

India as single bidding zone

1. Development of Indian Grid and Markets

Presently, Indian electricity grid operates as “one nation-one grid-one frequency”. In 1960s, the development of five Regional grids viz. Norther Region (NR), Western Region (WR), Southern Region (SR), Eastern Region (ER) and North-Eastern Region (NER) was taken up in India. For the formation of National Grid, the Regional grids were first interconnected through HVDC links for controlled power flow and later on with Inter-Regional AC links. Interconnection of various regions by Inter-Regional AC lines started in 1990 and was completed in 2013 leading to formation of One Nation One Grid, which is one of the largest synchronous grid in the world.

The Indian power sector has grown tremendously over the span of a century. The various milestones in the evolution of the development of the grid and markets in India are mentioned below.

- 1948 – Electricity (Supply) Act 1948 - Formation of State Electricity Boards (SEBs) with full powers to control generation, distribution and utilization of electricity within their respective states and Central Electricity Authority (CEA) for planning and development of power system
- 1964 – Five Regional Electricity Boards (REBs) were formed by the Government of India with the concurrence of State Governments with a view to ensuring integrated grid operation and regional cooperation on power. There were five (05) Regional Grids operating in the South, West, North, East and North-East. Each of the regional grids was governed by a Regional Electricity Board.
- 1970, Regional Load Despatch Centers (RLDCs) were established in each region by CEA for operational control of the regional electricity grids.
- 1989 – National Power Transmission Corporation (NPTC) Limited was formed on 23rd October 1989 under the Companies Act, 1956 (renamed as Power Grid Corporation of India Limited in October 1992) and assigned the responsibility of the planning, executing, owning, operating and maintaining the high voltage transmission systems in the country
- 1998 – Electricity Regulatory Commission Act 1998 was enacted paving the way for the formation of Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions (SERC). This led to a robust regulatory framework on which the rapid growth of transmission grid and markets were possible in the next decades.
- 2000 – Indian Electricity Grid Code (IEGC) was approved by CERC.
- 2003 – Electricity Act 2003 enacted by the Parliament. This Act repeals the Indian Electricity Act 1910, Electricity supply Act 1948, Electricity Regulatory Commission Act 1998. The major

features impacting grid development and power markets of the Electricity Act 2003 are as follows –

- Recognizing trading as an independent activity.
- Open access in transmission facilitating multi buyer -seller model.
 - Open access to consumers having demand above one MW within five years from the date of enforcement of Electricity (Amendment) Act 2003
- 2007 – Guidelines were issued by CERC for grant of permission for setting up and operation of Power Exchange. In 2008 the two power exchange became operational in India.
 - 2010 – CERC (Power Market) Regulations were introduced with a focus on operations of Power Exchanges.
- 2011 – Competitive bidding for ownership and establishment of inter-State transmission schemes unleashed the private sector energies and led to ramped up investment in transmission. The transmission charges sharing model in India gives the business of transmission developer a regulatory certainty for future revenues.
- 2022- CERC introduced framework for General Network Access (GNA). Development of transmission system is now linked to planned growth in generation and demand and not limited to contracts for power. GNA is a more market friendly approach in open access rather than undertaking construction of transmission system only if there is firm users requisition such construction

2. Power Markets

The electricity market in India can be classified based on the time horizons for which contracts are entered into for power purchase by buyers (mostly Discoms). Contracts for 7 years or more (upto 25 years) are classified under long-term market, 1 year to 5 years contracts are classified as medium-term market and upto 1-year contracts are classified as short-term market. Most of the generation capacities are tied up in long term and medium-term market (~ 88%) and the rest (~ 12%) is transacted in the short-term market. Long term and Medium-term contracts have traditionally been entered into based on bilateral Power Purchase Agreements (PPA). However, in the short-term market, procurement is done either through bilateral route (OTC route), or through Power Exchanges. Other than Distribution Companies, bulk consumer and captive power plants also transact electricity through market. The power under these contracts is delivered through the national grid with proper accounting of generation and consumption by the system operators (NLDC/RLDC/SLDC) as per the respective contracts between seller and buyer. Any deviation in generation or consumption is settled through a balancing mechanism i.e. deviation settlement mechanism specified by the Central Electricity Regulatory Commission

(CERC).

As regards Power Exchanges, India has adopted voluntary market model with room for multiple Power Exchange operating at the national level (whole Indian geography) subject to permission granted by CERC. Presently there are three power exchanges operating in India namely Indian Energy Exchange (IEX), Power Exchange of India Limited (PXIL) and Hindustan Power Exchange (HPX) in whole of India. These Power Exchanges are governed by the regulations of CERC. IEX and PXIL are operating from June 2008 and HPX has started operations in 2022. Power Exchanges offers various contracts for physical delivery of electricity in different time-period from real time (1 hr ahead) to 90 days ahead contracts which are further classified into Conventional and Green (Renewable energy) contracts. The exchanges are discovering the prices & clearing volume and carrying out physical & financial settlement of transactions taking place at their platform as per the CERC Regulations. The contracts at Power Exchanges are broadly categorized into collective transactions (GDAM/DAM/HP-DAM/RTM) & bilateral transactions (TAM/ GTAM).

Power procurement contracts under Long Term and Medium Term are likely to be scheduled under GNA, which has higher precedence over contracts scheduled under T-GNA in case of transmission constraints/grid security issues. Within T-GNA, bilateral transactions are curtailed first followed by collective transactions under Day Ahead Market (DAM), followed by Green Day Ahead Market (GDAM) followed by collective transactions under real time market (RTM). Therefore, a Long Term PPA has the highest priority of dispatch.

The contracts transacted on the Power Exchanges are physically delivered through inter-state and intra-state transmission systems. National Load Dispatch Centre (NLDC) is the nodal agency providing transmission access to the power exchanges. NLDC is the system operator in India at the national level. The overall market at the exchanges constitutes approx. 6.3% of the All-India consumption and was to the tune of around 102.95 TWh during FY 22-23. Of this around 70% was traded through collective transactions (pooled collective transaction) [DAM/RTM] and the remaining 30% through bilateral transactions. Price discovery in pooled collective transactions (DAM, RTM) is for each 15 minutes block totaling to 96 blocks in a day.

3. Continuous investment in transmission Capacity to provide congestion free power market

Congestion for the volume of electricity transacted through power exchanges has reduced to a great extent since National grid integration in December 2013. India has massively invested in its transmission system for competitive congestion free power markets. As on May 2024, the National Grid comprises of 4, 85,935 circuit km (ckm) of transmission lines with 12, 57,305 MVA transformation capacity at 220 kV and above levels. The strength of the national grid allows to meet peak demand of about 250 GW. The growth of transmission and transformation

capacity over the years is given below:-

End of FY	Cumulative transmission line length-220 kV and above (ckm)	Cumulative Transformation capacity-220 kV and above S/s (MVA)
2012	257481	409551
2017	367851	740765
2022	456716	1104450
2023	471341	1180352
2024	485544	1251080

Because of such huge transmission capacity addition, there have been very few instances in the power market when any volume is lost owing to congestion and the congestion remains at a level of around 0.02% in FY 2022-23. The congestion faced by the power exchanges in last 5 years is as below: -

Year	Unconstrained Cleared Volume (BU)	Actual Cleared Volume and hence scheduled* (BU)	Volume of electricity that could not be cleared due to congestion (BU)	Volume of electricity that could not be cleared as % to Unconstrained Cleared Volume
2017-18	45.86	45.65	0.21	0.5%
2018-19	50.69	50.22	0.47	0.9%
2019-20	49.36	49.16	0.20	0.4%
2020-21	70.13	70.09	0.04	0.06%
2021-22	86.09	86.01	0.06	0.09%
2022-23	79.39	79.37	0.02	0.02%

Effectively, it implies that only one price is discovered in the Power Exchanges for whole of the country for more than 99.98% of the transacted volume. Therefore, India serves as one bidding

zone, except for some minor moments of market congestion.

4. Policy initiatives to promote 100% generation from Renewable Energy Project

India is continuously creating policy enablers to ensure that renewable energy generation and consumption is prioritized in line with its global commitments. In line with this, the Ministry of Power has issued the Electricity (Promotion of Generation of Electricity from Must Run Power Plants), Rules 2021. A wind, solar, wind-solar hybrid or hydro power plant (in case of excess water leading to spillage) or designated sources, which has entered into an agreement to sell the electricity to any person, shall be treated as a must-run power plant. A must-run power plant shall not be subjected to curtailment or regulation of generation or supply of electricity on account of merit order dispatch or any other commercial consideration. Therefore, a must run plant supplying under long term PPA (GNA based) has the highest priority of dispatch among all contracts.

5. Electricity Pricing and India as Single Bidding Zone

The electricity had traditionally been priced at cost plus principles in the country, but during the last one decade, the trend has shifted to tariff determination/adoption on competitive basis- a procurement method under section 63 of the Electricity Act 2003. The norms for tariff are prescribed by the Regulatory Commissions at the Central and State levels. Around 88% of total power consumption in the country is transacted through PPA route i.e. under long term and medium term agreements. Remaining 12% is under the short-term route i.e., less than one-year agreements including those through power exchanges also. Within the short-term market, around 53% (FY23) is through power exchanges while rest is through bilateral transactions which have different prices as per arrangement between the parties. Only one price is discovered in the Power Exchanges for whole of the country for more than 99.98% of the transacted volume.

Therefore, India serves as one bidding zone, except for some minor moments (around 0.02% only) of market congestion.
