



# Indian Power Market



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# Overview of the Indian Electricity Market



India's electricity market is one of the largest and most dynamic in the world.

It encompasses various segments, including **generation, transmission, distribution, and trading.**

The market operates under the purview of the **Central Electricity Regulatory Commission (CERC)**, Power System Operation Corporation (POSOCO) and various state electricity regulatory commissions.

# Market Structure



## Generation:

- India's power generation industry comprises a mix of thermal (Coal, gas, oil), renewable (solar, wind, hydro, biomass), and nuclear sources.

## Transmission:

- The transmission network, managed by Power Grid Corporation of India Limited (PGCIL), ensures the efficient transfer of electricity across states.

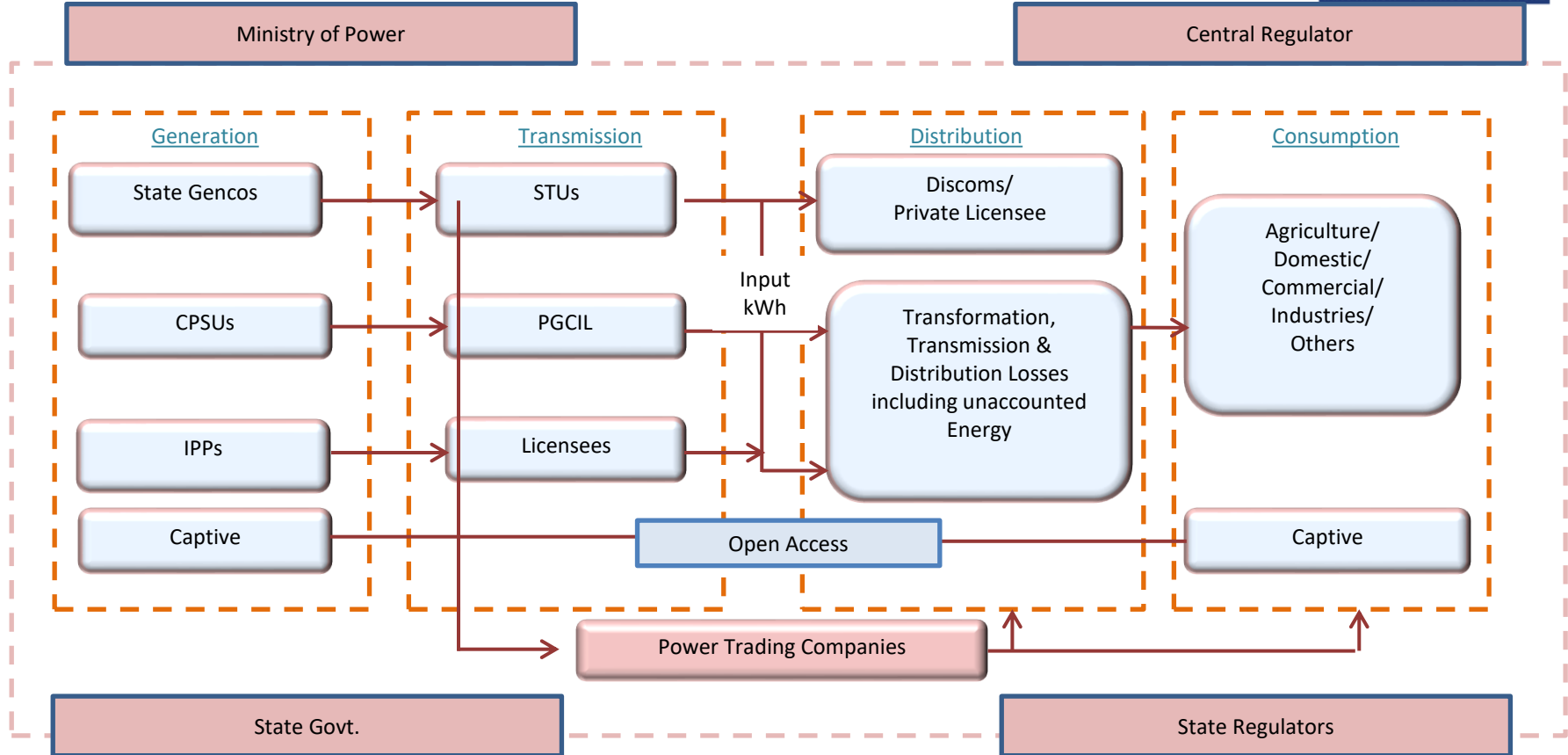
## Distribution:

- Distribution companies (DISCOMs) are responsible for supplying electricity to end consumers. DISCOMs face challenges related to financial health, technical losses, and revenue collection.

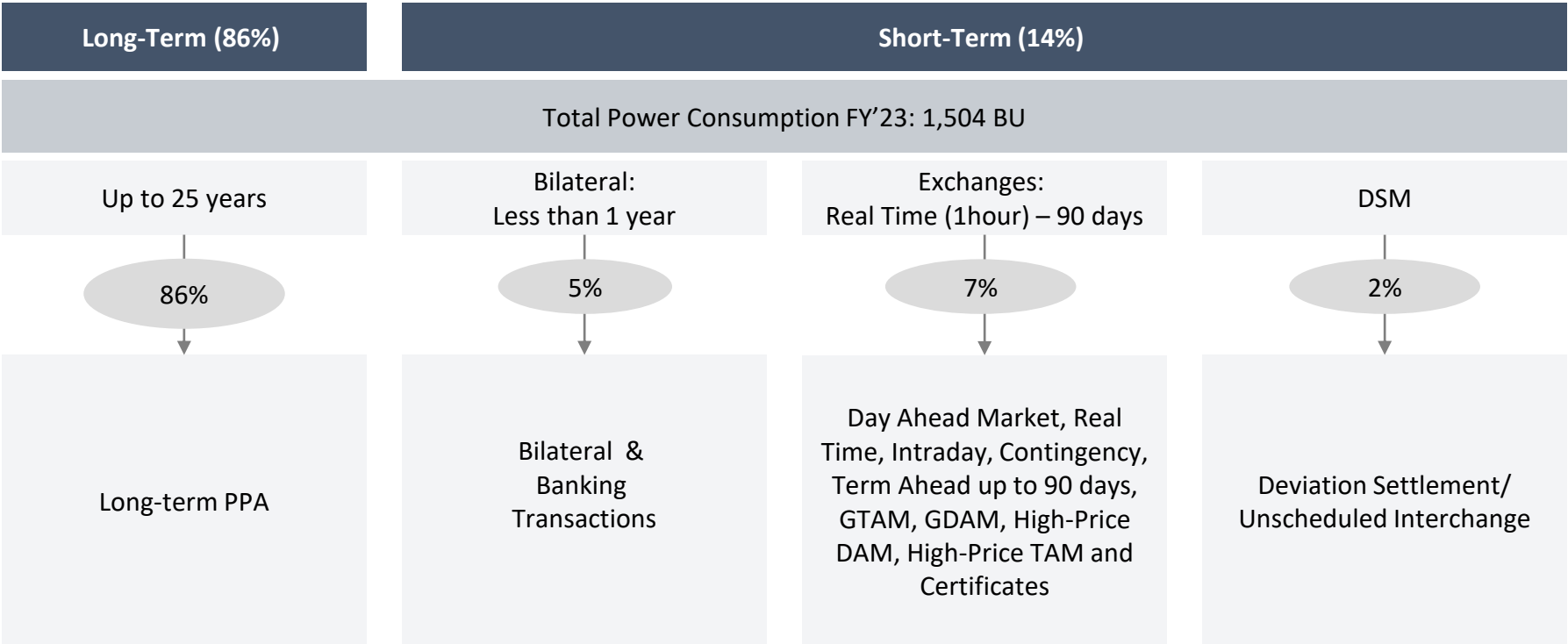
## Trading:

- The Indian Energy Exchange (IEX) and two other Power Exchanges facilitate electricity trading through day-ahead, intra-day, real-time markets and Term Ahead Contracts.

# Indian Power Market Structure

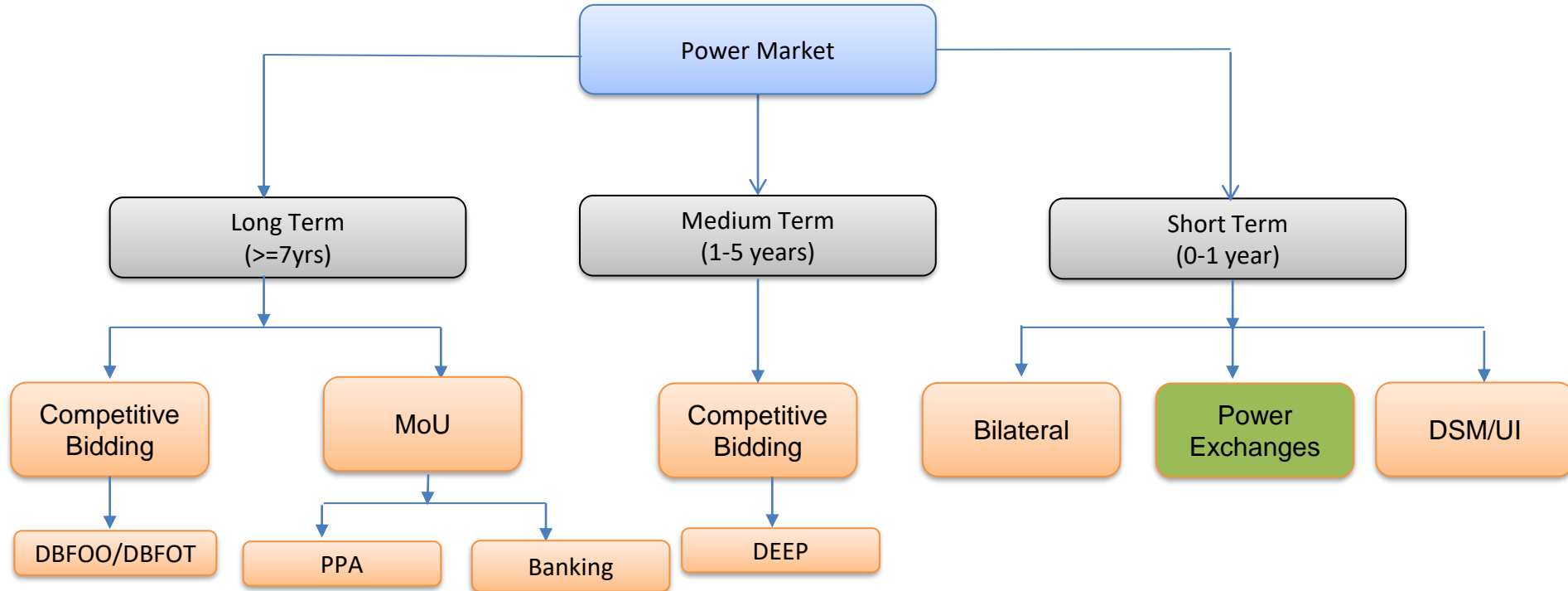


# Power Market Construct



Source: CERC MMR Report till Sep'23

# Types of Contracts in Wholesale Electricity Market



- Over the years, as India has significantly reduced its energy deficit
- Fluctuation in power demand, surplus long term power contracts, and more variable renewable energy being integrated into the grid, have all contributed to trend of increased share of short term power sale (especially through power exchanges)

# Design Features and Products

## Open Access:

- Allows consumers to choose their power supplier and encourages competition.

## Power Purchase Agreements (PPAs):

- Long-term contracts between generators and DISCOMs or other buyers.

## Renewable Energy Certificates (RECs):

- Tradable certificates promoting renewable energy adoption.

## Energy Efficiency Certificates (EECs):

- Encourage energy-saving initiatives.

## Bilateral Contracts:

- Direct agreements between buyers and sellers.

## Market-Based Economic Dispatch (MBED):

- Proposed mechanism to optimize generation dispatch based on cost and grid stability.



## Merit Order Dispatch

- Generators are dispatched based on their variable costs (merit order).

## Load Dispatch Centres

- Coordinate real-time generation and demand.

## Frequency Control:

- Maintains grid stability.

## Demand-Side Management:

- Encourages efficient consumption.

## Market Clearing Price (MCP):

- Determines the price at which electricity is traded in the market.

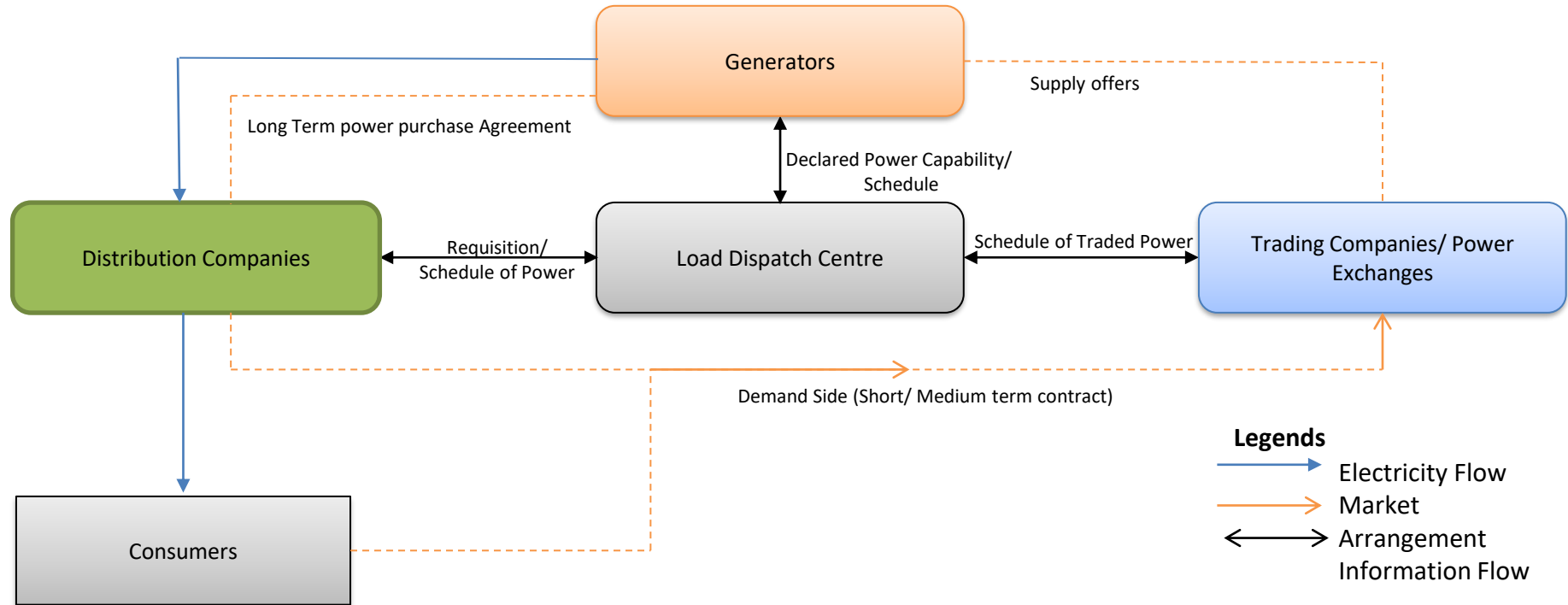
## Challenges:

- Technical losses, financial viability of DISCOMs, integration of renewables, and grid reliability



# History & Evolution of Power Exchanges

# Indian Power Market Wholesale Structure



- Wholesale markets act as a platform where electricity is traded (bought and sold) before being delivered to the end consumers (households, businesses, industries, etc.).
- It is crucial for stability of the power system since it allows for balancing of demand and supply.

# Initial Challenges in Market Design



- **Inflexible Long-Term Contracts:**

- Dominance of long-term bilateral power purchase agreements (PPAs) between utilities and generators limited flexibility.

- **Resource Adequacy Planning:**

- Lack of robust resource planning at both central and state levels.

- **Self-Scheduling Practices:**

- States heavily relied on self-scheduling, impacting market participation.

- **Complex Regulatory Frameworks:**

- The regulatory landscape can be intricate, making it challenging for states to participate in electricity markets.

# Evolution of Market- E'Act 2003 salient features



De-licensing of generation

Development of a Multi-Buyer Multi-Seller framework in power

Introduced Tariff based Competitive Bidding for procurement of Power

Provision of Non-discriminatory Open Access

Provision of Parallel license in Distribution

Setting up State Electricity Regulatory Commission (SERC) made mandatory

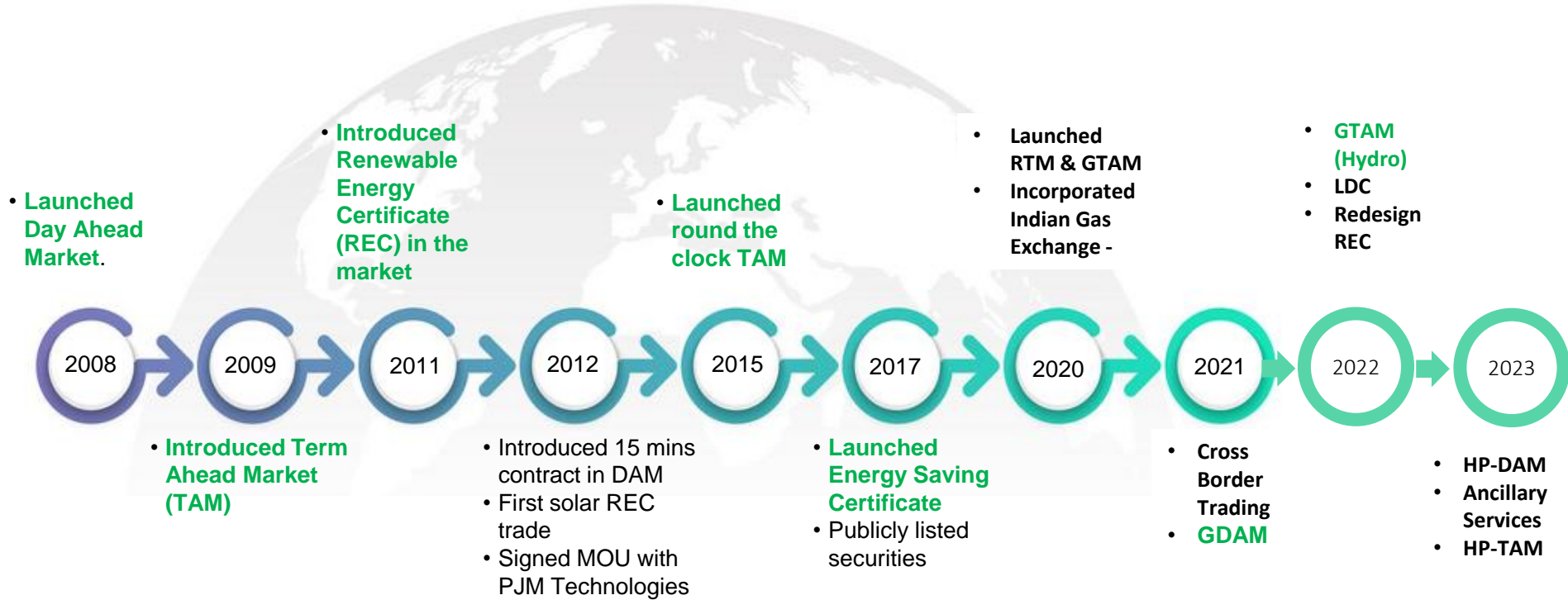
Development of National Electricity Policy (NEP-2005) and National Tariff Policy (NTP-2006)

# Evolution of Market- Post E'Act 2003



Regulations	Summary
<b>Open Access</b>	<ul style="list-style-type: none"> <li>➤ Introduced in 2004 allowed trading of bulk power with open access to transmission networks</li> <li>➤ Bilateral and collective regulations in 2008 ; &gt;1MW allowed to buy from generators/PX/traders directly in 2009</li> <li>➤ National Open Access Registry started in May '22</li> </ul>
<b>Electricity Policy, Rules &amp; amendments</b>	<ul style="list-style-type: none"> <li>➤ Gradual move towards competitive market regime from the LT PPA</li> <li>➤ Draft NEP envisages spot market share of ~25% by 2024</li> <li>➤ Green Open access rules, Jun 22 allows consumer with 100 kW &amp; above green energy open access</li> </ul>
<b>Deviation Settlement Mechanism</b>	<ul style="list-style-type: none"> <li>➤ Unscheduled Interchange (UI) charges regulations – 2009 &amp; amendments -ceiling rates, frequency band/ vectors; Gradual tightening of frequency bands (49-50.5 to 49.85-50.05) and stringent penalties</li> <li>➤ Recent regulations in 2022 linked DSM vector price to DAM and de-linked frequency from DSM</li> </ul>
<b>Transmission charges –allocation &amp; sharing</b>	<ul style="list-style-type: none"> <li>➤ POC mechanism introduced in 2012 replacing postage stamp methodology; Subsequent amendments – last amendment in 2020 clubbed injection &amp; drawl charges, brought in distinction b/n bilateral &amp; collective transactions</li> <li>➤ General Network Access (GNA) introduced in 2022- a revamp; notified; key clauses expected to operate Draft Grid Code &amp; sharing regulations</li> </ul>
<b>Power market regulations</b>	<ul style="list-style-type: none"> <li>➤ 2010 regulations provided norms for setting up and operating power exchanges</li> <li>➤ 2021 regulations incorporated various changes over the years, introduced concepts of Over the counter (OTC) platforms, Market coupling operators and enhances focus on information dissemination and oversight</li> </ul>
<b>Newer Market Segments</b>	<ul style="list-style-type: none"> <li>➤ Real Time market in Jun 2020; Green Markets- GTAM in Aug 2020, GDAM in Oct 21, HP (DAM &amp; TAM)</li> <li>➤ Longer Duration contracts in Jun 22; Future markets under evaluation</li> <li>➤ Ancillary Services regulations in Jan 22 – framework for secondary &amp; tertiary reserve markets</li> </ul>

# IEX Over the Years – Journey of innovation basis the market

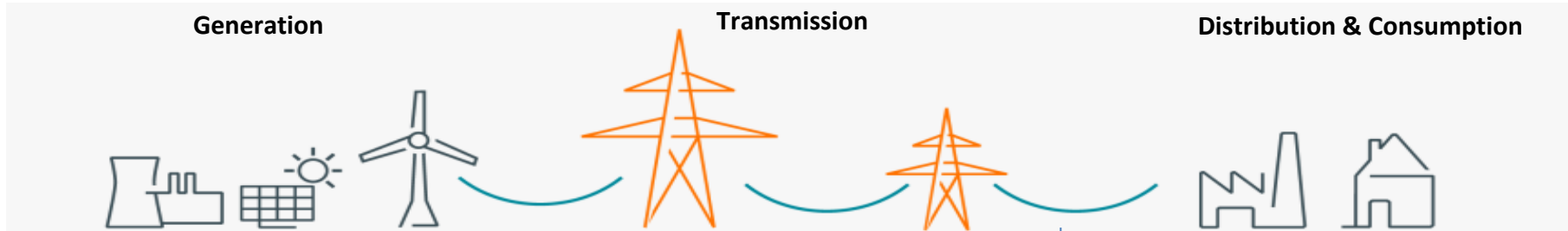




# Current Market Structure



# Electricity Value Chain



## Energy Transition

Installed Capacity	As on 31 <sup>st</sup> Dec'23	FY 2030 CEA Proj.
<b>Total GW</b>	428	817
<b>Fossil Cap GW</b>	240	267
<b>Coal (%)</b>	56	32.7
<b>RE &amp; Hydro GW</b>	188	506
<b>RE &amp; Hydro %</b>	43	61.9
<b>Upcoming Coal Cap GW (in next 3 Yrs)</b>	27 GW	-

## World's largest network

- Inter-reg. trans. Cap.: 112.3 GW
- 4.72 Lakh CKM of trans. Lines (FY'25)
- Green Corridor: RE rich states; projects for evacuation of RE into National grid
- 99.9% times no congestion

## Distribution & Consumption

### Reforms Underway

- **Avg. AT & C Losses:** FY'21 – 22.3%; FY'22 – 16.4%; Have declined to 15.4% for FY23
- **Reduction in Outstanding dues & ensuring future payments**
- Liquidity Infusion Schemes
- Choice to Consumers
- Electrification as Decarbonization Lever: EV, Cooking, Traction

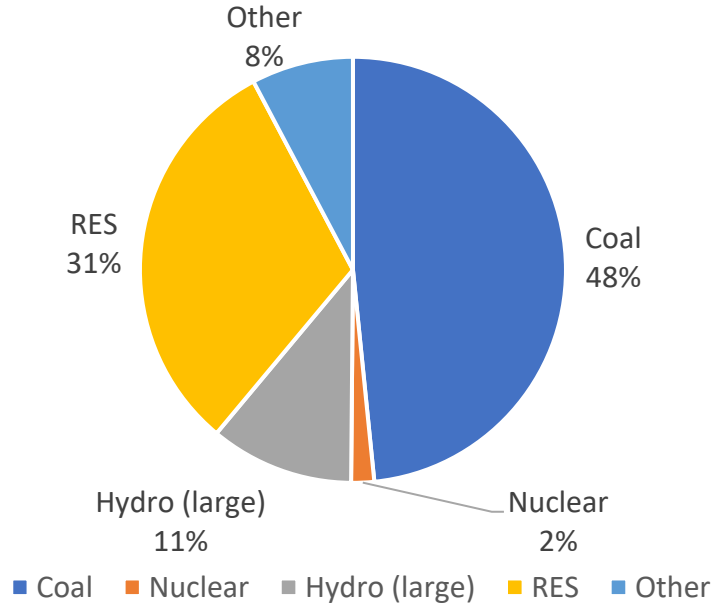
50% Non-fossil fuel based Capacity by 2030

One Nation One Grid One Price

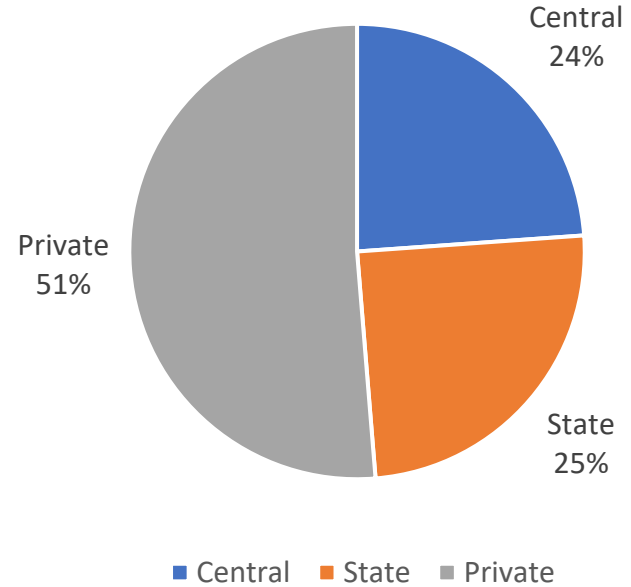
Regulatory Strengthening

# Installed Capacity - 428 GW

## Capacity by Source

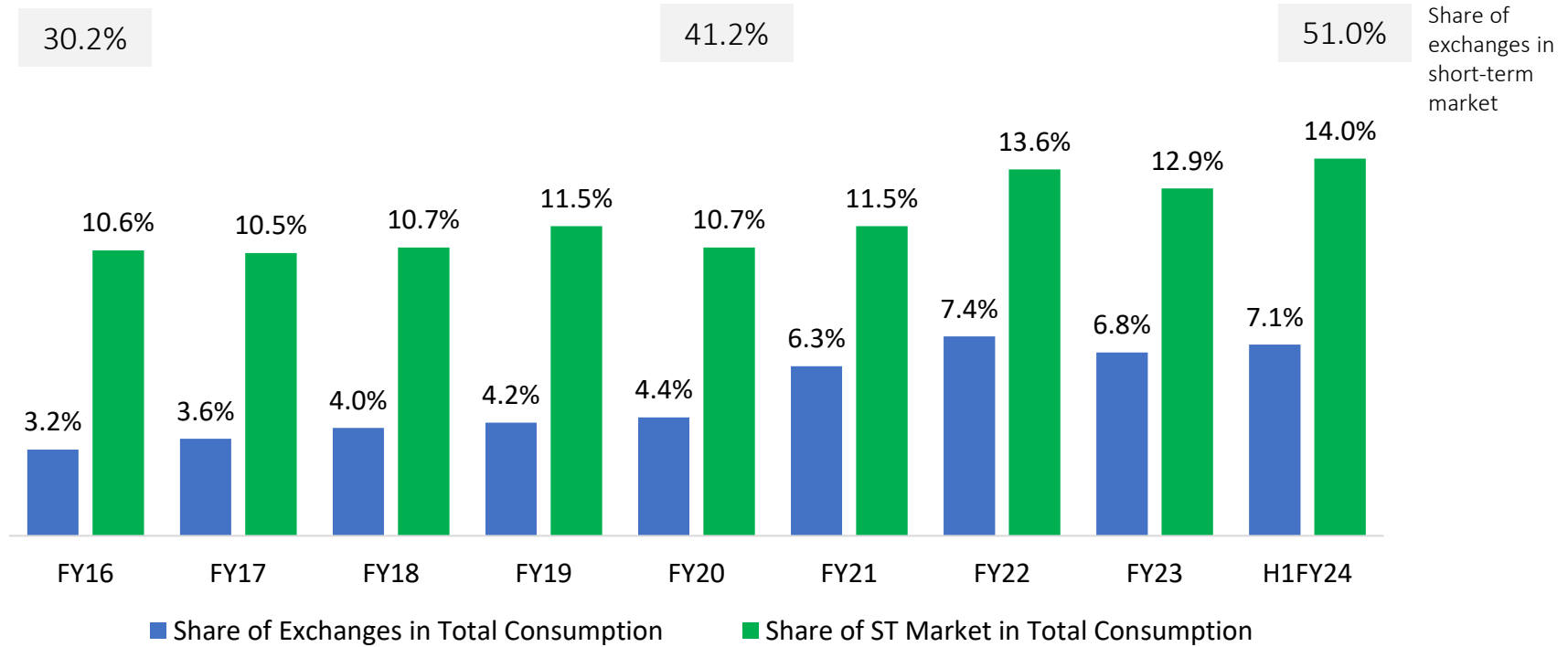


## Capacity by Ownership



# Exchanges Share in Short Term Market

Exchange Market and ST Market - % of Total Consumption – India

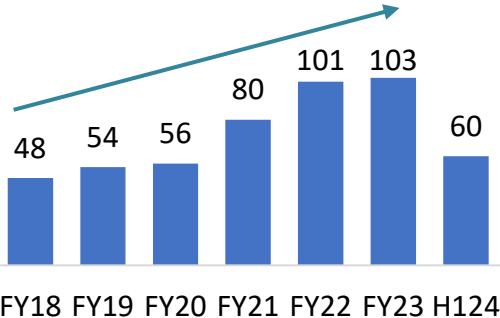


Source: CERC MMR Report, Sep'23

# Exchange Markets are growing fast

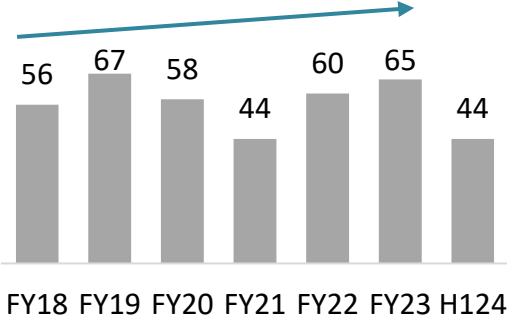
## Exchanges (BU)

CAGR: 14%



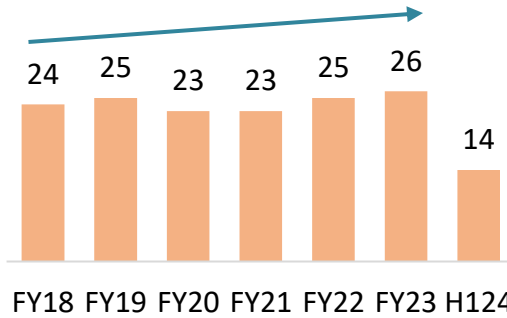
## Bilateral (BU)

CAGR: 2.5%



## DSM (BU)

CAGR: 1.3%



Driven by competition and flexible procurement, the Exchange markets constitute >50% of ST power market.

# Electricity Growth Drivers

India is placed as the most promising economy on the global map

## ➤ Industrialization

- ✓ High GDP growth of about 7% expected to drive electricity
- ✓ Core sector, traction, EV, cooking will drive electricity consumption

## ➤ Rapid urbanization/ Rural Electrification

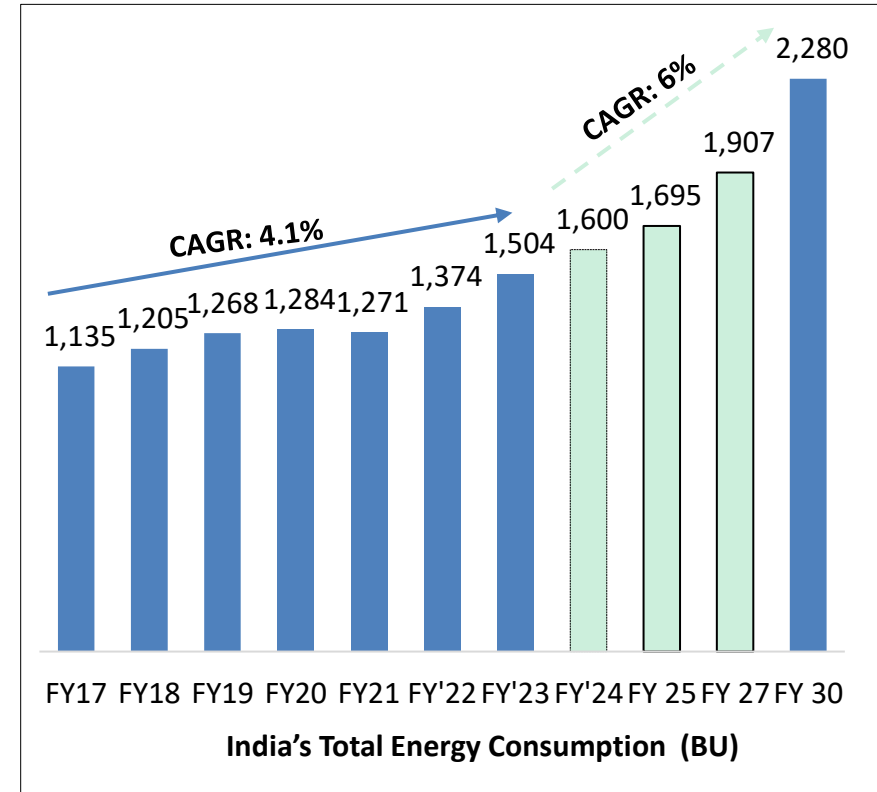
- ✓ 17 out of 20 of world's fastest growing cities in India

## ➤ Consumer demand growth

- ✓ Last mile connectivity – Power on 24x7 basis
- ✓ FY23 energy consumption growth 9.4% YoY

## ➤ Power Demand Projection for FY 23-30

- ✓ FY 23 onwards – CEA demand growth projections
- ✓ FY 25 CEA Peak Demand Projection – 256 GW
- ✓ Expected to grow at CAGR of 6%



# Understanding Exchanges



**Neutral** Trade Platform  
No influence on *price determination*



Participation in bilateral or the Power Exchanges is *purely voluntary*



**Competitive and anonymous**  
Buy & Sell *independent of one another*



**Regulated Platform**  
Managed under the *oversight of CERC*



**Risks Management** with standardised contracts  
Exchange as *counterparty*



Operates on **inherent transmission margins**  
*Transparent & public upfront*

# Market Segments

## Integrated Day Ahead Market

DAM since Jun'08

- Delivery for next day; 15 min. contracts, Daily trade
- Price discovery: Closed, Double-sided Auction

G-DAM since Oct'21

- Same as DAM, priority for GDAM in price & volume
- Option to carry forward uncleared bids in GDAM to conventional DAM; Single price for different RE - solar, non-solar

HP-DAM since Mar '23

- Segment within I-DAM on day ahead basis; Double-Sided Closed Auction
- Separate price discovery with price cap of Rs. 20/unit and floor price of zero
- Bidding during DAM, GDAM hours; Market Clearing in sequential manner GDAM, DAM, HP-DAM

Ancillary Services (DAM-AS) since Jun'23

- Procurement of capacity for TRAS by NLDC
- Separate windows for TRAS-UP and TRAS-DOWN

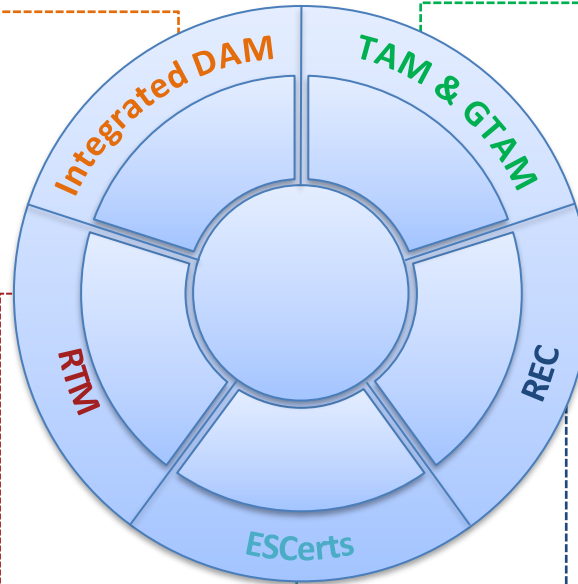
## Real Time Market

Since Jun'20

- Half Hourly market (48 times per day)
- Delivery for 30 mins in two-time blocks of 15 min each
- Double sided closed auction with uniform price

Ancillary Services (RTM-AS) since Jun'23

- Separate windows for TRAS-UP and TRAS-DOWN



## Energy Saving Certificates

Since Sep'17

- 1 ESCert = 1 Mtoe (Metric Tonne Oil Equivalent)

## Intraday Market & Contingency Market Segment

Since Jul'15

- Intraday Market : hourly and or 15-minute contracts on same day on rolling basis
- Day-Ahead Contingency- 24-hourly and or 15-minute contracts on day-ahead basis for 00:00 hours to 24:00 hours of next day
- Continuous Trade

## Term-Ahead Contracts

Since June'22 (up to 3 months)

- Any day (s) single side Reverse Auction
- Daily (up to 14 days)
- Weekly (up to 12 weeks)
- Monthly (up to 3 months)

## Green Term-Ahead Contracts

Since 21 Aug'20

- 15-minute quotation of quantity (MW) and price (Rs/MWh)
- Price discovery and matching on 'Continuous Trade' basis
- Revision in schedule not allowed

## High Price Term-Ahead Contracts

Since 18 Oct'23

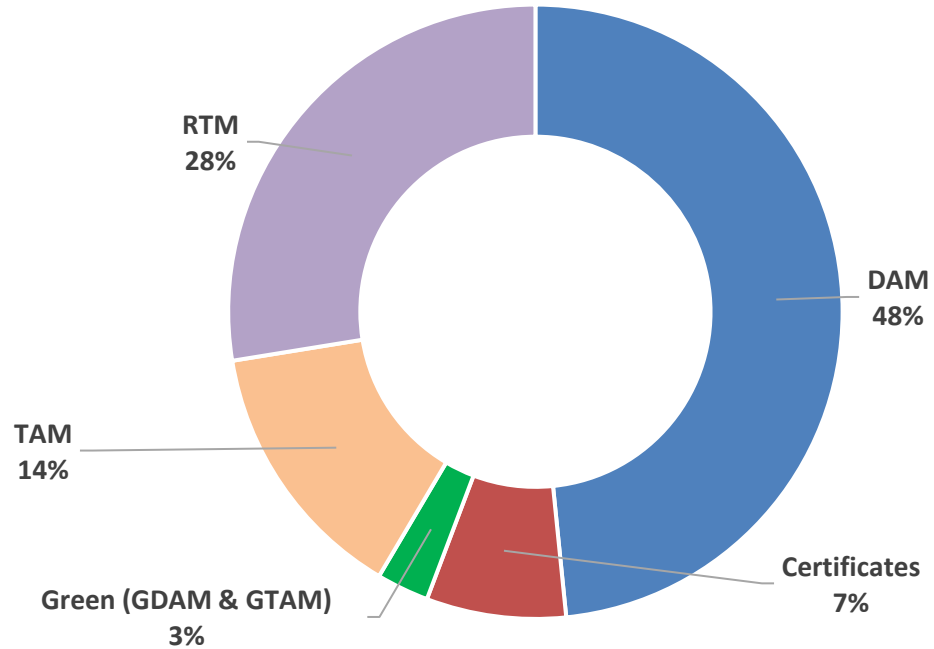
- Contracts include HP-Intraday, HP-DAC, HP Daily, HP Monthly, HP Any Day Single Side

## Renewable Energy Certificates

Since Feb'11

- Green Attributes as Certificates
- **Sellers:** RE generators not under feed in tariffs
- **Buyers:** Obligated entities; 1MWh equivalent to 1 REC

# IEX Product Mix (till Jan'24)



**Total Volume: 91 BU**





Way forward

# IEX: Growth Drivers (1/2)

## Growth from recently launched products

- **RTM:** June'20
- **Green Markets:** **GTAM** launched in Aug'20, **GDAM** launched in Oct'21
- **Cross Border:** April'21
- **Term Ahead Market Up to 3-Months** in June'22
- **HP-DAM (High Price-DAM):** March'23
- **Ancillary Market launched:** June'23
- **HP-TAM:** Oct'23

## New Products

- RE capacity through exchanges; Contract for Differences; Deepen Ancillary Market
- Launch of Derivatives will provide price hedging opportunity and lead to lower volatility in prices thereby increasing liquidity in the spot market
- Capacity Market

## New Business

- IGX launched in 2020 and achieved breakeven within first year of operations. Robust volume growth over next 5 years expected
- ICX – International Carbon Exchange – wholly owned subsidiary incorporated in Dec'22. Exploring business opportunities in voluntary carbon credit market
- Exploring Coal Exchange opportunity
- Other opportunities in energy marketplace

# IEX: Growth Drivers (2/2) - Future Opportunities



## Virtual PPA's

- Financial instrument used by buyers/sellers to hedge electricity cost
- Buyer not obligated to undertake direct physical delivery of electricity from seller
- Seller sells generated power at Exchange; undertakes realization from Exchange
- Bilateral settlement takes place w.r.t. contract price; buyer gets green attribute
- IEX working with corporates like Amazon, Google etc. to implement such models

## Dispatchable RE, BESS, Green Hydrogen

- Market to play crucial role to support Firm & Dispatchable RE Tenders (Excess or Deficit)
- IEX working with SECI, MNRE to promote use of market options for Dispatchable tenders & BESS. SECI's storage tender (500 MW) provides for 40% open capacity which can leverage power exchanges
- Green markets (GDAM/GTAM) can be leveraged to procure RE power for green hydrogen production
- Grid scale BESS expected to play crucial role in large scale RE integration (CEA: 42GW/208 GWH by 2030)
- Storage system will provide liquidity in peak hours

## Contracts for Difference (CfDs)

- CfD model beneficial for RE generators, provides long-term stable price to mitigate project development and finance risks
- Under market-based CfD mechanism for RE, power traded and scheduled at PXs at market prices
- Revenue to generator is guaranteed, termed as 'strike price', which is determined through auctions
- If discovered market price > strike price, generator pays difference to pool maintained by Government entity. If market price < strike price, pool pays difference to generator

## P2P Trading

- P2P trading of electricity is emerging in different parts of the world due to increasing number of Prosumers
- IEX through its MoU Partners ISGF & Power Ledger, Australia has been jointly exploring P2P opportunities in various states.
- The Guidelines have been issued in UP and draft guideline has been issued by DERC.
- We expect to see lot of traction in this segment.

# Net-Zero India 2070: Sectoral Impact and Implications



- A study by the **Council on Energy, Environment, and Water (CEEW)** explores alternative scenarios for India's transition to net-zero emissions.
- **Peaking and net-zero scenarios:** The study models four combinations of peaking and net-zero-year scenarios for India (2030–2050, 2030–2060, 2040–2070, and 2050–2080).
- **Fossil fuel share:** In the absence of **carbon capture and storage (CCS)**, India's fossil fuel share in the primary energy mix would need to decline to 5–6% in the net-zero year. With CCS availability, fossil fuels could contribute 19–30% to primary energy.
- **E-truck sales:** In a net-zero world, e-truck sales would likely reach 100% by the net-zero year.
- **Renewable energy:** By 2100, solar energy is estimated to constitute 70–72% of total electricity generation in net-zero scenarios.
- **Biofuels:** The share of biofuels in net-zero scenarios would be 80–83%.
- **Coal:** If CCS is available, coal might retain a small share (3–5%) in primary energy but would ultimately decline to around 1%.
- **Carbon pricing:** Without CCS, the carbon price could exceed \$900 per ton of CO<sub>2</sub>, but with CCS, it could reduce by half<sup>1</sup>.

# Future Plan: Achieving Net Zero Targets



## Green Hydrogen:

- **National Green Hydrogen Mission** – Budget Allocation doubled as compared to the previous year.
- **Strategic Interventions for Green Hydrogen Transition (SIGHT)** Program has a substantial outlay of **INR 17,490 Crore**.

## Electrification:

- The power sector is gearing up for accelerating electricity demand. India's peak demand has grown from 136 GW in 2014 to 240 GW today, with a CAGR rate of 6.5%
- Investments in flexible generation sources like battery storage and pumped hydro
- Modernization and digitalization of the grid to enhance efficiency and reliability.

## Sustainability and Climate Leadership:

- COP 26 Target:
  - ✓ Reach 500GW Non-fossil energy capacity by 2030.
  - ✓ 50 percent of its energy requirements from renewable energy by 2030.
  - ✓ Reduction of total projected carbon emissions by one billion tonnes from now to 2030.
  - ✓ Reduction of the carbon intensity of the economy by 45 per cent by 2030, over 2005 levels.
  - ✓ Achieving the target of net zero emissions by 2070
- The government's focus on renewable energy and environmental stewardship remains strong
- Promoting electric vehicles and decentralized renewable energy (such as rooftop solar) are integral to the transition

In summary, India's electricity sector is poised for transformation, emphasizing green energy, technological advancements, and sustainable practices.



# Thank you



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