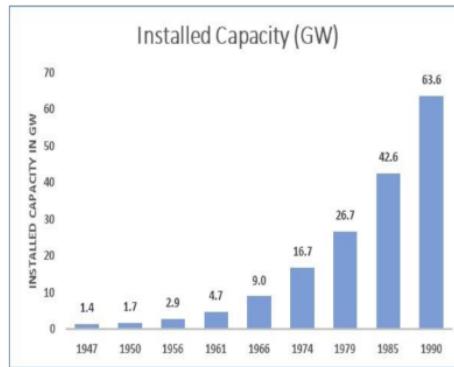


1. Pre-Historical Background:

1.1 Pre-Liberalization Era:

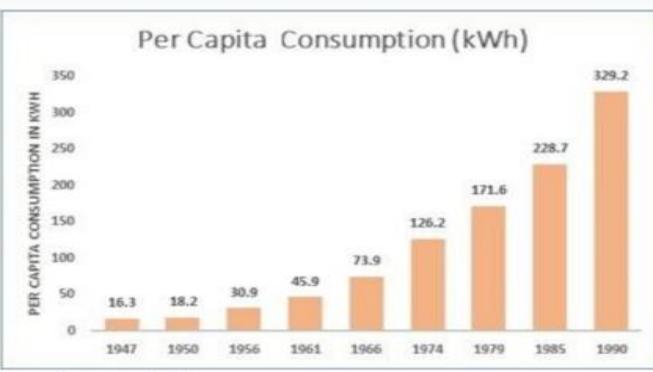
At the time of independence, the Indian electricity sector was very small with an installed capacity of 1.4 GW and was largely controlled by private companies and limited to big cities & industrial centres. The erstwhile State Electricity Boards (SEBs) were formed in 1950s under the provisions of Electricity Supply Act 1948 to supply electricity across the State. SEBs functioned as state owned vertically integrated utilities managing the entire value chain i.e., generation, transmission, and distribution of electricity within the state. As the SEBs were operating under State Energy Department, many important decisions relating to investments, budgetary support, appointments, tariffs etc. were taken by the State Government. During the period 1950-1980s, the SEBs were effective in meeting the growing demand of the country with their economies of scale and scope.

There was a commendable growth in the generation capacity, transmission & distribution network, per capita energy consumption, agricultural pump etc. There was also significant development in technological capabilities and the availability of skilled personnel in the sector. As a result, during the period 1947-



1990, the installed capacity grew from a meagre 1.4 GW to 63.6 GW and the per capita consumption grew from 16 kWh to 330 kWh showing an impressive year-on-year growth of 9% and 7% respectively.

However, during early 1990s it was realized that due to operational inefficiencies and excessive interference of the Government bodies these SEBs had become loss making entities with hardly any capital available for financing the capacity addition required to meet the growing demand of the country. The SEBs were unable



to generate adequate resources to sustain development and growth in the sector owing to poor operational efficiency, high tecno-commercial losses, inadequate tariffs, and political compulsions viz. supplying free power to agricultural consumers, cross-subsidization amongst different segments of consumers etc. The increase in dues from the SEBs to the Central Power Sector Undertakings (CPSUs) aggravated the problem of capacity addition in the sector as even the CPSUs were stretched to meet the targets. The energy deficit (11.5%) and peak deficit (~18%) rose to unsustainable levels during 1996-97.

According to various reports, the inefficiencies of SEBs were mainly due to:

- Unsatisfactory operational efficiencies, with poor availability of thermal plants
 - High transmission and distribution losses substantially higher than normal technical standards, with a high component on non-technical losses, accounted for by poor/inadequate metering and high incidence of theft of energy.
 - Poor billing and collection, because of incorrect reporting and billing, and inadequate collection efforts, tampering with meters and misreporting in collusion with consumers.
- Unmanageable size and monolithic structure, making it unwieldy, inefficient and unresponsive to change manpower as well related problems, poor productivity, low skills and lack of training for up gradation, low motivation levels. (Planning Commission Report, 2001 & 2002)

Several institutions advising the government provided suggestions in line with the Liberalisation, Privatisation and Globalisation approach of the government in the 1990s. The inability of state utilities to raise finances was considered as the main problem, and privatisation was suggested as the solution to address all ills of the sector. This was in accordance with other energy sector policies during this period, such as efforts to encourage private participation in oil and gas exploration and production. Reform measures were implemented with this understanding from the 1990s and continue to this day.

1.2 Post liberalization and Enactment of Electricity Act 2003:

The **first phase** of reforms began in 1991 with the introduction of Independent Power Producers (IPP) paradigm. In order to attract investments for capacity addition, the generation business was initially liberalized in 1991, and the private players including foreign investors were allowed to set up generating stations. Further, under the Mega Power Policy 1995, generating station with capacity greater than 1000 MW were allowed fiscal incentives viz. tax holidays, exemption from customs duty, hassle free clearance etc. This was broadly in alignment with the liberalization-privatization-globalization (LPG) policies adopted by the Government of India in response to the then prevailing economic and political conditions. Later a Common Minimum National Action Plan for Power (CMNAP) was also adopted in 1996 to bring comprehensive reforms in the sector wherein the measures viz. finalization of national energy policy, establishment of central regulatory authority, minimum tariff for agricultural consumers, private participation in distribution & transmission, compulsory energy metering & auditing etc. were considered.

Further, to reduce the Govt. interference in the day-to-day operations of SEBs, Electricity Regulatory Commission Act was passed in 1998 and independent regulatory commissions were constituted to determine the tariff on commercial principles and monitor the performances of the utilities. In the meantime, with the support of multilateral organizations viz. World Bank, Department for International Development (DfID) etc. some of the states like Odisha embarked upon structural reforms by unbundling their vertically integrated SEBs into

Generation, Transmission, and distribution companies to improve their operational efficiencies which became blueprint for the power sector reforms in the country.

Odisha was the first state to enact the comprehensive power sector reform in 1996. As part of the reform, the state established an independent regulatory commission, unbundled the SEB into separate generation, transmission and distribution utilities and eventually privatized the distribution utilities. The state was in dire need of reforms with its performance reaching all-time low. During 1994-95, the peak shortages were around 37%, PLF of state gencos was around 29%, tariff was around 71% of the cost and it was incurring huge financial losses. The financing requirement of the sector was estimated to \$ 995 million which the World Bank agreed to provide as a loan provided the state reform their power sector. Having experienced success in restructuring the electricity industry in the Latin American countries viz, Argentina, Chile, Brazil etc., the World Bank put forth power sector reforms as a necessary condition for future assistance to power sector. As a part of the reform process, Odisha Electricity Regulatory Commission (OERC) was formed under Odisha Electricity Reform (OER) Act in 1995. The OSEB was restructured in Odisha Power Generation Corporation (OPGC), Odisha Hydropower Corporation (OHPC), Odisha Power Transmission Company Limited, and Grid Corporation of Odisha (GRIDCO). Subsequently four Discoms namely CESCO, WESCO, NESCO and SOUTHCO were carved out of GRIDCO and privatized in 1999. GRIDCO was assigned the responsibility for bulk purchase and sale of power on behalf of all the Discoms.

Notwithstanding the reforms undertaken by both Central and State Government, the sector continued to face challenges viz. inadequate capacity addition, poor operational efficiency, financially unviable entities etc. Although the IPPs evinced interest for adding generation capacity, only around 6500 MW was added during the eighth and ninth five-year plans (1992-2002). The average rate of return of SEBs reduced to minus 44.1% in 2001-2002 from minus 12.7% in 1992-93 (World Energy Council Report, 2002). However, the reforms initiatives undertaken during the decade paved the way to enact the Electricity Act (EA or "Act") 2003 which is much more comprehensive and a landmark legislation for the sector. The EA 2003 replaced the earlier legislations namely Indian Electricity Act, 1910, the Electricity Supply Act 1948 and the ERC Act, 1998.

The EA 2003 seeks to create a liberal and transparent framework for the development of the power sector. Competition with regulatory oversight are the cardinal principals around which the entire Act is woven. The Act provides for competition to encourage efficiency in performance and regulatory oversight to protect the interest of all the stakeholders with special emphasis on protecting the consumers and ensuring recovery of costs for the investors. The Act entails encouraging private sector participation in generation, transmission and distribution with the role of the Governments being relegated to policy maker in nature. The important provisions targeted towards bringing competition in the sector which eventually led to development of electricity market are highlighted below:

- **Re-organization of SEBs:** State Governments are mandated to re-organize SEB into corporate entities across different functions namely Generation, Transmission and Distribution so that the inefficiencies across these segments can be clearly identified and addressed (Section 131).
- **De-licensing of Generation Business:** Any generating company could establish & operate a generating station without requirement of a license subject to compliance with the technical standards relating to grid connectivity etc. (Section 7)
- **Trading recognized as a licensed activity:** Trading of electricity is considered as a separate licensed activity with appropriate regulatory commissions authorized to stipulate the licensing conditions and supervise the functioning of trading licensees (Section 14).
- **Open Access to T&D Network:** Consumers with a load of 1 MW and above are permitted to source their power from other than the incumbent distribution licensee by accessing the T&D network in a non-discriminatory manner (Section 40 & 42).
- **Power procurement on competitive basis:** Distribution companies are mandated to procure power through transparent bidding process in which case the tariff discovered shall be adopted by the Appropriate Commission (Section 63).
- **Development of Electricity Market:** Appropriate Commission is mandated to promote the development of electricity market and shall be guided by the National Electricity Policy (Section 66)

2. Development of Electricity Market

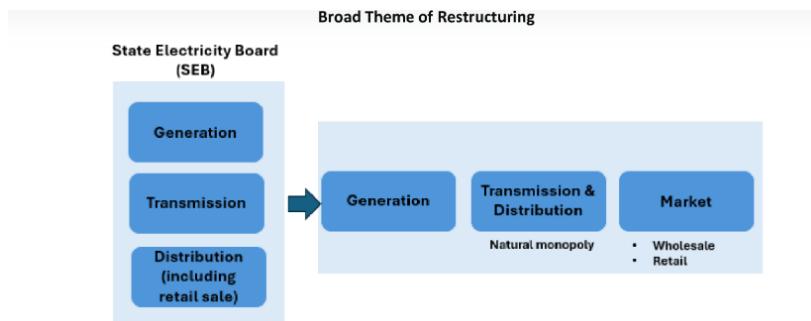
2.1. Key Initiatives

As mandated under the Electricity Act 2003, both Central & State Govt. along with Regulatory Commissions have taken several initiatives (some of these were undertaken prior to the notification of EA 2003) to promote competition in the sector. Some of the key initiatives taken which led to development of wholesale electricity market are discussed below:

2.1.1 Restructuring of SEBs:

Beginning from late 1990s, the States restructured and corporatized their vertically integrated SEBs along different functions i.e., Generation, Transmission and Distribution. The objective was to break the SEBs into manageable entities and, wherever possible, improve efficiency through competition and private participation. Generation business considered to be amenable to competition got de-licensed i.e., anyone could set up a new generating station subject to meeting the techno-economic requirements viz. safety standards, environmental clearance, pollution control etc. whereas the Transmission and Distribution businesses being natural monopolies were licensed and regulated by the independent regulatory commissions.

The broad approach towards restructuring of SEBs in India was influenced by the restructuring exercises carried out by many other developed countries in Europe where the electricity services were initially provided by state owned monopolies; however, realizing the inefficiencies involved in such an approach, allowed restructuring and privatization of the sector.



Almost all the States have restructured their SEBs into Generation (Genco), Transmission (Transco) and Distribution Company (Discom). Some of the larger States viz. Uttar Pradesh, Gujarat, Rajasthan, Andhra Pradesh, Odisha etc. have formed multiple Discoms. Some States viz. Uttar Pradesh, Rajasthan, Gujarat, Odisha etc. have also created an entity or division for bulk purchase and sale of electricity on behalf of State owned Discoms. States like Delhi and Odisha have privatized their Discoms. The present Discom structure is provided below:

Structure of Discom post SEB restructuring

Vertically Integrated-Power Department	Transmission separation-GEDCO (Generation & Distribution Co)	Unbundled with Single Public Discoms	Unbundled with Multiple Public Discoms and/or Private Licensee / Franchisee	
Arunachal Pradesh	Himachal Pradesh	Assam*	Andhra Pradesh/ Telangana	Maharashtra**
Goa	Kerala	Chhattisgarh	Bihar	Odisha**
Jammu & Kashmir ¹	Manipur	Jharkhand ²	Delhi ³	Rajasthan*
Mizoram	Punjab	Meghalaya*	Gujarat**	Uttar Pradesh**
Nagaland	Tamil Nadu	Uttarakhand	Haryana	West Bengal**
Puducherry	Tripura*		Karnataka	
Sikkim			Madhya Pradesh*	

*Indicates presence of private franchisee model; # indicates presence of private licensee model,
I&K's GENCO was set up as a private limited company.

2.1.2 Independent Regulatory Commission:

The Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions (SERCs) were formed initially under the provisions of Electricity Regulatory Commission 1998 (ERC Act, 1998). CERC was formed at the Centre to regulate the entities functioning at the national level viz. CPSUs like NTPC, NHPC, and Powergrid, composite IPPs selling power to multiple States etc. whereas the SERCs were formed at the State to regulate the entities functioning within the State. Initially the Regulatory Commissions were mainly assigned with the role to determine the tariff; however subsequently with the enactment of Electricity Act 2003 wide powers were delegated to them. The Regulatory Commissions are required to grant licenses, determine tariff, monitor performances, adjudicate disputes etc. The Regulatory Commissions are also required to take measures to promote competition in the sector through development of market. As mandated under the Act, the States have constituted their respective SERCs. The power sector of the state of Goa and Union Territories are regulated by Joint Electricity Regulatory Commission (JERC). Similarly, there is also a JERC for the states of Manipur & Mizoram.

Functions of CERC

Electricity Act 2003 under section 79 has specified the functions of CERC. The Act under Section 178 has also provided the list of the matters on which CERC can frame Regulations. The functions of CERC provided under Section 79(1) of the Act are follows:

- To regulate the tariff of Central Generating Stations & Generation under composite scheme
- To regulate & determine the tariff for inter-state transmission of electricity.
- To issue licenses for inter-state Transmission & Trading of electricity
- To adjudicate upon disputes involving generating & transmission pertaining to tariff etc.
- To specify Grid Code
- To specify & enforce the performance standards of licensees.
- To fix the trading margins in inter-State trading of electricity

The Hon'ble Supreme Court of India in the matter of CERC Vs. PTC in Civil Appeal No. 3902 of 2006 while dealing with the functions of the CERC observed that:

"...under the Act, the Central Commission is a decision-making as well as regulation-making authority, simultaneously. Section 79 delineates the functions of the Central Commission broadly into two categories – mandatory functions and advisory functions. Tariff regulation, licensing (including inter-State trading licensing), adjudication upon disputes involving generating companies or transmission licensees fall under the head "mandatory functions" whereas advising Central Government on formulation of National Electricity Policy and tariff policy would fall under the head "advisory functions". In this sense, the Central Commission is the decision-making authority. Such decision-making under Section 79(1) is not dependent upon making of regulations under Section 178 by the Central Commission. Therefore, functions of Central Commission enumerated in Section 79 are separate and distinct from function of Central Commission under Section 178. The former is administrative/adjudicatory function whereas the latter is legislative."

2.1.3 Power procurement through Competitive Bidding Mechanism:

Electricity Act 2003 provides for power procurement on competitive basis in which case the appropriate Regulatory Commission is required to only adopt the tariff discovered under Section 63 unlike the tariff determination done under Section 62 based on prudent norms. In order to promote competition in the wholesale market, the Central Govt. through the National Tariff Policy 2006 mandated the Discoms to meet any new power procurement only through competitive bidding after 2011. The Central Government issued the tariff based competitive bidding guidelines in the year 2005 providing for conducting the competitive bidding for procurement of power on long and medium-term basis on DBFOO (Design Build Finance Operate Own) model. The power could be procured competitively on Case 1 (where the location, technology or fuel is not specified) or Case 2 (location and fuel is specified) basis. The power procurement through competitive bidding resulted in significant capacity addition by the private sector. Subsequently, the Central Govt. also issued the bidding guidelines for

procuring power on a short-term basis in 2012 amended from time to time for procurement



Introduction to Electricity Market & Power Exchanges

of power for more than 1 day and up to 1 year. However, the transactions on the Power Exchanges which are short term in nature are excluded from the ambit of the short term bidding guidelines owing to the inherent competitive nature of contracts at the Power Exchanges. For both medium- and short-term procurement, under the guidelines, the bidding takes place through the e-bidding platform known as DEEP (Discovery of Efficient Electricity Price) platform managed by MSTC Limited which is a Govt. Enterprise. Thus, the Discoms could procure power both through regulated tariff under Section 62 and on a competitive basis under Section 63 on long, medium and short-term basis.

2.1.4 Open Access to Consumers:

CERC framed the regulations for providing open access to inter-state transmission system across different time horizons i.e., long, medium- and short-term basis. Similarly, the SERCs framed the respective regulations for providing open access to the state distribution and transmission system. Central Transmission Utility (CTU) and National Load Dispatch Centre (NLDC)/Regional Load Dispatch Centre (RLDCs) are considered as the nodal agency for long & medium term and short-term open access respectively at the national level. Similarly, STU and SLDC are considered as the nodal agency at the state level. Based on the CERC Regulations, CTU and NLDC at the ISTS level and based on SERC regulations, STU and SLDC at intra-state level have issued their Detailed Procedures for obtaining open access in the concerned system. For an entity connected to the state system and seeking open access to the ISTS, it is necessary that it avails open access to the state system and also to the ISTS. The eligibility criteria for seeking open access is based on the threshold contract demand, the necessary metering infrastructure etc. to take open access in the inter-state transmission system subject to them having a consent from the respective SLDCs. SERCs have also specified other conditions required at the state level to obtain consent by the state connected entity seeking to avail open access. Further, CERC has specified the scheduling of such transactions in the Grid Code so that the transmission corridor is utilized in a fair, transparent, and optimal manner. It was envisaged that the open access will not only provide alternative avenue for the large commercial & industrial consumers but also impel the Discoms to improve the efficiency to retain the consumers.

Open Access in Transmission and Distribution system

Open Access under section 2(47) of the Electricity Act 2003 means the *non-discriminatory provision for the use of transmission lines or distribution system or associated facilities with such lines or system by any licensee or consumer or a person engaged in generation in accordance with the regulations specified by the Appropriate Commission.*

Inter-state Open Access is regulated by the CERC and is allowed to licensees or generating companies or the eligible consumers for use of the inter-State transmission system through General Network Access (GNA) and on payment of the applicable transmission charges.

Intra-state Open Access is regulated by the SERCs and is allowed to the eligible state connected entities for use of intra-state transmission system and the distribution system on payment of charges such as Cross Subsidy Surcharge (CSS), Additional Surcharge (ASC), Transmission charge, Wheeling charge etc. Other requirements vary from state to state in terms of No Objection Certificate, restrictions on minimum drawl of quantum and duration, uniformity of drawl across time blocks etc.

2.1.5 Trading Licensees:

Electricity Trading is a licensed activity under the Electricity Act 2003. As per EA 2003, Trading of electricity means purchase of electricity for re-sale thereof. The trading license is issued by the Central and State Electricity Regulatory Commissions as per the terms and conditions of the license specified by the respective regulatory commissions. While license issued by the CERC is valid across the country, that issued by the SERCs is valid for transactions within the states. Trading licensees are envisaged to facilitate transactions between buyers and sellers by reducing the information gap and assuming market related risks viz. default risk, late payment risk, contract dishonour risk, inflationary risks etc. for which they are allowed to levy trading margins from the buyers. Trading margins are regulated by the appropriate regulatory commissions. Presently there are 47 inter-state trading licensees playing the role of intermediaries in the electricity market.

2.1.6 Power Exchanges:

CERC issued the Guidelines for grant of permission for setting up and operation of Power Exchanges in 2007 under which the two Power Exchanges namely Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL) were established. Subsequently, CERC notified the Power Market Regulations 2010 which provided the broad principles for the functioning of Power Exchanges in the country. Power Exchanges are providing nationwide automated platform for trading of electricity on short term basis. There are various products available in the power exchange platform viz. Day Ahead Market, Real Time Market, Intraday, Day Ahead Contingency, and Term Ahead Market which is enabling the market participants to buy or sell electricity in a competitive manner. The participation in the Power Exchanges has increased over time which has increased both liquidity and efficiency of the trading platform. CERC has notified the Power Market Regulations 2021 keeping in view the recent changes taking place in the market. A third power exchange namely Hindustan Power Exchange (HPX) has started its operations in the year 2022. The detail functioning of power exchanges is discussed in the chapters below.

2.1.7 Independent System Operations:

Electricity Act 03 (check uniformity) provided for the creation of National Load Dispatch Centre (NLDC), Regional Load Dispatch Centre (RLDC) and State Load Dispatch Centre (SLDC) at the national, regional and state level respectively for integrated grid operations and optimum scheduling and dispatch of electricity. National Electricity Policy 2005 also laid emphasis on the independent system operations through NLDC, RLDCs and SLDCs. Initially the Indian power system was developed as 5 regional grids which was integrated into a one nation-one grid-one frequency in 2013. Apart from having a secure, reliable and efficient grid operations the independent system operations has enabled participation of private transmission licensee under tariff based competitive bidding mechanism, allowed non-discriminatory open access to the transmission system and facilitated the development of

GRID-India

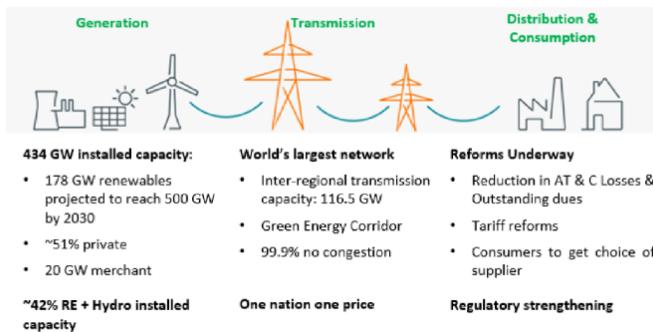
POSOCO was formed as a wholly owned subsidiary of the Powergrid in October 2010. The subsidiary was set up on the recommendations of the Pradhan Committee. The Committee recommended to make load dispatch centres financially self-reliant and autonomous institutions. It was recommended to set up a separate representative board structure overseeing the functions of five RLDCs run by PGCIL. Accordingly, POSOCO was formed as an umbrella organization to give a corporate structure to NLDC and RLDCs to ensure integrated operation of National and Regional Power Systems. POSOCO was eventually made a separate company in January 2017.

Recently POSOCO has changed its name to Grid Controller of India Ltd. (Grid-India) on 14 November 2022 to reflect the critical role of ensuring integrity, reliability, economy, resilience, and sustainable operation of the Indian Grid. Grid-India operates the NLDC and RLDCs. Grid-India is also designated as the nodal agency for major reforms in the power sector such as implementation and operation of Green Energy Open Access Portal, Renewable Energy Certificate (REC) mechanism, Transmission pricing, Short Term Open Access in Transmission, Cross Border Trade of Electricity, Deviation Settlement Mechanism, Power System Development Fund (PSDF) etc.

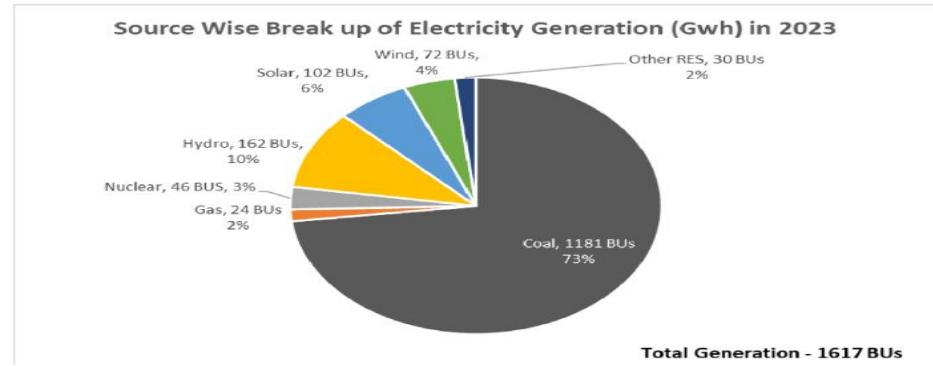
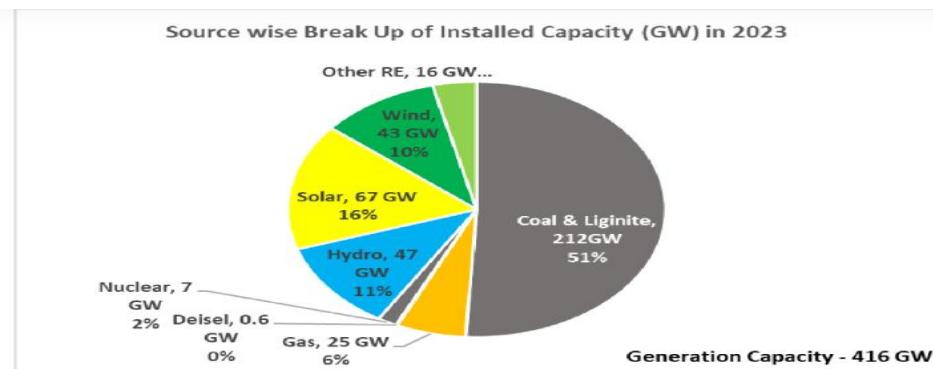
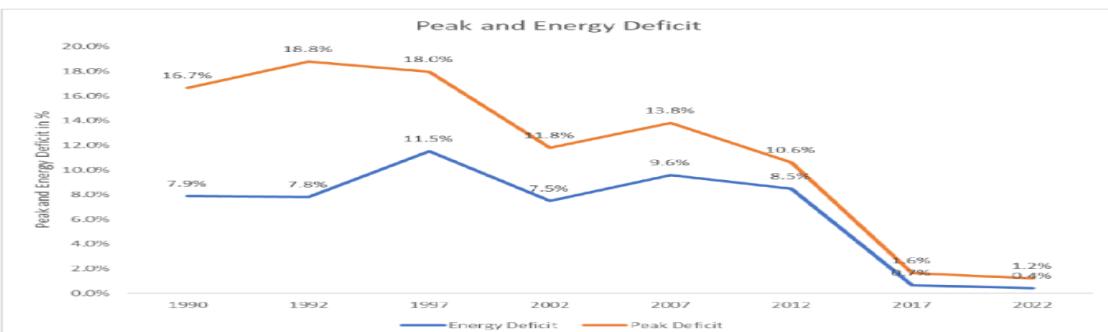
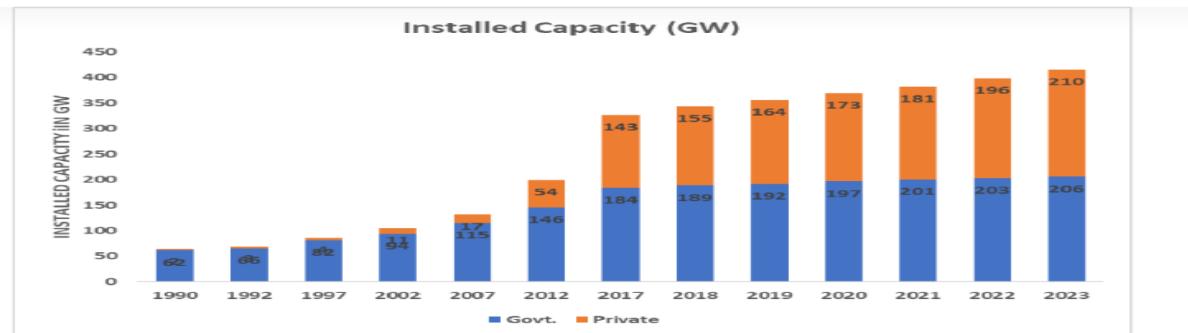
2.2 Growth in Electricity Sector & Market

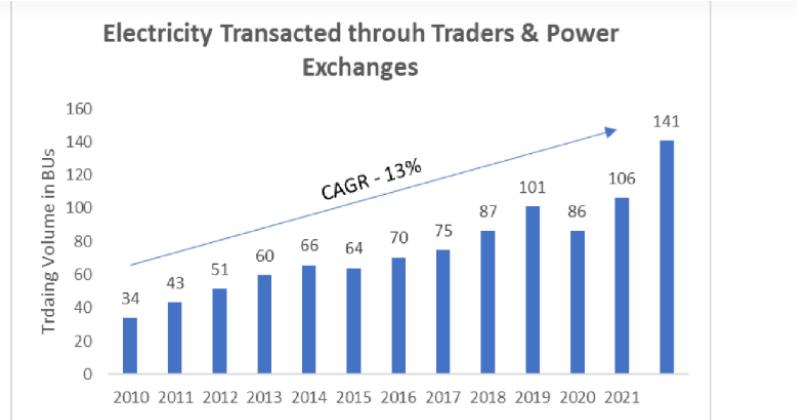
Due to various reform initiatives undertaken during last three decades the power sector has grown significantly during the period also fuelling the economic growth of the country. There has been a significant growth in the installed capacity with increased participation from the private sector. The country has turned around from the energy deficit situation to energy surplus situation. During last few years there has also been a significant renewable energy capacity addition keeping in view the challenges associated with climate change & India's commitment under UN Framework for Convention on Climate Change (UNFCCC). One Nation One Grid One Frequency has been achieved with minimal congestion observed during last few years. On the Discos side, there has been improvement in tariff setting process, operational efficiency, financial performance etc. though they continue to remain the critical link in the entire value chain. The wholesale electricity market has developed into a vibrant market with multiple avenues in market to buy or sell electricity. There are three power exchanges and 47 Trading Licensees etc. facilitating transactions between buyers and sellers in the short-term market.

Some of the highlights of this improvement are captured in the figures below:



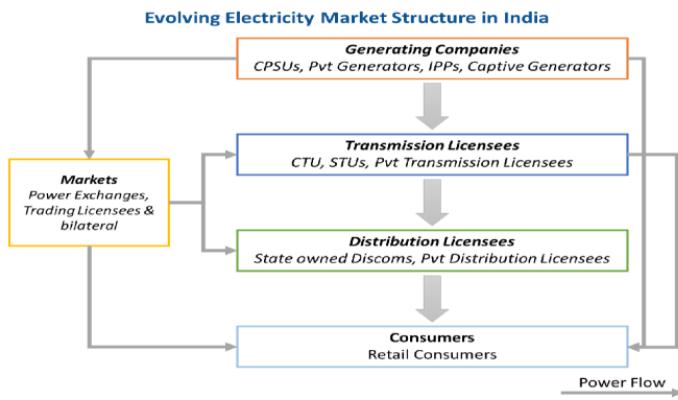
Wholesale market: Competitive bidding for Long, Medium & Short-Term Procurement; DEEP Platform, 3 Power Exchanges, 47 Trading Licensee





3.1 Overall Market Structure

The power sector has evolved over time from vertically integrated utilities to multi buyer model. The sector is characterized by multiplicity of players across all segments of the value chain viz., generation, transmission, trading and distribution. There are more than 600 generating stations, 30 transmission licensees, 70 distribution licensees, 3 Power Exchanges, 47 trading licensees, 1 National Load Dispatch Centre, five Regional Load Despatch Centres and 27 State Load Despatch Centres. Discoms and large Open Access consumers have the flexibility to procure power from different suppliers through different mediums and time horizons. For example, the Discoms can procure power from their existing Power Purchase Agreements (PPA) or through competitive bidding route on long term basis and through the power exchanges or bilateral on short term basis. Discoms can directly procure the power or through the Trading Licensees. Similarly, the large open access consumers can meet the power requirements through Discoms, Power Exchanges, Bilateral procurement. The evolving electricity market structure is depicted in the figure below:



Depending on the supply voltage level volume, the electricity market can be categorized into wholesale electricity market and retail electricity market:



The current power market can also be classified based on the time horizons of power procurement. Procurement of power for 7 years & above, more than 1 to 5 years, and up to 1 year is considered as long-term, medium-term and short-term, respectively. Around 88% of the overall power procurement is taking place through the long-term route whereas the remaining 12% is through the short-term market. Although the volume transacted through the short-term market has increased over the years, in terms of percentage of overall market it is still hovering around 10%.

Volume of Short-Term Transactions

Year	Volume of Short-Term Transactions (BUs)	Total Energy Generation (BUs)	% of Short-Term Transactions
2010	66	768	8.6%
2011	82	852	9.6%
2012	95	928	10.2%
2013	99	969	10.2%
2014	105	1026	10.2%
2015	99	1110	8.9%
2016	115	1173	9.8%
2017	119	1242	9.6%
2018	128	1308	9.8%
2019	145	1376	10.6%
2020	137	1391	9.9%
2021	146	1380	10.6%
2022	187	1492	12.5%
2023	194	1624	12.0%

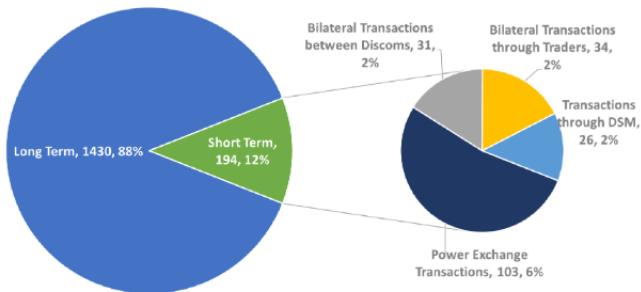
Source: CERC Market Monitoring Report

Short term market consists of the transactions through bilateral, Trading licensees, directly between the Discoms, the Power Exchanges and unscheduled interchanges with the Grid. During 2023 the overall power procurement in the country was 1624 BUs of which 1430 BUs were transacted through the long term and 194 BUs through the short term.

The break up of transactions taking place through different routes are provided in the figure below:

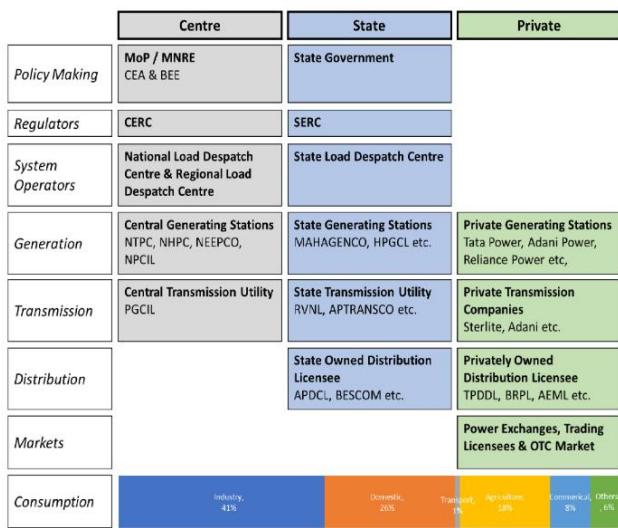
Volume (BUs) of Electricity transacted through different routes in in FY 2023

Share of Market Segments in Short Term Transactions



3.2 Institutional Arrangement

The various reform initiatives have also led to evolution of institutional arrangement in the sector which is more amenable to the development of market and competition. The present institutional arrangement is provided in the figure below:



Agency	Role
Ministry of Power	# Policy/Rule-making such as National Electricity and Tariff Policy, Guidelines for competitive bidding, etc.
Central Electricity Authority	# Technical regulations, National Electricity plan, monitoring of projects, maintaining data and statistics, demand forecast, feasibility analysis of Hydro projects, etc.
Bureau of Energy Efficiency (BEE)	# Energy efficiency & conservation programs
Regulatory Commission (CERC & SERC)	# Regulates, decides tariff, issues license, approves capital expenditure, monitors supply and service quality and ensure implementation of various provisions of Electricity Act 2003 # CERC regulates the Central Utilities and inter-state sale and transmission of power while SERC regulates the State Utilities and intra-state sale and transmission of power.
Appellate Tribunal for Electricity (APTEL)	# Appellate body for appeals against the orders of the regulatory commissions.
Generation company	# Generate power based on contracts or independently. Needs to abide by Load Dispatch directions for scheduling its generation.
(Central, State Utilities, IPPs, MPPs, CPP)	# Central Sector Generating Stations such as NTPC supplying power to multiple states come under the jurisdiction of CERC while State Owned Generating Stations or IPPs/CPGs supplying power to a particular state comes under jurisdiction of SERCs.
Transmission (CTU, PGCIL, STUs, Transmission Licensees)	# CTU to discharge all functions of planning and coordination and ensure development of an efficient transmission system. # Builds and operates the transmission network and infrastructure. # PGCIL and inter-state Transmission Licensees comes under the purview of CERC while State owned Transmission company comes under the purview of respective SERCs
Distribution company (State owned Discoms, Private Licensees, Distribution Franchises)	# Distributes electricity to consumers, responsible for maintaining and building distribution network, metering, billing, and collection from consumers.
Load Dispatch Centre (NLDC, RLDCs, SLDCs)	# Statutory autonomous body entrusted with system operation, scheduling and accounting of power at different levels. Responsible for maintaining grid stability and discipline. # National Load Dispatch Centre (NLDC) operates at national level while ERLDC, WRLDC, NRLDC, SRLCD, NERLDC are the five load dispatch centres operating at Eastern, Western, Northern, Southern and Northeastern regions of the country. # State Load Dispatch Centre (SLDC) operates and schedules power at the

Agency	Role
Power Exchanges	# Provide a nationwide automated platform for electricity trading. # IEX, PXIL and HPX are operational in India regulated under Power Market Regulations, 2021.
Trading Licensees	# Buy electricity for resale thereof and facilitate transactions between buyers and sellers

4.1 Key Milestones in Power Sector (Pre-Electricity Act 2003)

- **1948:** Electricity Supply Act – Creation of SEBs and Central Electricity Authority (CEA)
- **1964:** Five Regional Electricity Boards were formed i.e., South, West, North, East, and North-East for ensuring integrated grid operation and regional co-operation
- **1975:** Creation of Central generating Companies viz. NTPC and NHPC for development of largest thermal and hydroelectric generating stations
- **1989:** NTPC Ltd. was formed and assigned the responsibility to develop & maintain the high voltage transmission systems in the country
- **1991:** Electricity Supply Act 1948 amended to pave the way for private participation in Generating business. RBI allowed 100% foreign investment in the power sector. REBs given statutory status. CEA empowered to fix the norms for determining the generating tariffs.
- **1992:** NTPC Ltd. rechristened to Power Grid Corporation of India Ltd.
- **1992:** Gazette notification for fixing the tariff for generating companies
- **1994:** RLDCs which were originally part of CEA were transferred to Power Grid Corporation India Ltd.
- **1998:** Electricity Regulatory Commission Act was enacted paving the way for the formation of Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commission (SERC). Amendment also provided for Central Transmission Utility (CTU) and State Transmission Utility (STU). RLDC designated as the apex body to ensure integrated operation of the power system in a region.
- **2000:** Indian Electricity Grid Code - lay down the principles for integrated operations of Indian grid
- **2002:** Availability Based Tariff – separated the generation tariff into capacity charge, variable charge and unscheduled interchange charge. Besides the grid discipline it promoted merit order dispatch and trading of power
- **2003:** Electricity Act 2003 - consolidated the earlier laws regarding generation, transmission & distribution; recognised trading activity, introduced open access in transmission and distribution. Promotion of competition in the sector is one of its key objectives.
- **2004:** CERC notified the Open Access Regulations
- **2005:** Central Govt. issued the National Electricity Policy providing the long-term vision for the sector. Considered development of 15% of generation capacity outside of long term PPAs
- **2006:** Central Govt. issued National Tariff Policy providing for competitive bidding and Ultra Mega Power Projects
- **2007:** CERC issued the guidelines for grant of permission for setting up and operation of Power Exchange
- **2008:** Indian Energy Exchange (IEX) and Power Exchange of India Limited (PXIL) commenced their operations with Day Ahead Market
- **2009:** POSOCO was incorporated for ring fencing of system operation, as a 100% subsidiary of PGCIL; CERC notified the unscheduled interchange (UI) charges Regulations
- **2010:** CERC notified Power Market Regulations laying down the broad framework for power exchanges. CERC also issued the Renewable Energy Certificate (REC) Regulations and Transmission Sharing Regulations providing for Point of Connection Charges & Losses
- **2011:** Competitive bidding for establishment of inter-State Transmission System
- **2012:** Central Govt. issued the Competitive Bidding Guidelines for short term procurement of power

-
- **2015:** CERC notified the Ancillary Services Regulations providing the mechanism for procurement of Up & Down Reserves

 - **2016:** CERC notified the Escorts Regulations for trading of Energy Savings Certificate under the Perform Achieve Trade (PAT) scheme of Bureau of Energy Efficiency (BEE)

 - **2017:** POSOCO got separated from POWERGRID w.e.f. 2nd January 2017; As an Independent Government Company, POSOCO started operating the NLDC and RLDCs

 - **2019:** CERC notified the Cross Border Trade of Electricity Regulations allowing entities from neighbouring to participate in Indian Market

 - **2022:** CERC notified revised REC mechanism, market linked deviation rates and procurement of tertiary reserves through the market.

 - **2023:** CERC implemented General Network Access (GNA) Regulations, 2022 and Indian Electricity Grid Code (IEGC) Regulations, 2023.

1. Overview of Power Exchanges

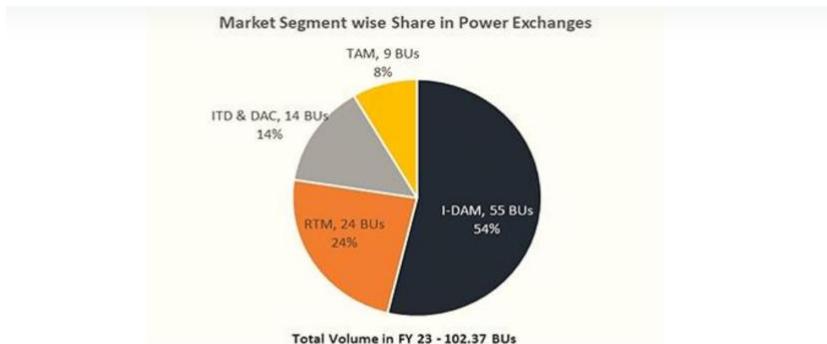
Power exchanges provide nationwide automated electronic platform for trading of electricity. Multiple buyers and sellers, participating in the exchange platform and trading across different market segments based on pre-defined rules and contract specifications, are meeting their requirement in a competitive manner. Electricity Act 2003 under Section 66 has mandated the Appropriate Commission to take measures for the development of power market including trading of electricity under the provisions of which CERC issued the Guidelines for the grant of permission for setting up and operation of Power Exchange in 2007. The Indian power exchanges were conceived to facilitate the trading in a transparent and competitive manner. Their role in the electricity market has been adequately captured in the first Discussion Paper published by the CERC in July 2006 on "Developing a Common Platform for Electricity Trading".

CERC Discussion Paper on "Developing a Common Platform for Electricity Trading"

CERC Staff Paper, July 2006- Power Exchange (PX) is a proven mechanism for efficient and transparent trading. Power Exchange can provide an alternative to bilateral trade with or without replacing it. After unbundling of the electricity sector, developing the electricity market is a next logical step, which is also mandated by the Electricity Act and the National Electricity Policy. We will have to design our PX in a manner compliant with the Indian Electricity Grid Code while fulfilling the expectations of market participants.

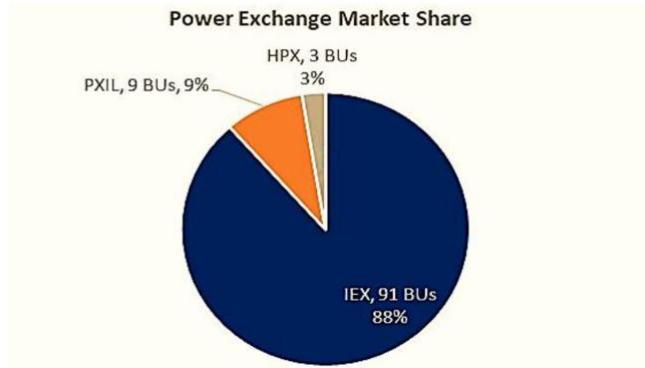
In a Power Exchange, it is possible to allow both buyers and suppliers to participate in the bidding process in an equitable manner. The Power exchange could be a counter party to all the deals in order to ensure payment security to all the participants. A well-designed and functioning Power Exchange providing payment security to participants has the potential to energize the power sector and put it into orbit of self- sustained growth. At the same time, it has to be kept in mind that Power Exchange is merely a facilitator for trading and therefore price discovery in a Power Exchange cannot be anything other than the reflection of the ground realities. In a Power Exchange, the electricity prices are bound to reflect varying conditions of generation, transmission, and consumption.

Presently there are three power exchanges functional in the country namely Indian Energy Exchange (IEX), Power Exchange India Ltd. (PXIL) and Hindustan Power Exchange (HPX). IEX and PXIL started their operations in 2008 whereas HPX started its operations in 2022. The Power Exchanges are now offering multiple market segments namely Integrated Day Ahead Market (I-DAM), Real Time Market (RTM), Intraday & Day Ahead Contingency (DAC), Term Ahead Market (TAM) enabling the market participants to meet their buy or sell requirement for conventional and RE power starting from 1 hour ahead to the duration permitted by CERC for different products. The overall participation and the volume traded through the Power Exchanges have increased over time enhancing the liquidity and efficiency of the exchange platform; however, in percentage terms it is still around 6.5% of the overall transactions. The volume of electricity traded through the Power Exchanges during FY 2009- FY2023 along with market segment wise share is provided in the figure given below:



During FY 23, the overall market share of IEX was around 88% whereas PXIL & HPX had around 9% and 3% share respectively.

The overall market share of different power exchanges is provided in the figure given below:



The power exchanges are functioning under the regulatory supervision of Central Electricity Regulatory Commission (CERC) under the provisions of Power Market Regulations. CERC initially issued the 'Guidelines for setting up of Power Exchanges' in 2007 laying down the broad contours for functioning of Power Exchanges. Subsequently, CERC issued the Power Market Regulations 2010 providing a comprehensive framework governing the power exchanges. These regulations have been replaced with the Power Market Regulations 2021, notified on 15th February 2021 in view of the recent changes taking place in the power sector.

As per Power Market Regulations 2021, the Power Exchanges are required to provide the following:

Ensure fair, neutral, efficient and robust price discovery to provide equal opportunity to all participants in the market.

Provide extensive and quick price dissemination to reduce information asymmetry in the market and improve informed pricing decisions for participants.

Design electricity contracts and work towards increasing liquidity in such contracts. As liquidity improves the pricing becomes more efficient. Liquidity is a measure of ease of entering or exiting into a trade without changing the market's price;

Power exchange shall also provide price signal for efficiently allocating resources in the power sector.

Evolution of Power Exchanges in global markets

The first serious attempt to form a liberalized electricity market was launched in Chile in 1982. Markets were launched in England and Wales in 1990. Nordic market, now known as Nord Pool, was started in 1991. A common electricity exchange for Norway and Sweden was established under the name of Nord Pool. Electricity markets started operating in Australia and New Zealand in 1994 and 1996, respectively. In North America, several markets were started in the late 1990s, such as PJM, New England, New York and California markets. Spain and Netherlands opened their

such as PJM, New England, New York and California markets. Spain and Netherlands opened their electricity markets in 1998. Texas and Alberta (Canada) opened electricity markets in 2001.



Role of Power Exchanges and Trading Licensee

Some of the important power exchanges in the world are tabulated below:

Title	Countries Involved	Headquarter	Products
APX Power	UK	London	Day-Ahead-Auctions
EMC	Singapore	Singapore	
EPEX Spot	Austria, Belgium, France, Germany, Luxembourg, UK, Netherlands Switzerland	Paris (FRA)	Day-Ahead-Auctions, Continuous Intraday & Intraday-Auctions
ERCOT	USA	Austin	Real-Time Energy Market, Day-Ahead
EXAA	Austria, Germany	Vienna	Day-Ahead-Auctions
GME	Austria, France, Greece, Italy, Malta, Slovenia, Switzerland	Rome	Day-Ahead-Auctions, Intraday-Auctions
JEPX	Japan	Tokyo	Day-Ahead-Auction, Intraday-Auction
Nordpool Spot	Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Norway, Sweden, UK	Oslo	Day-Ahead-Auctions, Continuous Intraday
OMIE	Spain, Portugal	Madrid	Day-Ahead-Auctions, Intraday
PJM	USA	Pennsylvania	Real-Time Energy Market, Day-Ahead

CERC through the Guidelines, Power Market Regulations (PMR) and various Orders has laid down the broad principles for functioning of Power Exchanges in the country viz. neutral platform, voluntary participation, standardized contracts, efficient price discovery, risk management etc. These are elaborated in the sections below.

2.1 Transparent & Neutral Platform

Power Exchanges are required to provide a transparent and neutral platform for trading of electricity. To ensure neutrality, Power Exchanges are required to function in a de-mutualized and ring-fenced manner where there is a separation between ownership, management and participation. As per PMR 2021, no Member or Clients of a Power Exchange can directly or indirectly, individual or together, have more than 5% of shareholding in Power Exchange. Further, the total shareholding of all the Members and Clients combined cannot exceed 49% of the shareholding of the Power Exchange, and no Member or Client can also be on the Board of Directors of any Power Exchange. This ensures that the Members or Clients of a Power Exchange trading in the exchange platform cannot in any manner influence the decision making & functioning of the Power Exchange.

2.2 Contract Design

Power Exchanges are required to design standardize contracts in their platform to promote liquidity and competition in the market. Standardized contracts make the participants aware of the contract terms & conditions in advance and promote participation from both buy & sell side attracting liquidity in the market. PMR 2021 has stipulated that a Power Exchange seeking permission to introduce new contract shall submit to the Commission complete and detailed contract specifications including the following:

- Type of Contract
- Price discovery and matching methodology

- Timelines, including commencement of bidding and duration of bidding session;
- Delivery mechanism and delivery duration i.e., whether delivery is for intraday, daily, weekly, monthly, seasonal, yearly or beyond;
- Risk management mechanism including margining and final price settlement mechanism;

The Commission before giving approval to such new contract conducts wider stakeholder consultations to thoroughly assess the implications of the proposed contract on the functioning of the market.

2.3 Trading through Members

The trading in a Power Exchange is carried out by the Members registered in the Exchange.

The Members can trade and settle for themselves or on behalf of their clients. As per PMR

2021, Members can be of three categories as provided below:

Trader Member	Proprietary Member	Facilitator Member
Any person who has been granted Trading license under the Trading License Regulations 2020 by CERC and has become a Member of the Power Exchange is called as Trader Member. A Trader Member has the right to trade and clear on its own account or on behalf of its client apart from providing any credit or financing or working capital facility to the clients. PTC India Ltd, Tata Power Trading, Adani Enterprises Ltd, NTPC Vidyut Vyapar Nigam Ltd (NVVN) etc. are some of the Trader Members of the Power Exchanges.	Any person who is a distribution licensee or a deemed distribution licensee or a grid connected entity and admitted as a Member of the Power Exchange is called Proprietary Member. A Proprietary Member can transact and clear trade through its own account. It cannot trade or clear on behalf of any other client.	A Member who is neither a Trader Member nor a Proprietary Member but admitted as a Member of the Power Exchange to facilitate trading of its client including providing the IT infrastructure is called Facilitator Member. There is a fundamental distinction between Trader Member and Facilitator Member. While a Trader Member can trade and clear on its own account or trade and clear on behalf of its clients, a Facilitator Member can neither trade for itself nor settle and clear the transactions on the exchange on behalf of its clients. Further, a Facilitator Member cannot provide any credit or financing or working capital to its client.

PMR 2021 has provided that Power Exchanges can stipulate criteria for obtaining its membership including net-worth, minimum base capital, security deposit requirement and

2.4 Automated Trading & Clearing

Power Exchanges are required to provide electronic trading system along with all the necessary communication system to the market participants for carrying out the trading activities. The buyers can electronically place the 'buy bids' and sellers 'sell bids' which is a combination of price & quantity in relation to a particular contract or market segment. Based on the bids submitted and contract specifications , a Power Exchange discovers the market clearing price and volume for a particular market segment. The price is discovered as per the mechanism approved by the Commission using suitable Software Algorithm. For instance, in case of Day Ahead Market (DAM) and Real Time Market (RTM) which are based on double sided closed bid auction mechanism, the price has to be discovered based on the principle of 'economic surplus maximization'. Apart from bidding & price discovery, the Power Exchanges are also carrying out the clearing & settlement of the transactions taking place at their platform. Assured and timely pay-in and pay-outs are a vital function of Power Exchanges and in the Indian context it is a key value proposition considering the recurring payment issues in all other forms of transactions in the sector.

The Power Exchanges have established a credible and viable settlement and clearance mechanism to achieve this objective. The Power Exchanges have appointed 'Clearing Banks' through which the transactions are settled between Exchange & Members and Members & Clients. Presently the Indian Power Exchanges are operating the clearing & settlement function on their own unlike the Indian stock exchanges and global power exchanges that have a separate clearing house. As per PMR 2021, the Power Exchanges are required to maintain automated audit of bids, matching of bids and execution of transactions etc. for the audit purpose. Power Exchanges are also required to carry out the periodic IT Audit, Algorithm Audit and implement Cyber Security and Cyber Resilience to manage risk to systems, networks, and databased from cyber-attacks.

The Exchange System is illustrated in the figure below:



2.5 Risk Management & Default Remedy Mechanism

The Power Exchanges being central to all the transactions taking place at their platform assume the counterparty risks. The Power Exchanges have to ensure that there is no default in the contract executed at the exchange platform i.e., the buyer gets the delivery of power and seller the fund as per the contract. PMR 2021 have stipulated the Power Exchanges to develop and implement a prudent risk management framework to manage the risks that may arise due to the transactions taking place in the exchange. Presently, as a practice, the Power Exchanges are collecting the dues upfront from the buyers (Pay-ins) and transferring it to the sellers post-delivery of power (Pay-outs). Power Exchanges are also keeping margins from the buyers to manage the payment in case of any defaults. PMR 2021 has stipulated Power Exchanges to create and maintain Settlement Guarantee Fund (SGF) to be used for settlement in case of defaults by any of their Members or Clients. PMR 2021 has also stipulated the Power

Exchanges to constitute a Risk Assessment and Management Committee (RAMC) headed by an Independent Director to monitor the adherence to the risk management framework by the Power Exchange.

Settlement Guarantee Fund (SGF)

Settlement Guarantee Fund (SGF) means a fund created and maintained by Power Exchange to settle the defaults of its Members or Clients. PMR 2021 has stipulated that the Power Exchange shall invest the proceeds of SGF in safe investments and ensure that the principal amount is not at risk. Not less than 50% of the proceeds of SGF shall be kept in safe liquid investments but not limited to fixed deposits with Scheduled Public Sector Banks, Treasury Bills and Govt. Securities. Power Exchanges are required to submit the details of SGF to the Commission on an Annual Basis. In the event of any default when the Member or Client of a Power Exchange fails to meet the payment obligations, the Power Exchange may utilize the SGF and other monies to the extent necessary to fulfil the obligations of the defaulting Member or client in the following order:

- Liquidation of collaterals: Contributions or deposits, including margins in any form, of the defaulting member or client.
- Liquidation of security deposit: Membership deposit given by the defaulting member to the Power Exchange.
- Insurance money: Insurance taken by the Power Exchange of an amount as considered appropriate by the Power Exchange for protection against defaults.
- Initial contribution by the Power Exchange towards the Settlement Guarantee Fund.
- Current year's profits of the Power Exchange including fines, penalty collected from members.
- Retained earnings of the Power Exchange.
- Contribution towards Settlement Guarantee Fund by all members or clients: All non-defaulting members or client's contribution in proportion of deposits towards Settlement Guarantee Fund.
- Balance obligations remaining outstanding after above funds will be met by contribution from members or clients in proportion to their contribution to the SGF.

2.6 Multiple Power Exchanges with Regulatory Oversight

PMR 2021 has laid down the eligibility conditions and procedures to be followed to establish a Power Exchange. Anyone who meets the requirements can obtain grant of registration from the Commission and establish the Power Exchange. From the beginning itself the approach has been to allow multiple power exchanges operate in the market so that the competition amongst the exchanges will bring in innovation and efficiency in the marketplace. The approach has been to provide principle-based regulations and give the operational freedom to the power exchanges to develop their IT infrastructure, price discovery algorithm, clearing & settlement, risk management mechanism etc. to provide an efficient trading platform for the market participants. While the regulations have provided the operational freedom to promote competition in the market it has provided enough checks & balances to ensure that the market is functioning in a fair, transparent & competitive manner and there is no market manipulation, insider trading, cartelization, and abuse of dominant position by any market participant. CERC monitors the market through various information & reports collected from the Power Exchanges and Trading Licensees on a periodic basis. Based on the requirement, the Commission can ask for additional information, conduct audit & investigations etc. and intervene in the market by issuing directions viz. imposition of penalty, suspension of trade, debarment of Members or Clients, cancellation of Registration etc.

2.7 Business Rules, Rules & Bye Laws

The Power Exchanges are functioning as per their Business Rules, Rules and Bye-laws approved by CERC. While the Business Rule is concerned with the day to day market operations of the Power Exchanges, the Rules & Bye-Laws are concerned with governance structure & management of Power Exchanges. The different aspects covered under the Business Rules, Rules & Bye-laws are as follows:

- Qualifications for membership, exclusion, suspension and expulsion of members of the Power Exchange;
- Risk management;



Role of Power Exchanges and Trading Licensee

- Price discovery and matching mechanism, including market splitting to handle congestion in transmission corridor;
- Reporting of default (delivery of electricity or payment or both) and penalty mechanism;
- Penalty for deviation from contract;
- Clearing and Settlement procedure;
- Timeline for publishing trading and settlement calendar;
- Transaction timelines;
- Procedure from opening of the platform up to its scheduling by Load Despatch Centre;

- Market surveillance and investigation;
- Procedure for handling default;
- Dispute resolution mechanism;
- Mechanism for redressal of grievances;
- Exit scheme;

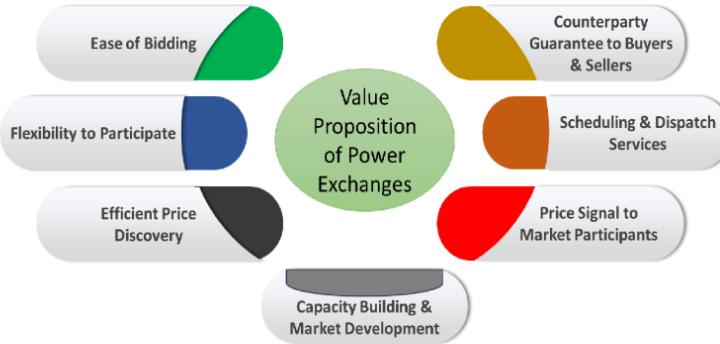
The Business Rules, Rules and Bye-laws are binding on the Power Exchanges. As per PMR 2021, no amendment to Business Rules, Rules and Bye-laws can be carried out without the prior approval of Commission.

2.8 Information dissemination by Power Exchanges

PMR 2021 has stipulated that the Power Exchanges shall provide the details of prices & volume traded at the exchange platform in their websites. Power Exchanges are required to give the maximum, minimum, and average traded prices for all types of contracts transacted at the exchange platform.

3. Key Value Proposition of Power Exchange

The Power Exchanges have emerged as a viable alternative for the market participants to meet their buy or sell requirement at a competitive price. Apart from discovering the price competitively, the Exchange (check uniformity in the document) platform also provides flexibility to the market participants to both buy and sell electricity across different time frame & market segments to meet their requirements.



The value proposition of Power Exchanges is discussed below:

3.1 Ease of Bidding

The Power Exchanges are providing the nationwide platform for market participants to trade and meet their requirements. The technology platform has made it easy for buyers and sellers to place bid in the market after which the Exchanges are clearing the markets, scheduling the transactions and settling the dues amongst the buyers and sellers through the automated system. The participants have the option of bidding from any location, through trading

window screen or through web-based bidding. As multiple buyers and sellers participate in the platform there is also no counterparty risk involved in the Exchange transactions. This has made bidding in the Exchange much more convenient as compared to the bilateral transactions.

3.2 Flexibility to Participate

Power Exchanges are now offering multiple products at the Exchange platform across different time frames to cater to the requirement of the market participants. Electricity can be procured from an hour ahead basis up to the permissible duration, during different time of day viz. round the clock, peak, off-peak hours etc. The market participants can also buy or sell green power in the market through green contracts. Besides, the Discoms can both buy and sell in the market across different time horizons enabling them to manage & balance their portfolio in an optimal manner. As RE penetration is increasing along with the intermittency, the Power Exchanges provide flexibility to manage such intermittencies. The Power Exchanges are providing different electricity products namely Integrated Day Ahead Market (DAM), Real Time Market (RTM), Term Ahead Market (TAM), Intraday, and Day Ahead Contingency (DAC) market. Power Exchanges are also providing the Renewable Energy Certificate (REC) market for the Obligated Entities to meet their Renewable Purchase Obligation (RPO) and Energy Saving Certificates (Escorts) under the Perform Achieve Trade (PAT) scheme of BEE. The details about various products available in Power Exchanges are provided in subsequent chapters.

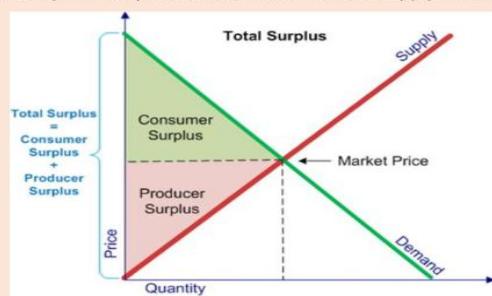
3.3 Efficient Price Discovery

Power Exchanges are known for efficient price discovery across the contracts. Due to participation of multiple buyers & sellers, the prices are discovered in a competitive manner. Particularly, in the case of Day Ahead Market and Real Time Market segments, which are based on collective transactions, the price is discovered on the Economic Surplus Maximization principles generating surplus for both buyers and sellers in the process.

Economic Surplus Maximization

Economic Surplus in general is a concept which gives an assessment of how efficient a market is functioning. It is the sum total of the consumer surplus and producer surplus i.e., the benefits (surplus) derived by the consumers and suppliers participating in a market. The consumer surplus is defined as the difference between the consumer's willingness to pay for a good and the actual amount it has to pay; similarly, the producer surplus is defined as the difference between the actual amount the producer receives and the minimum amount it is willing to accept for the good.

The economic surplus of any market can be computed by calculating the area within the demand and supply curve as illustrated in the figure below. Theoretically, the social welfare is maximized at the equilibrium point where the demand and supply curves meet:



It is observed that during past years the prices discovered in the exchange platform were more competitive than the prices discovered in the short-term bilateral market. The efficient price discovery has attracted participation and liquidity in the exchange platform enabling the Discoms to reduce their power procurement cost.

3.4 Counterparty Guarantee to Buyers & Sellers

Power Exchanges are providing the counterparty guarantee to the market participants assuming the risks involved in the transactions. Power Exchanges ensure that the power gets delivered to the buyer and seller receives the payments. As a risk management practice, the Power Exchanges receive the payments (Pay-ins) from the buyers prior to delivery of power on D-1 basis and transferring this amount to sellers, post delivery of power on D+1 basis; where D is the day of delivery. Due to the robust risk management practices of the Power Exchanges, there has not been a single default in the past. This has encouraged the sellers to participate in the market and offer a competitive price in the market.

3.5 Scheduling & Dispatch Services

Apart from clearing & settlement of transactions, the Power Exchanges provide scheduling & dispatch services to the market participants. Power Exchanges carry out scheduling of transactions in accordance with Regulations and Procedures. Power Exchanges make application to NLDC or RLDC on behalf of the participants depending on whether the transactions are collective or bilateral transactions. Market participants are only required to place bids in the market as per their requirement and adhere to the schedule provided by the Exchanges

3.6 Price Signal to Market Participants

Power Exchanges play a vital role in efficiently discovering the electricity prices which gives signal to the market participants & other stakeholders at large including the regulator and policymaker, to act on the supply-demand situations, energy mix, fuel sourcing, transmission capacity etc. and intervene through appropriate measures if required. Based on the price discovered at the Exchange platform particularly in the Day Ahead Market, several market participants take business decisions viz. how much to purchase from the Exchange, which generating stations to operate etc. In case of transmission congestion, the market gets split into surplus and deficit region with higher prices in the deficit region. This provides signal for addition of transmission capacity.

3.7 Capacity Building & Market Development

Although the volume traded in the Power Exchanges is only around 6-7% of the overall transactions, the volume traded in the exchange has grown by a CAGR of 29% during the period FY 2009-2023. During this period the Power Exchanges have immensely contributed towards capacity building of the utilities by conducting workshops, seminars, hand-holding sessions etc. and exposing them to the benefit of participating in the market. Power Exchanges have also contributed to the formulation of market related policies and regulations by participating in the consultation process and giving feedback for strengthening the market. Power exchanges have been educating the stakeholders on the changes brought in the regulations pertaining to the power market.

Power Exchanges- FAQs

1. What is a Power Exchange?

- A. A Power Exchange is a platform on which buyers and sellers come together to transact. It is not the market but a host to the market. Its core function is to ensure fair and transparent transactions as well as efficient dissemination of price information to its stakeholders. Globally, the evolution of Power Exchanges can be traced to Nordic Markets in the early 1990s, when several Nordic countries came together to share and benefit from their diverse sources of power generation.

2. What is the value proposition of a Power Exchange?

- A. Power Exchanges are platforms that enhance competition, enable transparent price discovery, insure against counter party default, provide flexibility to market participants and foster technical innovations and investments in the sector.

3. Who regulates the Power Exchange in India?

- A. Power Exchanges in India are approved and regulated by Central Electricity Regulatory Commission (ERC) which is a statutory authority constituted under the Electricity Act 2003 with quasi judiciary role. The activities are regulated under the various regulations and procedures notified by CERC including the Power Market Regulations 2021, as amended from time to time.



Role of Power Exchanges and Trading Licensee

4. Who can set up a Power Exchange in India?

- A. Eligible entities/corporates under the CERC Power Market Regulations can set up a Power Exchange in India.

5. Who can trade at the Power Exchanges in India?

- A. Only the Exchange Members and the Clients through a registered Exchange Member, who have been admitted by the Power Exchanges, are eligible to enter into Contracts, and undertake transactions relating to such Contracts. .

6. How much electricity is traded through the Power Exchanges in India?

- A. 6% of the overall electricity consumption i.e., around 115 BUs, was traded through the Power Exchanges in FY 2022-23.

4. Role of Trading Licensees

The Electricity Act 2003 has defined trading of electricity as purchase of electricity for re-sale thereof. The Act has also stipulated that no person shall take up trading of electricity unless he is authorized to do so by the Appropriate Commission. Accordingly, the Central Commission has framed the Trading Licensee Regulations governing the functioning of inter-state trading licensees in the country. CERC initially framed the Trading License Regulations in 2004 which were subsequently amended in 2009. Keeping in view the changes taken place in the market, CERC has issued the Trading License Regulations 2020 repealing earlier regulations in this regard.

The Trading Licensees play the role of intermediaries in the power sector. Trading Licensees reduce the search costs by providing market information, match buyers and sellers and act as a facilitator in concluding trading arrangements. Trading Licensees can also provide credit or working capital support while procuring the power. Trading licensees facilitate in trading of electricity by assuming some of the risks associated in the transactions. As members of the Power Exchange, Trading Licensee can facilitate trade through the Exchanges. This has helped to deepen the short-term market in the country bringing efficiency in transactions.

Trading Licensees enter separate contracts with the buyers and sellers i.e., Power Purchase Agreement (PPA) with the Seller and Power Sales Agreement (PSA) with the buyers. Trading Licensees can facilitate a payment security mechanism to seller. As per the Trading Licensee Regulations 2020, if the Trading Licensees do not provide the payment security mechanism, they can only charge a trading margin up to 2 paise/unit in lieu of up to 7 paise/unit allowed for any short-term transactions.

Trading Licensees can charge a trading margin of not less than 0.0 paise/unit and not more than 7.0 paise/unit for transactions under short term contracts and through power exchange up to 1 year. However, in contracts where escrow arrangement or irrevocable, unconditional and revolving letter of credit is not provided by the Trading Licensee in favour of the seller, the Trading Licensee shall not charge trading margin exceeding two (2.0) paise/kWh.

For transactions under long term contracts, the trading margins shall be decided mutually between Trading Licensee and the seller/buyer. However, in contracts where escrow arrangement or irrevocable, unconditional and revolving letter of credit is not provided by the Trading Licensee in favour of the seller, the Trading Licensee shall not charge trading margin exceeding two (2.0) paise/kWh.

For banking of electricity, the Trading Licensee can charge a cumulative margin of not less than zero (0.0) paise/kWh and not exceeding seven (7.0) paise/kWh. For transactions under Back to Back contracts, where escrow arrangement or irrevocable, unconditional and revolving letter of credit is not provided by the Trading Licensee in favour of the seller, the Trading Licensee shall not charge trading margin exceeding two (2.0) paise/kWh. For Cross Border Trade of Electricity, the trading margin shall be decided mutually between the Trading Licensee and the seller.

As per CERC Trading License Regulations 2020 the trading licensees are categorized into five categories depending upon their volume traded by them. The five categories along with the minimum net worth requirement of Trading Licensees are provided below.

S. No	Category	Minimum Net Worth (Rs Crs.)	Volume of Electricity Traded
1	I	50	Above 7000 MUs
2	II	35	Not more than 7000 MUs
3	III	20	Not more than 4000 MUs
4	IV	10	Not more than 2000 MUs
5	V	2	Not more than 500 MUS

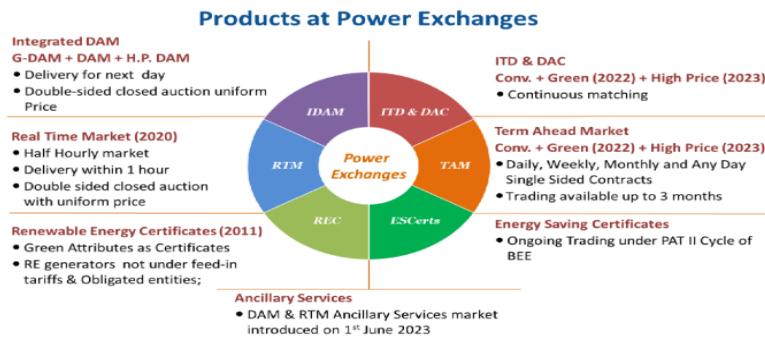
The Regulations have further specified that for Category-I trading licensee, if the volume traded exceeds 10,000 MUs the Trading Licensee should have a minimum net worth of Rs. 75 crores. The Trading Licensee can participate in long term contracts, short term contracts including DEEP platform and Power Exchanges, cross border trading, and banking of electricity. Banking of electricity essentially means exchange of electricity between two utilities over different period. The list of Trading Licensee granted registration over period is provided in the Table below:

List of Trading Licensees

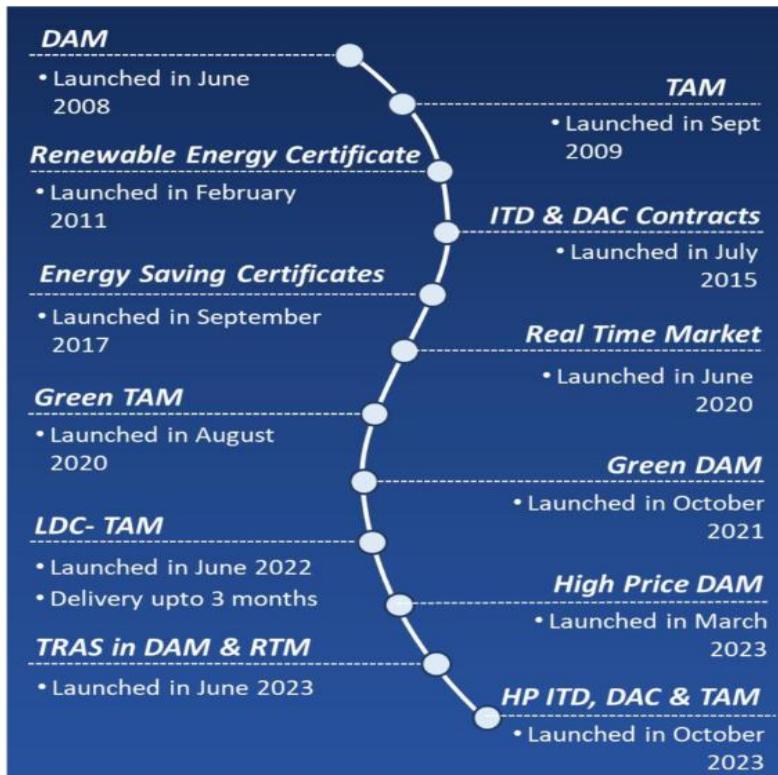
S.No	Name of Trading Licensee	Date of Issue of License	Category of License
1	Tata Power Trading Company Ltd.	9-6-2004	I
2	Adani Enterprises Ltd.	9-6-2004	I
3	PTC India Ltd.	30-6-2004	I
4	NTPC Vidyut Vyapar Nigam Ltd.	23-7-2004	I
5	National Energy Trading & Services Ltd.	23-7-2004	III
6	Instinct Infra & Power Ltd.	7-9-2005	III
7	Essar Electric Power Development Corporation Ltd.*	14-12-2005	-
8	JSW Power Trading Company Ltd.	25-4-2006	IV
9	Greenko Energies (P) Ltd.	22-1-2008	III
10	Ambitious Power Trading Company Ltd.	16-9-2008	IV
11	RPG Power Trading Company Ltd.	23-9-2008	II
12	GMR Energy Trading Ltd.	14-10-2008	I
13	Knowledge Infrastructure Systems (P) Ltd.	18-12-2008	IV
14	Kreate Energy (I) Pvt. Ltd.	12-2-2009	II
15	Shree Cement Ltd.	16-3-2010	IV
16	ABJA Power Pvt. Ltd.	26-4-2011	III
17	Customised Energy Solutions India (P) Ltd.	8-6-2011	V
18	Statkraft Markets (P) Ltd.	21-6-2012	I
19	Manikaran Power Ltd.	29-6-2012	I

1. Overview of Products in Power Exchanges

At present the Power Exchanges are offering multiple products at their platform catering to the varying needs of the market participants. These products were introduced at different point of time looking at the requirement of the market based on approval of CERC. The different products available at the exchange platform along with their time of introduction is provided in the figure below:



IEX Product Timeline



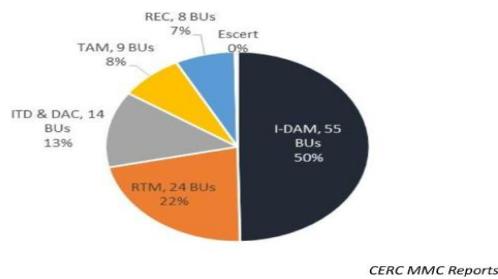
DAM	Day Ahead Market	TAM	Term Ahead Market
G-DAM	Green Day Ahead Market	G-TAM	Green Term Ahead Market
HP-DAM	High Price DAM	RTM	Real Time Market

During FY 23 the total volume traded through the power exchanges was 111 BUS including 8 BUS of equivalent trading of RECs.

Volume Traded Across Different Market Segments in Power Exchanges (BUS)

Market Segments	IEX	PXIL	HPX	Total Power Exchange Market
I-DAM	55	0	0	55
RTM	24	0	0	24
ITD & DAC	7	6	2	14
TAM	5	3	0	9
REC	6	2	0	8
Escort	0	0	0	0
	97	11	3	111

The break-up of volume across different segments and power exchanges is provided in the figure below:



CERC MMC Reports

2. Integrated-Day Ahead Market (I-DAM)

2.1 Overview:

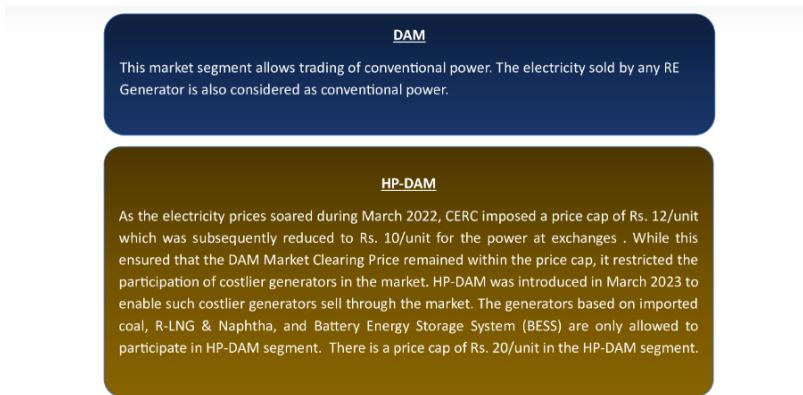
The DAM segment was the first market to be introduced in the Power Exchanges in the year 2008. It is also the most liquid of all market segments at the Power Exchanges with almost 50% of overall exchange volume being traded through this segment. With later additions of G-DAM and HP-DAM, the DAM became the Integrated DAM. IDAM is utilized for buying & selling of power on a day ahead basis. The market is based on collective transactions principle where many to many matching takes place. The market is designed based on double sided closed bid uniform price auction mechanism where both buyer and seller bid anonymously in the market and the price discovered is a uniform clearing price for all cleared buyers and sellers. The cleared volume is settled at uniform Market Clearing Price (MCP) regardless of the price bids submitted by the cleared buyers & sellers.

2.2 Sub-Segments in Integrated DAM:

The DAM is called integrated DAM (I-DAM) because it has three sub-market segments namely Green-DAM, DAM and High Price-DAM getting cleared in a sequential and integrated manner.

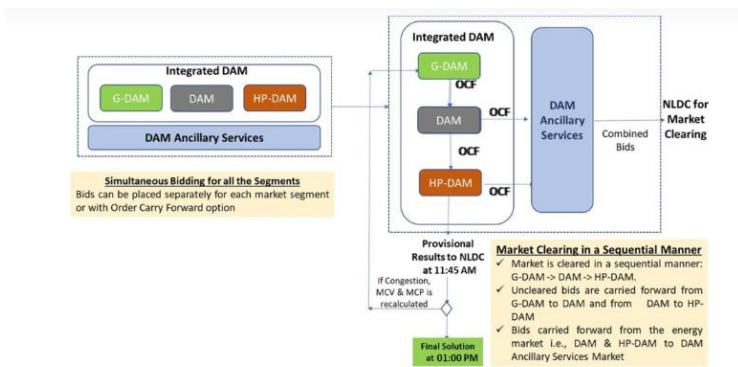
G-DAM

This market segment allows trading of only green power. Only RE Generators or Discoms selling power on behalf of RE Generators are allowed to sell in G-DAM. The buyers can be the Obligated Entities (mandated to purchase RE through Renewable Purchase Obligation mechanism) or anyone who is interested in buying green power. G-DAM was introduced in October 2021.



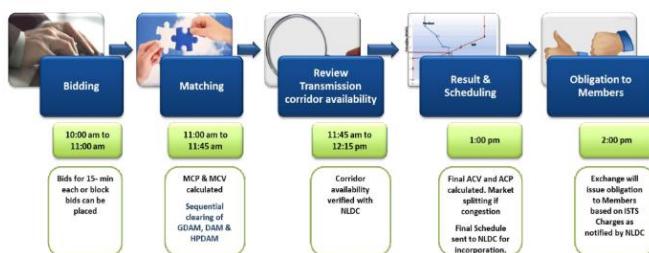
2.3 Order Carry Forward Option (OCF):

The three sub segments i.e., G-DAM, DAM and HP-DAM are interlinked with each other through order carry forward option. The market participants have the option of transferring the unselected bids in G-DAM to DAM and from DAM to HP-DAM. While giving the option, the market participants can specify a minimum quantity and the price at which the transfer of unselected bids will take place. Thus, while the bidding in this market takes place simultaneously during the market hours the clearing of these market segments take place in a sequential manner. G-DAM is first cleared followed by DAM and H.P DAM. At each stage, bids that are not cleared get transferred to the next stage depending upon the market participants' preferences.



2.4 Trading Process and Timelines:

The trading process of I-DAM along with the timelines is provided in the figure below:



- **Bidding:** The market window for bidding is open during 10:00-11:00 am. The market participants can place their 15-minute time block wise bids during this period. While bidding, the market participants can provide option for transferring the unselected bids from G-DAM to DAM and from DAM to HP-DAM. The bids can be modified or deleted till the gate closure.
- **Matching:** After the bidding window is closed at 11:00 am the market clearing engine of respective Power Exchanges computes the Market Clearing Volume (MCV) and Market Clearing Price (MCP) for G-DAM, DAM and HP-DAM in a sequential manner. IEX uses mathematical model based on Mixed Integer Linear Programming (MILP) technique to arrive at its market solutions. The market clearing engine also gives the power flow between the inter-regional transmission corridors.
- **Provisional Results:** Power Exchanges compute the MCV & MCP and the resultant flows on a provisional basis assuming unconstrained transmission scenario and submit it to National Load Dispatch Center (NLDC) for allocation of transmission corridor by 11:45 am. NLDC checks for the availability of transmission corridor through National Open Access Registry (NOAR) and in case there is no congestion, the provisional results get finalized. In case of transmission congestion across any corridor, NLDC allocates the available transmission corridor amongst the Power Exchanges based on their provisional cleared quantity and intimates it to the Power Exchanges by 12:15 pm.
- **Final Results & Scheduling:** In case of transmission congestion, Power Exchanges re-run the market clearing engine considering the available transmission capacity across different corridors as input to the system. Power Exchanges follow the mechanism of market splitting wherein the region with the transmission congestion is segregated from the rest of India and the MCP & MCV are computed separately. Subsequently, the power flow equivalent to available transmission capacity is considered from surplus to deficit region to arrive at the final results. The Power Exchanges submit the final results to NLDC by 1:00 pm. NLDC sends the final result to RLDC for incorporation in the day ahead schedule.

2.5 Type of Bids in I-DAM:

Bids are the instrument through which buyers & sellers submit their requirement to the Power Exchanges. Bids are nothing but a combination of price & quantity over the range of prices allowed in I-DAM. The buy bids are monotonically decreasing bids which means that with the increasing price the purchase quantity either remains same or decreases. Conversely, the sell bids are monotonically increasing bids which means that with increasing price the sell quantity either remains same or increases. Presently, there are mainly two types of bids i.e., Single & Block Bids. In addition to these bids, IEX has introduced Linked Bids, Minimum Quantity Block Bids, Profile Block Bids to enable participants bid as per their requirements.

- **Single bid:** Multiple sequences of price and quantity pairs in a portfolio manner. Single bid can be partially selected.
- **Block bid:** One price and one quantity for a combination of continuous 15 minute time blocks. Selection criterion shall be average of Market Clearing Price (MCP) for the quoted 15 minute time blocks, of respective client's bid area. Block bid will be an 'All or None' type of order.
- **Linked Bid:** Two different block bids can be linked as parent and child bid. The child bid is considered for selection only when the parent bid is selected. Both bids will be selected if combined value obtained is positive.
- **Minimum Quantity Block Bid:** One price and one quantity for a combination of continuous 15-minute time blocks along with a 'Minimum Quantity percentage' and number of sub-bids. Minimum quantity block bids are block bids wherein partial acceptance of Block Bid is possible, if Min Quantity is selected, system would then consider remaining sub bids.
- **Profile Block Bids:** One price and varying quantities for a combination of continuous 15-minute time blocks. Selection criterion shall be based on weighted average of ACP for the quoted 15-minute time blocks of the respective client's bid

2.6 Price Discovery Mechanism:

The price discovery in I-DAM is based on double sided closed bid uniform price auction mechanism. Essentially the buy bids and sells bids are aggregated to form Aggregated Buy and Aggregated Sell curve and the intersection of the aggregated curve gives the Market Clearing Price (MCP) and Market Clearing Volume (MCV). The price discovery is illustrated through the following example.

- Illustration (Only Single Bids):** Let's assume the following single bids to have been received in the system for the following time block and bid area:

Time: 00:00-00:15

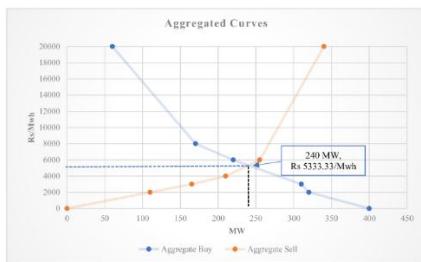
Bids	Price/Qty	P/Q 1	P/Q 2	P/Q2	P/Q3
Buy Bid 1	Price (Rs/Mwh)	0	3000	8000	20000
	Quantity (MW)	200	200	100	50
Buy Bid 2	Price (Rs/Mwh)	0	2000	6000	20000
	Quantity (MW)	200	120	80	10
Sell Bid 1	Price (Rs/Mwh)	0	2000	4000	20000
	Quantity (MW)	0	-50	-100	-140
Sell Bid 2	Price (Rs/Mwh)	0	3000	6000	20000
	Quantity (MW)	0	-90	-150	-200

Aggregation of Buy and Sell Bids:

The buy and sell bids are aggregated to form Aggregated Demand and Aggregated Supply bids as under:

Aggregated Bids	Price/Qty	P/Q 1	P/Q 2	P/Q 3	P/Q 4	P/Q 5	P/Q 6
Buy Bids	Price (Rs/Mwh)	0	2000	3000	6000	8000	20000
	Quantity (MW)	400	320	310	220	170	60
Sell Bids	Price (Rs/Mwh)	0	2000	3000	4000	6000	20000
	Quantity (MW)	0	-110	-165	-210	-255	-340

In the Buy and Sell Bids, the quantity at several price points is not quoted. Hence for aggregation of the Buy and Sell Bids, the quantity corresponding to such price points are being determined through straight line equation. The Aggregated Buy & Sell curves are traced, and the intersection of the curves gives the solutions for the market i.e., Market Clearing Price (MCP) and Market Clearing Volume (MCV) as provided in the figure below.



The aggregated curves cut each other at Rs. 5333.33/Mwh and the cleared volume is 240 MW. Hence the volume corresponding to the price Rs. 5333.33/Mwh gets allocated to the respective Buy and Sell bids. In the present case, 153.33 MW shall be allocated to Buyer-1 and 86.67 MW to Buyer-2 whereas 103.33 MW will be allocated to Seller-1 and 136.67 MW to Seller -2.

2.7 Market Splitting Mechanism:

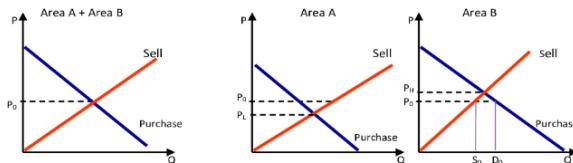
Market splitting is a form of implicit auctioning wherein energy component and corresponding transmission capacity between bid areas are traded simultaneously. In the market splitting methodology, areas on either side of congested corridor are identified separately and initially both are cleared as if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

- **Illustration:**

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

Step-1: All bids from both areas are aggregated together, similar to the System Price calculation. The common price, P_0 , for both areas are established.

Step-2: The bids are then aggregated in the area A and B separately. The aggregated curves could then look like this:



Step-3: Aggregated curves of area A intersect at a lower price, P_L , than the common price, P_0 .

Applying P_0 in area A show that sale at $P_0 >$ purchase at P_0 . Thus area A is surplus area.

Step-4: Aggregated curves of area B intersect at a higher price, P_H , than the common price P_0 .

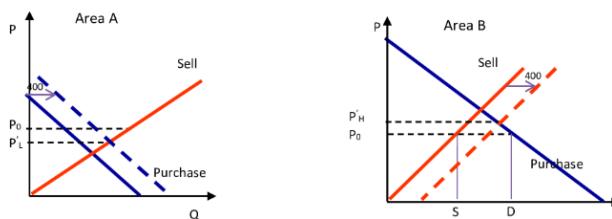
Applying P_0 in area B show that the purchase at $P_0 >$ sale at P_0 . Thus, area B is a deficit area.

Step-5: Then transmission capacity is introduced in the Area Price calculation process. The power flow will be from surplus to deficit area, thus transmission capacity from A to B will be used.

The needed capacity is the difference between sale S_0 and purchase D_0 at price P_0 in the deficit area. Assuming $S_0=2000$ and $D_0=2600$, giving a difference of 600.

- If available capacity from A to B ≥ 600 , area prices in A and B will be P_0 .
- If available capacity from A to B = 0, area prices will be P_L in A and P_H in B.

- If available capacity is between 0 to 600, e.g. 400, available capacity is added to the purchase curve in the surplus area (A) and to the sale curve in the deficit area (B), resulting in a parallel displacement of these curves:



Area price will now be set at intersection of sale curve and displaced purchase curve in area A, and at intersection of displaced sale curve and purchase curve in area B. Transmission capacity is utilized so that power flow exactly equals the available capacity. As a result of this-

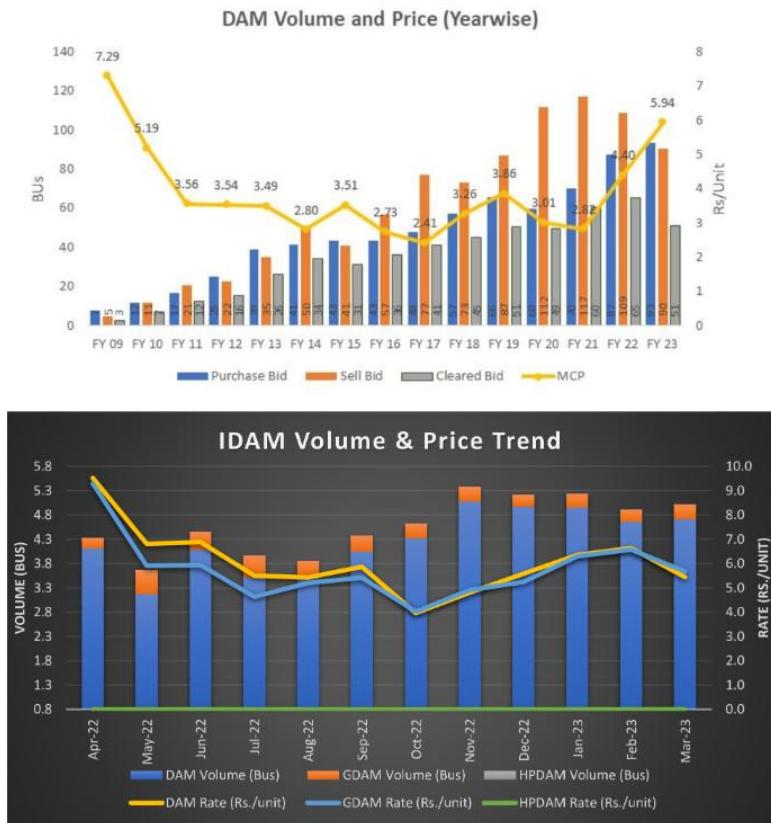
- All grid constraints are relieved
- Available capacities are fully utilized
- Sale-purchase balance requirement is satisfied in both areas (at different price levels).

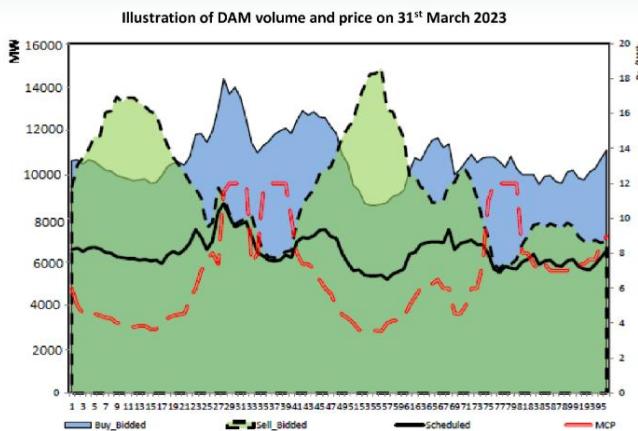
2.8 Key Features of I-DAM at IEX:

I-DAM includes Green DAM, DAM and High Price DAM
Trading window: 10:00 am to 11:00 am everyday; Trading of 15 minute contracts
Matching Mechanism: Double-sided anonymous closed bid auction mechanism
Congestion Management through market splitting and determining Area Clearing Price (ACP) specific to an area
Risk Management through the requisite Margin, including any additional Margin
Price Discovery aims towards economic surplus maximization.
Sequential trading: GDAM → DAM → HPDAM
Financial Settlement: Pay In / Pay Out will be done on D-1 and D+1 respectively where D is the delivery date subject to banking hours and holidays.

2.9 DAM Volume and Price Trends:

The DAM volume and price trend is provided in the figures below:





The price discovered at the exchange platform is a function of the underlying demand and supply forces prevailing in the market. The prices are higher when the demand is relatively higher than the supply and vice-versa.

3. Real Time Market (RTM)

3.1 Overview:

The RTM was introduced in June 2020. RTM is utilized for buying and selling of power on an hour ahead basis. RTM features a new auction session every half an hour with power to be delivered after 4 time blocks or an hour. There are in total 48 15-minute sessions during a day. Similar, to the DAM, RTM is based on collective transactions and the price is discovered based on double sided uniform price auction mechanism.

3.2 Trading Process and Timelines:

The trading process of RTM along with the timelines is provided in the figure below:



The trading process is similar to that of I-DAM; however the timeline is much more stringent.

The different steps of the trading process are explained below:

- **Bidding:** The bidding takes place during 10:45-11:00 PM for delivery of power during 12:00-12:30 AM. The right to revision of schedule for the two time blocks in delivery period 12:00-12:30 AM ends for discoms and generators at 10:45 PM. The gate closes at 11:00 PM for any change in the bid in RTM.

- **Matching:** The matching of bid takes place immediately after the market is closed. The price is discovered considering unconstrained scenario and based on double sided closed bid uniform price auction mechanism.
- **Provisional Results:** The Power Exchanges submit the provisional results to NLDC assuming unconstrained scenario. In case there is no transmission congestion the provisional results become the final result. In case there is a congestion, NLDC allocates the transmission corridor across exchanges on the basis of their provisional cleared volume and inform the Power Exchanges at 11:05 PM.
- **Final Result & Scheduling:** In case of congestion the Power Exchanges re-compute the ACP & ACV through market splitting mechanism and submit the final result to NLDC at 11:09 for onward communication to RLDC.

The trading activities carried out for RTM are similar to that of I-DAM; however, the time available is much more stringent. All the trading related activities are carried out within 30 minutes for the RTM transactions. In order to ensure that RTM runs smoothly, the Power Exchanges have entirely automated the system including the communication between the Power Exchanges and NLDC. The information sharing is taking place through Application Programming Interface (API) that allows the applications to interact with each other. This has ensured that the RTM system is available for 99.9% of time.

3.3 Price Discovery:

The price discovery mechanism including market splitting mechanism during transmission congestion followed in case of RTM is same as that of I-DAM.

3.4 Key Features of RTM at IEX:

Trading Session: Each session of 15 Minute duration on rolling basis with a gap of 15 minutes (E.g. 2245 to 2300 than 2315 to 2330); 48 sessions in Day
Trading Window: Auction for two 15-minute time blocks to be delivered after 4 time blocks.
Matching Mechanism: Double-sided anonymous closed bid uniform price auction mechanism

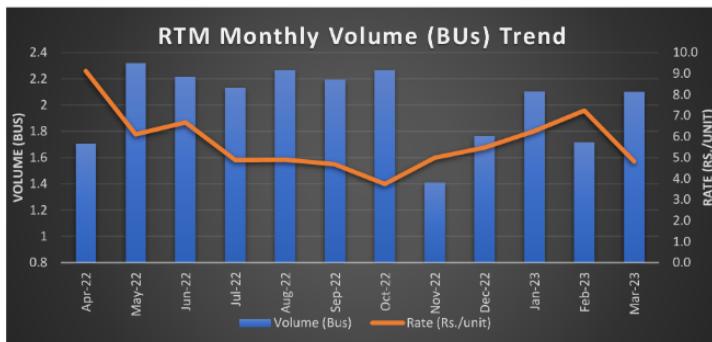


Products at Power Exchanges

Congestion Management through market splitting and determining Area Clearing Price (ACP) specific to an area
Risk Management through the requisite Margin, including any additional Margin
Price Discovery aims towards economic surplus maximization.
Financial Settlement: Pay In / Pay Out will be done on T/ T+1 date respectively subject to banking hours and holidays

3.5 RTM Volume and Price Trends:

The participation in RTM has steadily increased since its launch. RTM provides opportunity to the market participants to manage their variability nearer to delivery and maintain their schedule. Generators are selling their surplus power through RTM whereas the Discoms are both buying & selling in RTM to balance their portfolio. As the RE generation is increasing, the importance of RTM is also growing to manage the increasing intermittency in the system. During FY 23, the total volume traded in RTM was 24 BUs constituting around 22% of the overall volume traded in Power Exchanges. The RTM volume and price trends is provided in the figures given below.



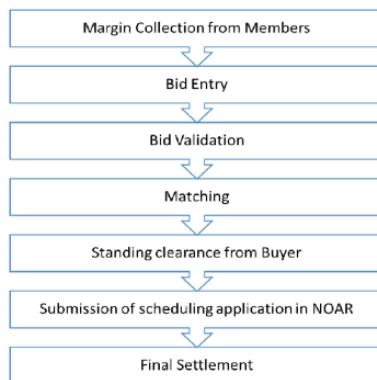
Source: CERC MMC Report

4.1 Overview:

Intraday (ITD) market is available round the clock for delivery of power on the same day. ITD contracts are available for trading on 15 minute basis, 3.5 hours before the delivery of power. Day Ahead Contingency (DAC) contracts are meant for delivery of power on the next day. DAC market opens at 1:00 PM after the finalization of DAM results and closes at 11:30 PM. In case a buyer or a seller fails to meet their requirement through DAM then they can utilize the DAC to meet their requirement for the next day. Both ITD and DAC contracts are based on bilateral transaction principle where one to one matching takes place. The price is matched on a continuous basis during the trading period. Apart from the conventional ITD and DAC segment there are also Green-ITD and Green-DAC segments for trading of RE power meant for RPO fulfilment of Obligated entities and High price ITD & high price DAC for procurement of power from costlier eligible generators based on imported coal, R-LNG & Naphtha, and Battery Energy Storage System (BESS). There is a price cap of Rs. 20/unit in the high price segment.

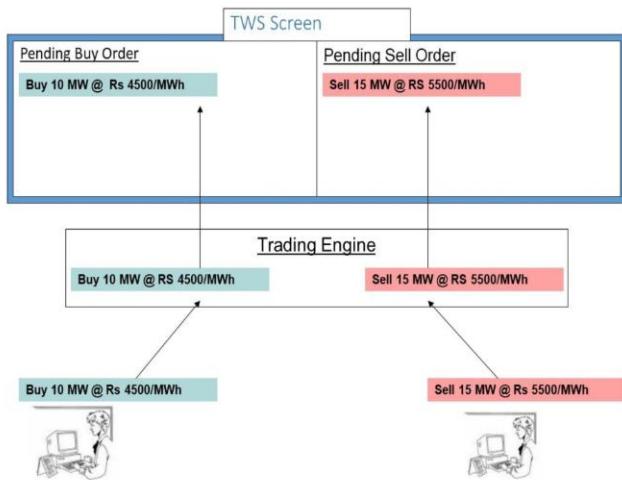
4.2 Trading Process:

The trading process is provided in the figure on the right:



4.3 Continuous Matching:

In the continuous trading session, the participants submit their buy and sell bids during the trading period. The buyers and sellers get matched on continuous basis on a price-time priority. The seller with minimum price quote and buyer with the maximum price quote is considered as best seller and best buyer. Best five buy and sell bids, excluding the details of participants, is displayed to all the participants to show the market depth.



4.4 Key Features of Intra-day Contracts at IEX:

The contracts are available for trading from 00:15 hrs to 19:30 hrs daily through continuous trading process.
Matching Mechanism: Continuous Trade sessions.
Delivery shall commence 3.5 hours after expiry of the contract.
Contracts available for trading hourly and / or 15-minute contracts for delivery on same day on rolling basis.
The contracts are regional contracts available for trading across Northern Region (NR), Eastern Region (ER), Western Region (WR), Southern Region (SR) and North East Region (NER)
Trade once executed shall not be revised.
Financial Settlement: Pay In / Pay Out will be done on T+1/ T+1 date respectively subject to banking hours and holidays

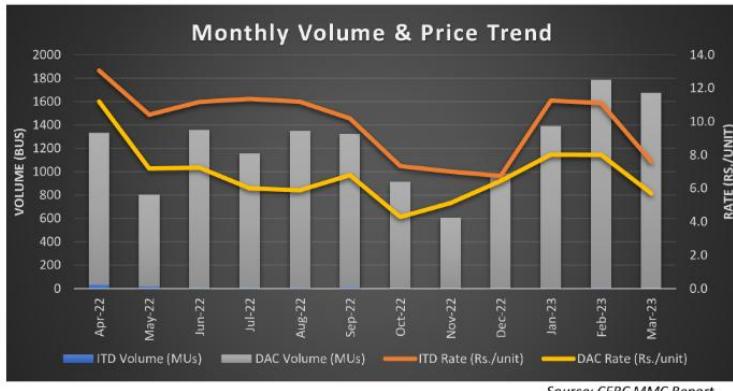
4.5 Key Features of Day Ahead Contingency Contracts at IEX:

The contracts are available for trading from 13:00 hrs to 23:30 hrs on daily basis for next day delivery.
Matching Mechanism: Continuous Trade sessions.
Contracts available for trading hourly and / or 15-minute contracts for next day delivery.
Trading starts after DAM session
The contracts are regional contracts available for trading across Northern Region (NR), Eastern Region (ER), Western Region (WR), Southern Region (SR) and North East Region (NER)
Trade once executed shall not be revised
Financial Settlement: Pay In / Pay Out will be done on T+1/ T+2 date respectively subjected to banking hours and holidays

INTRADAY (ITD) AND DAY AHEAD CONTINGENCY (DAC) MARKET

3

4.6 Power Exchanges ITD & DAC Volume and Price Trends:



5.1 Overview:

Power Market Regulations 2021 has defined TAM segment wherein the transactions occur on day (T) and physical delivery of electricity is on a day more than one day ahead ($T + 2$ or more; T being the trade day). At present there are four contracts namely Daily, Weekly, Monthly, and Any Day Single Sided contract under the TAM segments. Similarly, there is a G-TAM segment having Solar, Non-Solar & Hydro segments. Similar to TAM, for GTAM also, there are Daily, Weekly, Monthly, and Any Day Single Sided contracts. Further, for both TAM and GTAM, their corresponding high price segments exist. These contracts are based on bilateral transactions. For Daily, Weekly, and Monthly contracts, uniform price step auction mechanism is followed for price discovery whereas for Any Day Single Sided contract, Reverse Auction Mechanism is followed. These contracts allow trading of power from $T+2$ day to 90 days at present.

5.2 Different Contracts under TAM/G-TAM:

The four different contracts available under TAM, G-TAM segments are:

Daily Contract Daily contracts are available for buying or selling electricity for any particular day from $T+2$ to 90 days, where T is the trading day.	Weekly Contract Weekly Contracts are available for calendar weeks from Monday to Sunday on rolling basis from $TW+1$ to $TW+12$ (TW = Trade Week) week zero being the trade week.
Monthly Contract Available for calendar Months or combination thereof on rolling basis, upto next 3 months for $TM+1$ to $TM+3$ (TM = Trade Month) month zero being the trade month. Under the Daily, Weekly and Monthly Contracts the Power Exchanges have specified standardized contracts viz. Round the Clock (RTC-00-24 Hrs), Firm Day (07-18 Hrs), Firm Night (23-07 Hrs), Evening Peak (18-23 Hrs) etc.	Any Day Single Sided Reverse Auction Contract The ADSS Contract allows buyer to buy as per their requirement both in quantity and duration. The buyer initiates the bidding on the basis of which sellers participate in the reverse auction.

The details of different contracts along with the timelines is provided in the Table below:

Name of Contracts	Commencement of Bidding	Last Day of Bidding	Bidding Time	Matching Mechanism	Delivery Duration	Remarks
Daily Contract	On daily Basis	Two days before delivery day	00:00-24:00 hours	Uniform Price Step Auction	T+2 to T+90 Days	For pre-specified time blocks
Weekly Contracts	Monday of the week prior to delivery	Friday of the week prior to delivery	12:00-17:00 hours		TW+1 to TW+12 Weeks	notified to the market participants
Monthly Contract	First Day of the zero month	For the first month (M1) contract – ten days prior to the close of zero month (M0); For the second month (M2) contract – five days prior to the close of zero month (M0); For the third month (M3) contract – last day of zero month (M0).	12:00-17:00 hours		TM+1 to TM+3 Months	well in advance through circulars
Any-Day Single Sided Contracts	On Daily Basis	Two days before delivery day	00:00-24:00 hours	Reverse Auction	T+2 to T+90 Days	For user defined days and time blocks

5.3 Price Discovery Mechanism:

For Daily, Weekly and Monthly contracts, uniform price step auction mechanism is followed for price discovery whereas for Any Day Single Sided Contract, Reverse Auction is followed. These mechanisms are briefly explained below:

5.3.1 Uniform Price Step Auction:

In the double-sided open bid uniform price step auction, the matching takes place if there are crossing prices (buy price \geq sell price) in the order book, that is, if the best bid price is equal

TERM AHEAD MARKET (TAM)

2



to or higher than the best ask price. In that case, the equilibrium price is determined according to the following criteria:

- **Maximum tradable volume:** The Equilibrium Price will be the price at which there is maximum tradable volume.
- **Minimum unbalance:** If there is more than one price with equal value for maximum tradable volume, the price that leaves the least volume untraded at its level is chosen as Equilibrium Price.

Illustrations:

Let's assume we have received various buy and sell bids during the trading hours for e.g. A, B, C, etc. The order book would be sorted on best buy and best sell basis at the end of the auction session as below:

BUY			SELL		
Buyer	Qty	Price	Qty	Price	Seller
A	1000	4.5	200	2	J
B	1500	5	1000	3	K
C	500	3.5	800	2.5	L
D	800	6	1500	3.5	M
E	1200	4	2000	4.5	N

Principle: Determining the Maximum Tradable Volume

The principle would establish the price(s) at which maximum tradable volume would be executed. There would be two steps involved in applying this principle.

STEP 1 - Determine the cumulative buy and sell quantities at each eligible price. The cumulative buy and sell quantities at each price for 'XYZ' are as follows:

Cumulative Buy	Buy Qty at Price	Price	Sell Qty at Price	Cumulative Sell
800	800	6	0	5500
2300	1500	5	0	5500
3300	1000	4.5	2000	5500
4500	1200	4	0	3500
5000	500	3.5	1500	3500
5000		3	1000	2000
5000		2.5	800	1000
5000		2	200	200
5000		0	0	0

STEP 2 – Establish the total tradable volume at each eligible price (i.e., Maximum Quantity which may be traded at that each price). The total tradable volume at a price would be computed as 'Minimum of Cumulative Buy and Cumulative Sell quantity' at the respective price. The Maximum Tradable Volume (MEV) for each eligible price is as below:

Cumulative Buy	Buy	Price	Sell	Cumulative Sell	Maximum Executable Volume
800	800	6	0	5500	800
2300	1500	5	0	5500	2300
3300	1000	4.5	2000	5500	3300
4500	1200	4	0	3500	3500
5000	500	3.5	1500	3500	3500
5000		3	1000	2000	2000
5000		2.5	800	1000	1000
5000		2	200	200	200
5000		0	0	0	0

In this example, the maximum quantity that may be traded is 3,500 MW at prices Rs. 4 and Rs. 3.5. As per Principle 1, the prices eligible for Auction Uniform Price Calculation are Rs. 4 and Rs. 3.5. The algorithm would eliminate all other price points as the potential Auction Uniform Price. To further narrow the choices for Uniform Auction Price, Principle 2 would be used to determine the Minimum Unbalance level.

Principle: Establishing the Minimum Unbalance

The second principle would ascertain the eligible price levels (from prices 4 and 3.5) at which the Unmatched Quantity is a minimum. The Minimum Unbalance at each price level is equal to 'Cumulative Buy Quantity – Cumulative Sell Quantity' as shown in the Table below.

Cumulative Buy	Buy	Price	Sell	Cumulative Sell	Maximum Executable Volume	Minimum Imbalance
4500	1200	4	0	3500	3500	1000
5000	500	3.5	1500	3500	3500	1500



Products at Power Exchanges

As per completion of Principle 2, the prices eligible for Auction Uniform Price Calculation are 4 and 3.5. The algorithm would further eliminate 3.5 as Auction Uniform prices and select Rs. 4 as uniform auction price.

5.3.2 Reverse Auction Mechanism:

In the reverse auction mechanism, the buyers create requisitions against which the sellers submit their offers and compete amongst themselves. The Auction is conducted in two stages i.e., Initial Public Offer (IPO) and Reverse Auction.

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STEP -I : Initial Public Offer (IPO)

Sellers submit their price and quantity against each requisition issued by the buyer. The system ranks the Bidders according to their price bids. The Bidder with the highest price bid in IPO stage is called the H1 Bidder. The Highest Bidder (H1) gets eliminated provided that the total quoted quantity after elimination is not less than twice the requisitioned quantity.

STEP -II : Reverse Auction (RA)

After completion of IPO stage, RA is conducted. During the auction session only prevailing lowest quoted price (L1) will be displayed to the market. The RA is for a period of 120 minutes. Before the scheduled closure of RA, if there is a change in the lowest quoted price (L1), the RA gets auto extended by a specific duration. During the RA, the seller has the option of reducing the price quoted in decrements of 1 Rs./MWh or multiples thereof and the option of increasing the quoted quantum by 1 MW or multiples thereof. After the RA process , the sellers get ranked in accordance with the prices offered in ascending order. The sellers, in order of their rankings, cumulatively offering the quantum of power up to the requisitioned capacity, become the Successful Bidders. The buyer may accept and decide to procure power from the Successful Bidders in the order of their rankings until the accepted quantity is met.

5.4 Features of TAM at IEX:

Type of Contract: There are four contracts under TAM: Daily, Weekly, Monthly, and Any Day Single Sided Contract
Duration of Contract: Daily and Weekly are available from T+2 to 90 days; Weekly contracts are available up to 12 weeks and Monthly contracts up to 3 months
Price Discovery: Daily, Weekly and Monthly Contract follows Double sided uniform price step open auction mechanism; Any Day Single Sided Contract is based on Reverse Auction mechanism
Revision of Contract: The contract once executed are not allowed to revise other than transmission constraint and force majeure situation
Risk Management: Power Exchanges take the margins from buyers & sellers to avoid any default in the contract

5.5 Power Exchanges TAM Volume and Price Trends:



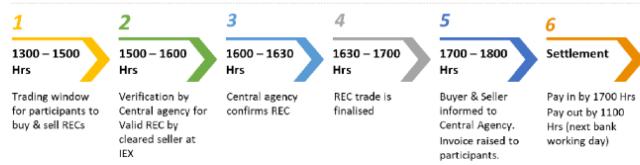
Source: CERC MMC Report

6.1 Overview:

Renewable Energy Certificate (REC) market allows trading of RECs. As per the CERC REC Regulations 2022, the RECs are to be issued without any attribution to a technology viz, solar, non-solar etc. There is also no forbearance and floor price in the market for trade of RECs. For generators, the RE energy injected into the grid but not accounted for meeting RPO by any obligated entity is considered for issuance of RECs. On the power exchanges, the trading of RECs is taking place on the 2nd and last Wednesday of every month. Once traded, the REC gets extinguished. REC market is based on double sided closed bidding and the price discovery is taking place on the basis of uniform price step auction. NLDC which is the Central Agency for REC maintains the registry for REC, keeping a record of the REC inventory and accounting for new issuance and trading of RECs.

6.2 Process and Timelines for REC trade at the Power Exchanges:

The trading process and timelines is provided in the chart below:



The different stages are briefly explained below:

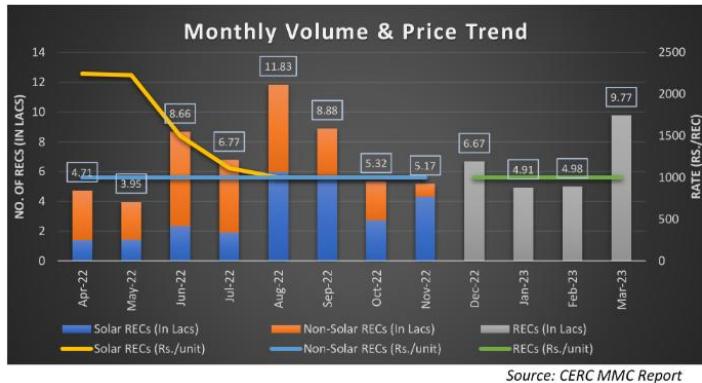
- **Bidding:** The bidding takes places during 1:00-3:00 PM on the 2nd and last Wednesday of every month. The RE Generators holding the RECs place the offers while the obligated entities bid for the RECs in the market.

- Verification of Bid Volume:** The total quantity of RECs placed for dealing on the Power Exchange(s) has to be less than or equal to the total quantity of valid Certificates held by an entity. After the bidding hours the Power Exchanges share the no. of RECs bid by different sellers with the Central Agency to verify their validity. Central Agency checks the combined maximum bid volume in the Power Exchange(s) for each entity against the quantity of valid RECs for that entity for RE Certificates. The Central Agency confirms the availability of the valid RECs with the entity by 4:00 PM. In case the combined maximum bid volume placed for dealing in the Power Exchange(s) exceeds the quantity of valid RECs held by an entity as per the Central Agency records, then, the Central Agency advise the Power Exchange(s) to exclude such bid(s) while working out the MCP and MCV.
- Finalization of REC Trade:** Power Exchanges compute the final result i.e., MCP and MCV by following closed bid uniform step auction mechanism. Power Exchanges submit the final result to the Central Agency for updation in registry. The Central Agency extinguishes RECs sold in the records of the Central Agency. The certificates are extinguished by the Central Agency in the 'First-in-First-out' order.

6.3 Features of REC Contract at IEX:

REC Denomination -1 REC = 1 MWh;
Validity- Certificate valid till redeemed
Transfer Type- Single transfer only
Matching Mechanism: Closed double sided auction
REC Redemption: Through power exchange and traders
Certificate Multiplier: RECs to be issued to the Generators in multiple of multiplier. Multiplier is provided in CERC REC Regulation 2022.
Trading Frequency: Twice a month (2 nd and last Wednesday of the month)

6.4 Power Exchanges RECs Volume and Price Trends:



7. Energy Saving Certificates (ESCERTs) Market

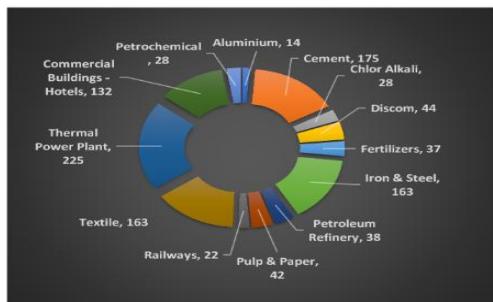
7.1 Overview:

The Energy Saving Certificates (Escerts) are introduced under the Perform Achieve Trade (PAT) Scheme of Bureau of Energy Efficiency (BEE) under Ministry of Power. PAT is a market-based mechanism to incentivize energy efficiency in large energy intensive industries. The scheme is based on cap and trade mechanism wherein the specific energy consumption targets are set for identified designated consumers over a period of time – ESCerts are issued to the DCs overachieving the targets which can be purchased by the under achievers DCs through the Power Exchanges. As per CERC Regulations, the ESCert Market is based on double sided pooled bidding principles and the price is discovered based on Uniform Price Step Closed Auction mechanism. The trading takes place on every tuesday of the week, subject to the notification of the BEE. Recently, the CERC has notified a floor price of Rs. 1840/Escert which is 10% of the price notified for 1 Metric Tonne of Oil Equivalent for the PAT cycle-. The table below provides the value of per metric tonne of oil equivalent of energy consumed (revised annually) for the purpose of Issue of Energy Savings Certificate:

Financial Year	PAT Cycle	Value of per metric tonne of oil equivalent	Floor Price of REC
FY 2018-19	PAT Cycle 2	18420	1840
FY 2019-20	PAT Cycle 3	21650	2165

7.2 Sector wise Designated Consumers (DCs):

First cycle of PAT scheme was for the period 1st April 2012 to 31st March 2015. Till now a total of six cycles of the PAT scheme have been launched till April 2020, covering 1073 industries from 13 industrial and service sectors.



7.3 Trading Process and Timelines:

The trading process and timelines are similar to REC market provided in the figure below:



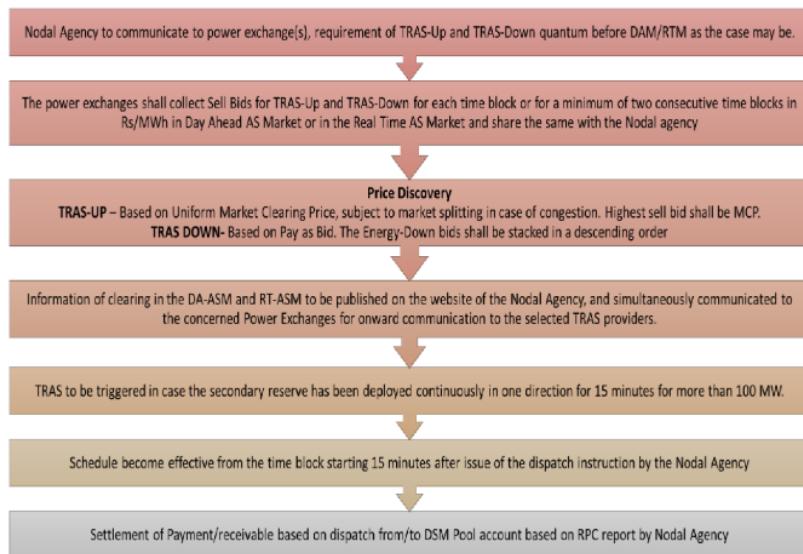
7.4 Features of ESCerts Contract at IEX:

Issuing Agency: Ministry of Power, GoI on recommendation of BEE
ESCert Denomination: 1 ESCert = 1 MTOE (Metric Tonne of Oil Equivalent)
Trading Platform: Power Exchange
PAT Cycle: 3 Years
Trading Frequency: Once a week (Every Tuesday)
Price Discovery: Double sided uniform price closed step auction
Penalty: As per Energy Conservation Act, 2001
Banking: Allowed for consecutive Cycle

8.1 Overview of Ancillary Services Market:

As provided under the CERC Ancillary Services Regulations 2022, the Tertiary Reserves Ancillary Services is now procured from the market. The Power Exchanges are providing the Day Ahead Ancillary Services Market (DAM-AS) and Real Time Ancillary Services Market (RTM-AS) to facilitate bidding for procurement of capacity for Tertiary Reserves Ancillary Services (TRAS). Within the DAM-AS and RTM-AS there are two segments- TRAS- UP and TRAS-Down segments. In TRAS-UP segment, the generators will increase their generation to meet the additional demand and in TRAS-DOWN segment, the generators will reduce their generation to balance the reduced demand as informed by the Nodal Agency.

8.2 TRAS Procurement Procedure



8.3 Features:

No Transmission charges or transmission losses or transmission deviation rate shall be payable on TRAS.
Bidding window for DAM AS: 10:00 am to 11:00 pm everyday; Trading of 15 minute contracts
Trading Session for RTM AS: Each session of 15 Minute duration on rolling basis with a gap of 15 minutes (E.g. 2245 to 2300 than 2315 to 2330); 48 sessions in Day
Bidding Window for RTM AS: Bidding for two 15-minute time blocks to be despatched after 4 time blocks.
Price Discovery to be done by NLDC.

The following Green markets are exclusively trade in renewable power are as follows:

- **Green-Day Ahead Market (G-DAM):** Green Day Ahead Market (G-DAM) is a part of I-DAM. In this market, the RE sellers or Discoms are allowed to sell in the market. Obligated Entities including Discoms & Open Access consumers can purchase green power through G-DAM to meet their RPO. The market is based on collective transaction principles and price discovery takes place on the basis of closed double-sided uniform price auction mechanism. In the I-DAM, G-DAM is cleared first followed by conventional DAM and H.P-DAM. In case of transmission congestion or real time curtailment, the G-DAM is given preference over other market segments in I-DAM.
- **Green Intraday & Day Ahead Contingency Market:** Green Intraday (G-ITD) market has presently Solar, Non-Solar and Hydro segments. Similar to conventional segments, G-ITD allows trading of RE power during the same day on 15-minute basis. The price matching takes place on continuous basis. G-Day Ahead Contingency (G-DAC) market also has three segments i.e., Solar, Non-Solar, and Hydro segment. G-DAC allows trading of power for the next day. After the DAM results are finalized at 1:00 PM the G-DAC segment opens, and it continues till 11:30 PM. The price matching takes place on continuous basis.
- **Green Term Ahead Market (G-TAM):** The G-TAM segment has different segments i.e., Solar, Non-Solar and Hydro segments. In each of these contracts there are 4 contracts available i.e., Daily, Weekly, Monthly, and Any Day Single Sided Contract. Unlike the conventional segment the trading takes place on energy basis. The profile of the RE generator in MW basis gets converted into energy terms based on which trading takes place. This allows the RE Generators having different generation profile to compete amongst themselves and enhance liquidity in the market.

- REC Market:** As mandated by the MoP, the obligated entities are utilizing various green segments to procure green power in a competitive manner and meet their RPO requirements. REC is an alternate market based mechanism to fulfil the RPO of obligated entities. RE power sold in the exchanges, that is not accounted for RPO fulfilment can be

GREEN MARKET

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issued REC. These RECs are tradable in the market., Purchase of REC goes towards the fulfilment of RPO by the obligated entities.

9.1 Green ITD & Green DAC Price & Volume Trends



Source: CERC MMC Report

9.2 Green TAM Price & Volume Trends



Source: CERC MMC Report

The Power Exchanges provide electronic platform for trading of electricity. The various activities undertaken by the Power Exchanges can be broadly classified into the following function:

- **Trading:** The Trading function include opening of market window, collection of bids, computation of market results i.e., Market Clearing Volume and Market Clearing Price, publication of results etc. Power Exchanges have developed their automated Trading System for bidding and computation of results across different products in accordance with CERC Regulations and approvals.
- **Market Surveillance:** As mandated under the Power Market Regulations, the Power Exchanges are carrying out day to day monitoring and surveillance of the bidding taking place through their platform. Power Exchanges are required to monitor the transaction pattern, volatility, sudden change in prices, marginal buyers & sellers, circular trading etc. Power Exchanges have constituted Market Surveillance Committee under an Independent Director and have been submitting their analysis to CERC on a quarterly basis.
- **Clearing & Settlement:** The clearing & settlement function include collection of margins from participants, pay-in of funds from buyers and pay-out of funds to sellers etc. Power Exchanges are carrying out the clearing & settlement through the clearing banks empanelled with the Exchange.
- **Risk Management:** Power Exchanges are assuming the counterparty risk to all the transactions taking place at their platform. Power Exchanges have developed their risk management framework to secure payments to the sellers within timelines. As mandated under the Power Market Regulations, the Power Exchanges are also maintaining the Settlement Guarantee Fund (SGF). Power Exchanges have also constituted a Risk Assessment and Management Committee (RAMC) headed by an Independent Director to review the risk management framework of the exchange and submit its assessment report to CERC.
- **Scheduling & Delivery:** The transactions taking place at the exchange platform are physically deliverable contract and are required to be scheduled by the load despatch centres. Power Exchanges are making applications to NLDC/RLDCs in accordance with the timelines specified in the Grid Controller of India Limited (Grid India) procedures for scheduling of the transactions. Power Exchanges are following the Grid India Procedure for Grant of Temporary General Network Access (T-GNA) to the inter-State Transmission system through National Open Access Registry NOAR for scheduling collective (IDAM and RTM) and bilateral transactions (ITD, DAC, TAM).

The key exchange functions along with the various activities carried out under these functions are provided in the figure below.

Key Exchange Functions				
Trading	Surveillance	Risk Management	Clearing	Delivery
<ul style="list-style-type: none"> ✓ Bid accumulation ✓ Calculation of Provisional result ✓ Publishing provisional results ✓ Calculation of Final result (with technical constraints) ✓ Publishing final results ✓ Publishing Daily Obligation reports 	<ul style="list-style-type: none"> ✓ Round the clock ✓ Checking of Collateral ✓ Checking of Permissible Quantity as per NoC & Margins ✓ Deviation from Bidding Pattern ✓ Daily MIS reporting ✓ Real time support to members ✓ Market Surveillance Report on Quarterly Basis 	<ul style="list-style-type: none"> ✓ Collect Initial and Additional Margins ✓ Provide exposure to market participants based on the margins ✓ Maintain Settlement Guarantee Fund (SGF) ✓ Regular updation of Risk Management Framework ✓ Risk Assessment & Management Committee Report on half yearly basis 	<ul style="list-style-type: none"> Generate the Obligation Report based on MCV and MCP ✓ Daily Obligation settlement <ul style="list-style-type: none"> ✓ Pay In ✓ Pay Outs ✓ Maintain Settlement Guarantee Fund (SGF) ✓ Regular updation of Risk Management Framework ✓ Risk Assessment & Management Committee Report on half yearly basis 	<ul style="list-style-type: none"> Update NoC ✓ Calculation of transmission capacity requirement based on market clearing volume Interaction with NLDC for transmission capacity availability ✓ Delivery schedule for every portfolio ✓ Scheduling with SLDCs Member communication for schedule ✓ Monthly and weekly reporting to CERC ✓ Real Time Congestion Management

The activities are further elaborated in the subsequent sections.

The key aspect of trading function is collection of bid and computation of results i.e., price, volume, transmission flows etc. These are briefly discussed in the section below.

2.1 Bidding:

Power Exchanges provide the nationwide automated trading platform for trading of electricity across different contracts. Power Exchanges through their automated platform are collecting bids and also undertaking price discovery & matching of bids in accordance with the CERC approvals.

Trading is open on the power exchange on all days except on holidays declared in advance. The Power Exchanges are publishing the trading and settlement calendar in advance intimating the Members & Clients about the timelines of trading and other related activities. The Power Exchanges provide trading sessions for each market segment. In the auction-based market viz. DAM, RTM etc. the bids are collected during a pre-defined bidding window having a fixed opening and closing time after which the auction is carried out to arrive at the cleared volume & price. Whereas, for the continuous transactions the bids are collected and simultaneously cleared based on price-time priority.

Market Segment	Bidding Session
DAM	10:00-11:00 Hrs
RTM	15 minutes bidding session repeated in every alternate time block
ITD	3.5 Hrs before the delivery period
DAC	13:00 - 23:30 Hrs
Daily	12:00-17:00 Hrs
Weekly	12:00-17:00 Hrs
Monthly	12:00-17:00 Hrs
Any Day Single Sided	As per the Requisition

Members place their bids through the Trader Workstation (TWS) or web based bidding system. Members can also authorize their clients to access the TWS for directly placing bids in the system. As specified under the Power Market Regulations there are three types of Memberships i.e., Trader Member, Proprietary or Grid connected Member, and Facilitator Member. Persons interested in becoming Exchange Member have to approach a Power Exchange and follow the process specified by the Exchange. They have to fill up the Application and provide KYC details as specified by the Exchanges. In addition, they have to meet criteria viz. minimum net-worth and give the fees & security deposits for becoming a Member of the Exchange.

While submitting the bids, the Power Exchanges check for its validity. The bid submitted has to be as per the bid structure specified by the Exchanges and the quantum & price are within the limits. The participant cannot exceed its quantum beyond the limit allowed by the system operator (Standing Clearance quantum) and the limit as per the margin requirement of the specific segment of the Power Exchange. The Power Exchanges are fetching the standing clearance quantum from the National Open Access Registry (NOAR) portal and rejecting the bids in case the quantum bided exceeds the standing clearance quantum.

2.2 Price Discovery:

Once the bids are submitted by participants at the Exchange, the price discovery mechanisms are deployed by the Exchange to arrive at the cleared quantum and price corresponding to the concerned contract. The transactions under DAM & RTM, referred to as the collective transactions, are the ones whose price discovery mechanism is based on the principle of maximization of economic surplus (consumer surplus and seller surplus). For the contracts using continuous matching mechanism, best buy and best sell are matched to culminate in a trade while for step auction, an equilibrium price is determined based on maximum tradable volume and minimum imbalance.

The different products and their price discovery mechanism is provided in the Table below:

Market Segment	Sub Segment	Price Discovery Methodology
Integrated -Day Ahead Market (I-DAM)	Day Ahead Market	Double sided closed bid uniform price auction
	Green Day Ahead Market	
	High Price Day Ahead Market	
Real Time Market (RTM)	Real Time Market	
Intraday & Day Ahead Contingency Market (Green, Conventional & High Price)	Day Ahead Contingency	Continuous matching
	Intra-Day	
Term Ahead Market (Green, Conventional & High Price)	Daily Contracts	Double-sided open bid uniform price step auction
	Weekly Contracts	
	Monthly Contracts	
	Any Day Single Sided Contracts	Reverse Auction
Renewable Energy Certificates (REC) Market	Renewable Energy Certificates (REC) Market	Double-sided closed bid uniform price step auction
Energy Savings Certificate (ESCert) Market	Energy Savings Certificate (ESCert) Market	Double-sided closed bid uniform price step auction

National Open Access Registry (NOAR)

NOAR is a centralized online platform through which the short-term open access to the interstate transmission system is being managed in India. It is an integrated platform accessible to all stakeholders in the power sector, including open access customers (both sellers and buyers), power traders, power exchanges, National/Regional/State LDCs and others. The platform provides automation in the workflow to achieve shorter turnaround time for the transactions. NOAR platform also has a payment gateway integrated for making payments

related to interstate short-term open access transactions. NOAR platform provides transparency and seamless flow of information among stakeholders of open access NLDC is the nodal agency for implementation and operation of NOAR.

TRADING

3



Functioning of Power Exchanges

Key Features of NOAR

- Centralized System: Single point electronic platform for all the stakeholders.
- Automated Process: Automated administration process of the short-term open access.
- Common Interface: Interface with the RLDCs scheduling applications & Power Exchanges.
- Payment Gateway: Make payments related to STOA transactions.

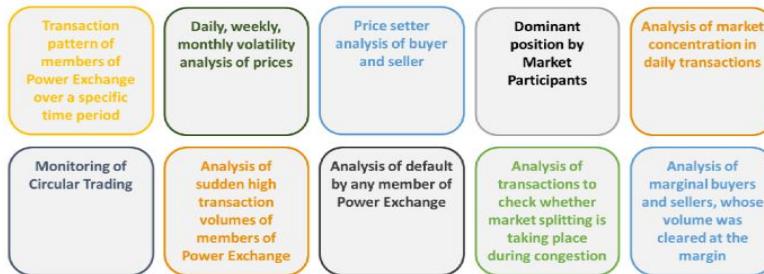
Key Benefits

- Simplified accounting of OA transactions
- Better communication and updated information
- Bringing in transparency, efficiency and economy
- Standardization and mapping of the entities

3. Market Surveillance

The CERC Power Market Regulation, 2021 mandates the Power Exchanges to set up a surveillance department to carry out day to day monitoring and surveillance of transactions and undertake their analysis. Power Exchanges have to ensure that market surveillance is executed from a physically secure and restricted area by authorised personnel. The CERC Regulations also require the Power Exchanges to constitute a Market Surveillance Committee (MSC) headed by an Independent Director of the Board and having members from the executive team of the Power Exchange.

The Market Surveillance Committee analyses bidding patterns and transactions of participants and submits quarterly surveillance report to the CERC. Such surveillance report includes mainly the following:



As provided under the PMR, CERC can enquire for any additional information or conduct 3rd party audit and investigation to ascertain that the market is functioning in a fair & transparent manner.

3.1 Member Inspection:

The Power Exchanges conducts inspection of books of accounts of the Facilitator & Trader Members annually through a third-party auditor conversant with the power market and submit the reports to the regulator. The scope of the inspection covers compliance with the Exchange Rules and CERC Regulations regarding the volume limits trading margin limits and other requirements. All Exchange Members are required to maintain Books of Accounts, documents, counterfoil of contract notes and other details for such period, as may be directed by the Exchange. They are supposed to produce such records before the inspection team as per directions issued by the inspection team and extend their full co-operation in terms of providing information to carry out inspection smoothly.

4. Risk Management

The Power Exchanges assume the counterparty risk to all the transactions taking place at their platform. As mandated by the Power Market Regulations, the Exchanges have developed their risk management framework to minimize the risks associated with the exchange transactions. The Power Exchanges also constitute a Risk Assessment and Management Committee (RAMC) headed by an Independent Director to review and assess the risk of the Exchanges and submit a RAMC report to CERC on half year basis.

Risk management at the Power Exchanges are primarily concerned with the following activities-



The various activities undertaken taken by the Power Exchanges as part of risk management are as follows:

- **Adequate Risk Disclosure:** Members and Clients are made adequately aware of the risks inherent in the short-term market transactions undertaken through Exchanges' platform. For this purpose, the members are required to ensure that their clients furnish a risk disclosure statement, as prescribed by the Exchange, willing to transact or clear through them. This disclosure contains all the risks relating to the transactions at Exchange.
- **Self-insurance by Members:** The Members may be required to obtain insurance cover at their own cost, so as to protect themselves from risks and hazards relating to their business operations at the Exchange.
- **Margin money from Member/Clients:** Member or the Clients, as applicable, are allowed to transact only when they maintain the requisite Margin, including any additional Margin as specified for the respective trading segment or the type of contracts or the directions issued by the Exchange.
- **Pay-in obligation by the Buyer towards their trade:** In case a Member or Client, as applicable, fails to pay to the Exchange any amount towards its pay in, the Exchange cancels the allocation of its trades and initiate appropriate action against such Member or the Client, as applicable. Any loss arising out of such instructions by the Exchange shall be borne by the defaulting Member or the Client, as applicable. The Exchange may also impose penalty on such defaulting member or the Client, as applicable.

Margin Money specified by IEX

Power Market Regulations has given the flexibility to the Power Exchanges to develop their own risk management framework. Accordingly, IEX has specified margins for its different contract as given below.

Contract	Initial Margin	Basis/Additional Margin
Integrated DAM	Margin equal to Last 7 Days Average of Buy turnover	
Intraday Contract (Green, Conventional & High Price)	105% of order value from buyer	-
DAC Contract (Green, Conventional & High Price)	100% of order value from buyer	-
TAM-Daily Contract (Green, Conventional & High Price)	5% of order Value for contracts up to 15 days	50% of trade value
TAM-Weekly Contract (Green, Conventional & High Price)	1% of order Value for contracts beyond 15 days	50% of trade value
TAM-Monthly Contract (Green, Conventional & High Price)		20% of trade value
TAM-Any Day Single Sided Contract (Green, Conventional & High Price)	Buyer- Non-refundable fee of Rs. 1,00,000 for initiating RA Seller- Rs. 30,000/MW/Month or part thereof	50% of trade value for contracts up to 7 days 25% of trade value for contracts between 7 to 15 days 20% of trade value for contracts beyond 15 days
REC	100% of order Value	-
ESCert	100% of order Value	

Power Market Regulations define "**Clearing**" as the process of determination of obligations of members of a Power Exchange resulting from the conclusion of a transaction at the Power Exchange. Similarly "**Settlement**" is defined as the process of **discharging** the obligations of members or clients of such members resulting from conclusion of a transaction at a Power Exchange. Presently the Exchanges are performing both the clearing and settlement functions inhouse.

5.1 Clearing:

At present the clearing of the transactions is carried out by the respective Power Exchanges. The Power Exchanges are acting as deemed central counter party for the transactions in contracts admitted on the Exchange. Once a Contract is matched, and accepted, the Exchange is substituted as deemed central counter party for all net financial liabilities of the Members or the Clients. The Power Exchanges are processing all the concluded transactions and notifying the net liability of the Clearing Member or the Client, as applicable through the Daily Obligation Report.

The Power Exchanges have empanelled Sscheduled Ccommercial Bank(s) as the designated Clearing Bank(s) for providing and facilitating the collection of funds, transfer of funds, sharing of information and other value-added services. The Power Exchanges and the designated Clearing Bank(s) have signed agreements for the services to be rendered by the Clearing Bank(s) and to be availed by the Exchange.

In order to facilitate smooth clearing and settlement, all Exchange Members, or the Clients, as applicable, participating in trading are required to open Member Settlement Account with any of the designated Clearing Banks. All such Members or the Clients, are required to strictly follow instructions of the Exchange in respect of operation of such bank accounts, minimum balance, segregation of Clients' funds and own fund, as may be required by the Exchange.

They are also submitting irrevocable mandate in writing enabling the Exchange to debit and credit their account electronically. They are required to keep the accounts adequately funded, so as to enable the Exchange to recover its dues by debiting their respective bank accounts.

5.2 Settlement:

The Power Exchanges are performing the functions of settlement of the transactions concluded at the Exchange. The Exchanges are also required to create and maintain a Settlement Guarantee Fund (SGF) for settlement of transactions in case of default by its members or clients of such members.

A robust settlement mechanism ensures that the market participants are able to carry out trades seamlessly at the Exchange.

6. Scheduling & Delivery

The Power Exchanges undertake scheduling of all transactions concluded at their platform. It is also required that the transactions through Power Exchanges be settled only by way of physical delivery. No financial set-off is allowed with respect to the Exchange transactions. The scheduling and delivery of transactions for Day Ahead Market and Real-time Market will be in coordination with the NLDC and in accordance with relevant provisions of the General Network Access Regulations, the Grid Code and the procedure issued for Grant of Temporary General Network Access (T-GNA) to the inter-State Transmission system through NOAR by Grid India in this regard. For the Intraday, Contingency and Term Ahead Contracts, scheduling has to be done in coordination with RLDC and in accordance with relevant provisions of the Grid Code, the GNA Regulations and the procedure issued for Grant of T-GNA to the inter-State Transmission system through NOAR by Grid India.

7. Regulatory Compliance

The Power Exchanges are functioning under the regulatory oversight of CERC. The Exchanges are mandated to comply with requirements stipulated under the Power Market Regulations and other relevant Orders issued by CERC from time to time. Power Exchanges are also required to function as per their Business Rules & Bye-laws approved by CERC. Some of the important compliance requirements under the Power Market Regulations are provided below:

- **Net-worth:** A Power Exchange shall have a minimum net-worth of Rs. 50 crores at all times
- **Ownership Structure:** No shareholders, other than members or clients, can hold more than 25% shareholding in Power Exchanges. Members or Clients can only hold up to 5% of the shareholding; however, their combined shareholding cannot go beyond 49% of the shareholding.
- **Governance Structure:** The number of Independent Directors should not be less than the number of shareholders directors in the Exchange. No member of Power Exchange or client shall be on the Board of Directors of any Power Exchange.
- **Market Surveillance:** Power Exchanges are required to carry out day to day monitoring and surveillance of transactions through a physically secure and restricted area. Power Exchanges to constitute a Market Surveillance Committee (MSC) headed by an Independent Director of the Board and submit the MSC Report containing the detailed analysis of the market to CERC on quarterly basis.
- **Risk Management:** Power Exchanges are required to develop a prudent risk management framework to minimize the risk. Power Exchanges to constitute a Risk Assessment and Management Committee headed by an Independent Director of the Board to review and assess the exchange risks and submit the report to CERC on half yearly basis.

- **Settlement Guarantee Fund:** Power Exchanges are required to maintain SGF for managing the defaults if any. Power Exchanges can invest the SGF in the safe and liquid fund. Power Exchanges to constitute SGF Committee headed by an Independent Director of the Board to oversee the management of SGF.
- **IT & Algorithm Audit:** Power Exchanges are required to conduct Algorithm Audit of software application used for price discovery once every 2 years. Power Exchanges are also required to conduct IT Audit for data security, data integrity and operational efficiency for every financial year and submit its reports to the CERC by 30th June. Power Exchanges to establish and maintain a disaster recovery site and alternate trading facility for business continuity in case of emergency. Power Exchanges to also formulate and implement a cyber security and cyber resilience framework to manage risk to systems, networks and databases from cyber-attacks and submit it to the Commission for information.
- **Information Dissemination & Data Submission:** Power Exchanges are required to publish all their market related information viz. prices, volume, demand supply curves etc. on their websites in downloadable formats. Power Exchanges are also required to submit to the Commission details of transactions on a monthly basis as per the formats prescribed by CERC. Besides, CERC can enquire for any additional information as and when it is necessary.
- **Approval from CERC:** The Power Exchanges have to take prior approval for introducing any new product, changing Business Rules, appointment of Independent Director, sources of SGF fund, transaction fees etc.

8. IT Infrastructure and Trading System

Power Exchange is a technology driven business. Power Exchanges provide electronic trading platform to enable the market participants trade through the exchanges. For secure and reliable platform for trading of electricity, the Power Exchanges needs to ensure that the IT infrastructure & Trading System is robust and enough redundancies are built in the system to ensure 24x7 availability of the platform. Power Market Regulations have mandated exchanges to provide Disaster Recovery site and alternate trading facility for business continuity. Besides, the Power Exchanges are required to take adequate measures for ensuring cyber security and avoid any systemic risk for the sector.

8.1 Trading System of Power Exchanges

8.1.1 Trading System

- Trading at the Power Exchanges is conducted through Automated Screen based Trading system and through web-based portal.
- An Exchange Member has a non-exclusive permission to use the Trading Work Station (TWS) as provided by the Power Exchange. Each Member has a unique identification number for the purpose of logging in to the system.
- The member is able to use TWS subject to payment of such charges as the Power Exchange may prescribe from time to time.
- The Power Exchange provides the application software for installation of TWS. However, the Member is responsible to arrange for installation of trading application software.
- The Member of the TWS is required to obtain registration of the Approved User who will be responsible for use of TWS.

8.1.2 Connectivity

- In order to connect the TWS of the Members with the exchange server, the Members have option to connect using any connectivity options as provided by the power exchange and through any service provider authorized by the power exchange.
- **Equipment requirement:** A Member has to procure one router, dedicated for TWS connectivity.
- **Router configuration:** Power Exchange provides router configuration to the Member once the leased line connectivity is commissioned. Configuration and testing of the router at the Member end is responsibility of the respective users.
- **Charges:** Members are responsible for payment of necessary charges towards installation, equipment rental, leased line, network connectivity etc. to the service provider.

8.1.3 Expansion of Trading Terminals

- In case a Member wants to install multiple trading terminals they request for additional leased lines. There is no limit on the number of leased lines that one Member can opt for.
- All classes of Members are entitled to expand their trading terminals.
- A Member can set up multiple terminals either in the same city, where he is located or in multiple cities within India, either by way of opening branch offices or by appointing their franchise/approved users.

- There can be various models of expansion of terminals, such as:
 - **Direct connectivity to IEX system:** The Member can install terminals at various places, which can be linked to the Exchange system through Lease line directly. In such cases, the Member will be able to set trading limits for all such terminals from his office using the Member administrator terminal.
 - **Private network of a Member:** If a Member is already having a private network or he proposes to put in place a private network of leased line or ISDN connectivity for expanding his terminals, such private networks could be connected to the Exchange system by way of installing one lease line at Member's central office.



Functioning of Power Exchanges

The Member has to bear all cost with respect to performance and maintenance of such private network.

8.1.4 Major breakdown of the system or failure of communication link

In the event of a major breakdown of the Exchange system or failure of communication link with NLDC, leading to interruption in Exchange Operations or on the directions of the NLDC, the Exchange may extend the trading hours. Such decisions will be taken considering the overall interests of the market. The decision of the Exchange in this regard shall be final and binding.

The Electricity Act 2003 brought a paradigm shift in the power sector. One of the primary objectives of the Act was to bring competition in the sector through the market development. The Act brought many groundbreaking changes viz. de-licensing of generation, competitive bidding, trading of electricity, open access etc. to increase competition in the sector. The Act also mandated the Central and State Commission to promote development of power market. Accordingly, the CERC has framed various Regulations viz. Power Market Regulations, Trading License Regulations, Open Access Regulations etc. to promote development of market in the sector. Similarly, the Ministry of Power (MoP) and other statutory bodies viz. Ministry of Renewable Energy (MNRE), Central Electricity Authority (CEA), Bureau of Energy Efficiency (BEE) etc. while framing policies have seen to be increasingly disposed towards development of power market in the country.

Key objectives that present regulatory framework has endeavoured to achieve are:



These objectives are briefly discussed below:

- **Development of an Efficient Market:** One of the primary objectives has been to develop a market which allows multiple players to participate and compete amongst each other to bring efficiency in the sector. The Power Market Regulations and Trading License Regulations allows multiple Power Exchanges and Trading Licensees to function in the market. The Power Market Regulations, 2021 have also allowed OTC platforms to operate

in the market for information sharing between buyers and sellers. Consequently, there are now 43 Trading Licensees, 3 Power Exchanges, 2 OTC Platform competing amongst each other to become the preferred choice of customers and in the process also bringing innovation & efficiency in the market. Apart from bringing efficiency, the objective also has been to bring fairness & transparency in the market without any instances of market manipulation or abuse. As per the Power Markets Regulations 2021, CERC shall be carrying out the market oversight to ensure the fairness and integrity of power market.

- **Optimal Utilization of Transmission System:** As the transmission of electricity continues to be dependent upon the wired meshed network having natural monopoly characteristics, the important consideration other than having a secure and reliable grid, is to develop adequate transmission capacity and ensure efficient utilization of these highly capital intensive & scarce resources. The availability and efficient utilization of the transmission system will facilitate efficient transactions between the buyers and sellers of electricity which will automatically lead to optimal utilization of generation resources and lowering of power procurement cost. CERC has recently notified the General Network Access (GNA) Regulations, 2022 and Indian Electricity Grid Code (IEGC), 2023 targeting to improve the allocation & utilization of transmission system. The GNA Regulations have decoupled the development of transmission system with the underlying commercial contracts and allowed any contract i.e., long medium- or short-term contracts to be scheduled within the GNA quantum without any additional transmission charges. Both GNA Regulations and Grid Code have provided for day ahead scheduling of all contracts in the following order -- GNA, T-GNA Advance, Day Ahead Market (DAM), and T-GNA Exigency, RTM & GNA revisions. In case the transmission corridor remains unutilized after its allocation as per the priority during the day, it will get released for allocation in subsequent steps. This is likely to bring an improvement in allocation and utilization of the inter-state transmission system and promote market development.
- **Safe and Secure Grid Operations through Market Mechanism:** The safe and secure grid operations is of paramount importance for the economic well-being of the country. However, as the RE penetration is increasing the grid intermittency is also increasing



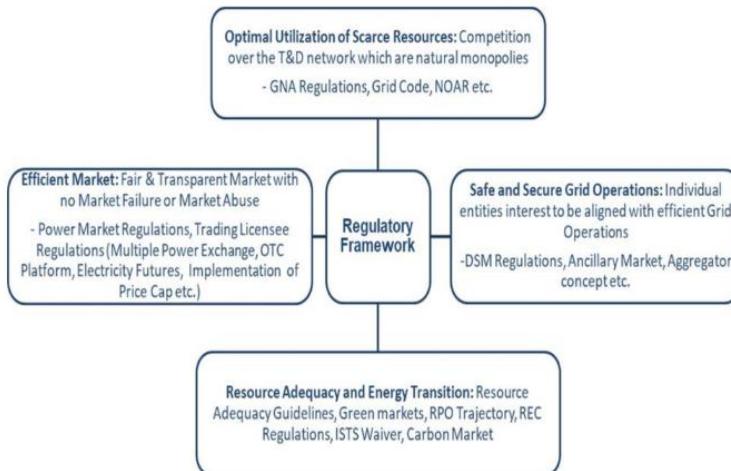
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posing a challenge for maintaining a stable grid frequency. In order to achieve a stable grid frequency, it requires support from different entities viz. Generator, Discoms, Consumers etc. for which the regulatory framework should align the individual interests with secure & reliable grid operations. CERC has made Ancillary Services Regulations, 2022 effective from 1st June 2023 based on which the Tertiary Reserves Ancillary Services (TRAS) is competitively procured through the Power Exchange platforms on a day ahead and real time basis. Further, as per DSM Regulations, 2022, in case of deviation the market participants will have to bear the deviation charges linked to the weighted average rates of Ancillary Service Charge deployed for grid stability. However, during the transition period of 1 year the deviation rate is to be considered as the highest of the weighted Area Clearing Price of DAM, RTM, and Ancillary Services charges. It is envisaged that the market-based procurement of Ancillary Services will incentivize the generator/demand response sources to provide for reserves whereas market linked deviation rates will disincentivize the market participants from deviating from their schedule thereby aligning the interest of the individual entities with safe and secure operations of grid.

- **Resource Adequacy and Energy Transition:** Resource adequacy both in long & short term is important from the energy security of the country. CEA issued Final Guidelines for Resource Adequacy planning framework for India in June 2023. CERC notified the Grid Code, 2023 having a dedicated chapter on Resource Adequacy. Both the Draft Guidelines and Grid Code have provided a framework for achieving resource adequacy in the country. Discoms are required to forecast their demand over long medium & short term & submit it to the STU for aggregation of demand at the State level. This will further be submitted to NLDC for simulation at the national level based on inputs provided by NLDC the Discoms are required to maintain resource adequacy by contracting with adequate capacity in long medium and short term. Recently the MoP constituted 'Group on Development of Electricity Market in India' has recommended that Capacity Market may be created both in long and short term for meeting the resource adequacy needs of Discoms. As regards to energy transition, the MoP has issued new RPO trajectories up to FY 2029-30. MoP has also provided ISTS charges waiver for different RE Generators viz. Solar, Wind, Hydro,

Green Hydrogen/Ammonia, Offshore Wind etc. Power Exchanges have introduced green products namely G-DAM and G-TAM segments and redesigned the REC market in accordance with CERC REC Regulations, 2022. In order to promote the RE merchant capacity addition the MoP constituted 'Group on Development of Electricity Market in India' has recommended to allow RE Generation capacities to participate in the market through revenue protection mechanism. It is recommended that an initial capacity (~ 1000 MW) can be tendered by nodal agency as a pilot project under the single price option with a 15-year PPA tenure. The capacities would be mandatorily required to trade and be scheduled through the power exchange. Under recovery or over-recovery by the capacities with respect to the strike price would need to be paid by / refunded back to the beneficiary accordingly. Based on the experience gained additional RE capacity may be brought through this scheme with improvement in contracting mechanism.

The above developments are also illustrated in the figure given below.



In the recent past, the CERC has issued a number of Regulations amending/repealing the earlier ones viz. Trading License Regulations 2020, Power Market Regulations 2021, REC Regulations 2022, GNA Regulations 2022, Ancillary Services Regulations, 2022, Grid Code 2023 etc. The major highlights of some of these Regulations are provided below.

2.1 CERC (Procedure, Terms and Conditions for grant of trading licence and other related matters) Regulations, 2020

CERC has notified the regulations for Procedure, Terms and Conditions for grant of trading licence (Trading Licensee Regulations) on 2nd January 2020 repealing the earlier Trading License Regulations, 2009 and Fixation of Trading Margin Regulations, 2010. The major highlights of Trading License Regulations 2020 are as follows:

- **Categories of Trading Licensees:** Trading Licensee Regulations 2020 have categorized the trading licensees into five categories depending upon the volume traded by the Licensees and accordingly specified the minimum net-worth to be maintained by the licensees. The different categories of Trading Licensees are provided in the Table below:

S. No	Category of Trading Licensee	Minimum Net Worth (Rs in Crores)	Volume of Electricity traded in Financial Year
1	Category I	50	Above 7000 MUs
2	Category II	35	Not more than 7000 MUs
3	Category III	20	Not more than 4000 MUs
4	Category IV	10	Not more than 2000 MUs
5	Category V	2	Not more than 500 MUs

The Regulations have also provided that for Category I Trading Licensee, if the annual volume of electricity proposed to be traded exceeds 10,000 MUs, the Trading Licensees shall have minimum net worth of Rs. 75 crores.

- **Trading Margins:**

- For transactions under short term contracts and contracts through power exchanges upto one year, the Trading Licensee shall charge a trading margin of not less than zero (0.0) paise/kWh and not exceeding seven (7.0) paise/kWh:

Provided that in contracts where escrow arrangement or irrevocable, unconditional and revolving letter of credit is not provided by the Trading Licensee in favour of the seller, the Trading Licensee shall not charge trading margin exceeding two (2.0) paise/kWh

- For transactions under long term contracts, the trading margin shall be decided mutually between the Trading Licensee and the seller:

Provided that in contracts where escrow arrangement or irrevocable, unconditional and revolving letter of credit is not provided by the Trading Licensee in favour of the seller, the Trading Licensee shall not charge trading margin exceeding two (2.0) paise/kWh.

- For banking of electricity, the Trading Licensee shall charge a cumulative trading margin of not less than zero (0.0) paise/kWh and not exceeding seven (7.0) paise/kWh.

- For transactions under Back to Back contracts, where escrow arrangement or irrevocable, unconditional and revolving letter of credit as specified in clause (10) of Regulation 9 is not provided by the Trading Licensee in favour of the seller, the Trading Licensee shall not charge trading margin exceeding two (2.0) paise/kWh.

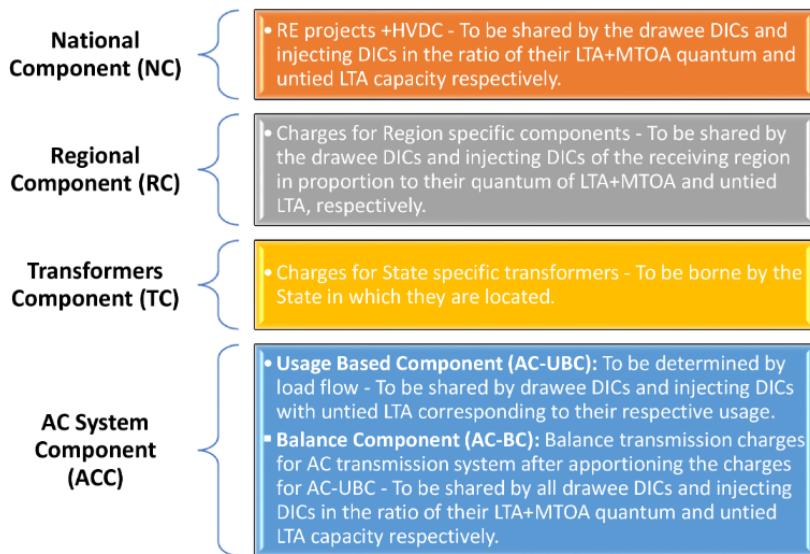
- For Cross Border Trade of Electricity, the trading margin shall be decided mutually between the Trading Licensee and the seller.

- The Trading Licensees are required to furnish monthly information through the forms prescribed in the Trading License Regulations pertaining to overall trading volume, trading through power exchanges, banking of electricity, short-term & long-term trade, cross border trading etc.

2.2 CERC (Sharing of Inter-State Transmission Charges and Losses) Regulations, 2020

CERC has notified the Sharing of Inter-State Transmission Charges and Losses Regulations, 2020 (Transmission Charges Sharing Regulations) on 4th May 2020 and made it effective from 1st November 2021 repealing the earlier Transmission Charges Sharing Regulations, 2010. The major highlights of Transmission Charges Sharing Regulations 2020 are as follows:

- **Transmission Charges:** Monthly Transmission Charges will be divided into



- **Billing:**
 - First Bill shall contain the transmission charges for the Billing month based on the Methodology detailed in the regulations.
 - Second Bill shall be raised to adjust variations on account of any revision in transmission charges as allowed by the Commission including incentives. (On quarterly basis)
 - Third Bill for transmission deviation
- **Transmission charges (TC) for Short Term Open Access:**
 - T-GNA Rate (in Rs./MW/time-block)= Transmission charges for all drawee DICs located in the State X 1.10 / (number of days in a month X 96 X GNA and GNARE quantum , in MW, for all drawee DICs located in the State considered for billing, for the corresponding billing period.
 - Transmission charges shall be payable by the entities granted T-GNA or TGNARE, as per the last published TGNA rate for the State in which such entity is located.
 - Transmission charges for T-GNA and T-GNARE collected in a billing month, shall be reimbursed to the drawee DICs in proportion to their share in the first bill in the following billing month, after adjustment of such charges for RE waiver
- **Transmission Deviation:**
 - Transmission Deviation Rate in Rs./MW, for a State or any other DIC located in the State, for a time block during a billing month shall be computed as under:
1.25 X Transmission charges
 - The Transmission Deviation charges shall be recovered through the third bill and shall be reimbursed to the DICs in proportion to their share in the first bill in the following billing month.

- **Sharing of transmission losses:**
 - All India Average Transmission losses for ISTS to be calculated for each week, from Monday to Sunday
 - Drawl Schedule of DICs shall be worked out after taking into account the transmission losses of previous week.

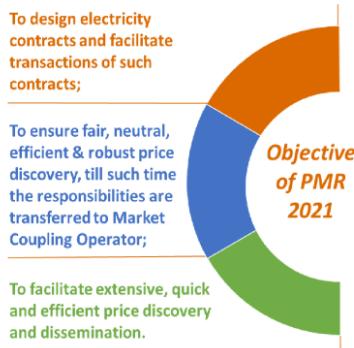


- No transmission loss for ISTS shall be applicable while preparing schedule for injection node including that for Collective Transactions over the Power Exchanges.

2.3 Power Market Regulations (PMR) 2021

CERC has notified the Power Market Regulations on 15th February 2021 and made it effective from 15th August 2021 repealing the earlier Power Market Regulations, 2010. The major highlights of Power Market Regulations 2021 are as follows:

- **Prudential Norms for Power Exchange:**
 - Minimum Net worth of Power Exchange increased from Rs. 25 Cr as per PMR 2010 to Rs. 50 crores.
- **Shareholding Norms of Power Exchanges:**
 - Any shareholder other than a member or a client, shall not acquire or hold more than 25% of shareholding in the Power Exchange.
 - A member or a client shall not acquire or hold more than 5% of shareholding in the Power Exchange and they together can have a maximum of 49% of the shareholding in the Power Exchange.
- **Governance Structure of Power Exchanges:**
 - No member of Power Exchange or their client shall be on the Board of Directors of any Power Exchange.
 - Number of Independent Directors shall not be less than the number of Shareholder Directors on the Board of the Power Exchange:
- Power Exchanges to carry out Clearing and Settlement in accordance with Payment and Settlement Systems Act 2007.



- Definition of Term Ahead Market was revised, as per Power Market Regulation 2010, TAM contracts were restricted to a delivery of 11 days, however, as per PMR 2021 there no restriction of 11 days on TAM contracts.
- In event of forced outage, Generators eligible to buy from DAM, RTM, INTRA-DAY, Contingency and TAM market.
- Transaction fees capped at 2 ps/unit on either side of electricity transaction.
- Enabling provision for carrying out the Market coupling - the process whereby collected bids from all the Power Exchanges are matched, after taking into account all bid types, to discover the uniform market clearing price for the Day Ahead Market or Real-time Market etc. through a separate regulation. Objective of Market Coupling stated as Single Uniform Price, Optimal Utilization of Transmission System, Economic surplus maximization.
- Allowed OTC Platform for providing information sharing services to buyers and sellers. Minimum net-worth – Rs. 1 crore; OTC platform not to engage in TC Platform shall not engage in the negotiation, execution, clearance or settlement of the contracts. Trading Licensees and Power Exchange cannot participate in OTC Platform.

2.4 CERC (Terms and Conditions for Renewable Energy

Certificates for Renewable Energy Generation) Regulations,

2022

CERC has notified the regulations for the Terms and Conditions for Renewable Energy Certificates for Renewable Energy Generation (REC Regulations) on 9th May 2022 and made it effective from 5th December 2022 repealing the earlier REC Regulations, 2010. The major highlights of REC Regulations 2022 are as follows:

- The Regulation introduced the concept of single RE certificate for compliance of fungible across different technologies for meeting RPO.
- No forbearance or floor price. REC will be valid till redemption.
- Multiplier for promoting any specific technology. For e.g., for Hydro power the multiplier is 1.5 i.e., 1.5 REC shall be issued for 1 Mwh injection into the grid. Similarly, the multiplier for Municipal Waste is 2 and Biomass & Bio fuel is 2.5.
- RE Generators whose energy is not accounted for meeting RPO shall be considered for issuance of RECs
- RECs issued to CPP to the extent of self-consumption, shall not be eligible for sale.
- A discom or an OA consumer, which purchases RE in excess of the RPO determined by the SERC shall be eligible for issuance of RECs to the extent of excess RE purchase.
- RECs can be traded in the exchange platform based on collective transactions or bilaterally through the Trading Licensees on mutual agreed terms & conditions. Traders to intimate in advance about certificates to be sold through trader, which will be blocked by the Central agency.

2.5 Central Electricity Regulatory Commission (Ancillary Services)

2.5 Central Electricity Regulatory Commission (Ancillary Services)

Regulations, 2022

CERC has notified the Ancillary Services Regulations, 2022 on 31st January 2022 and made it effective from 5th December 2022 repealing the earlier Ancillary Services Regulations, 2015.

The major highlights of Ancillary Services Regulations 2022 are as follows:

- Tertiary Reserve Ancillary Service (TRAS) to be procured through the Power Exchange platform in a competitive manner.
 - Generating station or entity having energy storage resource or capable of providing demand response, are eligible to provide TRAS provided they meet the technical requirement specified by NLDC viz. ramp rate etc.
 - TRAS will have two segments TRAS Up and TRAS Down in DAM-AS Market and RTM-AS market. TRAS Up providers will increase their generation or reduce their demand whereas the TRAS Down providers will either decrease their generation or increase their demand.
 - For TRAS Up Energy Bid Up Bid in Rs/Mwh shall be offered whereas for TRAS Down Energy Down Bid shall be offered.
- **Procurement of TRAS shall be done by Nodal Agency through Day Ahead Ancillary Services Market and Real Time Ancillary Services Market.** Timelines for such market to be same as existing DAM/RTM.
 - Nodal Agency shall communicate its requirement for TRAS-UP and TRAS- DOWN to Power Exchanges
 - Power Exchanges to collect bids of TRAS-UP and TRAS DOWN providers and send to Nodal Agency.
- **Price Discovery by Nodal Agency**
 - TRAS-UP - Uniform Market Clearing Price - highest Energy-Up bid
 - TRAS-DOWN - Pay-as-bid
 - Price Cap: Sellers not eligible for HP-DAM (other imported coal, RLNG based Generating Stations and Battery Energy Storage System) shall bid up to Rs. 10/unit; Sellers eligible for HP-DAM can bid up to Rs. 20/unit.
 - Price will be discovered in a combined manner, if the MCP is <= 10/unit all the TRAS providers will receive the payout at MCP; however, if the MCP is > Es. 10/unit then the sellers who are not eligible for HP-DAM will receive the payout at Rs. 10/unit and sellers eligible for HP-DAM at the MCP.
 - **Scheduling and Despatch:** Schedule for TRAS shall become effective from the time block starting 15 minutes after issue of despatch instruction by the Nodal Agency as per IEGC. Dispatch will be made on merit order basis.
 - TRAS-UP provider will receive the payout at MCP when dispatched. In case TRAS Up Provider is cleared but not dispatched it will receive 10% of MCP as commitment charge capped at Re. 0.20/unit. TRAS-DOWN provider pays respective energy-down bid to the pool when dispatched.
 - Settlement will be done by Nodal Agency on weekly basis through Deviation and Ancillary Service Pool Account.
- No transmission charges or transmission losses or transmission deviation charges shall be payable for SARS and TRAS.

2.6 CERC (Connectivity and General Network Access to the inter-State Transmission System) Regulations, 2022

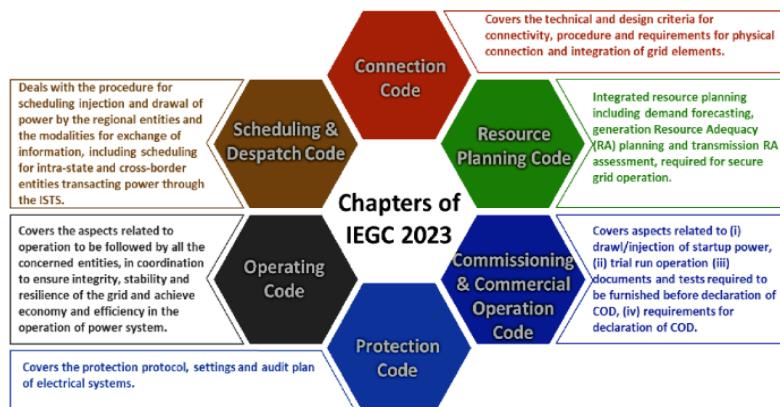
CERC has notified the regulations for Connectivity and General Network Access to the inter-State Transmission System (GNA Regulations) on 7th June 2022 and made it partially effective from 15th October 2022 repealing the earlier Connectivity, Long-Term and Medium-Term Open Access Regulations, 2009, Short-Term Open Access Regulations, 2008 and the Procedures issued thereunder. The major highlights of GNA Regulations 2022 are as follows:

- Generators will take Connectivity whereas Discoms will take GNA and or Temporary-GNA (lesser than 11 months) to undertake any inter-state transactions
 - Generators shall apply for grant of Connectivity for the quantum equal to the installed capacity of the generating station
 - Generators will give the Bank Guarantee equivalent to their cost of Terminal Bays & Switchyard and Augmentation of Transmission System which shall be refunded to the Generators within 5 years of COD
 - Deemed GNA for a State shall be average of A during FY 19, 20, FY 21, where: $A = \{0.5 * \text{Max ISTS drawl in a time block during the Year}\} + \{0.5 * \text{Average of Maximum ISTS drawl in a Day during the Year}\}$
 - STU on behalf of Discoms & intra-State entities or entities themselves can apply for additional GNA depending on their demand
 - A GNA grantee may authorize another GNA Grantees to utilize its GNA in full or part for a period not more than 1 year at a time on a mutual basis
 - T-GNA can be applied from 1 time block up to 11 months. Type of T-GNA Applications:
 - Bilateral:
 - Advance T-GNA: For T-GNA starting from D+3 day;
 - Exigency T-GNA: For T-GNA on D, D+1, D+2 day
 - Collective: Application shall be made by the Power Exchanges
 - Discoms can schedule power under any contract within their GNA and T-GNA quantum
- Scheduling will take place on Day Ahead Basis: GNA -> T-GNA Advance -> Collective Transactions -> T-GNA Exigency -> RTM -> Revision of Schedule by GNA Grantees
- Drawee GNA Grantees will bear the Transmission charges for GNA on a monthly basis as per the methodology proposed in the Sharing Regulations (Rs/MW);
 - T-GNA Rates will be the 1.1* Transmission charges and TDR at 1.35*Transmission charges
 - Power Exchanges will collect T-GNA charges over and above GNA charges for the collective transactions and deposit to the NLDC on D+2 basis.

2.7 CERC (Indian Electricity Grid Code) Regulations, 2023

CERC has notified the regulations for the Indian Electricity Grid Code (IEGC Regulations) on 29th May 2023 but yet to be made it effective. It will repeal the Indian Electricity Grid Code, 2010. The major highlights of Grid Code 2023 pertaining to market are as follows:

- Chapters of Electricity Grid Code, 2023



- The procedure for scheduling and dispatch for inter-state transactions are as follows:
 - (1) **By 6 AM:** Declaration of DC by generating stations.
 - (2) **By 7 AM:** Based on DC of generating station, RLDC shall declare entitled share of each beneficiary or buyer.
 - (3) **By 8 AM:** SLDC on behalf of the intra-State entities which are drawee GNA grantees, other drawee GNA grantees, Settlement Nodal Agency (SNA) on behalf of cross border entity, shall furnish time block-wise requisition for drawl in accordance with the contracts.
 - (4) **By 8.15 AM:** Allocation of corridors by RLDC for GNA grantees; in case of transmission congestion allocation of transmission corridor to the GNA grantees in proportion to their GNA.
 - (5) **By 8.30 AM:** Drawee GNA grantees shall revise their requisition based on availability of transmission corridors.
 - (6) **By 9 AM:** RLDC shall issue final drawl/injection schedules for drawee and injecting GNA grantees by 9 AM on 'D-1' day.
 - (7) **By 9 AM:** Drawee T-GNA grantees who are regional entities shall furnish requisition for drawl to concerned RLDC in accordance with contracts by 9 AM of 'D-1' day.
 - (8) **By 9.15 AM:** In case a generating station other than REGS intends to replace its schedule by power supplied from REGS, it shall intimate the quantum and source of power by which it intends to replace the power already scheduled.
 - (9) **By 9:15 AM:** Based on the entitlement or otherwise, SLDC on behalf of intra-State entities which are T-GNA grantees, shall furnish requisition, to the concerned RLDC in accordance with contracts by 9.15 AM.
- (10) **By 9.45 AM:** After allocation of corridors corresponding to the requisition of T-GNA Grantees, RLDC shall issue final drawl schedules for T-GNA grantees by 9.45 AM of 'D-1' day. RLDC shall release the balance corridors after finalisation of schedules for GNA and T-GNA grantees for day ahead collective transactions. The generating station whose tariff is determined u/s 62, may sell its URS as available at 9.45 AM in the DAM, unless the consent is withheld by the beneficiary in writing.

- (11) **Scheduling of collective transactions:**
 - (a) Trading window: 10-11 AM
 - (b) Provisional trade schedules to NLDC by 11.45 AM
 - (c) NLDC shall validate by 12.15 PM.
 - (d) The power exchange shall submit the final trade schedules to NLDC by 1.00 PM.
- (12) **By 1:00 PM:** RLDC shall release balance corridors after finalisation of schedules under day ahead collective transactions by 1.00 PM.
- (13) **By 1:00 PM:** NLDC shall publish a tentative list of stations or units, likely to be scheduled below the minimum turndown level for some or all blocks
- (14) **By 2 PM:** RLDC shall process exigency applications received till 1 PM of 'D-1' day for the 'D' day by 2 PM of 'D-1' day. The balance transmission corridor may be utilised by GNA grantees by way of revision of schedule, under any contract within its GNA or for exigency applications or in RTM on first cum first serve basis. Based on the above, issuance of day-ahead schedule to be done by RLDC and consequently by SLDC.
- (15) **By 2:30 PM:** Beneficiaries of stations likely to go below minimum turndown level, shall be permitted to revise their requisitions from such stations by 2.30 PM, in order to enable such units to be on bar. The revised requisition shall be final and binding after 2.30 PM and further reduction shall not be allowed except in cases when the stations remain above minimum turn-down level.
- (16) **After 2.30 PM,** the NLDC shall prepare the final list of such units that are likely to go below their minimum turndown level and such units shall be stacked as per merit order. The generating units so identified shall be considered for undertaking SCUC.
- (17) **By 3 PM-** If the NLDC after considering the bid results as finalized and available from DAM-AS, anticipates shortfall of reserves in D Day, it may schedule incremental energy from the generating units earmarked under SCUC, so as to bring them to their minimum turndown level by 3 PM. Downward revision shall not be allowed for such units.

- **Security Constrained Unit Commitment (SCUC) Mechanism:**

- (1) The objective of SCUC is to commit a generating station or unit thereof, for the maximisation of reserves in the interest of grid security, without altering the entitlements and schedule of the buyers of the said generating station in the day ahead time horizon.
- (2) It shall supplement the procurement of reserves done under ancillary regulations.
- (3) It may be undertaken by NLDC for regional generation stations whose tariff is determined u/s 62 of Act, if a shortage of reserves is expected on day ahead basis.
- (4) SCUC may also be done three days in advance under certain circumstances: In case NLDC anticipates based on assessment that adequate reserves may not be available on D-1 Day or D-day either under day ahead SCUC or under AS Regulations, it may also carry out SCUC, 3 days in advance of the actual day of scheduling for the regional entity generating stations.

- **Security Constrained Economic Dispatch (SCED)**

- (1) The objective of SCED is to optimise generation despatch after gate closure in the real time market and after finalisation of schedules under RTM.
- (2) NLDC shall be the nodal agency for implementing SCED for the generating stations connected to ISTS which are willing to participate under SCED.
- (3) The generating stations which are willing to participate in SCED shall declare the energy charge, or the SCED Compensation Charge to NLDC on weekly basis.
- (4) NLDC shall prepare a consolidated stack of URS available in such generating stations from the lowest energy charge and SCED Compensation Charge to the highest energy charge and SCED Compensation Charge in each time block.
- (5) After RTM gate closure, the generating stations so identified shall be instructed and despatched for SCED Up in merit order and corresponding SCED Down instruction shall be given to the generating stations in the order of the highest charge to the lowest charge.

- **Scheduling from alternate source of power by a generating station:**

- (1) A generating station may supply power from alternate source in case of (i) USD (ii) forced outage of unit(s) or (iii) a generating station other than REGS replacing its scheduled generation by power supplied from REGS irrespective of whether such identified sources are located within or outside the premises of the generating station or at a different location. The methodology for scheduling of power from alternate sources shall be as per the following steps:
 - (a) The generating station may enter a contract with alternate supplier under bilateral transaction or collective transaction.
 - (b) In case of bilateral transaction, the generating station shall request RLDC to schedule power from such alternate supplier to its beneficiaries which shall become effective from 7th or 8th time blocks, as the case may be
 - (c) The power scheduled from alternate supplier shall be reduced from the schedule of the generating station.
 - (d) In case it is arranged through collective transactions, the transacted quantum shall be reduced from the scheduled generation of the generating station.
 - (e) The generating station may also request the concerned RLDC to arrange alternate supply through SCED
 - (f) The generating station shall not be required to pay the transmission charges and losses for such purchase of power to supply to the buyer from alternate sources.

- **Arrangement of power by a regional entity generating station participating in SCED to meet schedules below minimum turndown level:**

- (1) In case a regional entity generating station gets schedule below minimum turndown level and wishes to arrange power scheduled by its buyers through SCED, it shall submit consent to NLDC before gate closure for arranging the scheduled power for such generating station through SCED.
- (2) NLDC shall consider the drawl schedules in respect of such generating station, under SCED subject to availability of scope of optimisation, that is, if the energy charge or SCED Compensation Charge, as applicable, of such generating station is higher than that of the marginal generating station in the stack prepared under, and also subject



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to the condition the entire drawl schedule against such generating station can be accommodated under SCED.

- **Curtailment of scheduled transactions for grid security:**

- (1) Transactions under T-GNA shall be curtailed first followed by transactions under GNA.
- (2) Transactions under T- GNA shall be curtailed as: Bilateral followed by collective transactions under DAM followed RTM
- (3) Within Bilateral, conventional followed by RE in both GNA & T-GNA

- **Revision of schedules on request of buyers which are GNA grantees:**

- (1) GNA grantees may revise their schedules under GNA in accordance with their respective contracts. Scheduled transactions under T-GNA cannot be revised other than in case of forced outage.
- (2) The request for revision of scheduled transaction for 'D' day, shall be allowed subject to the following:
 - (a) Request of buyers for upward revision of schedule from the generating station whose tariff is determined u/s 62 shall be allowed starting 2 PM on 'D-1' day, only in respect of the remaining available quantum of URS in such generating stations, after finalization of schedules under DAM.
 - (b) Request of buyers for downward revision of schedule from the stations, whose tariff is determined u/s 62 shall be allowed in any time block subject to the provision relating to SCUC.
 - (c) Request of buyers for upward or downward revision in respect of other generating stations, shall be allowed in terms of provisions of the respective contracts.
 - (d) Any revision in schedule shall become effective from 7th/8th time block.