market related policies. In such an institutional structure, the authority may have the following functions:

- Act as apex authority for implementation/adoption of market related policies among member nations for creation of electricity market
- Facilitate implementation and adoption of new market products, Renewable Energy or gas trade in electricity market

Degree of Independence of SAFEM

SAFEM can either be established as a completely new entity for creation of electricity market in South Asia or it can be established under one of the existing institutions in the region which is working to facilitate energy cooperation among the member countries and will act as an overarching body for SAFEM.

Option 1-Independent Body: An independent body will be more agile and focused towards its objective of creating an electricity market. Being completely independent will also enable framing of independent policies without an obligation to adhere to the policies of an overarching body. As an independent body, it can implement solutions to resolve issues/challenges for regional electricity market development in the region. Such a body will also be agile in introducing renewable energy trade and promoting development of new power market products in the proposed electricity market.

However, the formation of a completely new entity is challenging and may take more time than instituting a similar body under an existing overarching body.

Option 2 – Placing SAFEM under an existing overarching body: Formation of SAFEM under an existing overarching body is expected to lead to the following benefits:

- Complement and coordinate the work for facilitating cross border trade among member nations
- Since structure will be in place, implementation SAFEM will need lesser time

Selection of an overarching body for SAFEM might be done based on the following parameters:

Table 49: Selection of an Overarching Body

Regional Organization in SA	Member countries as participants	Recent involvement in power sector reforms or development	Gas Trading
BIMSTEC	- Bangladesh - Bhutan - India - Nepal - Sri Lanka - Myanmar - Thailand	• The grid interconnection MoU was signed in 2018 by member-states of BIMSTEC. • A trilateral cooperation between India-Myanmar-Thailand was underway for setting up a power grid which is 3,000 km long	No
SAARC	- Bangladesh, - Bhutan - India - Maldives - Nepal - Pakistan - Sri Lanka	SAARC Energy Center established in was to act as an institution fostering initiation, coordination and facilitation in terms of energy for member nations.	No

	- Afghanistan		
SASEC	- Bangladesh - Bhutan - India - Maldives - Myanmar - Nepal - Sri Lanka	Under the SASEC initiative, SASEC Power Trade Working Group (SPT-WG) has been formed with an objective to promote cross border power trade and development of regional cross-border infrastructure	No
BBIN	- Bangladesh, - Bhutan, - India - Nepal	Efforts to improve physical connectivity and encourage improved energy cooperation have been repeatedly stalled in SAARC summits	No
SAFIR	- Bangladesh, - Bhutan - India - Nepal - Pakistan - Sri Lanka	Studies on regulatory pathway for electricity/ energy exchange and energy cooperation in South Asia, Grid discipline and Grid reliability in the region,	No

Among the forums in the table, no existing organizations have all the member countries as participants. SAARC is an exception, but it has a rigorous framework in place already and has a mature institutional structure in place. In such case, it might not be feasible to accommodate the SAFEM aims and objectives to its already existing framework. Some of the pros and cons of the different options discussed above are tabulated below:

Table 50:Comparison of Institutional Structure

Particulars	Pros	Cons
Option 1 – Independent Body	Freedom to define its own aims and objective to achieve goals without an obligation to accommodate existing policies of an overarching body. More focused approach to achieve goals related to promoting regional power market formation.	May take a large time to setup a completely new entity
Option 2 – Placing under an existing overarching body	Having well established framework in place in terms of institutional structure, funding, organization structure will save time. Alignment with policies of an existing body will require fewer brainstorming sessions for new body.	This structure is less agile which can slow down the decision making process Might be difficult to take decisions which fall outside the purview of current working of overarching body

6. Key Takeaways from Stakeholder Consultations

6.1. Key takeaways and learnings from Stakeholders

This section briefly covers key points of exhaustive stakeholder consultation with representatives from Bangladesh, Bhutan, India, Nepal, and Sri Lanka. The stakeholders welcomed the initiative of South Asia Forum for Electricity Market (SAFEM) and agreed that SAFEM will promote regional trade and facilitate regional electricity market development and creation.

6.1.1. Acknowledged Benefits of SAFEM by Stakeholders

Stakeholders have acknowledged some of key objectives and benefits that SAFEM would propose in the regional energy landscape, would be advantageous for member countries. Some of such key acknowledged benefits, as stated by the stakeholders have been listed as below:

Optimization of Tariff	•The South Asian countries can leverage the benefit of lower cost of generation in neighbouring countries to meet the burgeoning demand and ensure supply of electricity to the consumers at affordable tariffs.
Facilitating Seasonal Energy Requirements	•SAFEM would help in managing system demand in Nepal by compensating resources and seasonal complementary by facilitating regional electricity market development. •Further Bangladesh can procure peak power to flatten the load curve and reduce overall cost of generation .
Enhanced Investors Confidence	•SAFEM will be beneficial for member countries to trade energy at cost effective rates by exploration of new interconnection to the regional grid. This will also boost investor confidence to develop regional generation projects
Supporting RE transition	•SAFEM has the potential to play a key role in promoting RE power trade and successful RE integration among member countries
Deepening of Regional Trade	•SAFEM would help meet future demand of member countries by a regional power market to trade surplus energy including evolution of new forms of market trade such as triletaeral, multilateral, energy banking, etc.
Knowledge Sharing	• SAFEM would provide knowledge sharing platform, in which member countries could work together towards developing market products that would better utilize their energy resources and needs.

6.1.2. Synopsis of the Stakeholder Views and Suggestions

The in-depth stakeholder consultation and engagement conducted through semi-structured discussions, virtual meetings, presentations, online survey etc. has facilitated the views and opinions of the stakeholders about the establishment of SAFEM in the SA region and operationalization for cumulative benefit of the SA nations and the region as a whole. Such views and suggestions have been captured as below:

Topic of Discussion	Views and Suggestions
1. Roles and Responsibilities	As per Stakeholders' point of view some additional roles and responsibilities should be fulfilled though SAFEM, as listed below. • SAFEM may be initially started by signing a Memorandum of Understanding (MOU) among member nations • Need for the Capacity programs to increase knowledge about market products as most of member countries are currently in developing stage of power market. • Need more clear rules related to renewable trade and energy banking. • Requirement of discussion on tariff of generation
2. Organization structure	3. Majority of stakeholders agreed with **Option 1** (where a governing body shall be formed by representatives, nominated from each of the member nations) as an organization structure for SAFEM. They also highlighted the importance of inclusion of regulators and policy makers (mid-level experience) to gain more acceptability for implementation of SAFEM. 4. The stakeholders suggested that presence and support from government stakeholders would be required to operationalize the forum.
5. Financing and Administrative Costs	• Majority of stakeholders agreed that initial financial support from multilateral agencies is critical. However, in the long run, it will have to be self-sustaining by funding through member contributions. Membership contribution can be distributed majorly based on energy trading volume (30%-equal contribution from members and 70% based on the energy trading volume). It was also suggested that membership fees should not be onerous to small member countries like Bhutan.
6. Headquarters	• As per stakeholders Location of headquarters for SAFEM can be identified by mutual discussions between member countries and further it should be accessible to everybody and must have all services to fulfill purpose of SAFEM
7. Institutional Arrangement	• Majority of stakeholders agreed on the role of SAFEM as an advisory body for initial stage of development in which SAFEM will make detailed suggestions to the member countries for achieving mutually agreed goals. • It was also mentioned by a few stakeholders that participation of members should be on a voluntarily basis.
8. Degree of Independence	i. According to some stakeholders, it would be worthwhile to explore placing SAFEM under an existing body like SAARC or BIMSTEC, etc., to avoid multiplicity of forums in the region. i. However, some other stakeholders suggested that the process to bring about SAFEM should not become slow, because of the slow process in these bodies.

7. Suggestions for Formation of SAFEM

Based on the understanding developed from the case study of regional power markets in different parts of the world, stakeholder consultations and detailed internal deliberations, the following suggestions are made for the formation of SAFEM:

i. Organization Structure :

Based on the views of majority of the stakeholders received during the consultations, it would be apt for SAFEM to have an organization structure as formulated under Option-1 (as earlier described in Section 4 of the report). In this structure, a governing body shall be formed by representatives, nominated from each of the member nations.

ii. Membership :

Besides this, the patronage by the government would be beneficial for the accelerated development and operationalization process of SAFEM, and to expedite the approval process for SAFEM. Finally, inclusion of the regulatory and policy makers from (mid-level experience) in the subcommittees would not only aid in smooth functioning of SAFEM but also ensure quicker decision making due to confidence among the governments and regulators.

iii. Financing for Administrative Costs:

In line with the suggestions of majority of stakeholders, SAFEM can be initiated by the initial funding by the multilaterals (which is in-line with the agencies like SASEC, BBIN, GMS etc.) for the administrative costs. However, in the long run, SAFEM shall become self-sustaining, for which a membership fee-based model can be followed, where the annual membership fee can be mutually decided by the member nations.

The overall membership fee can be decided with a specific proportion of contribution to be made equally by all participating nations and the rest to be made on energy consumption/energy trade etc (e.g., 30% as an equal contribution by the member nations and remaining 70% based on energy trading volume). Hence, an annual membership fee/contribution from the members could be collected to run the operations of the SAFEM later.

Additionally, grants and funding can be raised by SAFEM (on ad-hoc basis) from multilateral agencies in the SA region to fund the studies and projects and further the objectives of regional cooperation.

iv. Selection of Headquarters:

The electricity subcommittee formed to support the ministers of SADC countries started working from Harare, Zimbabwe. When South African Power Pool (SAPP) was formed, it was headquartered in Harare to avoid any disruption in the functioning of the group.

During the stakeholder discussion it was observed that the headquarters shall be selected with mutual consensus among all the members and shall provide all the facilities for proper functioning of the forum. It was also suggested that since India already has a functional power market it could take the lead in training and capacity building activities for member countries of SAFEM. Based on the above mentioned factors it is suggested that SAFEM may be headquartered in India.

v. Institutional Arrangement:

During the stakeholder discussions, majority of the stakeholders agreed on the role of SAFEM as an advisory body for initial stage of development, in which SAFEM will make detailed suggestions to the member countries for achieving mutually agreed goals. SAFEM would facilitate sharing of experiences and best practices in aspects such as innovative market products, multilateral/ trilateral trade, RE trade and other market aspects with respect to cross-border electricity trade. It was also suggested that participation in SAFEM shall be kept voluntary for all the members.

After a few years, when the functioning of the forum has stabilized and it has proved to be an entity of importance, members of the forum may consider elevating the status of SAFEM to a formal regional agency in the matters of market development for CBET.

vi. Degree of Independence:

During the stakeholder discussion, it was observed by one of the stakeholders that there are already entities working on the various aspects of cross-border electricity trade in the region and multiplicity of forums could be avoided considering the resource constraint in the region. Therefore, they could come under one of the forums like SAARC, SASEC or BIMSTEC. However, it was acknowledged that it would then become less supple and time taking to arrive at decisions.

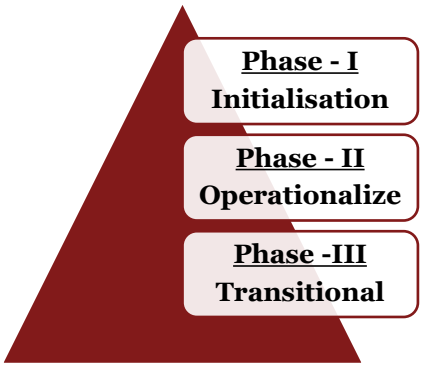
In line with the opinion of majority of the stakeholders it is suggested that SAFEM shall start its functioning as an independent body and not under an existing overarching body such as SAARC, BIMSTEC etc. The objective of the forum shall be to help arrive at a consensus between the countries and make suggestions to the respective country governments on market related aspects of cross-border electricity trade.

Looking at the growing volume of electricity trade through CBET and the absence of a regional body on market aspects, it is suggested that SAFEM shall start functioning as an independent body with its sole focus on providing advisory services on market related aspects.

8. Proposed Roadmap for SAFEM

8.1. Roadmap for the Formulation of the Proposed South Asian Forum for Electricity Market

The proposed roadmap for the formulation, development, and operations of SAFEM has been disaggregated into three phases based on the time requirement and the level of maturity of the forum in the respective stage. The three phases governing the development of the forum of electricity markets are exhibited in the graphic (provided alongside). Key activities and envisaged timelines influencing the timelines are elaborated in the tabular representation as below:



	Order of Activity	Activities Details	Envisaged Timelines (months)
Initialization Phase	Activity 1: Formation as an Informal Body	• SAFEM could initially start functioning as an informal body comprising of utilities from the member countries	T
	Activity 2: Drafting and Signing of MoU	• In principle, drafting and signing of the the Memorandum of Understanding (MoU) by the member nations	T + 12
	Activity 3: AoA and Charter	• Development of the Charter and Article of Association (AoA) inclusive of aspects like Roles, Responsibilities, Headquarters, Funding etc.	T + 15
	Activity 4: Finalisation of the AoA	• Discussions by the member nation towards finalisation of the Charter and AoA • Finalisation and signinig of the AoA	T + 22
	Activity 5: Constitution of Board and Committes	• Consitution of the Member Committee and Board • Selection of the board members	T + 24
Operationalize Phase	Activity 6: Operationalisation and Appointment of Staff	• Operationalisation of the forum and appointment of the staff with requisite experience and qualification • Developments related to functioning of the forum	T + 27
	Activity 7: Commencement of Operations	• Arrangement of Capacity Building, Programs and Knowledge Sharing Workshops • Contribution towards regional level studies • Sensitizing the nations about market products	T + 30
Transition Phase	Activity 8: Enabling activities towards creating Regional Market Authority *	• Development of the roadmap, framework agreements/by laws and directives for transitioning towards Regional Market Authority	T + (84 to 132)

**This step is contingent upon the level of maturity and progress of power trade in the SA region and would be decided by mutual dialogue between the participant nations*

8.1.1. Formation of Informal Body

SAFEM could initially start functioning as an informal body comprising of utilities from the member nations. The informal body could function with following responsibilities:

1. Advisory Services to Member Countries: SAFEM could carry out study on the current status of CBET between the member countries and suggest a roadmap for boosting CBET in coming years. It could also suggest the market products to be introduced in the coming years to facilitate meeting requirements of the member countries.
2. Experience Sharing: The members of the forum could share their needs, expectations, and experiences with other members of the forum, policy making bodies and regulatory bodies. Sharing of experiences by the member utilities shall help in building a robust CBET ecosystem in the region with positive contribution from all the involved stakeholders.
3. Capacity Building: SAFEM could start with start with the preparation of a skill development plan on the basis of the current status of knowledge level of the participants regarding the regional market for power trade. Based on the skill development plan SAFEM could organize training programs for the participants from the member utilities to enhance the skill of personnel and make them ready for greater responsibilities related to CBET in the future.

After having functioned as an informal body for a certain time period, the forum can moot a proposal to the member countries for the creation of a formal body to facilitate CBET in the South Asian Region.

8.1.2. Memorandum of Understanding (MoU)

A formal Memorandum of Understanding (MoU) between member countries would be signed, which highlights mutual concordance between member countries for the development of regional forum for electricity market. The MoU shall mention the desire of member countries to co-operate and undertake mutually beneficial activities wherever possible. The MoU shall also establish the basic principles under which SAFEM shall operate along with the objectives of the organization. This MoU would include:

1. Basic principles and objectives of SAFEM
2. Institutional arrangements, Membership and other administrative measures for SAFEM
3. Others like entry into force and validity of MoU
4. Common ideas which form the basis of SAFEM and could be mentioned under Mission and Vision for the organization

South African Power Pool (SAPP)

Recognizing the benefits of a regional power pool that would reduce investment and operating costs of electricity generation while maximizing reliability, South African Development Community (SADC) passed the South African Power Pool (SAPP) Inter-Utility Memorandum of Understanding on 7th December 1994. The Memorandum of Understanding established an official cooperation among SADC member states for promoting regional power trade.

8.1.3. Development of Articles of Association (AoA) on organization and functioning of SAFEM

After signing of MoU, the next step would be drafting of the charter for setting up and operationalization of SAFEM. This AoA would provide details of SAFEM in the areas of:

1. Legal set up (Association/Society etc.)
2. Purpose of the Association
3. Organization structure
4. Selection, qualifications, admission of members, change of control of a member, procedures for membership, resignation etc.
5. Committees and Subcommittees and their roles and responsibilities
6. Management Structure and their roles and responsibilities

7. Procedure for making recommendations
8. Guidelines for the selection and finalization of the seat/headquarters
9. Provisions for frequency of meetings of member nations (i.e. annual/semi-annual/quarterly/need basis)
10. Funding mechanism, financial year, annual accounts with financial obligations among member countries.
11. Finally, it will also provide the provisions for modification of AoA

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

ENTSOE was formed in 2008 with an objective of harmonization of electricity market rules and promoting an effectively competitive power market, delivering benefits to society. ENTSO-E is governed by detailed rules and regulations for different functions provided under the Articles of Association ratified by the Assembly. The AoA covered purpose, location, membership criteria, bodies of ENTSOE, financial arrangement and miscellaneous provisions of the organization.

8.1.4. Finalization of the AoA (Articles of Association)

Detailed discussion shall be carried out between the member nations for the finalization of the AOA for SAFEM. Discussions on the AoA shall have a fair representation from all the member nations and the mutually agreed rules for the forum shall be aligned in spirit with the conditions agreed to in the Memorandum of Understanding for the forum. Extensive deliberations on the AoA shall be followed by the signing of the AoA by members.

8.1.5. Constitution of Board and Committees/Working Groups

In this step, the process of the constitution of the Board would be initiated i.e., a governing/decision making body at the apex followed by an Executive body/Member Committee. This would be followed by Working Groups /Sub Committees to support the operations of the Member Committee.

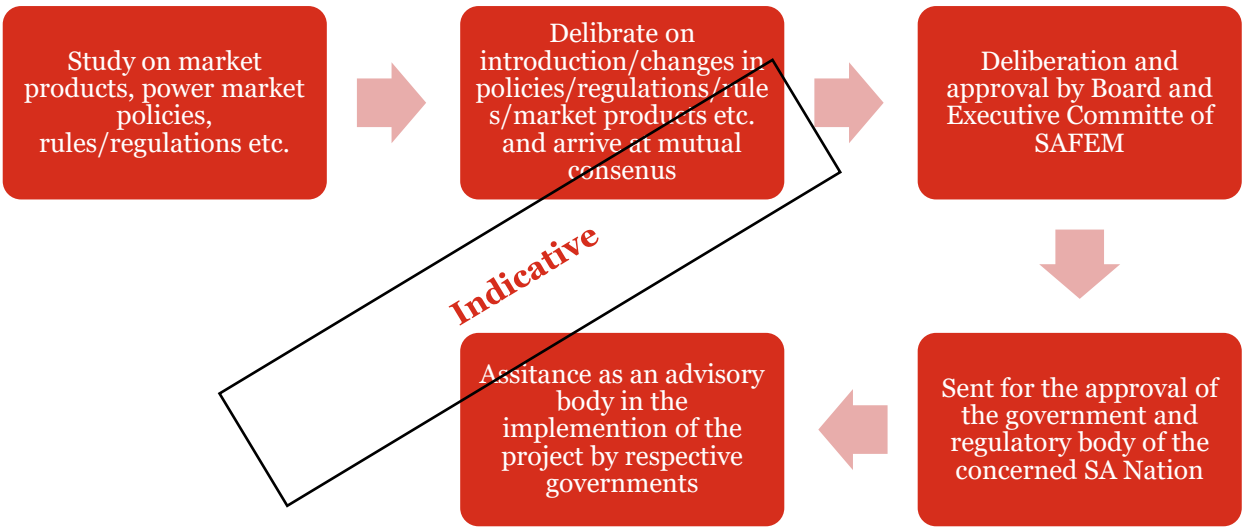
SIEPEC, the regional electricity market in South America is headed by an Apex/Governing body at the top echelon i.e., CEAC comprising of high executives from participating stakeholder institutions, from respective nations. This is followed by the 4 committees responsible for policy, programing and evaluation, advisory, and execution respectively. Lastly, there are several sub-committees which are operational to support the overall operations and activity at ground level.

8.1.6. Operationalization of SAFEM and Appointment of Staff

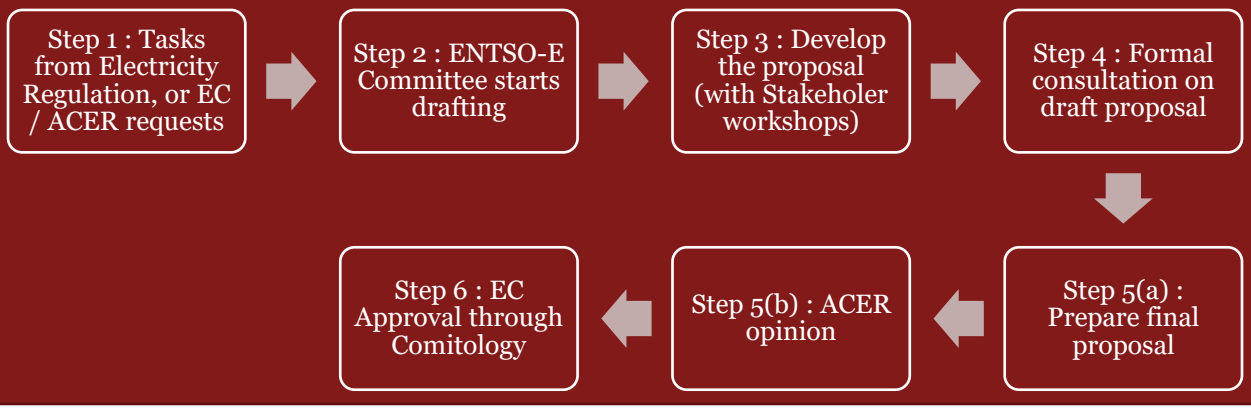
The operations and functioning of all the committees, sub-committees have to be supplemented by support staff which will assist in conducting the operations at ground level. The support staff may include Associates, Consultants, Administrative Support Staff, Accounting and Finance, IT and Technology Support, and HR Management.

8.1.7. Functioning of Forum

The functioning of the SAFEM would be governed by the board, members committee and the sub-committees within the bounds outlined by the AoA. A structured process should be followed by SAFEM for review of power market policies/Regulations/market rules prevailing in each country and framing of the same for formulation of the same for the South Asian market, introducing market products, etc. through a consultative process with all the relevant stakeholders. The broad indicative process of the function of SAFEM is exhibited as below:



ENTSO-E has a defined process of the approval of the products, studies etc. In line with the requirements of Regulation (EC) 714 / 2009 Art. 10, ENTSO-E defined in December 2009 in its consultation process. The process has been enclosed as below:



8.1.8. Capacity Building and Workshops

SAFEM would arrange and work towards the capacity building programs to increase knowledge sharing and information dissemination about market products as most of member countries are currently in developing stage of power market. SAFEM could arrange expert workshops (quarterly, semi-annually, or annually), to identify barriers and priorities, needed technologies, policies, development, and products for progressing regional power cooperation.

8.1.9. Transition towards the Regional Market Authority

SAFEM is currently envisioned to act as the Market Advisory body, working towards facilitating regional electricity market development, by acting as a platform for discussions among the various countries of South Asia and advising and assisting them in adoption and implementation of guidelines and policies, regulations, market products, etc., including devising market products for RE integration and new emerging energy solutions. In the long term, considering the level of maturity and liquidity in the power market, evolution of the trade between nations (trilateral, multilateral etc.), status of common grid codes, and competitiveness in the South Asian power market, the stakeholders from all the participating nations can mutually deliberate upon bestowing SAFEM with higher responsibilities and transitioning it to a Regional Market Authority.

Case Study

West African Power Pool (WAPP)

In West African power landscape, ECOWAS was founded in 1975 by signing of treaty, between fifteen WA Nations. ECOWAS was formulated to promote economic integration across the region. With the progress in the region and owing to the emerging economic needs of the region, the treaty was revised in 1993 and as per Article 23 of the ECOWAS revised treaty 1993, ECOWAS was endowed with the responsibility of the energy sector development and played the role of the market advisory authority.

In the field of Energy, ECOWAS was responsible to (a)ensure the effective development of the energy resources of the region;(b) establish appropriate co-operation mechanisms with a view to ensuring a regular supply of hydrocarbons;(c) promote the development of new and renewable energy particularly solar energy in the framework of the policy of diversification of sources of energy; (d) harmonize their national energy development plans by ensuring particularly, the inter-connection of electricity distribution networks; (e) articulate a common energy policy, particularly, in the field of research exploitation, production and distribution.[1]

However, due to limited development of the power trade and low progress in power system integration in the West African region, a need of a dedicated entity was felt to promote energy trades between member countries through the integration of the national power systems. Therefore in 1999, after building consensus during the Twenty-Second Summit of the Economic Community of West African States (ECOWAS) Authority of Head of States and Government, WAPP was established as a cooperation of the national electricity companies in Western Africa under the auspices of the ECOWAS. Hence, ECOWAS observed the progress from the sole market advisory body to an all-encompassing Market Authority enabled through an off-shoot cooperation i.e., WAPP to ensure Regional Power System integration and realization of a Regional Electricity Market.

9. Conclusion and Way Forward

As discussed, and exhibited in the previous chapters of the report, majority of the regions across the globe are on different levels of progress towards the creation of the common power markets alongside the development of the regional institutions or entities geared towards regional cooperation, integrated power systems, creation of liquid and competitive power market, formulation of regulations, grid codes etc. South Asian power ecosystem is relatively at the nascent stage, yet it is picking up fast and there would be an imminent requirement for a regional power market forum/institution which can advise towards the integration of the power systems, development of the vibrant regional power market to leverage the resource complementarity and to plug in the seasonal deficits in cost effective manner, promote competitive prices of tariffs and utilize the surplus RE potential across the SA region for the mutual benefit of all member nations.

Additionally, integration of large scale RE with the existing system and grid infrastructure would necessitate enhancing flexibility of the overall electricity system in terms of grid operation, commercial arrangement, and market structure. In this backdrop, the resources like hydro/storage plants can be leveraged to accommodate the variability of RE. Renewable sources such as solar and wind exhibit variability and intermittency in generation due to seasonality and changes in weather conditions. Countries such as India and Bangladesh could leverage the benefit of storage/pondage hydro from Nepal and Bhutan for balancing support on regional level under the purview of regional entity.

It is therefore an imperative to formulate a regional market body/forum/entity in the region which can facilitate regional electricity market development and creation. Such entity will also contribute towards the adoption and implementation of guidelines and policies by advising the South Asian countries on power trade and markets in the region. Such a proposed body can play a pivotal role in the progress of the cross-border power trade, innovative market products development, knowledge sharing, capacity building for CBET and finally integration of power markets. Owing to the imminent need of a regional level market forum in South Asia, the creation of South Asian Forum of Electricity Market is felt to fulfil the aforementioned and ensure envisaged benefits in the South Asian power ecosystem. SAFEM may start functioning as an informal body to advise the member countries and later take up the role of a formal body subject to acceptance by government of the member countries.

This report draws on the international and regional experiences, to propose various options across all the key aspects of setting up the envisaged forum for electricity market. As a subsequent step, this Report can be employed as a background paper for supporting further discussions and deliberations amongst the stakeholders from respective participating nations to initiate the process so the formulation of the proposed forum for electricity market in the SA Region.

10. Annexures

Annexure-1

Regional Projects:

Project Name	Country (Location)	Project Cost (Estimates) *($ million)#*	Indicative Funding Source
118 MW Nikachhu HPP	BHU/IND	200	ADB
1200 MW Punatsangchhu I HPP	BHU/IND	1340	GoI
1020 MW Punatsangchhu II HPP	BHU/IND	1041	GoI
600 MW Kholongchhu HPP	BHU/IND	553	Joint venture between DGPC and SJVNL
900 MW Arun 3 HPP	NEP/IND	1040	SJVNL
900 MW Upper Karnali HPP	NEP/IND/BAN	1500	GMR-

Estimates based on DPRs, company sites
1 USD: 70 INR

Annexure 2

Member States	Ministry	Federal Institute	Regulator	Financial Institute
Afghanistan	Ministry of Energy and Water	Renewable Energy Department	Ministry of Energy and Water	Non-existent
Bangladesh	Ministry of Power, Energy and Mineral Resource	Sustainable and Renewable Energy Development Authority	Bangladesh Energy Regulatory Commission	Infrastructure Development Company Limited
Bhutan	Ministry of Economic Affairs	Department of Renewable Energy	Bhutan Electricity Authority	Non-existent
India	Ministry of New and Renewable Energy	Solar Energy Corporation of India (SECI)	Central Energy Regulatory Commission	1. Indian Renewable Energy Development Agency Limited 2. Rural Electrification Corporation Limited
Maldives	Ministry of Environment & Energy	State Electric Company Limited	Maldives Energy Authority	Non-existent

Nepal	Ministry of Energy	Alternative Energy Promotion Center	Nepal Energy Authority	Non-existent
Pakistan	Ministry of Water and Power	Alternative Energy Development Board	National Electric Power Regulatory Authority	
Sri Lanka	Ministry of Power and energy	Sri Lanka sustainable Energy Authority	Public Utilities Commission of Sri Lanka	Non-existent

Other Activities envisaged under Phase - IV

Studies for Gas Segment

- Assess potential of gas trade within the BBIN region
- Assess economic benefits of electricity trade between India and Myanmar
- Disseminate study results on India-Nepal, India-Bangladesh and BBIN Multilateral trade

Capacity Building

- Focus on sharing of knowledge and learning within South Asia on Renewables Energy Development
- Energy efficiency, integration of RE into the power system.
- Training and Workshops on new and advanced technologies (e.g. energy storage, EV, etc.)

Private Sector Engagement

- Promote investments in regional energy projects and infrastructure through a "South Asia Joint working Groups
- or Forums for Regional Investment Facilitation"
- Facilitate regional or cross-border projects

Think Tank Forum

- Identify new partners (from South-Asia, Thailand and Myanmar) for Think Tank Forum
- Policy advocacy for public understanding of domestic and regional policy dynamics of CBET
- Integration with Climate Change and Sustainable Development
- Linking to electricity access for livelihoods and gender mainstreaming

Other Activities envisaged under Phase - IV

Concurrent Demand

	IND	India Peak MW date	India Peak time	BAN MW at india peak time	BHU MW at india peak time	NEP MW at india peak time	Diversity factor
APR	172000	26th April	19 hours	11500	330	1114	1.00
MAY	183000	30th May	20 hours	12983	333	1179	1.00
JUN	183000	14th June	20 hours	11983	271	1188	1.01
JUL	177000	3rd Jul	20 hours	11000	338	1247	1.01
AUG	179000	29th Aug	20 hours	11500	315	1337	1.01
SEP	174000	9th Sep	20 hours	9666	313	1313	1.02

	IND	India Peak MW date	India Peak time	BAN MW at india peak time	BHU MW at india peak time	NEP MW at india peak time	Diversity factor
OCT	164000	14th Oct	19 hours	11219	306	1141	1.00
NOV	156000	19th Nov	19 hours	9000	332	1242	1.01
DEC	172000	26th Dec	19 hours	8573	359	1374	1.00
JAN	171000	28th Jan	19 hours	8800	326	1122	1.00
FEB	179000	18th Feb	19 hours	8700	306	1242	1.01
MAR	170000	3rd Marc	19 hours	8400	323	1206	1.01

	IND	NEP	BAN	BHU
APR	172000	1261	12200	330
MAY	183000	1310	11941	348
JUN	183000	1320	12780	342
JUL	177000	1313	12436	331
AUG	179000	1407	12738	334
SEP	174000	1313	12717	320
OCT	164000	1285	11952	310
NOV	156000	1242	10255	356
DEC	172000	1374	8989	390
JAN	171000	1340	9223	374
FEB	179000	1242	9729	374
MAR	170000	1206	10790	359
Peak	183000	1407	12780	390

Member of SAPP

Name of Utility	Type	Status	Country
Botswana Power Corporation (BPC), (National Power Utility)	National Power Utility	Operating Member	Botswana
Electricidade de Mocambique (EDM)	National Power Utility	Operating Member	Mozambique
Electric Supply Corporation of Malawi (ESCOM)	National Power Utility	Non-Operating Member	Malawi
Eskom	National Power Utility	Operating Member	South Africa
Eswatini Electricity Company (EEC)	National Power Utility	Operating Member	Eswatini

Lesotho Electricity Corporation (LEC)	National Power Utility	Operating Member	Lesotho
NamPower	National Power Utility	Operating Member	Namibia
Rede Nacional de Transporte de Electricidade (RNT)	National Power Utility	Non-Operating Member	Angola
Societe Nationale d'Electricite (SNEL)	National Power Utility	Operating Member	DRC
Tanzania Electricity Supply Authority (TANESCO)	National Power Utility	Non-Operating Member	Tanzania
ZESCO Limited	National Power Utility	Operating Member	Zambia
Zimbabwe Electricity Supply Authority (ZESA)	National Power Utility	Operating Member	Zimbabwe
Copperbelt Energy Cooperation (CEC)	Private Utility	Independent Transmission Company	Zambia
Hidroelectrica de Cahora Bassa (HCB)	Private Utility	Observer	Mozambique
Lunsemfwa Hydro Power Company (LHPC)	Private Utility	Independent Power Producer	Zambia
Mozambique Transmission Company (MOTRACO)	Private Utility	Observer	Mozambique
Ndola Energy Company	Private Utility	Independent Power Producer	Zambia

Members of ENTSO-E

Country Code	**Country**	**TSO**
Full-time Member		
AL	Albania	Operatori i Sistemit te Transmetimit
AT	Austria	Verbund
AT	Austria	Vorarlberger Übertragungsnetz
BA	Bosnia Herzegovina	BiH Independent System Operator
BE	Belgium	Elia System Operator
BG	Bulgaria	Electroenergien Sistemen Operator
CH	Switzerland	Swissgrid
CY	Cyprus	Cyprus Transmission System Operator
CZ	Czech Republic	ČEPS
DE	Germany	TransnetBW
DE	Germany	Tennet TSO
DE	Germany	Amprion

DE	Germany	50Hertz Transmission
DK	Denmark	Energinet
EE	Estonia	Elering
ES	Spain	Red Eléctrica de España
FI	Finland	Fingrid
FR	France	Réseau de Transport d'Électricité
GB	United Kingdom	National Grid plc
GB	United Kingdom	System Operator for Northern Ireland
GB	United Kingdom	Scottish Hydro Electric Transmission plc
GB	United Kingdom	Scottish Power Transmission plc
GR	Greece	Independent Power Transmission Operator
HR	Croatia	Croatian Transmission System Operator
HU	Hungary	MAVIR
IE	Ireland	EirGrid
IS	Iceland	Landsnet
IT	Italy	Terna
KS	Kosovo	KOSTT
LT	Lithuania	Litgrid
LU	Luxembourg	Creos Luxembourg
LV	Latvia	Augstsprieguma tīkls
ME	Montenegro	Crnogorski elektroprenosni sistem AD
MK	Republic of Macedonia	MEPSO
NL	Netherlands	TenneT
NO	Norway	Statnett
PL	Poland	Polskie Sieci Elektroenergetyczne
PT	Portugal	Redes Energéticas Nacionais
RO	Romania	Transelectrica
RS	Serbia	Elektromreža Srbije
SE	Sweden	Svenska Kraftnät
SI	Slovenia	Elektro-Slovenija
SK	Slovak Republic	SEPS
Observer Member		
TR	Turkey (observer member)	Türkiye Elektrik İletim A.Ş.

Members of WAPP

List of Member Utilities	
Aksa Energy Company Ghana Ltd (Private Organisation, Ghana)	Mainstream Energy Solutions Limited (Private Organisation, Nigeria)
APR Energy (Private Organisation, Senegal)	National Water and Electricity Company Limited (Government Organisation, The Gambia)
CENIT Energy Limited (Government Organisation, Ghana)	North South Power Company Ltd (Private Organisation, Nigeria)
CenPOWER Generation Company Limited (Private Organisation, Ghana)	Northern Electricity Distribution Company Ltd (Government Organisation, Ghana)
Communauté Électrique du Bénin (Government Organisation, Togo, Benin)	Office National de l'Electricité et de l'Eau Potable du Maroc (Government Organisation, Morocco)
Compagnie Energie Electrique de Togo (Government Organisation, Togo)	Pacific Energy Company Limited (Private Organisation, Nigeria)
Compagnie Ivoirienne d'Electricité (Private Organisation, Côte d'Ivoire)	Paras Energy and Natural Resources Development Ltd (Private Organisation, Nigeria)
Contour Global (Private Organisation, Togo)	Sahara Power Group Ltd (Private Organisation, Nigeria)
Côte d'Ivoire Energies (Government Organisation, Côte d'Ivoire)	SAPELE Power PLC (Private Organisation, Nigeria)
Cummins Power Generation Ltd (Private Organisation, Nigeria)	Société Béninoise d'Energie Electrique (Government Organisation, Benin)
Empressa Publica de Electricidade e Agua de Guine-Bissau (Government Organisation, Guinea Bissau)	Société de Gestion de l'Energie de Manantali (Government Organisation, Mali, Senegal, Mauritania, Guinea)
Electricité de Guinée (Government Organisation, Guinea)	Société Nationale d'Electricité du Burkina (Government Organisation, Burkina)
Electricity Company of Ghana (Government Organisation, Ghana)	Société Nationale d'Electricité du Sénégal (Government Organisation, Senegal)
Electricity Distribution and Supply Company (Government Organisation, Sierra Leone)	Société Nigérienne d'Electricité (Government Organisation, Niger)
Energie du Mali-SA (Private Organisation, Mali)	Sunon Asogli Power (Ghana) Ltd. (Private Organisation, Ghana)
Ghana Grid Company (Private Organisation, Ghana)	Transcorp Power (Private Organisation, Nigeria)
Karpowership Ghana Company Ltd (Private Organisation, Ghana)	Transmission Company of Nigeria (Government Organisation, Nigeria)
Liberia Electricity Corporation (Government Organisation, Liberia)	Volta River Authority (Government Organisation, Ghana)

Members of AEMO

Type	Number	Remark	List (Non-exhaustive)
Internal Engagement (Within AEMO)			
Government Members	8 Members	Commonwealth and state government members	• Commonwealth of Australia • Australian Capital Territory

			• New South Wales • South Australia • Tasmania • Queensland • Victoria • Western Australia
Industry Members	106 Members	Industry members are registered participants in the gas and electricity markets and represent a diverse range of interests from across the energy sector to provide input into key AEMO governance processes and constitutional changes	• AGL Energy Ltd • Ararat Wind Farm Pty Ltd • Australian Gas Networks Limited • Australian Pipeline Trust • Aus Gas Trading Pty Ltd • Ausgrid • CitiPower Pty Ltd • Click Energy Pty Ltd • EDL Group Operations Pty Ltd • Hydro-Electric Corporation • Hydro Power Pty Ltd • Tasmanian Gas Pipeline Pty Ltd • TasNetworks Pty Ltd • TransGrid • Vicpower Trading • Water Corporation
External Engagement			
Energy Market Governance Bodies	-	AEMO operates within a broader energy market governance structure, Alongside these bodies to work on rules and regulations	• Australian Energy Market Commission (AEMC) • Australian Energy Regulator (AER) • Energy Security Board (ESB)
Central Bodies and Utilities	-	AEMO collaborates with, and undertakes work at the request of, individual jurisdictions of these bodies	• Council of Australian Governments • Western Australia's Public Utilities Office (PUO) • Economic Regulation Authority
State based Regulators	-	AEMO collaborated with the state based regulators for working on pricing, economic, human resource and state based operation aspects.	• Independent Pricing and Regulatory Commission (IPARC – ACT); • Independent Pricing and Regulatory Tribunal (IPART – NSW);

			• Essential Services Commission (ESC – VIC); • Queensland Competition Authority (QCA) • Essential Services Commission of South Australia (ESCOSA) • Office of the Tasmanian Economic Regulator (OTTER)

List of projects Undertaken under Projects of Common Interest (PCI), ENTSO

The Celtic Interconnector: It connects Ireland and Brittany in France and will enable the two countries to exchange 700 megawatts of electricity, the equivalent of supplying power to around 450,000 homes. It will provide Ireland's only direct energy connection to continental Europe, therefore enhancing security of supply for Irish electricity users, reducing the cost of electricity for consumers in Ireland and facilitating Ireland's transition to a low-carbon energy future. The project will also provide a direct fibre-optic communications link between Ireland and France.

The project is part of the Northern Seas Offshore Grid (NSOG) priority corridor and is expected to be completed in 2025.

COBRAcable: It is a new offshore link, stretching approximately 350km and with a capacity of 700 megawatts, that connects Denmark and the Netherlands. This interconnection will enable the integration of more renewable energy and has been designed to enable the connection of an offshore wind farm at a later stage. It will also ensure energy security by increasing energy exchanges between the two countries and providing a back-up for other connections in the event of failure.

The project was completed in 2019 and was part of the Northern Seas Offshore Grid (NSOG) priority corridor.

The Biscay Gulf Interconnector: The new 370 km-long electricity link through the Bay of Biscay will strengthen the interconnection between Spain and France and improve security and guarantee of supply. This undersea cable interconnection will also increase the efficiency of both electricity systems by reducing the need for generation power stations to cover demand peaks, lowering generation costs at the same time. As interconnection capacity is increased, the volume of renewable generation will be maximised and even redistributed within neighbouring systems to where it is needed most.

The project is part of the priority corrdidor for North-South interconnection in Western Europe and is expected to be completed in 2022.

German North-South Connection: This project is part of the German grid expansion programme and aims to increase capacity at Germany's northern and southern borders. This increased capacity will allow for greater integration of renewable energy and will make the energy supply from these sources more stable, therefore improving energy security. The project will also avoid spill-overs into the grid of neighbouring countries (such as Hungary, Poland, the Czechia and Slovakia). Spill-overs occur when the electricity produced in one country is diverted to a different part of its territory through a neighbouring country's grid.

The project is part of the priority corrdidor for North-South interconnection in Western Europe and isexpected to be completed in 2025.

Baltic Synchronisation project: The electricity network of the Baltic States is already well connected to other EU countries. Electricity interconnections have been built with EU support between Estonia and Finland (Estlink I and II), Latvia and Sweden (Nord Balt), and Lithuania and Poland (LitPol Link), in line with the aims of the Commission's baltic energy market interconnection plan. For historical reasons, however, the Baltic States' electricity grid is still operated in a synchronous mode with Russian and Belarusian systems.

This project is part of the priority corridor for the Baltic energy market interconnection plan and will allow for the synchronous operation of the Baltic States' electricity network with European networks and thus enhance security.

Estonia-Latvia third electricity interconnector: The project will consist of a 211 km-long transmission line that will contribute to the synchronisation of the Baltic States with European networks, alleviating congestion on the border and ensuring effectiveness of the operation of both systems. It will also increase the competitiveness of the electricity markets in the Baltic region and boost the use of renewable energy sources in Baltic coastal areas, by allowing for the construction of off-shore wind parks in Estonia and Latvia.

The project is part of the priority corridor for the Baltic energy market interconnection plan and should be completed by 2020.