PRESENT & FUTURE POWER MARKET ANALYSIS AND OPEN ACCESS POWER SALES IN INTER-REGIONAL TRANSMISSION CORRIDOR ANALYSIS

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A Declaration by the Guide

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Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA.

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EXECUTIVE SUMMARY

Power trading in India accounts for 9% of the net generation. Trading basically involves unscheduled exchange, bilateral trading and trading through power exchange. Unscheduled exchange accounts for around 40-45% of the total power traded, followed by 40-43% bilateral trade and rest through power exchanges. The proportion of unscheduled power exchange is expected to decline in coming years due to Power Ministry continuous effort to maintain grid discipline. In bilateral trade there are sub-sections like short term trading, medium and long term trading and cross border trading. Power Trading, as defined by Electricity Act 2003, is the purchase of electricity for resale thereof.

This Report comprises of an effort to study and analyse the Indian power market scenario and also power market size and structure. In this report I have studied and analysed the past and recent capacity addition of power, region wise demand and availability of power which help to determine the power deficit region.

Data collected and analysed for short term power trading data for past five months which help to identify the major firm in the market holding the largest share in volume of power transacted in the short term trading segment which enables a firm to make its long and short term strategy in power sales.

Through the study it is able to know quantity of power that was being traded in different regions of India and also the rate and trading margin gained from the transaction.

1. INTRODUCTION

India has the fifth largest power generation capacity in the world with installed capacity of 344 GW (as of FY 2018). The country ranks third globally while second in the Asia-Pacific region in terms of electricity production (equivalent to approximately 1,201 Billion Units (BU) during FY18). Owing to fast-paced economic growth, urbanization, and gains in electrification access, India's electricity demand has been growing at a rate of 5.5% on an average over the last decade. Despite being the country with the fastest growing electricity demand, nearly one-fourth of Indian households has no access to electricity and the per-capita consumption (~1100 units) remains the lowest worldwide.

India is now amongst the fastest developing countries in the world in terms of GDP as well as the electricity consumption. The challenge is to meet the energy needs of high economic growth & electricity consumption of about 1.3 billion people. The development of an efficient, coordinated, economical and robust electricity system is essential for smooth flow of electricity from generating station to load centers (as per Electricity Act, 2003) and for optimum utilization of resources in the country, in order to provide reliable, affordable, un-interruptible (24x7) and Quality Power for all. Transmission system establishes the link between source of generation on one side and distribution system, which is connected to load / ultimate consumer, on the other side. Transmission planning is a continuous process of identification of transmission system addition requirements, their timing and need.

India has one of the fastest—growing economies of the world. Globalization has positively influenced almost every sector in the country, including the power sector. To keep pace with the new energy challenges, the Government embarked upon a number of structural and operational changes to reform the power sector. The modifications mainly focused on bringing competition in different segments, setting up an independent regulatory commission, and establishing a proper funding mechanism. The Indian power sector has made remarkable progress since Independence.

The total installed capacity has gone up from 1,362 MW in 1947 to more than 2,00,000 MW in 2012 and the transmission network has increased from the isolated system concentrated around urban and industrial areas to country wide National Grid. However, the demand of electricity has always been overstepping the supply. The importance of electricity as a prime mover of growth is very well acknowledged and in order to boost the development of power system.

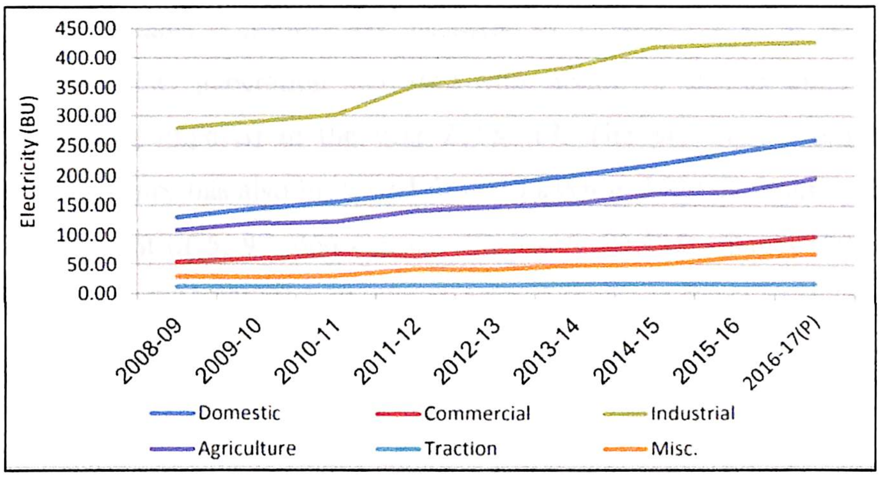


Fig. 1 : Growth of electricity Consumption in India (Consumer Category – wise), 2008-09 to 2016-17

Prior to the Electricity Act 2003, the electricity industry recognized generation, transmission and supply as three principal activities, and the legal provisions were also woven around these concepts. Bulk purchase and sale is a regular phenomenon between DISCOMs and licensees that was construed as part of the activity of supply of electricity. It is with the enactment of the Electricity Act, that the transaction involving purchase and sale of electricity has been recognized as a distinct licensed activity. Recognition of trading as a separate activity is in sync with the overall framework of encouraging competition in all segments of the electricity industry. The Electricity Act 2003 laid down provisions for promoting competition in the Indian power market. Introduction of non-discriminatory open access in electricity sector provided further motivation for enhancing competition in the market. The responsibility of developing the market in electricity has been vested with the Regulatory Commissions. The open access regulations, inter-state trading regulations, trading margin regulations, power market regulations etc., of the Central Commission have facilitated power trading in an organized manner.

1.1 Overview

Growth of Power sector is key to the economic development of the country as it facilitates development across various sectors of the economy, such as manufacturing, agriculture, commercial enterprises and railways. Since independence the power sector in India has grown considerably. However, the enactment of Electricity Act, 2003, has brought in revolutionary changes in almost all the areas of the sector. Through this Act a conducive environment has been created to promote private sector participation and competition in the sector by providing a level playing field. This has led to significant investment in generation, transmission and distribution areas. Over the years the installed capacity of Power Plants (Utilities) has increased to 3, 26,833 MW as on 31.3.2017. Similarly, the electricity generation increased from about 5.1 Billion units in 1950 to 1,242 BU (including imports) in the year 2016- 17. The per capita consumption of electricity in the country has also increased from 15 kWh in 1950 to about 1,122 kWh in the year 2016-17. Out of 5, 97, 464 census villages, 5, 92,135 villages (99.25%) have been electrified as on 31.03.2017. Regional grids have been integrated into a single national grid with effect from 31.12.2013 thereby providing free flow of power from one corner of the country to another through strong inter regional AC and HVDC links. As a result, the all India peak demand (MW) not met as well as energy (MU) not supplied have registered steady decline. The peak not met and energy not supplied were 1.6 % and 0.7 % respectively during the year 2016-17.

Table 1: Utility Power installed capacity in India

Installed Capacity as on	Total (MW)	% Growth (on yearly basis)
31-Dec-47	1,362	-
31-Dec-50	1,713	8.59%
31-Mar-56	2,886	13.04%
31-Mar-61	4,653	12.25%
31-Mar-66	9,027	18.80%
31-Mar-74	16,664	10.58%
31-Mar-79	26,680	12.02%
31-Mar-85	42,585	9.94%
31-Mar-90	63,636	9.89%
31-Mar-97	85,795	4.94%
31-Mar-02	1,05,046	4.49%
31-Mar-07	1,32,329	5.19%
31-Mar-12	1,99,877	9.00%
31-Mar-17	3,26,841	10.31%
31-Mar-18	3,44,002	5.25%
31-Mar-19	3,56,100	3.52%

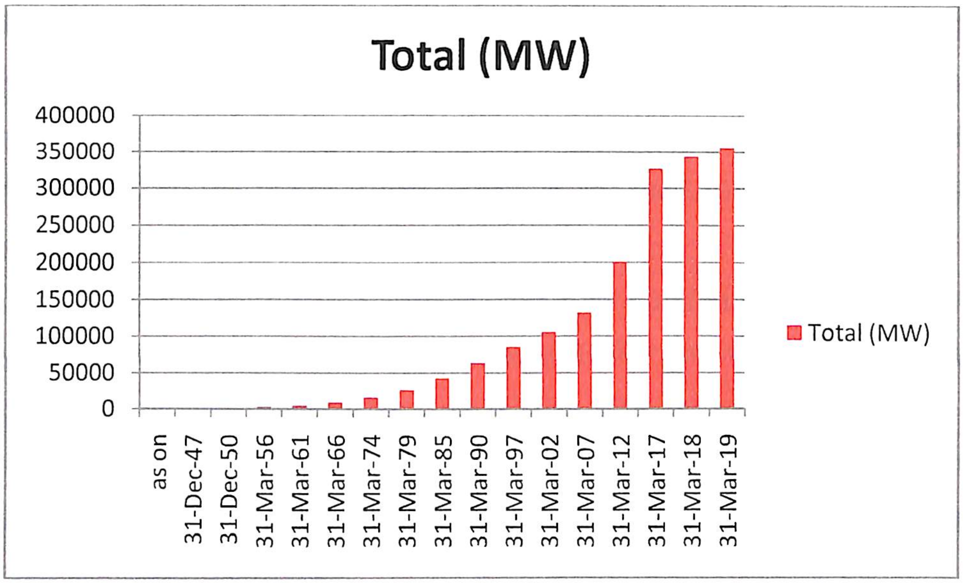


Fig. 2: Utility Power installed capacity in India

Table 2: All India per Capita Consumption of Electricity since 2006.

Year	Per Capita Consumption (kWh)
2005-06	631.4
2006-07	671.9
2007-08	717.1
2008-09	733.5
2009-10	778.6
2010-11	818.8
2011-12	883.6
2012-13	914.4
2013-14	957
2014-15	1010
2015-16	1075

1.2 Background

Electricity Act 2003 has been enacted and came into force from 15.06.2003. The objective is to introduce competition, protect consumer's interests and provide power for all. The Act provides for National Electricity Policy, Rural Electrification, Open access in transmission, phased open access in distribution, mandatory SERCs, license free generation and distribution, power trading, mandatory metering and stringent penalties for theft of electricity.

It is a comprehensive legislation replacing Electricity Act 1910, Electricity Supply Act 1948 and Electricity Regulatory Commission Act 1998.The Electricity Act, 2003 has been amended on two occasions by the Electricity (Amendment) Act, 2003 and the Electricity (Amendment) Act, 2007. The aim is to push the sector onto a trajectory of sound commercial growth and to enable the States and the Centre to move in harmony and coordination.

The Power industry is a vital infrastructure whose performance dictates growth of economy of our country. At present India is aiming at GDP growth of 10% and to achieve this, performance of power industry has to be reliable, efficient and economical.

The Electricity Act, 2003 provides an enabling legislation conducive to development of the Power Sector in transparent and competitive environment, keeping in view the interest of the consumers.

1.3 Purpose of the Study

There was a need to interconnect the north-eastern grid with a strong, reliable and secure interconnection with the rest of the Indian grid, which would also take care of the large potential of hydro power in the region," the Power Grid official explained. Currently, the north-eastern states are generating about 2,000 MW, while demand is around 1,610 MW. In the future, the HVDC line could help to evacuate electricity to the tune of 50,000 MW and supply to power-deficit northern states.

Feasibility studies aim to objectively and rationally uncover the strengths and weaknesses of the existing business or proposed venture, opportunities and threats as presented by the environment, the resources required to carry through, and ultimately the prospects for success. In its simplest term, the two criteria to judge feasibility are cost required and value to be attained. As such, a well-designed feasibility study should provide a historical background of the business or project, description of the product or service, accounting statements, details of the operations and management, marketing research and policies, financial data, legal requirements and tax obligations. Generally, feasibility studies precede technical development and project implementation.

1) To identify the implication of these changes on the power Sector companies in the light of reforms.
2) To explore problems and issues faced by power sector companies in India in the light of policy charges.

3) To examine the responses of power sector companies in gearing up to the changing need.

4) To identify strategic issues and future scenario of the power Sector.

The purpose of this project is to understand the various parameters affecting the power market which are significant in assessing the power sales. To study and analyze the past and present total installed capacity of power of India. Contribution of centre, state and private sector in it and also resource wise contribution of power.

1.4 Research Hypothesis

In the last twenty years the electricity power sector in both developed and developing countries has been subject to restructuring. The main objective has been to improve the economic efficiency of the sector by introducing private capital, liberalizing markets and introducing new regulatory institutions. In economic theory, ownership and the degree of competition are both important factors in determining output levels, costs of production and prices. More formally, the capital market and the product market determine the levels of allocative and productive efficiency. Therefore, privatization, competition and more effective state regulation of monopoly activities should lead to improve economic performance. This depends, however, on the reforms being appropriately designed and implemented. A country implementing reforms can suffer from serious institutional weaknesses, meaning that the planned reforms may not produce their intended benefits. Thus, the impact of privatization, competition and regulation on the electricity sector may produce different results depending on the design and its implementation.

2. REVIEW OF LITERATURE

As this region has rich coal blocks and other resources hence the power developers invest to build large size Thermal power plants in this region and also due to low demand the eastern region become power surplus. But the bulk power from eastern region is not transfer efficiently to power deficit other regions due to transmission constraint. This make the available resources underutilized. About 2,000 MW capacities of independent power projects likely to be commissioned during the year 2013-14 is not yet linked with any entity. Also it is hard for generating companies to sell power to open access consumers in Intra state trading in states like Chhatisgarh, Odisha. The cross subsidy surcharges of some states are very high and also due to the intra state transmission constraint the generating companies struggle to sell their power in medium term and short term basis on power market. This reduces the Plant Load Factor (PLF) of the generating units and the asset and resources of generating units are limiting.

Problem Statement:

- Weighted average purchase price and weighted average selling price of power are irregular from state to state and region to region.
- To analyze the trend of trading margins managed by the competitors.
- Challenges for electricity market in India.
- To study and analyze region wise demand and availability of Electricity to determine peak shortage and total energy deficit.
- To study and analyze the power market size and structure.
- To identify the need and importance of an efficient short term power market.
- To analyze Volume and Price of short term Power market Benchmarking of Trading License.

Need for the research:

1. Interconnector will facilitate bidirectional control flow of power, which means it can transfer power from the north-eastern region when it is in surplus during the high hydro period of the year.
2. The link will act as a highway from the north-eastern region to the rest of the country and shall play a significant role in the hydro potential in the north-eastern region.
3. HVDC transmission lines will reduce the transmission losses if this established. The corridor shall integrate the north-eastern region with other regions of the

country to facilitate smooth and reliable power transfer, giving rise to a stable national grid. The nature of control of power flow of the HVDC interconnection provides additional flexibility in grid operation, thereby improving various grid parameters.

The link will act as a highway from the north-eastern region to the rest of the country and shall play a significant role in the hydro potential in the north-eastern region.

4. Supply and demand will be managed efficiently in both regions as on requirement basis.

5. Some of the reasons for the shortage of supply are as follows: -
   - The growth in the installed capacity is not enough to meet the growing demand.
   - Lack of optimum utilization of existing capacity
   - Inefficient use of electricity by the end consumer.
   - Inadequate inter-regional transmission results in huge T&D losses.
   - Technical losses account for about 8 to 10% losses. Loss due to theft and technical metering is about 12to 14%.
   - Average cost of power is greater than average cost of revenue obtained.
   - Political interference and no firm policy on disconnection

2.3 Factors Critical to success of Study

There are number of limitations in the research which are acknowledged as under:-

- To begin with, obtained data on Privatization, Competition and Regulation to create our variables. There may be sample selection bias in the data provided by the country's central electricity authority. We have no reason to believe that this should be the case, but cannot of course rule it out.
- Performance indicators like Quality of service could not be estimated because of lack of data.
- The effects of privatization, competition and regulation on performance are not separately modelled , leaving open the possibility that economic gains attributed to privatization may have resulted from other structural reforms.
- The impact of reforms on prices charged for electricity generated could not be estimated, as there is lack of sufficient comparable data to carry out such an analysis.

2.4 Summary

India has the fifth largest power generation capacity in the world with installed capacity of 344 GW (as of financial year FY 2018). The country ranks third globally while second in the Asia-Pacific region in terms of electricity production (equivalent to approximately 1,201 Billion Units (BU) during FY18). Owing to fast-paced economic growth, urbanization, and gains in electrification access, India's electricity demand has been growing at a rate of 5.5% on an average over the last decade. Despite being the country with the fastest growing electricity demand, nearly one-fourth of Indian households has no access to electricity and the per-capita consumption (~1100 units) remains the lowest worldwide.

Electricity is a concurrent subject and both federal and state governments have jurisdiction in India's power market structure. Electricity Act 2003 (EA) marked the transformation of the sector, providing consolidation of laws, promotion of competition, private participation and delicensing of generation. EA also emphasized tariff-related policy formulation and setting up of regulatory commissions. Policy developments and establishment of power markets provided needed stimulus for capacity additions, which witnessed steep growth over the last decade. Annual average power generation capacity grew at 9% during FY 2008 to FY 2018 vis-à-vis a demand growth of 5.6% during the same period. This resulted in a decline in power shortages from highs of 11% during FY 2008 to current deficits of less than 1%.

The power generation mix is heavily skewed toward coal with 76% contribution, because of cheaper domestic fuel availability. Its share in the mix has increased over the years due to constraints in adding other conventional generation sources—hydro, nuclear and gas. Renewable energy sources, on the other hand, supported by state policies and declining costs, however, have seen strong gains, contributing 8% to the generation mix. The capacity additions during the last financial year came largely from renewable energy sources (approximately 12 GW), including 9.3 GW additions from solar power. Conversely, coal capacity additions were subdued during the same period as the narrowing demand-supply gap resulted in surplus power generating capacity impacting the average utilization rates of the coal plants. Natural gas, which makes up 8% of capacity, contributes to only 4% in the generation mix owing to the gas feedstock constraints. PLFs for gas-fired plants have also dropped to critically low levels, and close to 14 GW capacity stands stranded.

3. RESEARCH METHODOLOGY

3.1 Sources of Data

The present study is carried out by evaluating the findings of various studies, which have worth and validity, available in limited literature on the subject. Data used and analysed in the work are obtained from secondary sources.

The primary data was collected from published documents by the Central Electricity Authority, Indian Energy Exchange and FICCI over the subject Indian Power Transmission sector and its challenges. Secondly, in-depth structured questionnaire were organised to get data related to development in power transmission and open access power sales.

3.2 Research Design

For implementing the idea, required descriptive study of transmission sector, balance of power generated, current Indian power market, various power sales mechanism short term open access market, long term open access (LTOA) mechanism, medium term open access mechanism (MTOA) and corridor analysis. It also required the sector wise generation data and the percentage growth of generation capacity addition, region wise electricity demand and availability, Current power deficit, surplus scenario of different region. It also required Market Monitoring (MMC) Report, IEX market clearing volume and price, analysis of Load Generation Balance (LGBR) Report, region wise electricity demand and availability and Current power deficit.

3.2.1 Transmission Planning

Transmission planning in India has evolved over last few decades keeping pace with developments and needs of the electricity sector. The transmission planning has been aligned with the Electricity Act 2003, National electricity policy, tariff policy, regulations and market orientation of the electricity sector. The objectives, approach and criteria for transmission planning, which evolved in time, take care of uncertainties in load growth and generation capacity addition while optimizing investment in transmission on long term basis. These objectives, approach and criteria are kept in view while planning transmission addition requirements to meet targets for adequacy, security and reliability. Transmission plan is firmed up through system studies/analysis considering various technological options and the transmission planning philosophy. The Transmission system in India is planned considering the planning philosophy and guidelines given in " Manual on Transmission Planning Criteria" January, 2013 of Central Electricity Authority.

The transmission requirements could arise from:

a. new generation additions in the system,
b. increase in demand
c. system strengthening that may become necessary to achieve reliability as per the planning criteria under change load-generation scenario.

These transmission system requirements are identified, studied and firmed through the co-ordinated planning process i.e. through Regional Standing Committee(s) on Transmission (erstwhile Standing Committee(s) on Power System Planning for the Region) and operational feedback from POSOCO and other stakeholders. Development of adequate intra state transmission system is equally important in order to ensure delivery of power to the load centres and effective utilization of Inter-state transmission system.

3.2.2 Load Generation Balance Approach

In order to find out the requirement of transmission system, it is important to find out the surplus/deficit of each Region/State under various conditions which would give the import/export requirement of respective Region/State. For this, the total power available within a Region/State has been considered based on the generation projects physically located in the Region/State irrespective of its classification. Based on the combined availability of power from central sector/State sector/IPP projects in the Region / State as well as the projected demand, the import / export requirement has been worked out as shown below:

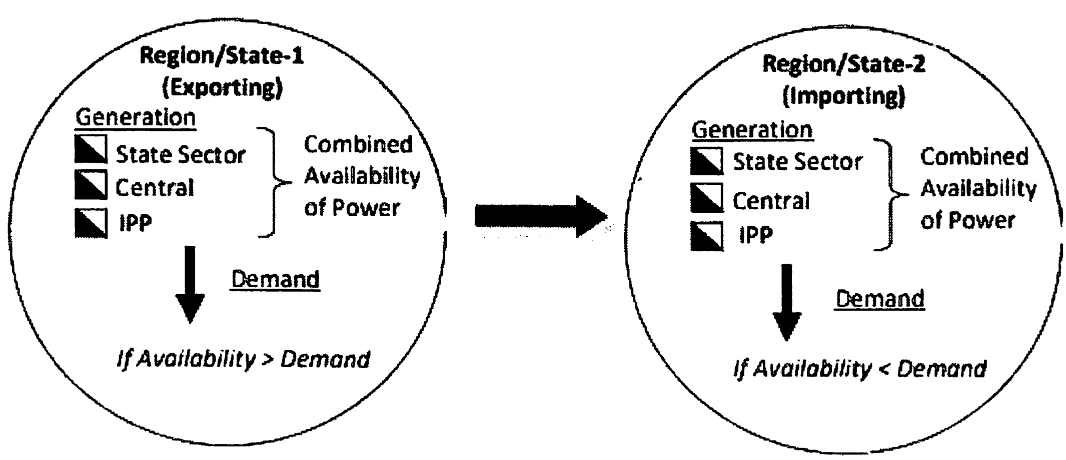


Fig. 3: Import & Export requirement

3.2.3 Open Access in Transmission

Open access in transmission has been introduced to promote competition amongst the generating companies who can now sell power to different distribution licensees across the country. This should lead to availability of cheaper power. The Act mandates non-discriminatory open access in transmission. When open access to distribution networks is introduced by the respective State Commissions for enabling bulk consumers to buy directly from competing generators, competition in the market would increase the availability of cheaper and reliable power supply. The Regulatory Commissions need to provide facilitative framework for non-discriminatory open access. This requires load dispatch facilities with state-of-the art communication and data acquisition capability on a real time basis. While this is the case currently at the regional load dispatch centres, appropriate State Commissions must ensure that matching facilities with technology upgrades are provided at the State level.

Table 3: Annual Price Trends between Traders and Power Exchangers

Annual price trends (Rs per unit)

	Traders	Power exchanges
2014-15	4.28	3.50
2015-16	4.11	2.72
2016-17	3.53	2.50
2017-18	3.59	3.45
2018-19	4.28	4.26

Source: CERC

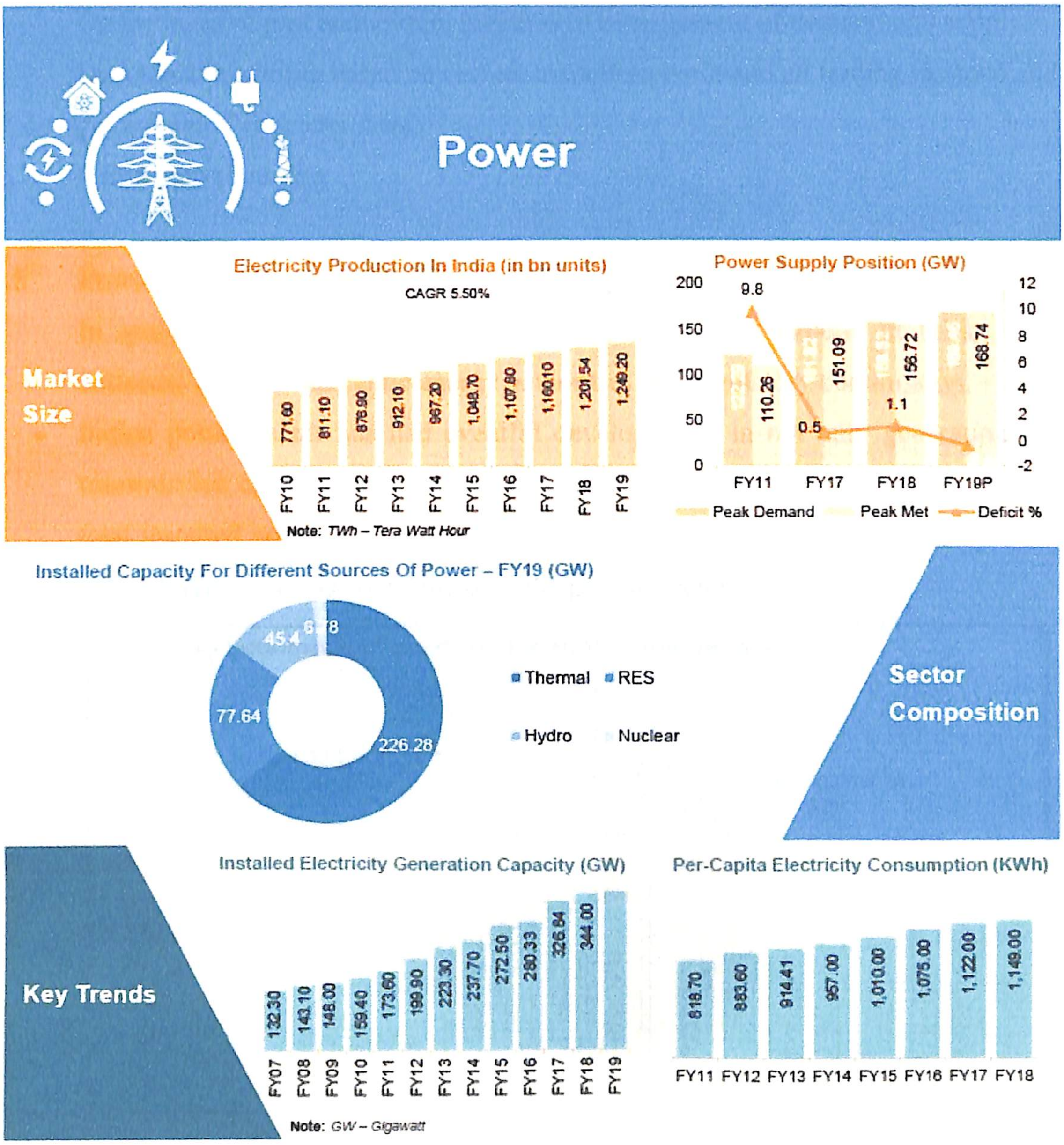


Fig 4. Power Generation Trends

3.3 Data collection method

Primary Data: Primary data through

1. Interview method – Interview of core corporate leaders energy sector, published in national level magazines.
2. Data collected from reports published by CEA, CERC and IEX.

3.4 Methods of Survey:

1. Analysis of efficiency and effectiveness of time.
2. Consulting with technical experts in core field.

3. On the basis of past and current scenario of management of demand and supply.
4. Data must be chosen based on current market scenario and all trading institute and government Electricity Acts.
5. Use of questionnaire.

3.5 Power Sector Analysis Report

In qualitative researches using interviews of industry experts in utility, data collected from the authentic energy authorities and regulatory commission.

- Indian power sector has had eventful developments in not only generation and transmission capacity addition, but also from the distribution reforms aspect. The total installed power generation capacity of India as on 31 January 2018 was 344 GW, of which 44% is contributed by the private sector.

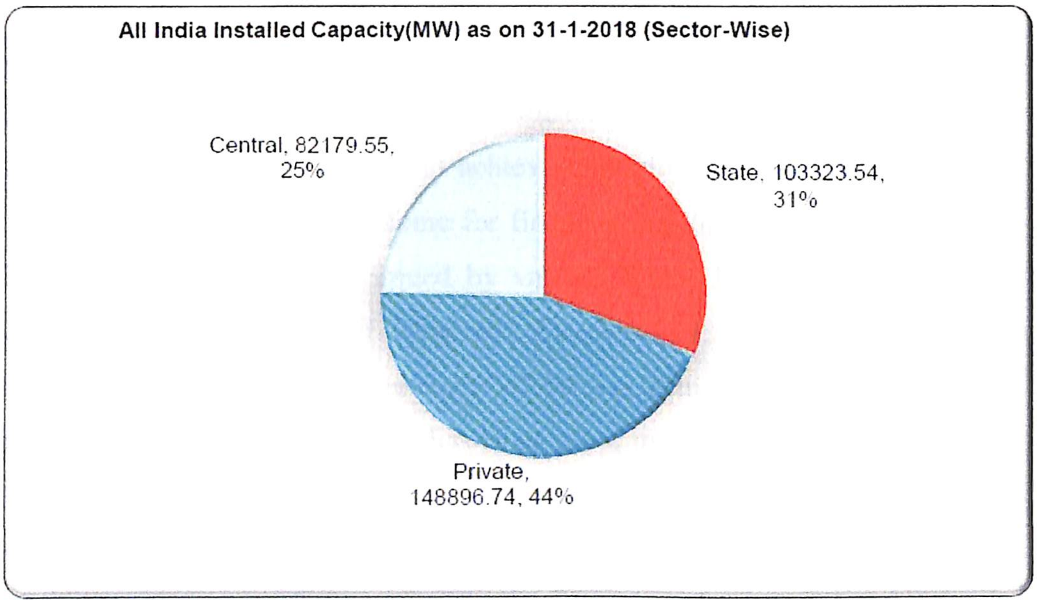


Fig. 5:All India Installed capacity (Sector – Wise)

- The major growth has been witnessed in renewable source with capacity reaching to 69,022 MW (growth of 20%). During FY18, renewable capacity surpassed conventional sector addition to the total generation capacity. The energy generation observed 6.1% growth to reach at 1,203 Bn Units as compared to previous year's generation of 1134 Bn Units. Transmission capacity addition was 23,119 ckms as against a target of 23,086 ckms. However, despite the capacity addition in generation and transmission there was a slight increase in the peak deficit situation from 1.6% to 2.0% during FY18. The Energy deficit remained constant at 0.7% during FY17 and FY18. The market witnessed higher liquidity and greater depth, with more participants than previous years.

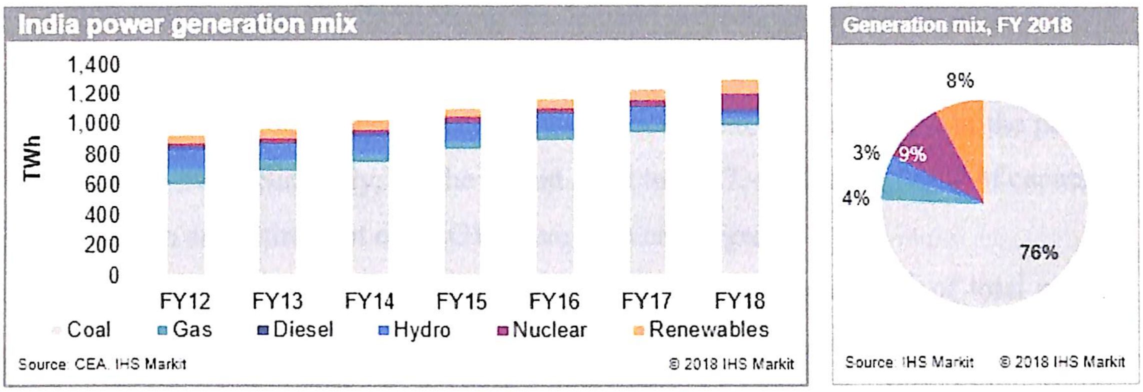


Fig. 6: India's Power Generation mix FY 12 – FY 18

- On the policy and regulatory front, the Government and Regulatory bodies continued the reform process for improvement in efficiency in various aspects of power supply. Government of India launched "Pradhan Mantri Sahaj Bijli Har Ghar Yojana (SAUBHAGYA)" to achieve universal household electrification in the country. Under UDAY scheme for financial and operational improvement of Discoms, bonds have been issued by various States for a total amount of Rs 2,321.6 billion. Ministry of New and Renewable Energy (MNRE) launched competitive bidding for procurement of power from wind projects and so far bidding for more than 6,000 MW has taken place in four phases.
- In further development for making coal allocation more transparent, Scheme for Harnessing and Allocating Koyala (Coal) (SHAKTI) was launched through which allocation of linkages for power sector shall be based on auction of linkages or through Power Purchase Agreement (PPA) based on competitive bidding of tariffs except for the State and the Central Power Generating companies, and the exceptions provided in Tariff Policy, 2016. Coal drawal will be permitted against valid Long Term PPAs and to be concluded Medium Term PPAs. The sector also witnessed emphasis on transparency through various web/mobile applications and digitization of competitive bidding through MSTC platform for short and medium term power procurement.
- Government's thrust on renewable energy with core focus on solar power dominated the power sector in the fiscal year 2018. The government has planned to add 175 GW of renewable energy by 2022 and increase the share of renewable

energy to power at 40% by 2030. It is also anticipated that India's peak demand for power will increase from current level of 153 GW to 226 GW by 2021-22 and 299 GW by 2026-27. Considering the demand projections and likely retirement of 22.7 GW of capacity, total capacity addition of 175 GW, including 47.8 GW of coal-based power projects currently under construction is envisaged in the period 2017 to 2022. Similarly, for the period 2022 to 2027, another 175 GW of capacity addition and retirement of 25 GW have been envisaged.

- Average transmission and distribution losses (T&D) exceed 22% of total power generation. India's T&D losses are almost 2.5 times the world average. The T&D losses are due to variety of reasons viz., substantial energy sold at low voltage, sparsely distributed loads over large rural areas, inadequate investment in distribution system, improper billing.
- Lack of coal supply was a major hurdle in the power sector till some time back. Majority of power generation takes place through thermal power plants which uses coal as its raw material. However, with e-coal auctions coming in the picture, this problem seems to have been resolved considerably. Major players in the generation space were sitting on sufficient inventories of coal as at the end of the previous fiscal year.
- Presently, major concern for the power generators is the off-take of electricity. Power generators sell power to SEBs or DISCOMs. SEBs are facing financial crisis and are suffering losses to the extent of Rs 700 billion annually. The SEBs do not have enough resources to purchase power from the generators. Hence a situation has risen wherein there is excess of power but no takers for the same.

Financial Year '18

- The demand supply gap for FY18 was range bound between 0.6-0.9% with few months reporting record-low peak and base deficit of 0.6%. The demand, however, still remains low due to various reasons including the low paying capacity of financially distressed Discoms and last mile connectivity to all consumers yet to be achieved. This has, in turn, led to a heavy financial burden in the form of NPAs to the banking sector.
- PLF of thermal plants which includes coal and gas-based power plants improved from 59.8% in FY17 to 60.7% in FY18. Gas based power plants continued to witness below-par capacity utilization at 22.9% during FY18. Around 11% of the

thermal power plants are gas based and have been facing fuel shortage due to limited production of natural gas domestically and most of the imported and domestically produced natural gas being diverted to other priority sectors like fertilizers, CGD etc. Nevertheless, the Central Public Sector Undertakings continued to be the best performers, followed by private sector.

- Energy deficit (difference between requirement and availability) was the lowest ever as numbers improved tremendously during the year with the same standing at about 1.1% (3.6% in FY15).
- It has been a land mark year for renewable energy, as 11.2GW capacity was added during the year. It accounted accounting for over 2/3rd of the new capacity addition during the year.
- As far as the Transmission & Distribution space is concerned, there has been rapid growth in the transmission sector with over 70 circuit-kilometers (CKms) of transmission capacity being added daily against an addition of 46 CKms a day between 2012 and 2014. However, the financial health of state electricity utilities in retail distribution continues to remain the most critical issue for the sector's viability. To resolve the challenge in the distribution business, the Government of India launched the Ujwal DISCOM Assurance Yojna (UDAY) to reduce the financial burden on state DISCOMs by transferring 75% of accumulated losses/debts of the DISCOM to the state in a 2-step phased manner over financial years 2016-2018. Nevertheless, the country continues to reel under the pressure of higher T&D losses with the government going slow with the reforms process in these segments. Financial turnaround of the distribution sector is essential for commercial viability of the entire sector.

4. FINDINGS AND ANALYSIS

How to Research the Power Sector

4.1 Supply and Demand

The total installed capacity in the country as on 31 March 2017 was 344 GW as on 31 March 2018, out of this 64.8% is accounted by the thermal power stations. With this the total capacity addition during the 12th plan period is 99,209.5 MW (excluding renewable) which is about 112.1% of the planned capacity addition of 88,537 MW for the Plan. Hence, sufficient capacity is being built to meet the demand requirements.

The long-term average demand growth rate is expected to remain in the higher single-digit growth levels given the much lower per capita power consumption in India as compared to the global average. Not only this, the poor financial state of SEBs could possibly lead to lower demand for power going ahead.

4.2 Competition

Getting intense, but despite there being enough room for many players, shortage of inputs such as coal and natural gas and regulatory hurdles has dissuaded new entrants. Competition has come across among all power generator and seller to sell power in most competitive prices, in the open access power market.

Transformation of the sector was well supported by creation of institutions to enhance efficiency through creation of markets via trading and later on in 2008 through trading on power exchanges. However, long-term contracts usually fail to meet the full requirements of the market participants as electricity cannot be stored, hourly consumption in the long-term without forecasting errs is difficult to predict, long-term contracts for peak load requirement are economically inefficient etc. Development of short-term trading markets is necessary to complement the long-term markets. Recognizing these problems, in 2006, CERC initiated organising electricity market by creating power exchanges. On this backdrop, the paper is directed towards the following objectives: (i) experience of power market operations in selected developed countries, and (ii) assessment of Indian power exchange market and its potential.

Power Scenario in India in Coming Future India's electricity consumption accounts for about 4 % of world's total electricity consumption and it is growing at the rate of 8–10 % per year. In India total energy shortage is 9 % with peak shortage at 15.2

% and country's power demand is likely to around 120 GW at present and to 315 to 335 GW in 2017. In order to estimate the total future requirements of individual fuels of the different sectors directly and indirectly through power, the study considers two fuel mix scenarios for the gross generation of electricity. In the first scenario, Power Scenario in India in Coming Future India's electricity consumption accounts for about 4 % of world's total electricity consumption and it is growing at the rate of 8–10 % per year. In India total energy shortage is 9 % with peak shortage at 15.2 % and country's power demand is likely to around 120 GW at present and to 315 to 335 GW in 2017. In order to estimate the total future requirements of individual fuels of the different sectors directly and indirectly through power, the study considers two fuel mix scenarios for the gross generation of electricity. In the first scenario, Power Scenario in India in Coming Future India's electricity consumption accounts for about 4 % of world's total electricity consumption and it is growing at the rate of 8–10 % per year. In India total energy shortage is 9 % with peak shortage at 15.2 % and country's power demand is likely to around 120 GW at present and to 315 to 335 GW in 2017. In order to estimate the total future requirements of individual fuels of the different sectors directly and indirectly through power, the study considers two fuel mix scenarios for the gross generation of electricity.

5. GROWTH OF TRANSMISSION SYSTEM IN INDIA

5.1 GROWTH OF TRANSMISSION SYSTEMS IN INDIA

To facilitate orderly growth and development of the power sector and also for secure and reliable operation of the grid, adequate margins in transmission system should be created. The transmission capacity would be planned and built to cater to both the redundancy levels and margins keeping in view international standards and practices. A well planned and strong transmission system will ensure not only optimal utilization of transmission capacities but also of generation facilities and would facilitate achieving ultimate objective of cost effective delivery of power. To facilitate cost effective transmission of power across the region, a national transmission tariff framework needs to be implemented by CERC. The tariff mechanism would be sensitive to distance, direction and related to quantum of flow. As far as possible, consistency needs to be maintained in transmission pricing framework in inter-State and intra-State systems. Further it should be ensured that the present network deficiencies do not result in unreasonable transmission loss compensation requirements.

5.1.1 Formation of State Grids for integrated planning

At the time of independence, power systems in the country were essentially isolated systems developed in and around urban and industrial areas. The installed generating capacity in the country was only about 1300 MW and the power system consisted of small generating stations feeding power radially to load centres. The highest transmission voltage was 132 kV. The voltage level of state-sector network grew from 132 kV level during the 50s and 60s to 220 kV during 60s and 70s. Subsequently, 400kV network was also developed in many states (Uttar Pradesh, Maharashtra, Madhya Pradesh, Gujarat, Orissa, Andhra Pradesh and Karnataka) for bulk power transfer over long distances. With the development of state grids in most states of the country, the stage was set for development of regional grids.

5.1.2 Concept of Regional Planning and Integration of State Grids

During the 3rd Five Year Plan, the concept of Regional planning in Power Sector was introduced. Accordingly, for the purposes of power system planning and development, the country was demarcated into five Regions viz. Northern, Western, Southern, Eastern and North-Eastern. In 1964, the Regional Electricity Boards were established in each of the Regions of the country for facilitating integrated operation of

State Systems in the Region and encouraging exchange of power among the States. To encourage the States to build transmission infrastructure for exchange of such power, inter-State lines were treated as 'centrally sponsored' and the States were provided interest free loans outside the State Plan. 55 nos. of inter-State lines were constructed under the programme of which 13 lines were connecting States located in different Regions and this created the initial set of inter-Regional links. These lines facilitated exchange of power in radial mode among the various Regions.

5.1.3 Development of inter-regional links

In 1989, transmission wings of Central generating companies were separated to set up Power Grid Corporation of India (POWERGRID) to give thrust to implementation of transmission system associated with Central generating stations and inter-Regional transmission programme based on perspective planning done by CEA. Till then, the generation and transmission systems in the country were planned and developed on the basis of regional self-sufficiency and the initial set of inter-regional links developed under the Centrally sponsored programme for building inter-state infrastructure of State utilities, was utilized to facilitate exchange of operational surpluses among the various Regions in a limited manner because the Regional Grids operated independently and had different operating frequencies and the power exchanges on these inter-regional links could take place only in radial mode.

Table 4: Interregional Transmission Capacity

Interregional transmission lines	Capacity (MW)
East-North	
Dehri-Sahupuri 220 kV S/C	130
Muzaffarpur-Gorakhpur 400 kV D/C (with Series cap+TCSC)	2,000
Patna-Balia 400 kV D/C (quad)	1,600
Biharsharif-Ballia 400 kV D/C (quad)	1,600
Barh- Ballia 400 kV D/C (quad)	1,600
Gaya-Ballia 765 kV S/C	2,100
Sasaram-Allahabad/Varanasi 400 kV D/C 1,000 (Sasaram HVDC back-to-back has been bypassed)	
Sasaram-Fatehpur 765 kV 2x S/C	4,200
Barh II-Gorakhpur 400 kV D/C (quad)	1,600
Gaya-Varanasi 765 kV S/C	2,100
LILO of Biswanath Chariali-Agra +/-800 kV , 3,000 MW HVDC Bipole at the new pooling station in Alipurduar and addition of the second 3,000 MW module	3,000
Biharsharif-Varanasi 400 kV D/C (quad)	1,600
Subtotal	**22,530**
East-West	
Budhipadar-Korba 220 kV 3 ckt	390
Rourkela-Raipur 400 kV D/C with series comp.+TCSC	1,400
Ranchi-Sipat 400 kV D/C with series comp.	1,200
Rourkela-Raipur 400 kV D/C (2nd) with series comp.	1,400
Ranchi-Dharamjaygarh-WR pooling station 765 kV S/C	2,100
Ranchi-Dharamjaygarh 765 kV second S/C	2,100
Jharsuguda-Dharamjaygarh 765 kV D/C	4,200
Subtotal	**12,790**
West-North	
Auriya-Malanpur 220 kV D/C	260
Kota-Ujjain 220 kV D/C	260
Vindhyachal HVDC back-to-back	500
Gwalior-Agra 765 kV 2x S/C	4,200
Zerda-Kankroli 400 kV D/C	1,000
Champa pool-Kurukshetra HVDC bipole	3,000
Gwalior-Jaipur 765 kV 2xS/C	4,200
RAPP-Sujalpur 400 kV D/C	1,000
Adani (Mundra)-Mahendranagar HVDC bipole	2,500

Interregional transmission lines	Capacity (MW)
Jabalpur-Orai 765 kV D/C	4,200
LILO of Satna-Gwalior 765 kV 2xS/C at Orai	4,200
Subtotal	**25,320**
East-South	
Balimela-Upper Sileru 220 kV S/C	130
Gazuwaka HVDC back-to-back	1,000
Talcher-Kolar HVDC bipole	2,000
Upgradation of Talcher-Kolar HVDC bipole	500
Angul-Srikakulum	4,200
Subtotal	**7,830**
WEST-SOUTH	
Chandrapur HVDC back-to-back	1,000
Kolhapur-Belgaum 220 kV D/C	260
Ponda-Nagajhari 220 kV D/C	260
Raichur-Solapur 765 kV S/C (PG)	2,100
Raichur-Solapur 765 kV S/C (Pvt. Sector)	2,100
Narendra-Kolhapur 765 kV D/C (ch at 400 kV)	2,200
Wardha-Hyderabad 765 kV D/C line	4,200
Subtotal	**12,120**
East-North East	
Birpara-Salakati 220 kV D/C	260
Malda-Bongaigaon 400 kV D/C	1,000
Siliguri-Bongaigaon 400 kV D/C (quad)	1,600
Subtotal	**2,860**
North East-North	
Biswanath Chariali-Agra +/-800 kV, 3,000 MW HVDC Bipole	3,000
Subtotal	**3,000**
TOTAL	**86,450**

S/C: Single circuit
D/C: Double vircuit
HVDC: High voltage direct current
Series cap: Series capacitors
TCSC: Thyristor-controlled series capacitor
Source: Central Electricity Authority

5.2 Power transmission corridors

Central Electricity Authority's (CEA) report on Advance National Transmission Plan for India, indicate that the 48 major high-transmission corridors that have already been planned and which are under implementation (expected to be completed by 2017) would be sufficient to meet the import/export of power among various regions till 2021-22.

The report also says that in another 20 years (2035-36), the transmission system needs to be expanded as the demand for power will grow. The all-India peak demand will rise four times from the current level of 153 GW to about 690 GW, hence quadrupling power generation and transmission systems will be required to transmit power, says the report. The report recommends setting up of massive transmission corridors towards northern and southern regions.

However, the CEA is cautious about advising any roadmap, including predicting accurate location for erecting transmission lines and their capacity, because of lack of enough details. The report also pointed out the poor electricity growth, which is in the range of 5-8 per cent per annum.

Table 5: Region wise Grid availability

Regions	Surplus/Deficit (-) Scenario in MW				Inter-state Grid availability in MW		
	2021-22	2026-27	2031-32	2035-36	as on October 29, 2015	expected by 2017	expected by 2021-22
Northern	-18400	-33200	-54800	-80100	30250	40850	45450
Western	10400	14000	21300	34200	10690	12790	12790
Southern	-7400	-16200	-30100	-47700	11550	15750	30150
Eastern	10900	22300	40600	66600			
North-East	1800	2100	3000	4000	2860	2860	2860

All eyes on 19th Electric Power Survey report

For an assertive planning of transmission corridors the authorities are waiting the 19th Electric Power Survey report that will elaborate the power demand and supply situation in India and project requirements for the future. Though the report was expected to be released in April, it is not likely to come out before August. The estimates of the report will be interesting to look at. The 18th Electric Survey report by CEA has been criticised by reporters for overestimation of power requirement with optimistic GDP figures.

Electricity growth is happening very slowly in India; roughly 40 per cent of installed capacity of coal-fired power stations remains unutilised. As per recent Load Generation Balance report of Central Electricity Authority, power demands have gone down in seven states in 2016 when compared to 2015. In another 16 states, the power requirement has grown by less than 3 per cent.

Table 6: Power requirement in state wise and change in percentage.

States	**Power Requirement**		**% Change**
	2015	**2016**	
Andhra Pradesh	113016	109216	-3.4
D.N. Haveli	5806	5615	-3.3
Himachal Pradesh	9401	9209	-2.0
Sikkim	427	423	-0.9
Uttar Pradesh	111858	110850	-0.9
Karnataka	70294	69781	-0.7
Rajasthan	72132	72070	-0.1
Pondicherry	2554	2554	0.0
Jammu & Kashmir	16922	17060	0.8
Chandigarh	1689	1705	0.9

States	Power Requirement		% Change
	2015	2016	
Tamil Nadu	102653	103806	1.1
Punjab	51268	52080	1.6
Arunachal Pradesh	816	830	1.7
Haryana	48870	49800	1.9
Tripura	1425	1453	2.0
Kerala	23703	24179	2.0
Assam	9115	9309	2.1
Delhi	30408	31110	2.3
Jharkhand	9106	9320	2.4
Uttarakhand	13247	13574	2.5
Meghalaya	2155	2215	2.8
Nagaland	825	849	2.9
Maharashtra	149773	154169	2.9
DVC	19224	20365	5.9
Mizoram	502	533	6.2
West Bengal	49654	52867	6.5

States	Power Requirement		% Change
	2015	2016	
Daman & Diu	2221	2372	6.8
Chhattisgarh	24980	27176	8.8
Orissa	26985	29805	10.5
Gujarat	94898	104845	10.5
Madhya Pradesh	65675	74199	13.0
Manipur	865	1008	16.5
Goa	3566	4367	22.5
Bihar	19215	26369	37.2

Mounting losses by state power distribution companies and their inability to procure power are cited as the major reasons for reduced power demand or non-growth of power in the country.

"Central Electricity Authority's data on power demand only partially captures the actual demand. There exists no count on the number of diesel generator sets operated to compensate the forced power cuts. Of late, no coal power plants are getting planned and average power consumption in India is not growing," says A K Khurrana, Director general, Association of Power Producers. "60 GW of captive power stations operate in India and we are collecting data about these units by encouraging plants to self-disclose," says N S Mondal, director, Central Electricity Authority.

5.3 Findings of Corridor Analysis:

The total transfer capability and available transfer capability between western region to southern region is 1000MW but all the power transfer capability allotted to long term access(LTA) and medium term open access (MTOA). There is no power transfer capability available for short term open access (STOA).The reliability margin between western region to southern region is zero.

The total transfer capability and available transfer capability between eastern region to southern region is 830MW. 612MW power transfer capability allotted to long term access(LTA) and medium term open access (MTOA). And 612MW of power transfer capability available for short term open access (STOA). The reliability margin between eastern region to southern region is zero.

The total transfer capability between northern region to western region is 2500MW and available transfer capability2000 MW. 286MW power transfer capability allotted to long term access(LTA) and medium term open access (MTOA). And 1714MW of power transfer capability available for short term open access (STOA). The reliability margin between northern region to western region is 500 MW.

The total transfer capability between northern region to eastern region is 1100MW and available transfer capability 900 MW. 0MW power transfer capability allotted to long term access (LTA) and medium term open access (MTOA). And 900 MW of power transfer capability available for short term open access (STOA). The reliability margin between northern region to eastern region is 200 MW.

The total transfer capability between eastern region to north- eastern region is 590MW and available transfer capability 555 MW. 230MW power transfer capability allotted to long term access(LTA) and medium term open access (MTOA). And 325 MW of power transfer capability available for short term open access (STOA). The reliability margin between eastern region to north- eastern region is 35 MW.

The total transfer capability between WR to NR_1 is 5700 MW and available transfer capability 5200 MW. 2787MW power transfer capability allotted to long term access(LTA) and medium term open access (MTOA). And 2413 MW of power transfer capability available for short term open access (STOA). The reliability margin between WR to NR_1 is 500 MW.

From corridor analysis found that there no reliable margin between western region to southern region and eastern region to southern region. This shows the congestion of these network due power deficit and huge demand in southern region. Also it shows that there is need for development high capacity transmission corridor between ER and SR to transfer surplus power from ER region to power deficit SR region.

Indian Power Market

In India, electricity reform re-evaluation of Electricity Supply Act, 1948 and Indian Electricity Act, 1910. This led to Electricity Act, 2003 which has been brought about to facilitate private sector participation to complement cash constrained State Electricity Boards (SEB) to meet the electricity demand. The act envisages transmission towards a competitive electricity market structure in India.

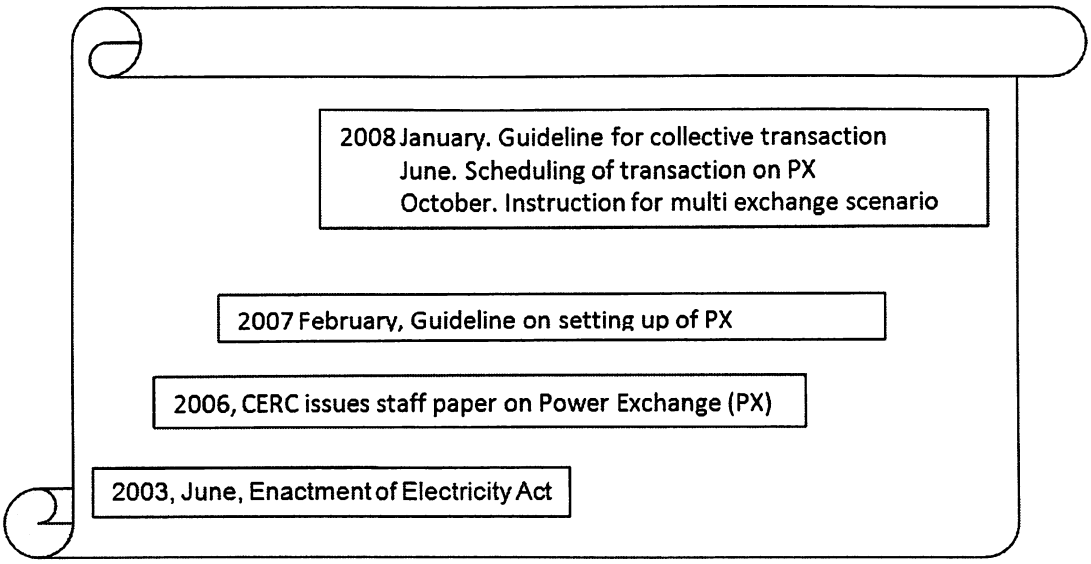


Fig. 7: Transmission towards a Competitive Electricity Market Structure in India.

Power exchanges have evolved rapidly to compliment and supplement the needs of the wholesale power markets in a transparent and efficient manner. Trading on exchanges has matured despite initial low volumes and high prices. After six years of operation, markets are now more efficient, liquid and promote investment as well as better utilisation of national resources. Indian Energy Exchange (IEX), as the power exchange with maximum volume and largest participation, has played an important role in furthering the objectives of the Electricity Act 2003 by enhancing competition, implementing open access and through realisation of the impact of de-licensing of generation. Creation of national grid has been supported by commercial contracts wherein huge volumes of electricity have been transferred across India to improve the reliability and security of supply in both the surplus and deficit regions. The exchanges have aided in better utilisation of national resources, reduced unmet demand and consequently reduced economic losses and improved energy security of the nation. Huge bottled up captive generation has also been brought into the national market to facilitate its most productive use of the economy. The Electricity Act, 2003 is for promoting competition in electricity market, protection of consumers 'interest and power for all'. The act recommended National Electricity Policy (NEP), open access in transmission, phased open access on distribution, mandatory State Electricity Regulatory Commissions (SERC), licence free generation and distribution, power trading, mandatory metering and stringent penalty for theft of electricity. Another step we have seen is the implementation of Availability Based Tariff (ABT) which brought about the day-ahead scheduling and frequency sensitive charges for deviation from schedule for efficient real-time balancing. ABT treats the fixed and variable costs separately. The fixed cost, known as capacity charge is associated with plant and its capacity to deliver MWs on day-to-day basis. Variable cost, known as energy charge and the total amount paid to the generators is based on their scheduled energy production rather than actual production. ABT has a third component called *Unscheduled Interchange* (UI) which is the payment for deviation from schedule and rate is decided in accordance with system frequency (e.g., Fig. 4). In India, ideal system frequency considered as about 50 Hz. Deviation from this requires synchronization which involves cost. That is the reason behind price difference for different frequencies.

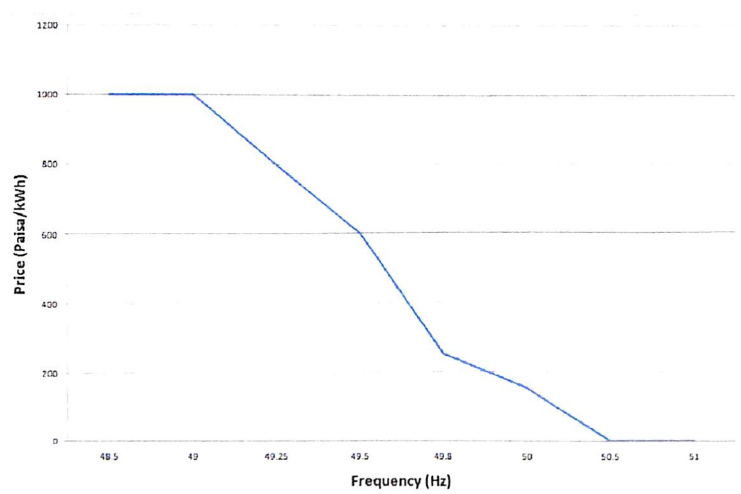


Fig. 8: UI Price Vector with Effect from 29/12/2007

Beneficiaries are paid for under withdrawal or charged for over withdrawal according to the system frequency. UI mechanism acts as balancing market in which real-time price is determined by system frequency.

To promote power trading, CERC approved the setting up of IEX. It is designed on the basis of the most successful international power exchange Nord Pool. The exchange has been developed as market based institution where the participation in exchange operation is voluntary. Presently, IEX offers day-ahead contracts with time line set in accordance with Regional Load Dispatch Centres (RLDC). IEX co-ordinates with National Load Dispatch Centres (NLDC)/ RLDCs and State Load Dispatch Centres (SLDC) for scheduling of traded contracts.

The day-ahead market of IEX is double-sided auction and discovers the price incorporating supply and demand side bidding. In the year 2008, and the first half of the year 2009, when the participants presented in each hour were relatively less, high prices were discovered not due to monopolistic behaviour of suppliers but because of the inelasticity of demand. This is typical of economies where demand exceeds supply and supply curves need to be extended vertically to discover the market clearing price as shown in Fig. 5. Hence, the prices were 'high' because of the inelasticity of demand and a strictly positive gap between the demand and supply. Though such high prices are not desirable from political and social considerations, from an economics perspective, this indicates functioning of the market in accordance with the principles of social welfare maximisation as enunciated in the regulations governing the operation of IEX. However, the incidence of such phenomenon has declined significantly. Thus, fewer price peaks together with declining volatility is an indicator of short term markets achieving higher liquidity. In the current market scenario, given the low prices on the exchange, the price is close to the marginal costs of generation, thus, reflecting any perceived lack of market abuse.

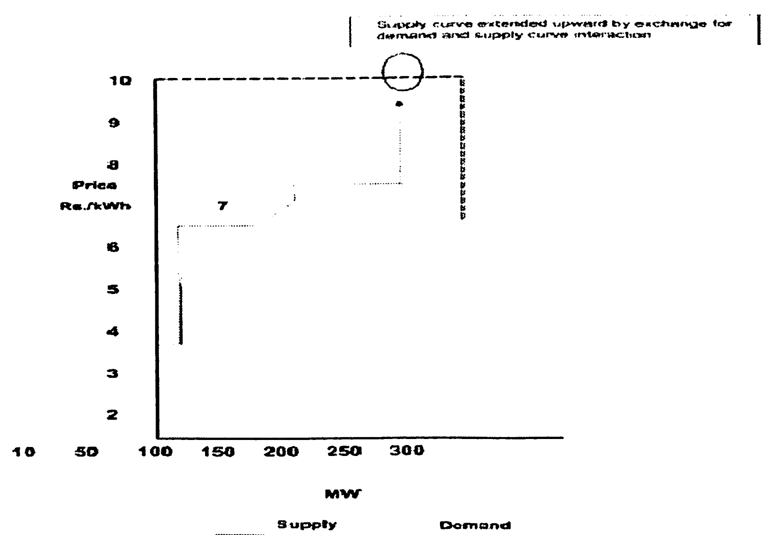


Fig. 9: Demand and Supply curve at IEX during initial period

Network constraints are considered in deriving the price and market splitting approach is used to clear the market with congested lines. The exchange, at present, offers only day-ahead contracts of an hourly time block. However, the exchange envisage plans to offer the adjustment contracts and long-term contracts like forwards and future to hedge the risk against electricity market uncertainty. Indian electricity market mechanism can be described as follows.

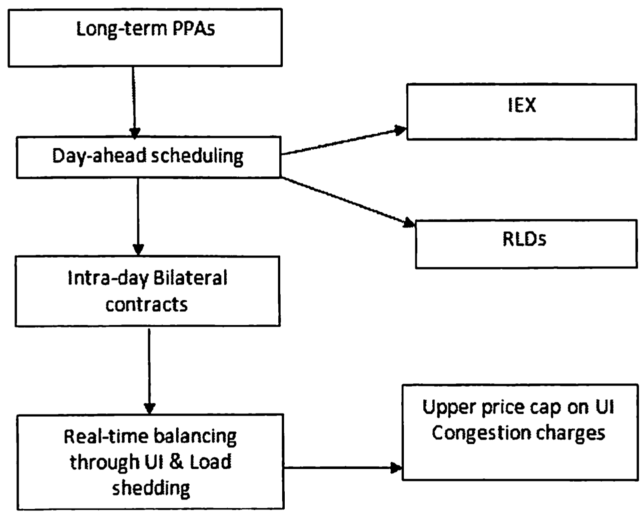


Fig. 10: Indian Electricity Market Mechanism

Potential of Indian Power Market

Indian power market is still to achieve full potential. In 2012013, India's buying potential was 15.35% while the selling potential was 4.57% at the national level. If 10% load shedding is considered, the potential size increases to 23.5%. This potential is only on account of co-skewness of the demand met in each state.

The actual potential is, however, higher and would be 23.5% if load shedding in energy terms, assumed conservatively to be 10%, is addressed. The potential would also increase if all the states were to allow their large industrial customers (greater than 1 MW) to procure from markets. The supply side potential is also high because: (a) the private sector plants–e.g. Sterlite, Jindal, JSWL, etc. sell a fixed percentage of their output in short term markets, (b) the un-requisitioned capacity of central sector plants (which the staff paper of CERC on Ancillary services market proposes to be used for providing frequency support ancillary services) is also available in short term markets.

There is huge untapped potential which provides opportunity for further development of power market in India. Given the impact of NEW and SR grids and CERC Regulation 20146, the size of the day-ahead market is expected to increase over time.

Gap between demand and supply from capacity tied up under long-term contracts, indicates that long-term contracts of utilities will be sufficient to meet entire demand across various states. States will continue to depend on markets for meeting their power requirements on real-time basis. In this context, power exchanges would play a lead role. Achieving full potential has some impediments also. The state level demand reported is usually the constrained demand that does not take into account the latent demand or unserved demand that is not recorded in the CEA/ Load Dispatch Centres (LDCs) recording systems. Demand currently reported does not capture demand of the large industrial and commercial open access consumers, which is met through captive diesel generating sets. The state level supply ignores the power 3.42% that is sold on merchant basis. Trading, in the short term markets, is governed by the differences in the load curves of various trading utilities/ entities in the country. It may not, however, always be possible to transmit power—from a region which has a peaking capacity, during other than peak periods—to another region where there is a peak requirement, due to transmission constraints. In these conditions, the local distribution utility facing peaking conditions may need to tie up with a local peaking generator for short term. Therefore, short-term planning is distinct from long term planning and involves consideration of both the local peaking resources and transmission from other regions for the reason of economy.

Open Access Mechanism In Power Market

For implementing the idea, required descriptive study of current Indian power market, various power sales mechanism short term open access market, long term open access (LTOA) mechanism, medium term open access mechanism (MTOA) and corridor analysis. It also required the sector wise generation data and the percentage growth of generation capacity addition, region wise electricity demand and availability, Current power deficit, surplus scenario of different region. It also required Market Monitoring (MMC) Report, IEX market clearing volume and price, analysis of Load Generation Balance (LGBR) Report, region wise electricity demand and availability and Current power deficit.

Open access allows large users of power — typically having connected load of 1 megawatt (MW) and above — to buy cheaper power from the open market. The idea is that the customers should be able to choose among a large number of competing power companies–instead of being forced to buy electricity from their existing electric utility monopoly. It helps large consumers particularly the sick textile, cement and steel industrial units by ensuring regular supply of electricity at competitive rates and boost business of power bourses.

Open Access on Transmission and Distribution on payment of charges to the Utility will enable number of players utilizing these capacities and transmit power from generation to the load centre. This will mean utilization of existing infrastructure and easing of power shortage. Trading, now a licensed activity and regulated will also help in innovative pricing which will lead to competition resulting in lowering of tariffs.

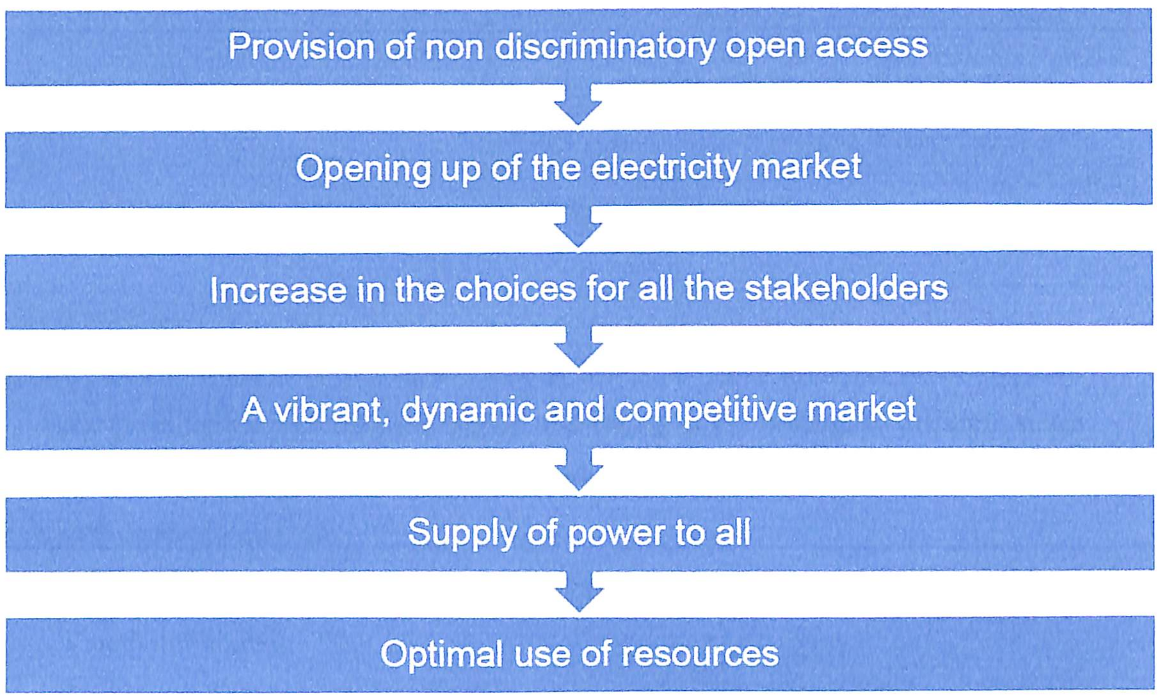


Fig. 11: Advantage of Open Access

THE ELECTRICITY Act 2003 is landmark legislation in that it opens the power sector to a number of players by laying down provisions for a power market and competition. As per Electricity Act 2003 Open Access is

"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".

Evolution of Open Access

Open Access – Stages of Evolution	
Stage of Evolution	**Description**
Electricity Act 2003	Introduction of Competition in Power Sector and Open Access in Inter State Transmission.
30.01.2004 First CERC Regulation	Introduced LTOA & STOA and Congestion Management through Fax/Email.
21.02.2005 Open Access 2005 (First Amendment)	Introduction of new products under STOA: Advanced Scheduling, FCFS, Day Ahead, Same day, E-bidding invited for STOA.
Open Access 2006-07 (Second Amendment)	Developing a common platform for Electricity Trading and grant of permission for setting up and operating Power Exchange.
25.01.2008 Open Access Regulation 2008	Exit Option provided with payment of up to 5 days of Open access charges.
20.05.2009 Amendment 2009	Exit Option provided with payment of up to 2 days of Open access charges.
CERC Power Market regulation 2010	Introduction of REC contracts

Categorization

On the basis of location of buying and selling entity, the open access is categorized as:

1. Inter State Open Access:When buying and selling entity belongs to different states. In this case CERC regulations are followed.

It is further categorized as:

A. Short Term Open Access (STOA): open access allowed for the period of less than one month.

B. Medium Term Open Access (MTOA): open access allowed for a period of 3 months to 3 years.

C. Long Term Open Access (LTOA): open access allowed for a period of 12 years to 25 years.

If suppose you require open access for two months, then you should re – apply for STOA before the expiry of first month.

2. Intra State Open Access: When buying and selling entity belongs to same state. In this case SERC regulations are followed. It is further categorized as STOA, MTOA, and LTOA and the duration of which depends on the respective state open access regulations.

Types of Transactions:

In general the buyer and seller of electricity can go for bilateral or collective transactions. In bilateral transactions a PPA is signed between the buyer and seller, which is generally facilitated by a trader for a little margin. In case of collective transactions the electricity is traded through exchanges, by exchange members for a very small margin fixed by commission. Currently India has two exchanges PXIL and IEX.

Open Access Charges:

There are several charges to be paid by open access consumers to distribution licensee, transmission licensees and other related entities, other than the power purchase cost paid to the generator or supplying entity. These charges include:

i. Connectivity Charges
ii. PoC Charges
iii. Transmission Charges
iv. Transmission Losses
v. Wheeling Charges
vi. Wheeling Losses
vii. Cross Subsidy Surcharge
viii. SLDC Charges
ix. RLDC Charges

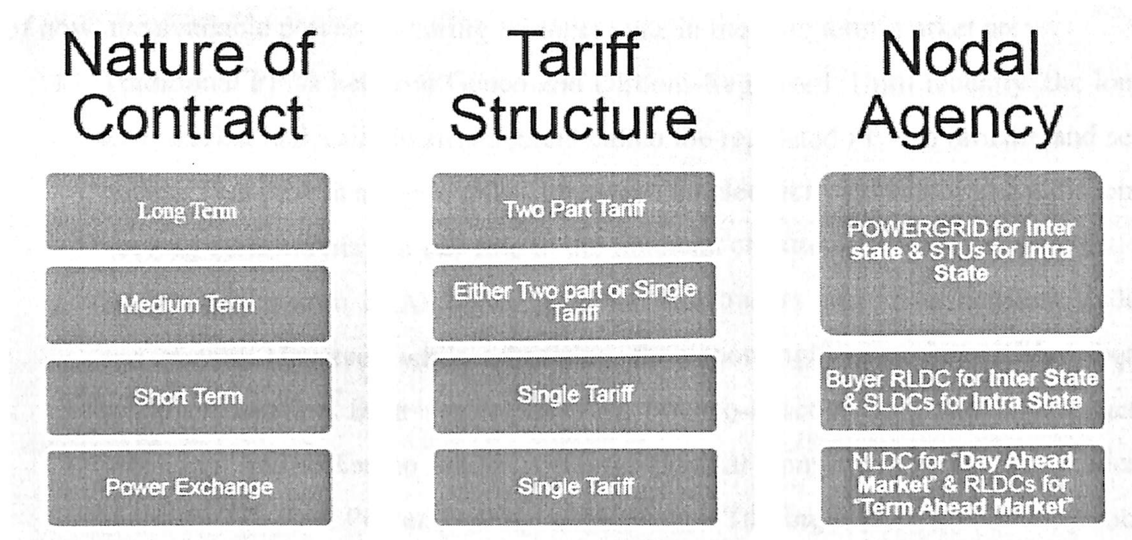


Fig. 12: Nodal Agency for Open Access:

Going forward, a supportive regulatory regime from the state electricity authorities combined with better grid stability can make long-term open access projects viable. These changes will facilitate more projects from the renewable energy companies who are taking huge upfront risks at present and will definitely upgrade the state of power trading in the country.

LTOA, MTOA, STOA, UI AND CORRIDOR ANALYSIS:

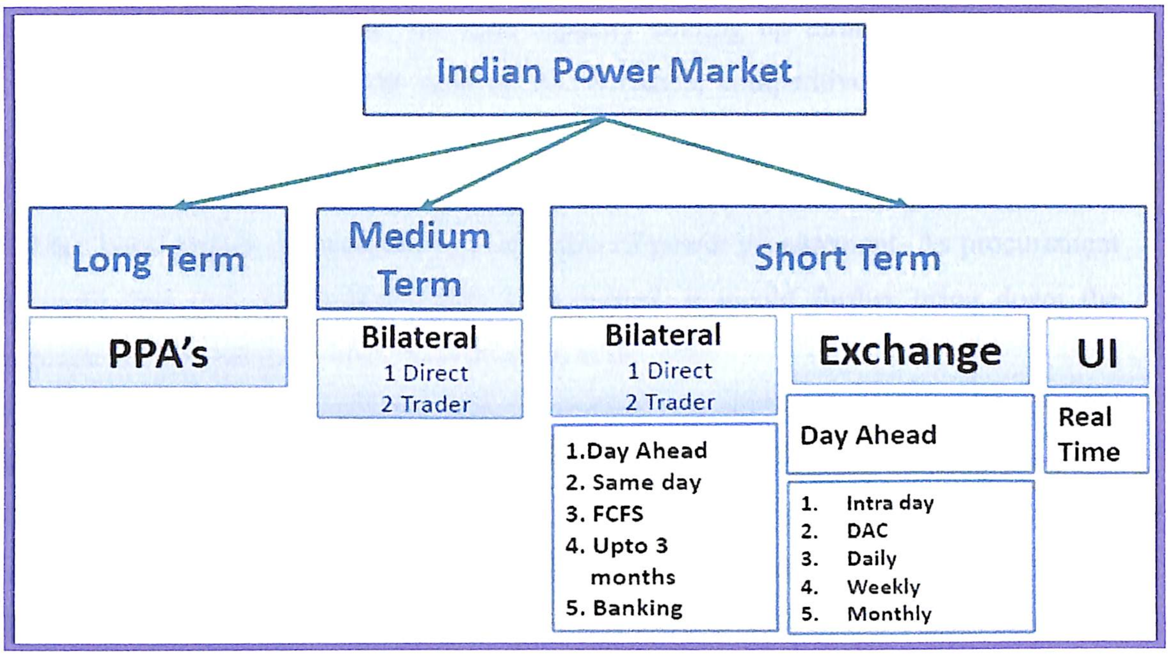


Fig.

Long Term Open Access Market(LTOA)

Long term market serves as a major platform to procure and sell power to the utilities. As of now, the available power procuring arrangements in the long term market are:

1. Traditional PPAs between Genco and Discom-Regulated: Until recently ,the long term market had a single arrangement called the regulated PPA to procure and sell power. This PPA is a legal contract between an electricity generator and a discom. Such agreements plays a key role in the financial closure of generation projects .
2. Long/medium term PPAs between Genco and traders and PSAs between trader and discom: However, while organising the upcoming/proposed capacities, there is slow transition from regulated PPAs (Genco-Discom) to bilateral contracts involving traders(Genco trader discom/industrial consumer/exchange). Traders such as PTC, Tata Power Trading and Reliance Trading had executed many such LT-PPA with generators and their strategy is to be in open position in the market and sell the contracted power in small quantities for shorter duration to different consumers at high price. PTC leads in dealing long –term power and has entered into many MoUs/PPAs with generators to procure long –term power.
4. Long /medium term PPAs between Genco and discom i.e. competitive bidding: MoP has issued the competitive bidding guidelines contemplated under Section 63 of the Act, titled "Guidelines for Determination of Tariff by Bidding Process for Procurement of Power by Distribution Licensees". As per these guidelines, the

discom can invite bids from prospective sellers both on long term and medium term basis. As of now, the total capacity coming up through the competitive bidding regime is to the tune of 30GW.Hence, competitive bidding is gaining momentum, and stakeholders' generic views on this are presented below:

- ***From Buyer's side:*** This new regime has helped them to discover competitive tariffs and has considerably reduced the discom's cost of power procurement. As procurement by more than one distribution utility is permitted, it would further bring down the aggregate efforts taken by individual discoms in the state.

From Developer's side: Both the private segment and public sector companies would have to forego the profit margin as fixed in the regulated cost-plus structure. As some of risks are thoroughly organization through competitive regime, the established private players would not get much affected by this transition; instead, could arrange cheaper finances for the project. As certain techno commercial competencies are required to organize the overall project cost and to arrive at lowest profitable tariff, the small players and new entrant would find it hard to compete with the established players.

From Traders side: This regime has helped to earn an unregulated profit margin for the entire transaction. As traders are allowed to participate in Case 1 bidding, they can also contract capacities from one or more generators and, in turn, bid for supplying to discom.

Table 7: Indian Power Market - Design

Nature of Contract	Duration of Contract	Transmission Open access availability
Long Term	> 7 years and up to 25 years	Long term open access is available for a period of 12 years to 25 years
Medium Term	> 1 years and up to 7 years	Medium term open access is available for a period of 3 months to 3 years
Short Term		
Short Term – Bilateral	Up to 1 year	For a period of up to 3 months
Short Term – Power Exchange	Day Ahead Market (1 day)	1 day (corridor left after short term bilateral)
	Term Ahead Market (up to 10 days)	Up to 10 days in advance
Deviation Settlement Mechanism	Real time balancing mechanism for settling deviation from schedule	

Table 8: Power Market : Present Status

Long Term (88%)	> 12 years	Power Purchase Agreements
Medium Term (1%)	3 months – 3 years	OTC (License Traders)
Short Term (9%)	Intra Day – 3 months	OTC, Power Exchanges (IEX)
Balancing (2%)	Real-time	Deviations (TSO)

Guidelines for Determination of Tariff by Bidding Process for Procurement of Power by Distribution Licensees -:

Bidding Process

TWO STAGE PROCESS:

For long-term procurement under these guidelines, a two-stage process featuring separate Request for Qualification (RFQ) and Request for Proposal (RFP) stages shall be adopted for the bid process under these guidelines. The procurer may, at his option, adopt a single stage tender process for medium term procurement, combining the RFP and RFQ processes. Procurer or authorized representative shall prepare bid documents including the RFQ and RFP in line with these guidelines and standard bid documents.

The procurer shall publish a RFQ notice in at least two national newspapers, company website and preferably in trade magazines also to accord it wide publicity. The bidding shall necessarily be by way of International Competitive Bidding (ICB). For the purpose of issue of RFQ minimum conditions to be met by the bidder shall be specified by the procurer in the RFQ notice.

Procurer shall provide only written interpretation of the tender document to any bidder / participant and the same shall be made available to all other bidders. All parties shall rely solely on the written communication and acceptances from the bidders.

Standard documentation to be provided by the procurer in the RFQ shall include,

Definition of Procurer's requirements, including:

- Quantum of electricity proposed to be bought in MW. To provide flexibility to the bidders, this may be specified as a range, within which bids would be accepted. Further, the procurer may also provide the bidders the flexibility to bid for a part of the tendered quantity, subject to a given minimum quantity.
- The procurer may separately specify distinct base load requirements and peak load requirements through the same bid process. Seasonal power requirements, if any, shall also be specified;
- Term of contract proposed; (as far as possible, it is advisable to go for contract coinciding with life of the project in case of long term procurement). The bidder shall be required to quote tariff structure for expected life of the project depending upon fuel proposed by him. The expected life project is estimated to be 15 years for gas/liquid fuel based projects, 25 years for coal based projects and 35 years for hydro projects.
- Normative availability requirement to be met by seller (separately for peak and off-peak hours, if necessary);
- Definition of peak and off-peak hours;
- Expected date of commencement of supply;
- Point(s) where electricity is to be delivered;
- Wherever applicable, the procurer may require construction milestones to be specified by the bidders;
- Financial requirements to be met by bidders including, minimum net-worth, revenues, etc with necessary proof of the same, as outlined in the bid documents;

(ii) Model PPA proposed to be entered into with the seller of electricity. The PPA shall include necessary details on:

- Risk allocation between parties;
- Technical requirements on minimum load conditions;
- Assured off take levels;
- Force majeure clauses as per industry standards;

- Lead times for scheduling of power;
- Default conditions and cure thereof, and penalties;
- Payment security proposed to be offered by the procurer.

(iii) Period of validity of offer of bidder;

(iv) Requirement of transfer of assets by the selected bidder (if any) to the procurer at the end of the term of the PPA.

(v) Other technical, operational and safety criteria to be met by bidder, including the provisions of the IEGC/State Grid Code, relevant orders of the Appropriate Commission (e.g– the ABT Order of the CERC), emission norms, etc., as applicable.

(vi) The procurer may, at his option, require demonstration of financial commitments from lenders at the time of submission of the bids. This would accelerate the process of financial closure and delivery of electricity;

(vii) The procurer and the supplier may exercise exit option subject to the condition that the new player satisfies all RFP conditions.

RFP shall be issued to all bidders who have qualified at the RFQ stage. In case the bidders seek any deviations and procurer finds that deviations are reasonable, the procurer shall obtain approval of the Appropriate Commission before agreeing to deviation. The clarification/revised- bidding document shall be distributed to all who had sought the RFQ document informing about the deviations and clarifications. Wherever revised bidding documents are issued, the procurer shall provide bidders at least two months after issue of such documents for submission of bids.

Standard documentation to be provided by the procurer in the RFP shall include,

(i) Structure of tariff to be detailed by bidders;

(ii)*PPA proposed to be entered with these elected bidders.* The model PPA proposed in the RFQ stage may be amended based on the inputs received from the interested parties, and shall be provided to all parties responding to the RFP. No further amendments shall be carried out beyond the RFP stage;

(iii) *Payment security to be made available by the procurer.*

The payment security indicated in the RFQ stage could be modified based on feedback received in the RFQ stage. However no further amendment to payment security would be permissible beyond the RFP stage.

(iv) *Bid evaluation methodology to be adopted by the procurer including the discount rates for evaluating the bids.*

The bids shall be evaluated for the composite levellised tariffs combining the capacity and energy components of the tariff quoted by the bidder. In case of assorted enquiry for procurement of base load, peak load and seasonal power, the bid evaluation for each type of requirement shall be carried out separately. The capacity component of tariffs may feature separate non-escalable (fixed) and escalable (indexed) components. The index to be adopted for escalation of the escalable component shall be specified in the RFP. For the purpose of bid evaluation, median escalation rate of the relevant fuel index in the international market for the last 30 years for coal and 15 years for gas / LNG (as per CERC's notification in below) shall be used for escalating the energy charge quoted by the bidder. However this shall not apply for cases where the bidder quotes firm energy charges for each of the years of proposed supply, and in such case the energy charges proposed by the bidder shall be adopted for bid evaluation. The rate for discounting the combination of fixed and variable charges for computing the levellised tariff shall be the prevailing rate for 10 year GoI securities;

(v) The RFP shall provide the maximum period within which the selected bidder must commence supplies after the PPA is entered into by the procurer with the selected bidder, subject to the obligations of the procurer being met. This shall ordinarily not be less than four years from the date of signing of the PPA with the selected bidder in case supply is called for long term procurement. The RFP shall also specify the liquidated damages that would apply in event of delay in supplies.

(vi) Following shall be notified and updated by the CERC every six months for the purpose of bid evaluation:

- Applicable discount rate Escalation rate for coal
- Escalation rate for gas/LNG
- Inflation rate to be applied to indexed capacity charge component.

Bid submission and evaluation

- To ensure competitiveness, the minimum number of qualified bidders should be at least two other than any affiliate company or companies of the procurer. If the number of qualified bidders responding to the RFQ/RFP is less than two, and procurer still wants to continue with the bidding process, the same may be done with the consent of the Appropriate Commission.

- Formation of consortium by bidders shall be permitted. In such cases the consortium shall identify a lead member and all correspondence for the bid process shall be done through the lead member. The procurer may specify technical and financial criteria, and lock in requirements for the lead member of the consortium, if required.
- The procurer shall constitute a committee for evaluation of the bids with at least one member external to the procurer's organization and affiliates. The external member shall have expertise in financial matters / bid evaluation. The procurer shall reveal past associations with the external member – directly or through its affiliates – that could create potential conflict of interest.
- Eligible bidders shall be required to submit separate technical and price bids. Bidders shall also be required to furnish necessary bid-guarantee along with the bids. Adequate and reasonable bid-guarantee shall be called for to eliminate non-serious bids. The bids shall be opened in public and representatives of bidders desiring to participate shall be allowed to remain present.
- The technical bids shall be scored to ensure that the bids submitted meet minimum eligibility criteria set out in the RFP documents on all technical evaluation parameters. Only the bids that meet all elements of the minimum technical criteria set out in the RFP shall be considered for further evaluation on the price bids.
- The price bid shall be rejected if it contains any deviation from the tender conditions for submission of price bids.
- Wherever applicable, the price bid shall also specify the terminal value payable by the Procurer for the transfer of assets by the selected bidder in accordance with the terms of the RFP.
- The bidder may quote the price of electricity at the generating station bus-bar (net of auxiliaries), or at the interface point with the State transmission network. For purposes of standardization in bid evaluation, the tariffs shall be compared at the interface point of the generator/supplier with the State transmission network. In case the bidder quotes his rate at the generating station bus-bar, normative transmission charges for the regional/inter-regional network, if applicable, based on the prevailing CERC orders shall be added to the price bid submitted. The charges for the State transmission network shall be payable by the procurer, and shall not be a part of the evaluation criteria.

The bidder who has quoted lowest levellised tariff as per evaluation procedure, shall be considered for the award. The evaluation committee shall have the right to reject all price bids if the rates quoted are not aligned to the prevailing market prices.

Deviation from process defined in the guidelines

In case there is any deviation from these guidelines, the same shall be subject to approval by the Appropriate Commission. The Appropriate Commission shall approve or require modification to the bid documents within a reasonable time not exceeding 90 days.

Arbitration

The procurer will establish an Amicable Dispute Resolution (ADR) mechanism in accordance with the provisions of the Indian Arbitration and Conciliation Act, 1996. The ADR shall be mandatory and time-bound to minimize disputes regarding the bid process and the documentation thereof.

If the ADR fails to resolve the dispute, the same will be subject to jurisdiction of the appropriate Regulatory Commission under the provisions of the Electricity Act 2003.

Time Table for Bid Process:

A suggested time-table for the bid process is indicated below. The procurer may give extended time-frame indicated herein based on the prevailing circumstances and such alterations shall not be construed to be deviation from these guidelines.

Table 9: Time table for bid process :

Event	Elapsed Time from Zero
Publication of RFQ	Zero date
Submission of Responses of RFQ	60 days
Short listing based on responses and issuance of RFP	90 days
Bid clarification, conferences etc	150 days
Final clarification and revision of	180 days
Technical and price bid submission	360 days
Short listing of bidder and issue of	390 days
Signing of Agreements	425 days

A suggested time-table for the Single stage bid process is indicated below. The procurer may give extended time-frame indicated herein based on the prevailing circumstances and such alterations shall not be construed to be deviation from these guidelines. For the single stage bidding process the developer has to get all the required licence and clearances from the concerned authority. The different stage of bidding should be completed as per the time given in the following table.

Table 10: Different stages of Bidding

Event	Elapsed Time from Zero date
Publication of RFP	Zero date
Bid clarification, conferences etc. & revision of RFP	90 days
Technical and price bid submission	180 days
Short-listing of bidder and issue of LOI	210 days
Signing of Agreements	240 days

Contract award and conclusion

- The PPA shall be signed with the selected bidder consequent to the selection process in accordance with the terms and conditions as finalized in the bid document before the RFP stage.
- Consequent to the signing of the PPA between the parties, the evaluation committee shall provide appropriate certification on adherence to these guidelines and to the bid process established by the procurer.
- The procurer shall make evaluation of bid public by indicating terms of winning bid and anonymous comparison of all other bids. The procurer shall also make public all contracts signed with the successful bidders.
- The final PPA along with the certification by the evaluation committee shall be forwarded to the Appropriate Commission for adoption of tariffs in terms of Section 63 of the Act.

Medium Term Open Access

MTOA (Medium Term Open Access) application for connectivity comes under The Regulation "Central Electricity Regulatory Commission (Grant of Connectivity, Long-term Access and Medium-term Open Access in inter-State Transmission and related matters) Regulations, 2009." As per the CERC regulation a Generating station of installed capacity 250 MW and above, including a captive generating plant of exportable capacity of 250 MW and above or a bulk consumer in respect of grant of connectivity and a generating station including a captive generating plant, a consumer, an Electricity Trader or a distribution licensee, in respect of long- term access or medium-term open access, as the case may be. A "Bulk consumer" who intends to avail supply of a minimum load of 100 MW from the Inter-State Transmission System can apply for connectivity.

The medium term open access(MTOA) means the right to use the inter-State transmission system for a period exceeding 3 months but not exceeding 3 years. The generating station including captive generating plant or a bulk consumer, seeking connectivity to the inter-State transmission system cannot apply for long-term access or medium-term open access without applying for connectivity. Provided that a generating station, including captive generating plant or a bulk consumer, seeking connectivity to the inter-State transmission. The nodal agency to grant of connectivity, for medium term open access to the inter-State transmission system shall be the Central Transmission Utility.

The application of connectivity should accompanied by a non refundable application fee payable in the name and in the manner to be laid down by the Central Transmission Utility in the detailed procedure.

Table 11: Fees Structure for the Application of Connectivity

Sr. No	Quantum of Power to be injected/off taken into/from ISTS	Application fee (Rs. In lakh)	
		For Connectivity	Medium-term Open Access
1	Up to 100 MW	2	1
2	More than 100MW up to 500 MW	3	2
3	More than 100MW and up to 500 MW	6	3
4	More than 1000 MW	9	4

The application form shall be processed within 40 days by nodal agency for medium term open access.

Procedure for Grant of Connectivity:

The application for connectivity shall contain details such as, proposed geographical location of the applicant, quantum of power to be interchanged that is the quantum of power to be injected in the case of a generating station including a captive generating plant and quantum of power to be drawn in the case of a bulk consumer, with the inter-State transmission system and such other details as may be laid down by the Central Transmission Utility in the detailed procedure. Provided that in cases where once an application has been filed and thereafter there has been any material change in the location of the applicant or change, by more than 100 MW in the quantum of power to be interchanged with the inter-State transmission system, the applicant shall make a fresh application, which shall be considered in accordance with these regulations. On receipt of the application, the nodal agency shall, in consultation and through coordination with other agencies involved in inter-State transmission system to be used, including State Transmission Utility, if the State network is likely to be used, process the application and carry out the necessary interconnection study as specified in the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007. While granting connectivity, the nodal agency shall specify the name of the sub-station or pooling station or switchyard where connectivity is to be granted. In case connectivity is to be granted by looping-in and looping-out of an existing or proposed line, the nodal agency shall specify the point of connection and name of the line at which connectivity is to be granted. The nodal agency shall indicate the broad design features of the dedicated. The applicant and all Inter-State Transmission Licensees including the Central Transmission Utility shall comply with the provisions of Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007. The applicant or inter-State transmission licensee, as the case may be, shall sign a connection agreement with the Central Transmission Utility or inter-State transmission licensee owning the sub-station or pooling station or switchyard or the transmission line as identified by the nodal agency where connectivity is being granted Provided that in case connectivity of a generating station, including captive generating plant or bulk consumer is granted to the inter-State transmission system of an inter-State transmission licensee other than the Central Transmission Utility, a tripartite agreement as provided in the Central Electricity Authority (Technical Standards for Connectivity to the Grid) Regulations, 2007 shall be signed between the applicant, the Central Transmission Utility and such inter-State transmission licensee. The grant of connectivity shall not entitle an applicant to interchange any power with the grid unless it obtains long-term access, medium-term open access or short-term open access.

A generating station, including captive generating plant which has been granted connectivity to the grid shall be allowed to undertake testing including full load testing by injecting its infirm power into the grid before being put into commercial operation, even before availing any type of open access, after obtaining permission of the concerned Regional Load Despatch Centre, which shall keep grid security in view while granting such permission. This infirm power from a generating station or a unit thereof, other than those based on non-conventional energy sources, the tariff of which is determined by the Commission, will be governed by the Central Electricity Regulatory Commission (Terms and Conditions of Tariff) Regulations, 2009. The power injected into the grid from other generating stations as a result of this testing shall also be charged at UI rates. An applicant may be required by the Central Transmission Utility to construct a dedicated line to the point of connection to enable connectivity to the grid Provided that a thermal generating station of 500 MW and above and a hydro generating station of 250 MW and above, other than a captive generating plant, shall not be required to construct a dedicated line to the point of connection and such stations shall be taken into account for coordinated transmission planning by the Central Transmission Utility and Central Electricity Authority.

Applications for long-term access or medium-term open access shall be processed on first-come- first-served basis separately for each of the aforesaid types of access: Provided that applications received during a month shall be construed to have arrived concurrently.

Application Procedure for MTOA:

1. The application for grant of medium-term open access shall contain such details as may be laid down under the detailed procedure and shall, in particular, include the point of injection into the grid, point of drawl from the grid and the quantum of power for which medium-term open access has been applied for.
2. The start date of the medium-term open access shall not be earlier than 5 months and not later than 1 year from the last day of the month in which application has been made.

3. On receipt of the application, the nodal agency shall, in consultation and through coordination with other agencies involved in inter-State transmission system to be used, including State Transmission Utility, if the State network is likely to be used, process the application and carry out the necessary system studies as expeditiously as possible so as to ensure that the decision to grant or refuse medium-term open access.
4. On being satisfied that the requirements specified under clause (2) of regulation 9 are met, the nodal agency shall grant medium-term open access for the period stated in the application. Provided that for reasons to be stated in writing, the nodal agency may grant medium-term open access for a period less than that sought for by the applicant; Provided further that the applicant shall sign an agreement for medium term open access with the Central Transmission Utility in case medium-term open access is granted by the Central Transmission Utility, in accordance with the provision as may be made in the detailed procedure. While seeking medium-term open access to an inter-State transmission licensee, other than the Central Transmission Utility, the applicant shall sign a tripartite medium term open access agreement with the Central Transmission Utility and the inter-State transmission licensee. The medium-term open access agreement shall contain the date of commencement and end of medium-term open access, the point of injection of power into the grid and point of drawl from the grid, the details of dedicated transmission lines required, if any, the bank guarantee required to be given by the applicant and other details in accordance with the detailed procedure. Immediately after grant of medium-term open access, the nodal agency shall inform the Regional Load Despatch Centres and the State Load Despatch Centres concerned so that they can consider the same while processing requests for short- term open access received under Central Electricity Regulatory Commission (Open Access in inter-State transmission) Regulations, 2008 as amended from time to time.
5. Medium-term customer may arrange for execution of the dedicated transmission line at its own risk and cost before the start date of the medium term open access.
6. On the expiry of period of the medium-term open access, the medium-term customer shall not be entitled to any overriding preference for renewal of the term.
7. A medium-term customer may relinquish rights, fully or partly, by giving at least 30 days prior notice to the nodal agency. Provided that the medium-term customer

relinquishing its rights shall pay applicable transmission charges for the period of relinquishment or 30 days which ever is lesser.

8. When for the reason of transmission constraints or in the interest of grid security, it becomes necessary to curtail power flow on a transmission corridor, the transactions already scheduled may be curtailed by the Regional Load Despatch Centre. Subject to provisions of the Grid Code and any other regulation specified by the Commission, the short-term customer shall be curtailed first followed by the medium-term customers, which shall be followed by the long term customers and amongst the customers of a particular category, curtailment shall be carried out on pro rata basis.
9. The transmission charges for use of the inter-State transmission system shall be recovered from the long-term customers and the medium-term customers in accordance with terms and conditions of tariff specified by the Commission from time to time. Provided that if the State network is also being used in the access as a part of inter-State transmission system for the conveyance of electricity across the territory of an intervening State as well as conveyance within the State which is incidental to such inter-State transmission of electricity, recovery of charges for such State network and terms and conditions thereof shall be in accordance with the regulation as may be specified by the Commission under section 36 of the Act for intervening transmission facilities, if such charges and terms and conditions cannot be mutually agreed upon by the licensees; Provided that any disagreement on transmission charges for such State network as specified above, shall not be the sole reason for denying access and either party may approach the Commission for determination of transmission charges for such State network.
10. Subject to the provisions of these regulations, the Central Transmission Utility shall submit the detailed procedure to the Commission for approval within 60 days of notification of these regulations in the Official Gazette. Provided that prior to submitting the detailed procedure to the Commission for approval, the Central Transmission Utility shall make the same available to the public and invite comments by putting the draft detailed procedure on its website and giving a period of one month to submit comments; Provided further that while submitting the detailed procedure to the Commission, the Central Transmission Utility shall submit a statement indicating as to which of the comments of stakeholders have

not been accepted by it along with reasons thereof. The detailed procedure submitted by the Central Transmission Utility shall, in particular, include—

- The proforma for the connection agreement.
- The proforma for the long-term access.

Provided that the Transmission Service Agreement issued by the Central Government as part of standard bid documents for competitive bidding for transmission in accordance with section 63 of the Act shall be a part of this Agreement along with necessary changes; Provided further that in case transmission system augmentation is undertaken through the process of competitive bidding in accordance with section 63 of the Act, the Transmission Service Agreement enclosed as part of bid documents shall be used as a part of the pro forma agreement to be entered into between the applicant and the Central Transmission Utility for long-term access. The time line for phasing of construction/modification of the transmission elements by the Central Transmission Utility/transmission licensee, as the case may be, and the coming up of generation facilities or facilities of bulk consumer, as the case may be, so as to match the completion times of the two; Provided that the time period for construction of the transmission elements shall be consistent with the timeline for completion of projects. Aspects such as payment security mechanism and bank guarantee during the period of construction and operation: Provided that the bank guarantee during construction phase shall not exceed Rs. 5 lakh per MW of the total power to be transmitted by that applicant through inter-State transmission system. Provisions for collection of the transmission charges for inter- State transmission system from the long-term customers or medium-term customers, as the case may be, by the transmission licensee or the Central Transmission Utility.

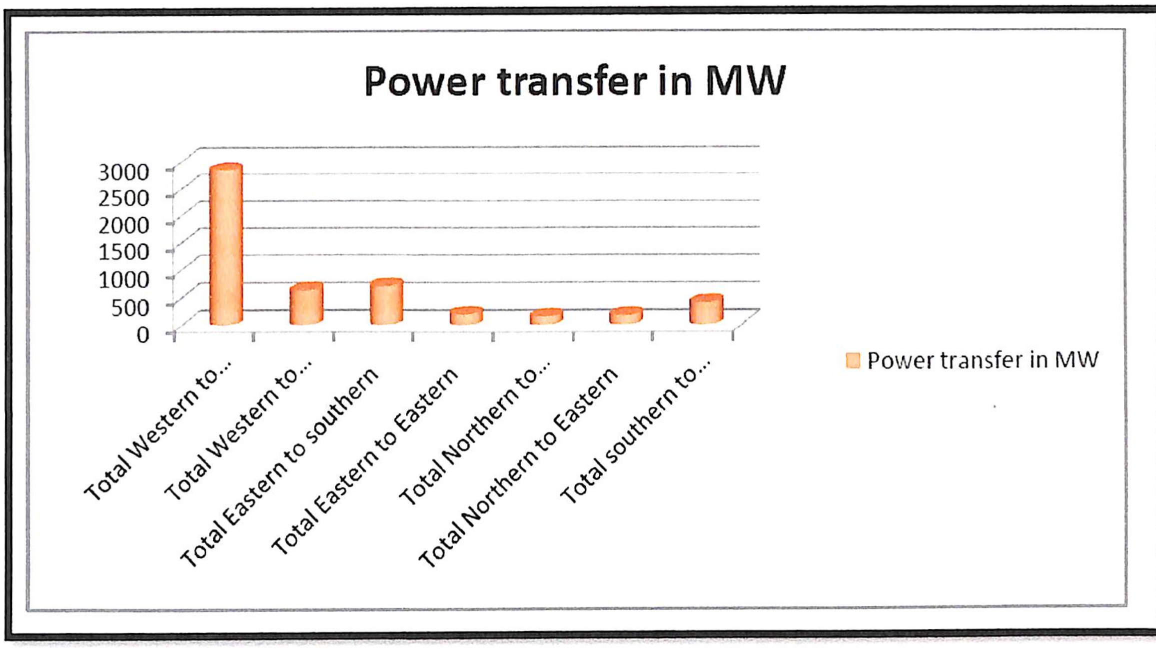


Fig. 13: Interregional Power Transfer, MW

Short Term Open Access

Short-term transactions of electricity refers to contracts of less than one year period, for electricity transacted under bilateral transactions through Inter-State Trading Licensees (only inter-state part) and directly by the Distribution Licensees, Power Exchanges (Indian Energy Exchange Ltd (IEX) and Power Exchange India Ltd (PXIL)), and Unscheduled Interchange (UI). The analysis includes

i. Years/Monthly/Daily trends in short-term transactions of electricity

ii. Analysis of open access consumers on power exchanges;

iii. Major Sellers and Buyers of Electricity through Licensed Traders and Power Exchanges

iv. Effect of congestion on Volume of Electricity transacted through Power Exchanges Comparison of short-term prices with tariffs of long-term sources of power for various distribution companies.

v. Ancillary services operations

I: Volume of Short-term Transactions of Electricity

During the month of April 2013, total electricity generation excluding generation from renewable and captive power plants in India was 77557.10 Mus .Of the total electricity generation, 7605.62 Mus (9.81%) were transacted through short-term, comprising of 3448.80 Mus (4.45%) through Bilateral (through traders and term ahead contracts on Power Exchanges and directly between distribution companies), followed by 2576.54 Mus (3.32%) through day ahead collective transactions on Power Exchanges (IEX and PXIL) and 1580.28 Mus (2.04%) through UI .Of the total short-term transactions, Bilateral constitute 45.35% (35.46% through traders and term-ahead contracts on Power Exchanges and 9.89% directly between distribution companies) followed by 33.88% through day ahead collective transactions on Power Exchanges and 20.78% through UI .

The percentage share of electricity traded by each trading licensee in the total volume of electricity traded by all trading licensees is provided in Table-2 & Figure-4. The trading licensees undertake electricity transactions through bilateral and through power exchanges. Here, the volume of electricity transacted by the trading licensees includes bilateral transactions and the transactions undertaken through power exchanges. There were 42 trading licensees as on 30.04.2013, of which only 21 have engaged in trading during April 2013. Top 5 trading licensees had a share of 68.91% in the total volume traded by all the licensees.

The volume of electricity transacted through IEX and PXIL in the day ahead market was 2515.68 Mus and 60.86 Mus respectively. The volume of total Buy bids and Sale bids was 3958.66 Mus and 3663.90 Mus respectively in IEX and 250.63 Mus and 162.49 Mus in PXIL. The gap between the volume of buy bids and sale bids placed through power exchanges shows that there was more demand in IEX (1.08 times) and PXIL (1.54times) when compared with the supply offered through these exchanges.

The volume of electricity transacted through IEX and PXIL in the term-ahead market was 7.48 Mus and 19.71 Musrespectively .

II: Price of Short-term Transactions of Electricity

(i) Price of electricity transacted through Traders:

Weighted average sale price has been computed for the electricity transacted through traders and it was "4.55/kWh. Weighted average sale price was also computed for the transactions during Round the Clock (RTC), Peak, and Off-Peak periods separately, and the sale prices were M60/kWh, '4.63/kWh and M12/kWh respectively. Minimum and Maximum sale prices were '2.90/kWh and '8.04/kWh respectively.

(ii) Price of electricity transacted Through Power Exchanges:

Minimum, Maximum and Weighted Average Prices have been computed for the electricity transacted through IEX and PXIL separately. The Minimum, Maximum and Weighted Average prices were U.31/kWh, U9.60/kWh and %.74/kWh respectively in IEX and U.31/kWh, A.00/kWh and '2.71/kWh respectively in PXIL . The price of electricity transacted through IEX and PXIL in the term-ahead market was %.14/kWh and %.38/kWh respectively.

(iii) Price of electricity transacted Through UI:

All-India UI price has been computed for NEW Grid and SR Grid separately. The average UI price was '2.27/kWh in the NEW Grid and M29/kWh in the SR Grid. Minimum and Maximum UI prices were '0.00/kWh and " 10.80/kWh respectively in the New Grid, and '0.00/kWh and " 10.80/kWh respectively in the SR Grid .

III: Volume of Short-term Transactions of Electricity (Regional Entity1-Wise)

Of the total bilateral transactions, top 5 regional entities sold 48.87% of the volume, and these were Sterlite, Karnataka, Damodar Valley Corporation, Jindal Power Limited and UT Chandigarh. Top 5 regional entities purchased 58.49% of the volume, and these were West Bengal, Tamilnadu, Gujarat, Andhra Pradesh and Kerala . Of the total Power Exchange transactions, top 5 regional entities sold 63.39% of the volume, and these were Gujarat, Karnataka, Delhi, Madhya Pradesh and Haryana. Top 5 regional entities purchased 66.64% of the volume, and these were Gujarat, Maharashtra, Andhra Pradesh, Punjab and Rajasthan .

Of the total UI transactions, top 5 regional entities under drew 38.59% of the volume, and these were Uttar Pradesh, Rajasthan, Madhya Pradesh, Maharashtra and Delhi. Top 5 regional entities overdrew 37.25% of the volume, and these were Chattisgarh, Maharashtra, Uttar Pradesh, Haryana and Gujarat . Regional entity-wise total volume of net short-term transactions of electricity i.e. volume of net transactions through bilateral, power exchanges and UI . Top 5 electricity selling regional entities were Karnataka, Sterlite Energy Limited, Delhi, Jindal Power Limited and Damodar Valley Corporation. Top 5 electricity purchasing regional entities were Tamilnadu, Andhra Pradesh, West Bengal, Maharashtra and Chattisgarh.

IV: Congestion on Inter-state Transmission Corridor for Day-Ahead Market on Power Exchanges

Power Exchanges use a price discovery mechanism in which the aggregate demand and supply are matched to arrive at an unconstrained market price and volume. This step assumes that there is no congestion in the inter-state transmission system between different regions. However, in reality, the system operator, NLDC in coordination with RLDCs, limits the flow due to congestion in the inter-state transmission system. In such a situation, Power Exchanges adopt a mechanism called "Market Splitting".

In the month of April 2013, congestion occurred in both the power exchanges, the details of which are shown in Table-16. The volume of electricity that could not be cleared due to congestion and could not be transacted through power exchanges is the difference between unconstrained cleared volume (volume of electricity that would have been scheduled, had there been no congestion) and actual cleared volume. During the month, the volume of electricity that could not be cleared in the power exchanges due to congestion was 17.17% and 56.37% of the unconstrained cleared volume in IEX and PXIL, respectively. In terms of time, congestion occurred was 100.00% in both the power exchanges.

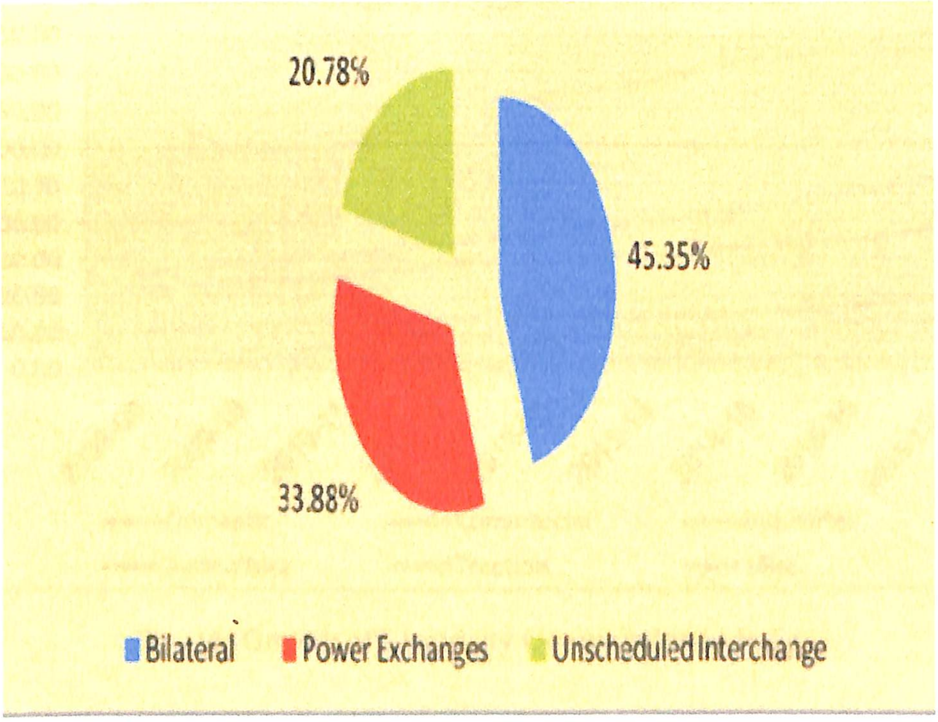


Fig. 14: Volume of Short term transactions of Electricity

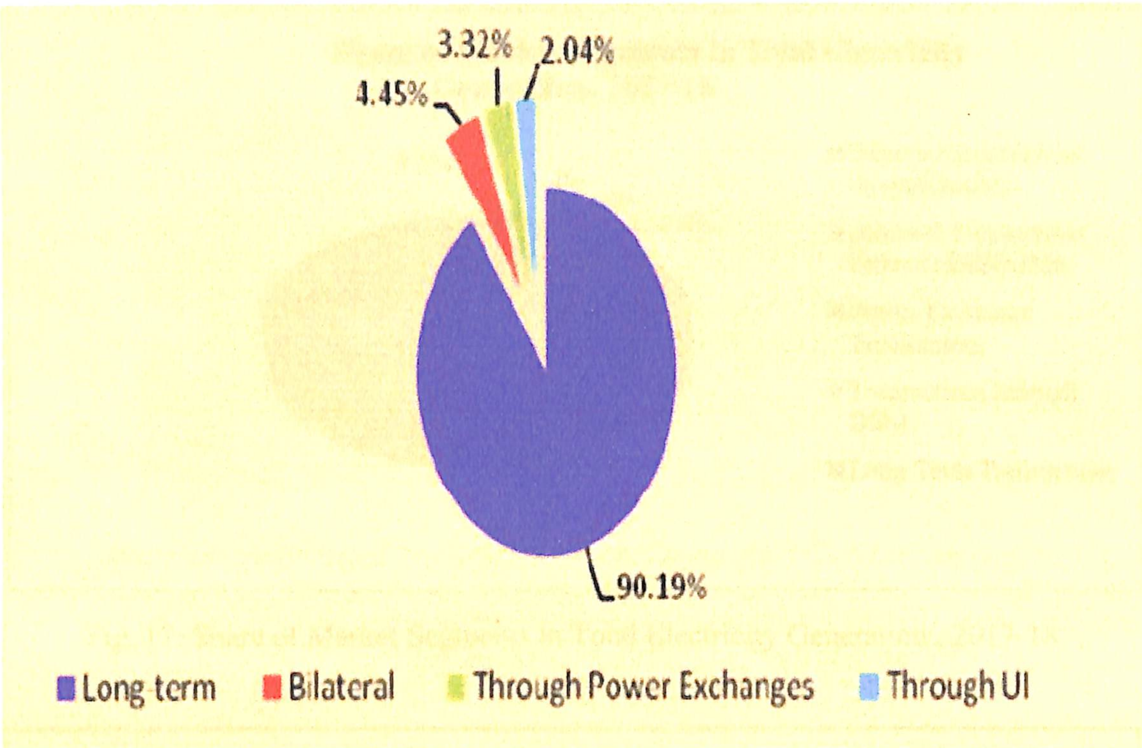


Fig. 15: Volume of various kinds of Electricity Transactions in Total Electricity Generation

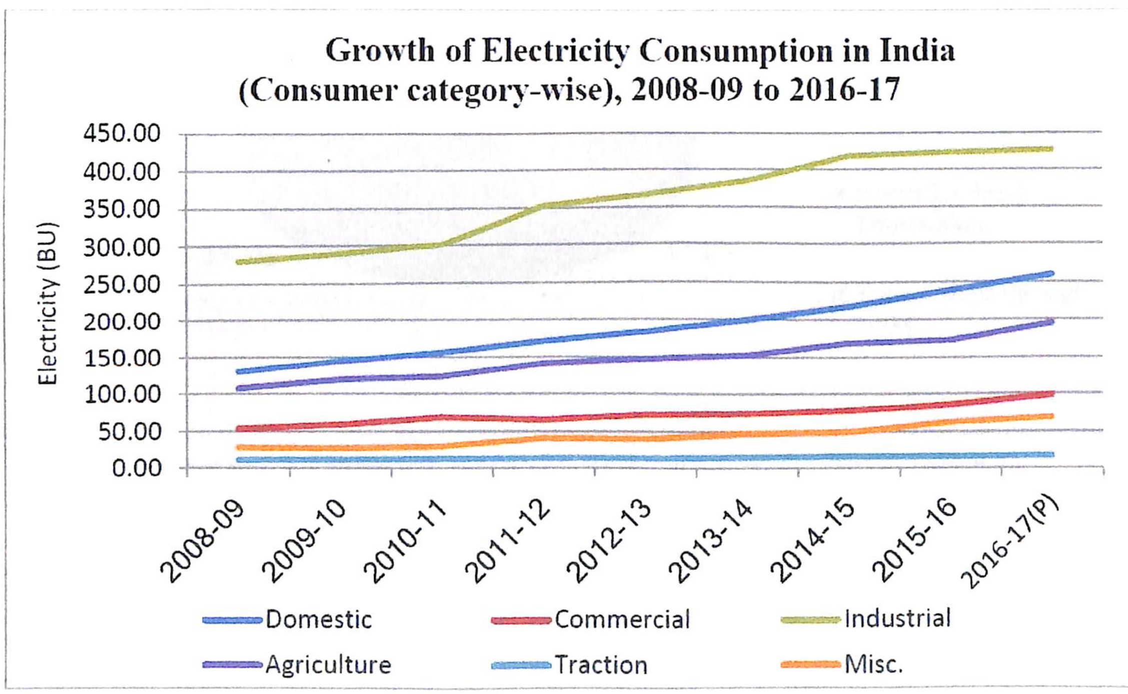


Fig. 16: Growth of Electricity Consumption in India

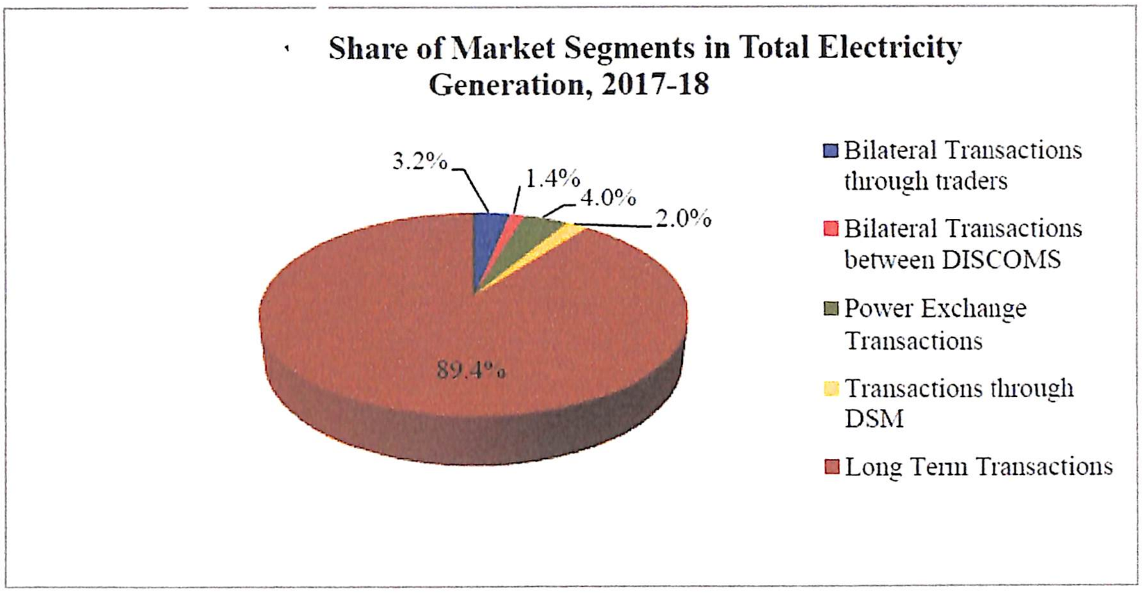


Fig. 17: Share of Market Segments in Total Electricity Generation , 2017-18

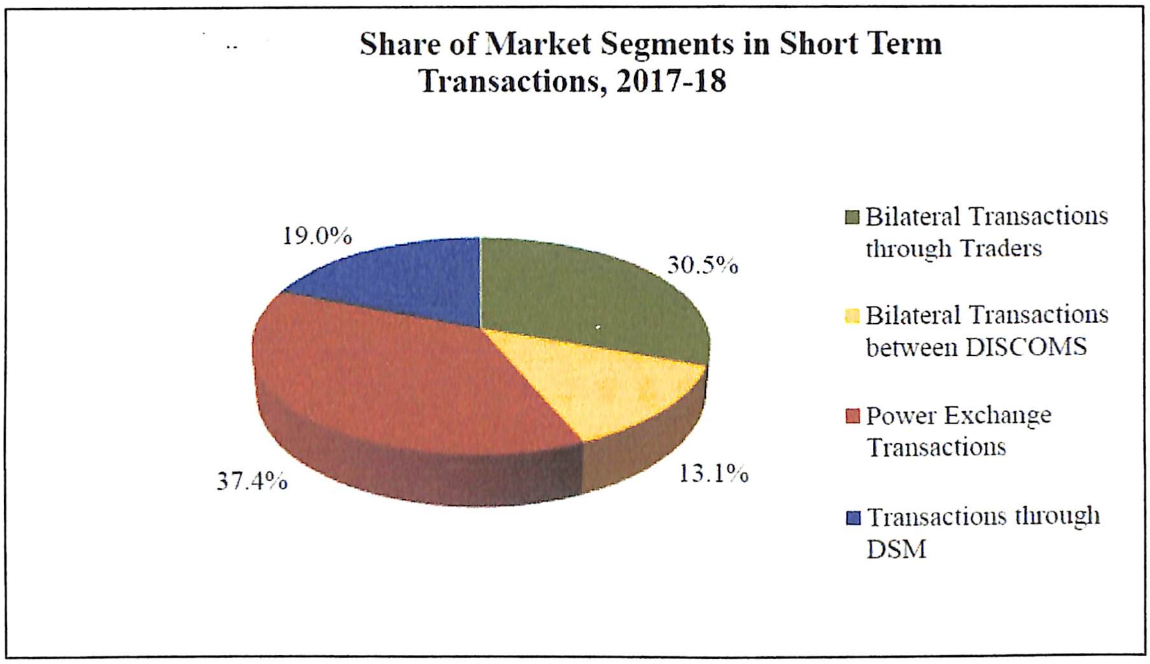
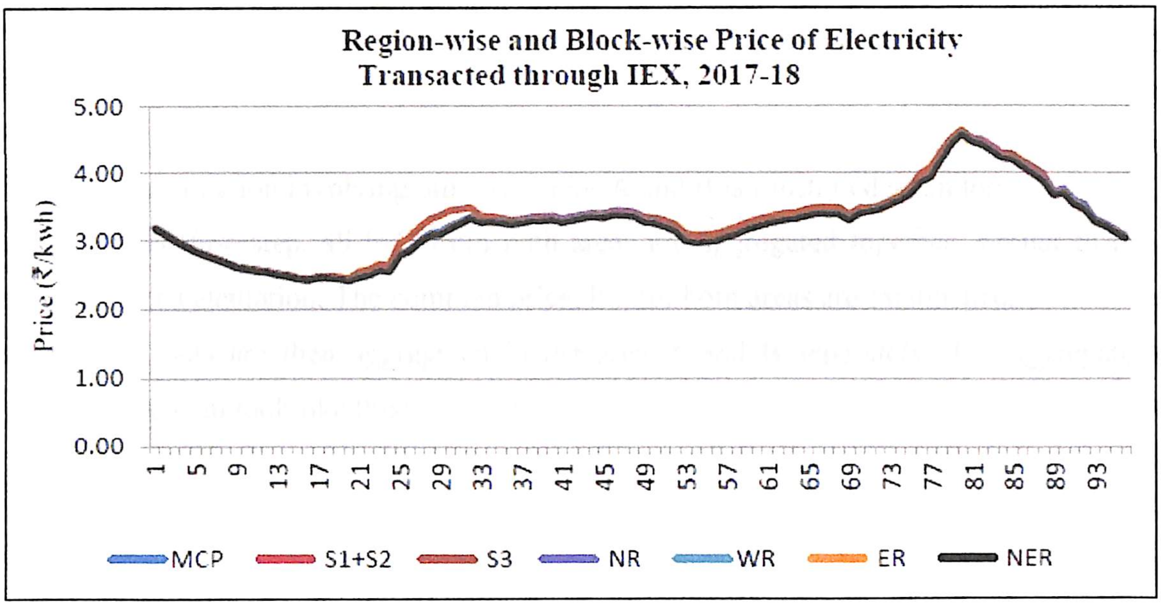


Fig. 18: Share of Market Segments in Short Term Transactions, 2017-18



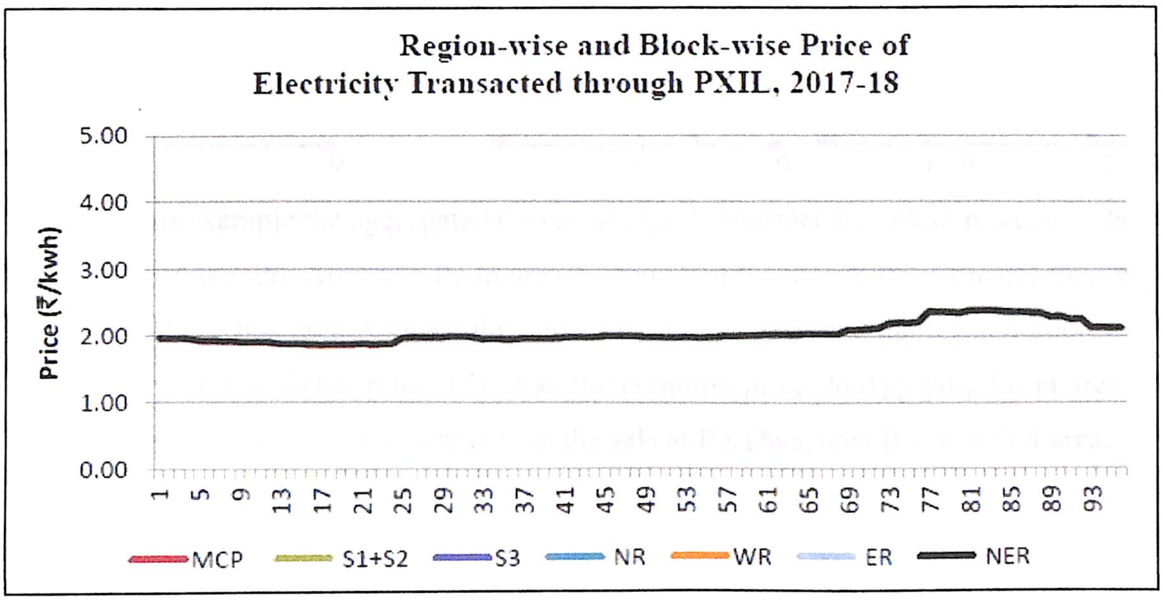


Fig. 19: Region wise and Block wise Price of Electricity Transacted through IEX and PXIL, 2017-18

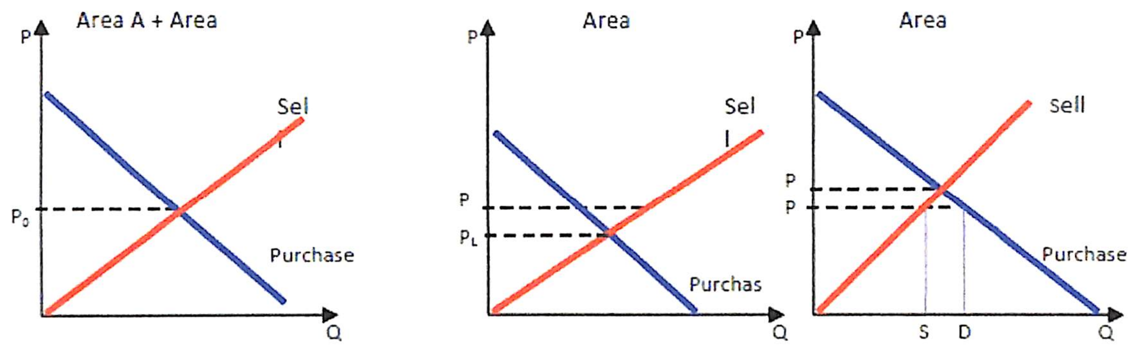
Market Splitting:

Market splitting is an evolved form of implicit auctioning wherein energy component and corresponding transmission capacity between bid areas are traded simultaneously. In the market splitting methodology areas on either side of congested corridor are identified separately and initially both are cleared as if there is no interconnection between the areas, and then the area which has highest price, draws electricity from the area with the lower price just as much as the capacity of the congested line will allow. Allowing this flow into higher price area will reduce prices in the higher price bid area and would increase prices in the lower price bid area depending upon the bid prices in the respective areas.

For a simple situation involving only two areas A and B is illustrated as under:

In the first step, all bids from both areas are aggregated together, similar to the System Price calculation. The common price, Po, for both areas are established.

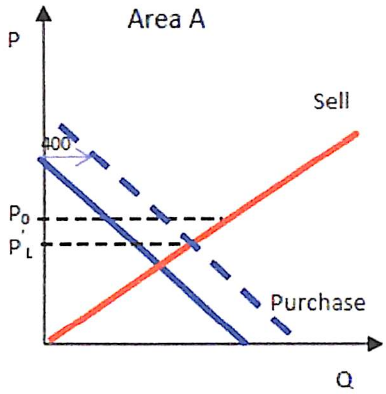
The bids are then aggregated in the area A and B separately. The aggregated curves could then look like this:

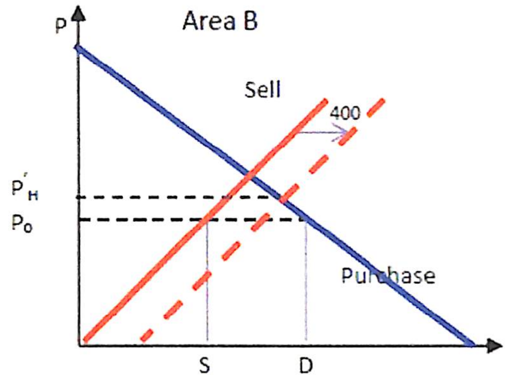


In this example the aggregated curves of area A intersect at a lower price, PL, than the common price, Po. Applying Po in area A show that the sale at Po is greater than the purchase at Po. Thus area A is surplus area. On the contrary, the aggregated curves of area B intersect at a higher price. PH, than the common price Po.Applying Po in area B show that the purchase at Po is greater than the sale at Po.Thus, area B is a deficit area.

At this step, the transmission capacity is introduced in the Area Price calculation process. The power flow will always be form the surplus area to the deficit area, thus the transmission capacity from A to B will be used. The needed capacity is simply the difference between sale So and purchase Do at price Po in the deficit area. Assume that So=2000 and Do=2600, giving a difference of 600. If the available capacity from A to B is 600 or higher, the resulting area prices in both A and B will be Po.

If the available capacity from A to B is 0, the area prices will be PL in are A and PH in area B. If the available capacity is anywhere between 0 to 600, e.g. 400, the available capacity is added to the purchase curve in the surplus area (A) and to the sale curve in the deficit area (B). This result in a parallel displacement of these curves, as shown below:





The area price will now be set at the intersection of the sale curve and displace purchase curve in area A, and at the intersection of the displaced sale curve and the purchase curve in area B. The transmission capacity is utilized so that the power flow exactly equals the available capacity. As a consequence of this, the area prices in A and B are leveled as much as possible. P'H, P'L are the new intersection points on movement of demand / supply curves. The difference between PH and PL is now lesser than it otherwise would have been if no power flow is possible between area A and area B) In case there is no constraint, price in area A and area B will be equal,

The Area Price calculation in now complete, including the congestion management described above. The main objective of the concept is fulfilled:

- All grid constraints are relieved
- The available capacities are fully utilized
- The sale-purchase balance requirement is satisfied in both areas (at different price levels).

6. CONCLUSION AND SCOPE FOR FUTURE WORK

Open access is being looked at with eyes full of expectations by market developers, there is a still a long and circuitous road to be covered for the dream to be fulfilled. The issues mentioned in the report are significant and need considerable attention. Moreover , lack of transmission corridors to make inter-regional open access feasible in the southern states may take long time to be taken care of. Many of the transmission projects are still under planning phase which may take at least a decade to be completely implemented because of various hurdles like the ROW issue.

During the past decade, a lot of generation capacity has been added to the Indian Power sector. And now it looks like the regulatory commissions are trying to optimise the usage of power markets and develop new opportunities for better functioning of distribution companies this new approach of regulators which has been indicated through new terms and conditions for tariff for 2014 -19 is being taken as a cure for financially sick distribution utilities and also as an optimising tool for insufficient generating utilities.

As Housing Infrastructure Development Finance Corporation (HDFC) chairman Mr. Deepak Parekh said, "India's power sector is a leaking bucket; the holes deliberately crafted by various stakeholders that control the system. The logical thing to do would be to fix the bucket rather than to persistently emphasise shortages of power and forever make exaggerated estimates of future demand. Most initiatives in the power sector are nothing but ways of pouring more water into the bucket so that consistency and quantity of leaks are assured.'' This statement is reality today, the current generation capacity of India reached 225133,11 MW and expected generation addition for 2013-14 is 18,432 MW. The growth in generation capacity addition from 2012-13 to 2013-14 is 11.65%. Also the energy requirement of India is also increasing, the energy requirement in the country is projected to grow at a CAGR of 7.5% during 12th plan period. After the huge capacity addition in past few years there is huge deficit in different region of India, as per CEA report except the eastern one would face an energy shortage. This would vary from 1.2 per cent in the western region to 19.1 per cent in the southern one. Peaking shortages in the northern, southern, and north-eastern regions would be 1.3, 26.1 and 10 per cent, respectively. This huge deficit in southern and north-eastern region is due to the transmission constraint between ER-SR and NER-SR region. Due to inter-regional transmission constraints between the NEW Grid and SR Grid, the overall average anticipated peak shortage of the NEW+SR Grid works out to 6.2 per cent.

As the eastern region has rich coal blocks the power developers invest to build large size Thermal power plants in this region and also due to low demand the eastern region become power surplus. But the bulk power from eastern region is not transfer efficiently to power deficit other regions due to transmission constraint. This make the available resources under utilized. About 2,000 Mw capacity of independent power projects likely to be commissioned during the year 2013-14 is not yet linked with any entity. Also the it is hard for generating companies to sell power to open access consumers in Intra state trading in states like Odisha. The cross subsidy surcharges of some states are very high and also due to the intra state transmission constraint the generating companies struggle to sell there power in medium term and short term basis on power market. This reduce the Plant Load Factor (PLF) of the generating units and the asset and resources of generating units are under utilized. Also in exchange the clearing volume of power is less as compare with buying and selling bid put by the seller and buyer. In Power Trading also the price in southern is much higher than the price of power in new grid this encourages the generating companies to sell power in southern region. But due to transmission constraint and bad financial condition of state utilities power trading is not much effective.

The central government should take necessary steps to strengthen the transmission capacity with help of public-private partnership in transmission sector. Also the state government and the central government should put proper strategy to improve the financial condition of state utilities. And also the state governments and central government put proper laws and frame work to allow open access and encourage supplier and buyers to trade through medium term and short term power market. This will encourage investor to invest in Indian Power Market and will help to bring growth in Power Sector.

Recommendations

1. Implementation of Smart Grid technology can attribute important role in energy scenario. Smart Grid refers to electric power system that enhances grid reliability and efficiency by automatically responding to system disturbances.

Smart Grid will access to 'electricity for all'

- Reduction of transmission and distribution
- Reduction in power cuts
- Improvement in power quality
- Renewable integration
- Standards for smart appliances-energy efficient and disaster recovery (DR) ready
- Increase in inter-regional power exchange capacity
- Wide area monitoring
- Efficient Power Exchanges
- Training and capacity building in utilities and in the industry to build, operate and maintain smart grid systems and application.

2. Energy Portfolio Management (EPM) provides a comprehensive offering of information, advisory, and software applications to support energy market participants and market operators to assess infrastructure investments such as new power stations and transmission lines as well as provide critical information and systems to support energy operations. EPM improves mission critical investments, trading, and operations decisions. EPM has four integrated offerings for its customers:

- Market intelligence services: historical, real-time and forecasted critical energy information
- Energy consultants who provide market advisory services
- Market analytics software
- Commercial energy operations software

To support critical energy investment decisions and to support efficient energy operations across planning, forecasting, trading, portfolio optimization and market operations.

Check back regularly for updated market insights, events, whitepapers, webinars, and other information to keep you abreast of energy market activity.

Good business decisions require good intelligence. Energy executives, planners and analysts constantly evaluate energy markets to understand the effects of tightening regulations, resource constraints, market volatility and environmental pressures. But with the complex nature of today's energy markets, the process of gathering, modeling and analyzing data, to produce good intelligence, is a monumental, resource-intensive task. What they need is a trusted advisor with tested models and rigorous data to help them analyze changes in the energy market and assess risks to their portfolio.

3. Power Market Analysis Solutions Provider

Energy markets are becoming increasingly complex. There are certain companies that provides solutions allow our customers to stay abreast of the market, forecast electricity and fuel prices, plan, value assets and manage organizational risk in order to improve their operational and financial performance.

These are leading provider of these solutions, offers the industry's most rigorous data and intelligence, forecasting software and independent market analysis. Offered solutions are used by industry leaders in the utility, independent power producer, finance and regulatory sectors to analyze, optimize and execute critical investment decisions.

Tools provided are powerful enough to span the time frames needed to support business decision making: from long-term strategic decisions, scenario and risk analysis, dashboard and interactive reporting and market intelligence, through to on-the-day portfolio analysis and optimization, communications and settlement.

4. Indian power exchange market is in a nascent stage compared to the developed world but it is developing in line with market models for power market in the world. It should expand its operations to enhance efficiency for delivering electricity in a cost effective manner to fulfil the national objective of Power for All, 24 x 7.

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