

# *Electricity Markets of the Future*

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**Abstract**— The “National Workshop Series on Electricity Markets of the Future” is a work package under the Technical Assistance Programme titled “Supporting Structural Reforms in the Indian Power Sector” or Power Sector Reforms (PSR) Programme. PSR is supported by the Department for International Development in collaboration with the Ministry of Power, Government of India. KPMG as lead service provider for the PSR programme has undertaken the workshop series comprising consultation with key stakeholders, to lay out a roadmap for Electricity Market Reforms. The paper covers the key challenges and actions necessary to move towards future electricity markets in India.

**Keywords**- *Electricity reforms, Distribution, Renewable Energy, India, Planning, Day Ahead Market, Short Term Market, Real Time Market, Power Purchase Agreement, Ancillary Services.*

## I. INTRODUCTION

Electricity markets in India have evolved rapidly, spurred by the liberalisation ushered through the Electricity Act 2003. The landmark Act expedited market reforms by institutionalising important legislations which were conducive for creation of markets, improving efficiency and promoting competition in wholesale markets.

However, the underlying conditions of electricity market operations have changed. Globally, the electricity markets are undergoing a radical transformation. The key forces driving change are the “4D’s” i.e. *Decarbonisation, Decentralisation, Distributed Generation and Digitalisation*. India is witnessing similar trends and focus has once again shifted towards structural and institutional reforms for embracing the imminent market transformation as well as addressing the present day inconsistencies in market design which are impeding efficiency of the markets.

One of the biggest achievement of the markets was the increased propensity of private sector to add generation capacity. The annual capacity addition rate doubled from ~10GW in earlier decennium to ~20GW in the current one. Private players emerged as the largest contributor to the overall capacity addition accounting for around ~165GW or 46% of the total installed capacity in 2019, up from 13% in 2007. Further, competitive markets resulted in enhanced price discovery at the wholesale level for long and short term power procurement. This allowed for better reflection of the underlying demand supply fundamentals and differentiation in various electricity products. Private players were also able to secure long-term Power Purchase Agreements (PPAs) for about ~90GW through competitive bidding route. RE capacity is also promoted through competitive processes and

now accounts for nearly 22% of capacity mix and ~10% of the energy mix with an ambitious goal of reaching 175 GW by 2022. The day ahead market on power exchanges has reached a share of ~4% of the overall portfolio, establishing the feasibility and acceptability of competitive markets.

However, the electricity markets, though effective in their goal of promoting capacity additions and establishing a limited wholesale competition are becoming less proficient in fulfilling the key objectives of reliable and least cost operations. This may be due to path-dependent reasons of the market evolution which have resulted in inefficiencies in implementation of the policies. The market design inconsistencies have thus got accentuated along the various components of the value chain as explained below:

## II. KEY CHALLENGES

### A. *Long term Power Purchase Agreements (PPA) locking in utilities into high cost positions*

The policy and market structure has prompted base load generation capacity additions which need to be underpinned by long-term PPAs for making the investments bankable. Therefore, the quantum and generation mix arrived through PPAs have resulted in significant energy surplus for States/Distribution Companies (DISCOMs), amplifying their financial burden due to fixed-cost payments for the non-requisitioned or backed down power. With sluggish demand growth and substantial baseload capacity in the pipeline, the situation may continue for a few more years, further aggravated by aggressive policy on renewable capacity additions, as well as exodus of consumers through open access.

### B. *Financial stress in generation sector*

About 34 private sector plants aggregating to ~40 GW or ~\$25 billion are financially stressed as per the report by Parliament Standing Committee on Energy. Of this, ~20GW is operational and balance is under construction. Gas-based projects with \$6.9 billion investments have already been declared Non Performing Assets (NPAs) or referred for debt restructuring. Reasons stated for stress include non-availability of fuel (both coal and gas), lack of demand for new PPAs by states, tariff related disputes and delays in project implementation leading to cost overruns.

### C. *Unfavourable fuel allocation mechanisms for private sector*

The regulated structure of fuel markets which assures Fuel Supply Agreements (FSA) only to plants having long term PPA with DISCOMs induces a conflict with merchant

capacity, which is exposed to spot prices for sourcing fuel i.e. e-auction and imported coal. This fuel price disparity may cause volatile input costs for open capacity, thus discouraging merchant markets. Therefore, the burden of baseload capacity tie-ups will continue to fall on DISCOMs further accentuating their vicious underutilisation cycle. On the other side, state and central sector capacity continue to free ride on notified prices by Coal India Limited. Such policy in turn places a burden on the coal supply chain, leading to lower materialisation for private players to serve their contractual loads. Given the distortionary incentives, DISCOMs favor PPAs with state and central sector capacity, fragmenting both the coal and generation sector along center-state vs private sector with no competition between the two, and often allowing inefficient and poorly located capacity in the state and central sectors to perpetuate.

#### *D. Unconducive transmission sector development, corridor allocation and system operating principles*

The availability of transmission system and scheduling practices are also severely impacting the development of markets and efficient operation of generation by states. For instance, the NER-ER-NR (Northeastern-Eastern-Northern) corridors have witnessed unprecedented low utilisation levels while there is prevalence of transmission congestion in other corridors WR-NR (Western- Northern) and WR-SR (Western-Southern). Priority to Long Term Access (LTA) over Short Term Open Access (STOA), will affect the ability of merchant plants to deliver power and for states to off-take it even if the capacity was available in the market.

#### *E. Financial viability of distribution utilities and existing system constraints*

The distribution sector in particular has been affected the most as several new challenges have emerged. High power procurement costs, non-competitive tariffs for large consumers, inadequate access and quality of supply, migration of high paying consumers due to open access and financial health of DISCOMs continue to afflict the distribution sector. In most states viz. Gujarat, Punjab, Rajasthan, Madhya Pradesh, the peaking deficits continue to exist, while the states have become surplus in energy demand. This may be attributed primarily to a skewed baseload capacity mix and renewables which lack the desired operational flexibility to meet the diurnal and seasonal swings in demand. The result is evident as majority of states are saddled with huge energy surpluses. Further, the surplus generation is not monetisable as states find it difficult to dispose it in market due to existing system constraints such as informational asymmetries, operational and contractual rigidities as well as the unfavorable prices in the spot markets as compared with their underlying costs.

#### *F. Retail competition, digitalisation and de-centralised grids*

Looking ahead, retail competition will become increasingly necessary as smart home technologies, electric vehicles, distributed generation and storage get diffused and adopted by the markets. The cost of these technologies is falling rapidly as the markets are expanding. With more and more appliances becoming smart and time controllable, greater opportunities for demand response will be possible. With decentralisation of grids, technology will need to ensure consistent and reliable power supply. The digitalisation of electricity sector has already begun, with block chain, smart

meters and virtual power plants breaking ground across different parts of the world. Therefore, in the foreseeable future DISCOMs will be at the forefront of the changes with intense competition to own and serve customers. These imminent transformations will present new market design challenges.

The prevalence of the above mentioned issues dictate the need to revamp the existing market structures and design alternate options in order to sustain the growth of electricity markets. While, there is increasing recognition of the problems, concerted efforts are required for tackling the issues comprehensively. As witnessed in different parts of the world, expanding the role of markets may go a long way in addressing the imminent issues and improving the economic efficiency of the markets.

### III. NATIONAL WORKSHOP SERIES ON 'ELECTRICITY MARKETS OF THE FUTURE'

The "National Workshop Series on Electricity Markets of the Future" has been organised under the aegis of Ministry of Power (MoP) and supported by the Department for International Development (DFID) under the Technical Assistance Programme titled "*Supporting Structural Reforms in the Indian Power Sector*" (Power Sector Reforms Programme). The purpose of the workshop series was to identify the inadequacies in the existing power market framework and evaluate possible options to chart out a roadmap for moving to the next generation of markets best suited for the Indian power sector. Stakeholders were consulted to capture their views on current market design and challenges, imperatives to prepare for integration of RE and other technologies, enablers for future market design and priorities.

The series of three workshops entailed consultation with key stakeholders from Ministry of Power (MoP), Central Electricity Authority (CEA), Central Electricity Regulatory Commission (CERC), State Electricity Regulatory Commissions (SERCs), Power Grid Corporation of India Ltd. (PGCIL), Power System Operation Corporation (POSOCO), various DISCOMs, State Load Dispatch Centres (SLDCs), Civil Society Groups, Federation of Indian Chambers of Commerce & Industry (FICCI), NTPC Ltd., and Independent Power Producers (IPPs) etc.

For wider stakeholder alignment and consultation, a dedicated three-day workshop was also held, participated by representatives from DISCOMs and SLDCs from 14 Indian states.

The subsequent sections summarise the priorities and actions identified in the workshop series, to enable movement towards future electricity markets in India.

### IV. PRIORITIES AND ACTIONS

Unless urgent measures are initiated, there is a looming risk of lack of reliable capacity to service the growing demand in the coming years. Markets could serve as an alternative mechanism to both support existing capacities and create new pipelines of capacity instead of long term contracts. However, even if the technical abilities exist to implement more advanced market designs that could include Ancillary Services markets, Real Time Markets and Capacity Markets that allow for a wider range of physical and financial trading products, the readiness of the DISCOMs and also their

operating realities limit the possibilities of a rapid transition to deep markets in a short period. Equally challenging are the non-existent fuel markets, and without fuel market reforms a rapid move to deeper power markets would be impracticable. Hence there is a need to consider measures for competition for the market (in the form of auctions) ahead of competition in the market (through deeper power markets).

Key stakeholders concur that irrespective of the specific design, products and development trajectory of the wholesale power markets there is an urgent need to get certain fundamental building blocks for power sector and market operations in place. There is also a consensus on the need to use the instruments of policy more effectively. In this process attention is required on positive bias that has crept in towards the public sector in various segments of sector value chain. While expedient at times, it can ultimately undermine investor confidence and reverse the path of reforms that has been charted out since the 1990s.

Finally, clear consensus emerged that markets must evolve to meet the larger objectives of system reliability, resource adequacy and economy. The changes need not always be transformational, rather a diverse mix of measures to move in the direction of deeper markets. Such key elements and actions identified are as follows:

#### A. Getting the building blocks right

- *Enforcement of Universal Supply Obligation (USO)*- Legislation ought to indicate that USO encompass the obligation for 24x7 supply to consumers. Enforcement of USO will ensure that DISCOMs plan ahead and ensure capacity adequacy, instead of resorting to load-curtailment. This forms a basic premise for expansion of customer service and reliability of market signals to the users of the system including generators and customers.
- *Capacity adequacy statements to support USO fulfilment*- Regulations must provide for submission of Capacity Adequacy statements by DISCOMs, for medium-long term, say up to 7 years. Regulators need to ensure prudent and periodic evaluation of these statements. Data disclosure from DISCOMs in form of these statements will help predict the system demand more accurately, provide inputs for national level planning and nudge DISCOMs to use the available market mechanisms for short term procurement.
- *Planning regime needs to be robust*- Need for strengthening the planning processes is palpable at the central and the state levels. While in a deregulated system the planning will be indicative in nature, it should be sufficiently robust to anticipate load growth at the various nodes in the system and match it with likely generation. The process should generate a number of alternate scenarios and distil the outcomes to identify necessary planning and implementation actions including for system augmentation at various levels. There should be capacity addition signals (location, size, cost and technology etc.) for the market to deliver on. Notwithstanding the planning roles of various state level

entities mandated in the Electricity Act, comprehensive national planning for electricity system need to be ideally carried out by a central agency. Proposals/ plans for setting up generation should be disclosed for incorporation in long term planning.

- *Data disclosure regime must be strengthened*- Data availability and accuracy is key for improved planning and forecasting. This needs strengthening across the board. Granular data from time block –wise load flows, efficiency and reliability parameters to long-term forecasts and capacity addition plans must be made accessible in form of an open registry to central planning agencies, policy makers and other market participants for informed decision making. Regulations must clearly mandate data disclosure scope, set accountability and enforce compliance by respective entities. Platform for submission of data and standardised formats must be used.
- *DISCOMs and Generation Companies (GENCOs) key to market liquidity*- Fundamentally, short term market cannot be deepened without the increased participation of buyers and suppliers. Increased participation is requisite for improving the demand and supply and reducing price volatility. Inducing DISCOM participation necessitates measure such as (i) introduction of Real Time Markets (RTM), (ii) stronger regulations/ stringent penalties for discouraging use of DSM to meet temporal and seasonal load variations, (iii) Gate closure/ right to recall norms to be reviewed and altered as required to ensure reliability of market operations. At the same time state and central GENCOs must be allowed to offload their surplus capacity in short term market to improve liquidity, enabled through RTM. Improved load forecasting and scheduling will also help improve the Un-requisitioned Surplus (URS) capacity available to participate in market. However, it is also essential that adequate safeguards are there to ensure larger players (buyers or sellers) do not exercise market power, and for this continuous market surveillance is recommended.
- *Continuous institutional capacity creation is key to sustainable reforms*- Market evolution is accompanied by increased adaption of more advanced tools, technologies and approaches from planning to operations. All market stakeholders, including regulators and planners must build capacities to keep pace with external changes and actively contribute to market evolution. We need to evolve a comprehensive national level programme in line with strategic direction for continuous upgrade of skills employed from planning to operations. For secure sector and market operations the key actors need to be trained adequately where necessary required to go through a certification process. Further, tools for forecasting, optimisation and trade visualisation/enablement need to be propagated rapidly to all load serving entities.

### *B. Innovation in contracting models and introduction of financial products necessary for risk mitigation*

Currently, there is over-dependence on contracts for physical delivery of electricity. While it is accepted that long-term PPAs may not be amenable to wholesale restructuring, these can be supplemented with standardised financial contracts which ensure security of supply for DISCOMs, yet hedge the price risks and induce economic procurement in short term market, supporting deeper markets. Instruments such as Contract for Differences (CfD) would greatly help in managing risks and/or dealing with the variability of market prices and can be introduced in the next 1-2 years. Additionally, shorter and innovative contracting models suited for the market need to be developed and adopted for future use. Planning for introduction of other financial products such as derivatives can be undertaken now to prepare for launch once the market is mature enough few years hence.

### *C. Capacity auction mechanisms before moving towards an advanced capacity market model*

There is consensus that at this stage, we need to put a simpler mechanism in place to ensure resource adequacy. Due to current capacity surplus, the long term capacity creation plans have largely stalled, barring that in RE sector. Similar to Discovery of Efficient Electricity Price (DEEP) platform, meant for shorter term procurement, there is need to evaluate creation of a dedicated auction platform for long term contracting periodically, rather than sporadically. Load serving entities and generators can chisel their contracts through this platform. Basis the experience, India could move towards more advanced capacity markets.

### *D. Real Time Market (RTM) and Ancillary Service (AS) are essential for improved reliability and control*

Further volume growth in the Short Term markets including the Day-Ahead Market (DAM) can only happen when the markets offer a wider set of avenues to chisel the positions of the participants in accordance to the changing needs after the DAM. There is strong consensus that RTM is necessary to improve grid reliability, particularly in view of increasing share of intermittent and variable RE. Market players cannot be allowed to fall back on load shedding at will for meeting intra-day load variations. Beyond reliability aspects, utilising expensive power available through DSM is not economically efficient and burdens end consumers. Similarly Ancillary Services, currently in nascent stage should be gradually expanded to include fast responding, reliable and economical technologies, aggregators and service providers to improve the grid resilience.

### *E. Opening up fuel linkages critical for deepening markets*

Large privately owned capacity with potential to provide the required liquidity and competition in short term market is stranded due to lack of fuel availability. The situation creates dichotomy in market where on one hand exchange prices are peaking at INR18/kWh, while gigawatts of capacity is underutilised due to artificial limitations imposed by fuel supply agreements/linkages. Conducive policies are needed to free up coal linkages for utilisation by the stranded capacity, at least on short term basis, moving on to more

liberalisation in coal mining to harness efficiency upstream of power sector value chain. Better fuel planning and storage is also essential and in this regard the implementation and enforcement of fuel storage norms specified is necessary.

### *F. Retail market reforms should not be lost sight of*

The significance of improving retail market efficiencies is amply clear and reforms are much needed. Coupling of retail and wholesale market is imperative to pass on the economic benefits in latter to end consumers. Considering the federal structure and embedded political economy in distribution segment, transition to retail competition is bound to be complex. As an immediate measure, stakeholder/ expert views converge on improving efficiencies by improving the operational practices of DISCOMs and enabling their active participation in wholesale markets. Encouraging competition through other forms including fair and consistent open access policies/regulation and their application would also be important.

### *G. Move towards General Network Access (GNA) will support markets*

Transmission is a common carrier for all market participants. Accelerated implementation of GNA regulations will further help congestion management, and economic utilisation of networks, leading to benefits for end consumers. Ease of transmission access to IPPs will further aid deepening of markets. Further, in view of evolving regulations and nature of system utilisation, states should also plan for future transmission import and export capacity.

### *H. Other Imperatives*

- *RE can play more active role in markets-* Future market designs should look at incorporating RE to enable it play a bigger role as a market maker, rather than a must-run generator. Better structuring of RE projects could alleviate risks perceived by developers and financiers to further bring down electricity prices. Green contracts could also play a key role in meeting the Renewable Purchase Obligation (RPO) for DISCOMs.
- *Decentralised resources could be an alternative form of retail market competition-* Decentralised resources connected to the low voltage networks and behind the meter create de-facto competition in retail segment. Technologies such as rooftop solar are already becoming competitive with grid based electricity and increasingly substituting the latter. Introduction of aggregators could play a vital role in operational control and coordination with system operators. They can also provide a gamut of services ranging from balancing reserves to load curtailment, aiding grid reliability.
- *Evaluation of next generation Information and Communication Technology (ICT) -* Technology is backbone for secure, efficient and reliable system and market operations. Focus is also needed on evaluating the technological imperatives to develop a resilient power system. The power sector needs to embrace the digital revolution right down to the end consumer.

- *Continued engagement and communication-* Ongoing dialogue is needed for awareness creation, consensus development, issue resolution and capacity building. For this, a structured calendar for consultation with the various players and in particular the State owned DISCOMs has to be instituted.
- *Adoption of learnings from States-* Certain states like Gujarat, Rajasthan, Telangana, West Bengal, etc. have made very substantial progress in implementation of robust processes for market operations and associated activities including resource forecasting, scheduling and intra-state Availability Based Tariff (ABT) implementation. These need to be studied and identified good practices need to be harmonised and converted into Standard Operating Procedures (SoP) for the various stakeholders.

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#### BIOGRAPHICAL INFORMATION



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Prior to joining KPMG, he was the Chief Executive of the Asian Operations of AF-Mercados EMI, a specialist international energy advisory firm where he founded the Asian operations and went on to create a successful growth story and a strong and reputed team.

He is a regular speaker on sectoral/policy matters in the media and industry forums. Anish has conceptualised and authored thought leadership publications on energy pricing, gas market development and pooling, renewable energy integration, etc. He has a large number of publications to his credit. He is a regular speaker at various economic and industry fora and writes regularly on energy challenges.



**Manas Tiwari** is an Associate Director with KPMG in India. He has 13 years of experience in different capacities, across the power sector value chain. As a management consultant he has worked on turnaround strategy for Discoms, reforms and restructuring in power sector, corporate/ business plan for generation and distribution utilities, energy policy and regulation, tariff setting of utilities, capacity building and business process improvement etc.

At KPMG, he has been deeply involved in execution of several activities targeted at power market reforms, institutional strengthening of regulators, development of innovative business model and financing instruments, business planning and integrated electricity planning for states.

Prior to consulting, he has worked with Tata Power Delhi Distribution Ltd., and helped set up their Distribution Franchisee cell and at LANCO Infratech Ltd. in Engineering, Procurement and Construction division.