ENERGY ANALYTICS LAB
Department of Industrial and Management Engineering
Indian Institute of Technology Kanpur

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Editorial

EAL's analysis as presented in this issue shows significant variations in the regional demand profiles (except Southern Region) over the months October to December, although the national level load profiles were relatively consistent.

Based on inputs from readers, the analysis of URS at national level, as presented in this issue, excludes gas-based plants. Similar to the previous quarter, Northern Region (NR) continues to witness peak-hour shortage even in the presence of non-gas URS capacity in the region. This, highlights the need for inter-regional exchange of power to meet the electricity shortage in the region.

State Electricity Tradability Index for the October – December quarter shows that pairs of states with high tradability index are different from those identified in the previous quarter. This shows the dynamic nature of the demand-supply balance and underscores the importance of a dynamic power procurement strategy.

Electricity prices on Indian Energy Exchange (IEX) crossed Rs. 18/kWh, a new high in recent history. To avoid such high prices, design of an efficient demand side management programme and its effective implementation is the need of the hour. This issue also includes an analysis of Term-Ahead Market (TAM) transactions.

Based on a discussion paper by Central Electricity Regulatory Commissions (CERCs), this issue highlights the effects of implementation of *Market Based Economic Dispatch (MBED) of Electricity*, along with its implications on the overall market. Another development in the sector concerns a petition pertaining to proposed bid (order) types in Day-Ahead Market (DAM), filed by Indian Energy Exchange (IEX) before CERC.

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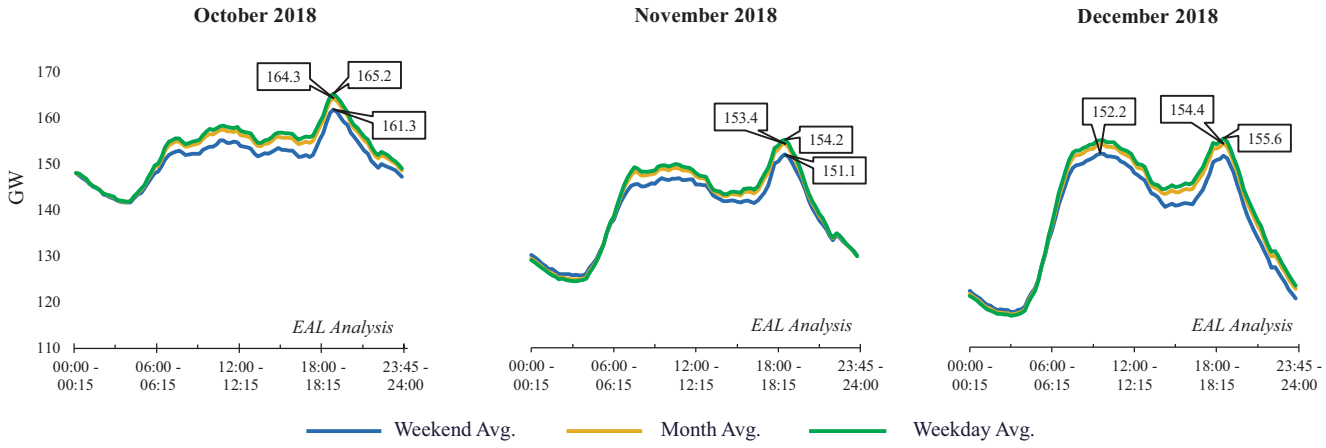
Power System Overview & Analysis

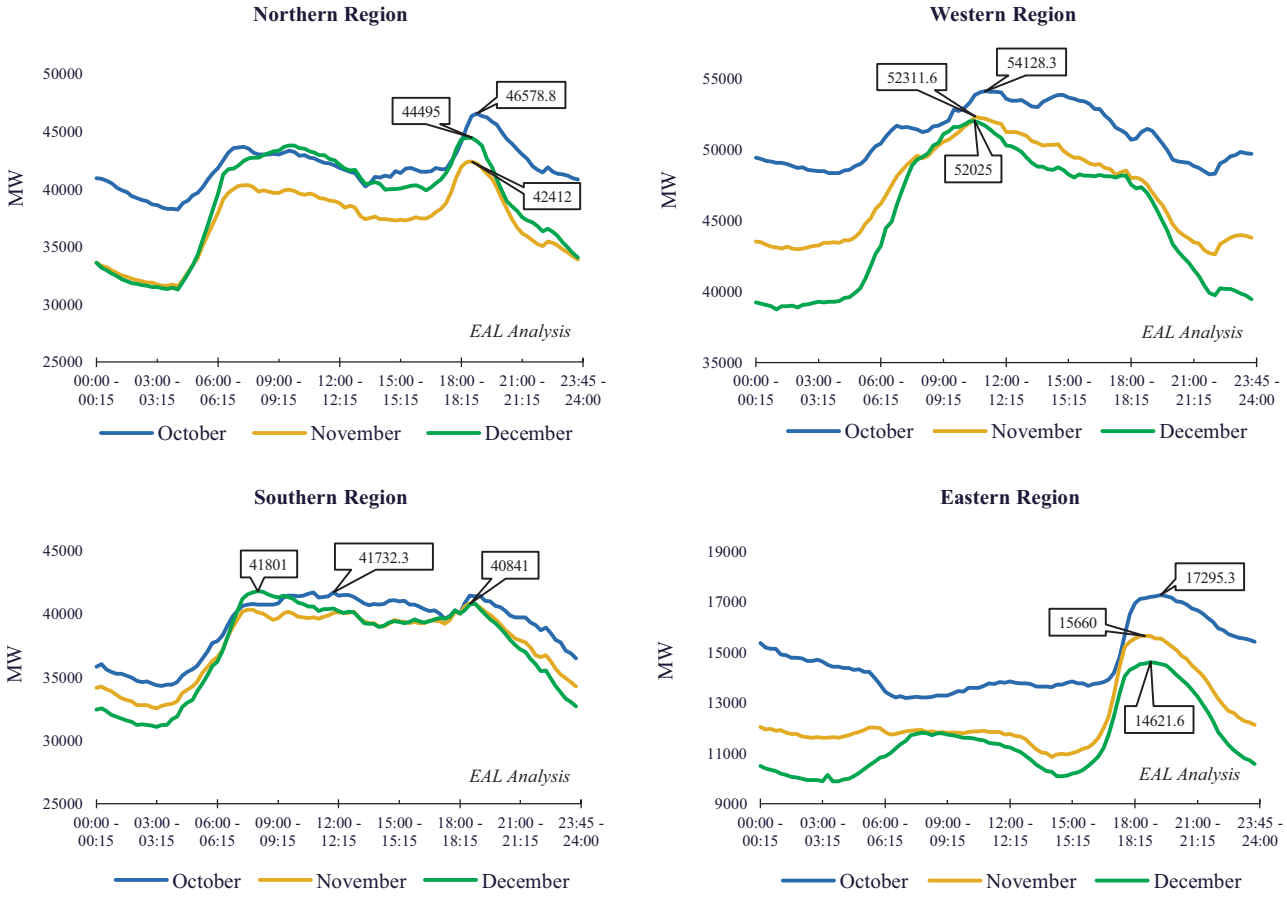
All India Demand Met Profile



For the months of October to December, the all India peak demand reached 168.6 GW on 10th October 2018 – about 8.84 percent higher than that in the previous year (154.9 GW on 11th October 2017).

All India, region-wise and state-wise load profiles can be accessed at EAL web portal.

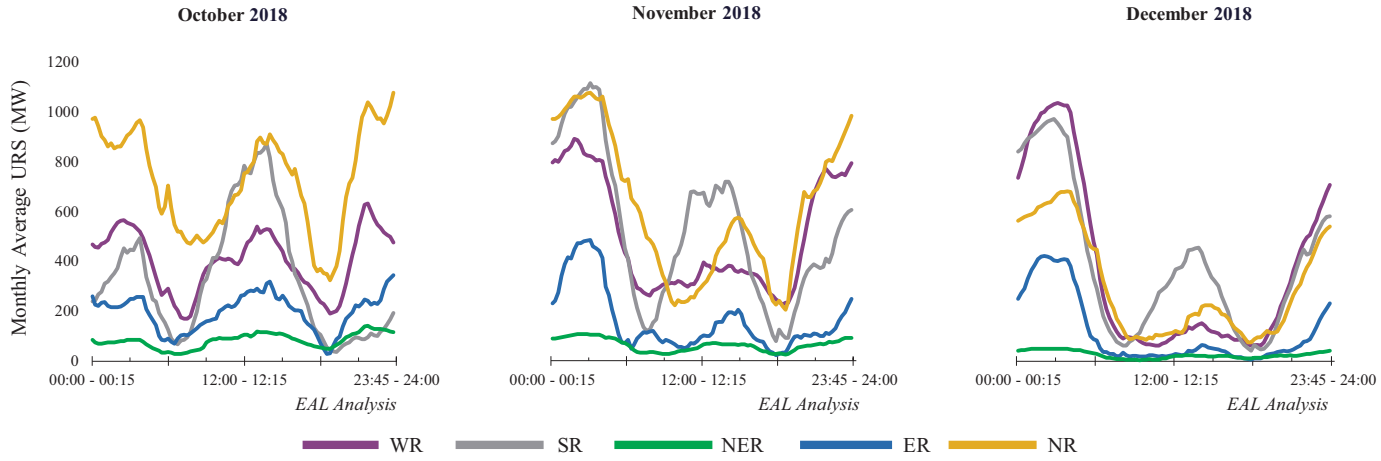
Region-wise Demand Met Profile



Note: *Load profile for North-Eastern Region is not reported here due to inaccessibility of data.*

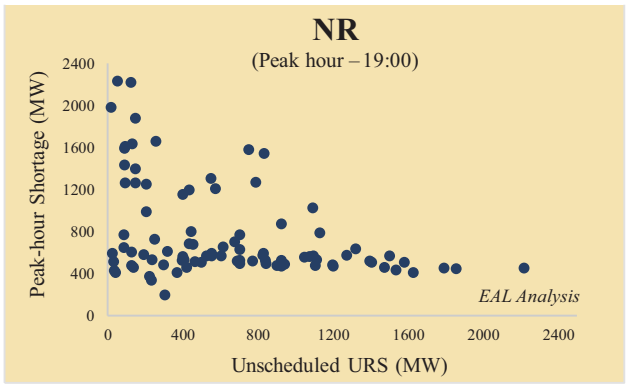
Un-requisitioned Surplus (URS) Analysis

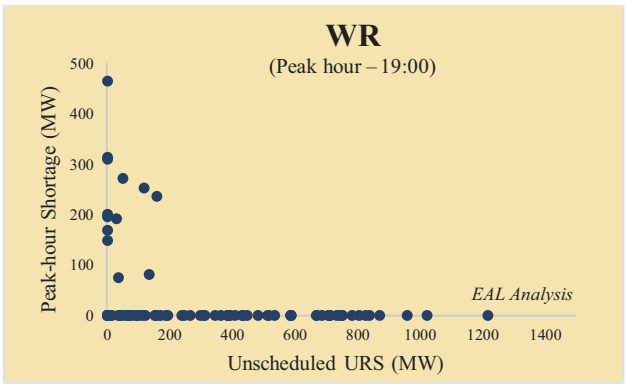
Region-wise Scheduled Thermal URS

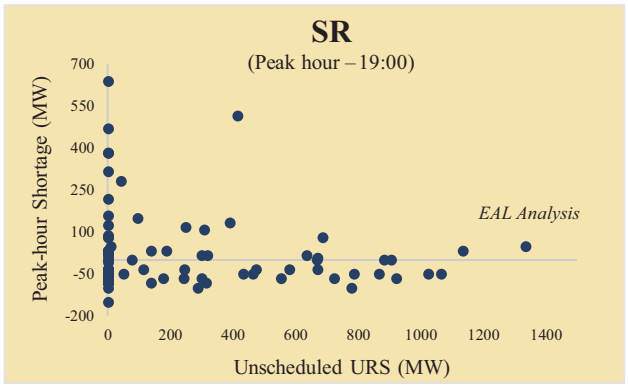


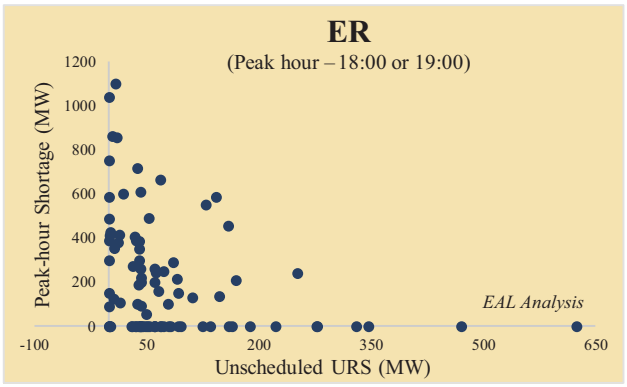
Region-wise Unscheduled Thermal URS (Excluding Gas Power Plants)

All India highest peak-hour demand shortage during October to December 2018 was recorded to be 2234 MW, on 5th October 2018, for NR. Persistence of shortage amidst availability of unscheduled URS highlights a need to explore the economics of furthering the exchange of unscheduled URS.









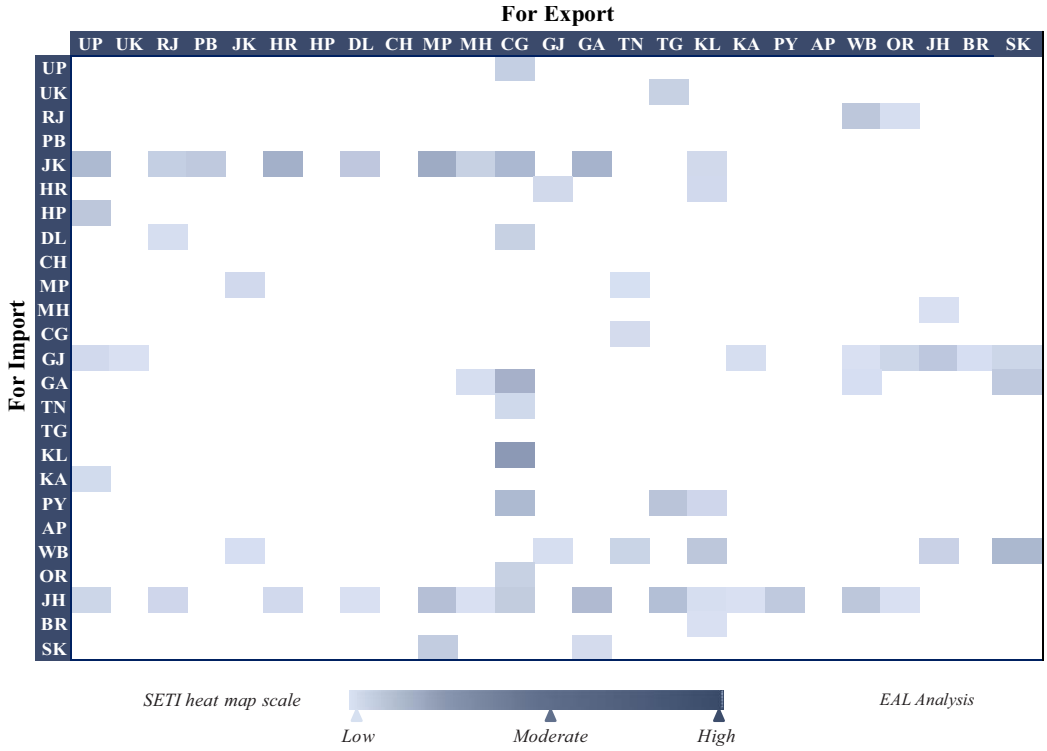
Although NR records peak-hour shortage, the region continues to have unscheduled URS. Subject to intra-regional transmission availability and economics, unscheduled URS can be utilised for reducing the peak-hour shortage. A similar approach can also be adopted at inter-regional level for minimising shortages economically.

All India and regional URS can be accessed on System Dashboard of EAL web portal.

State Electricity Tradability Index (SETI)

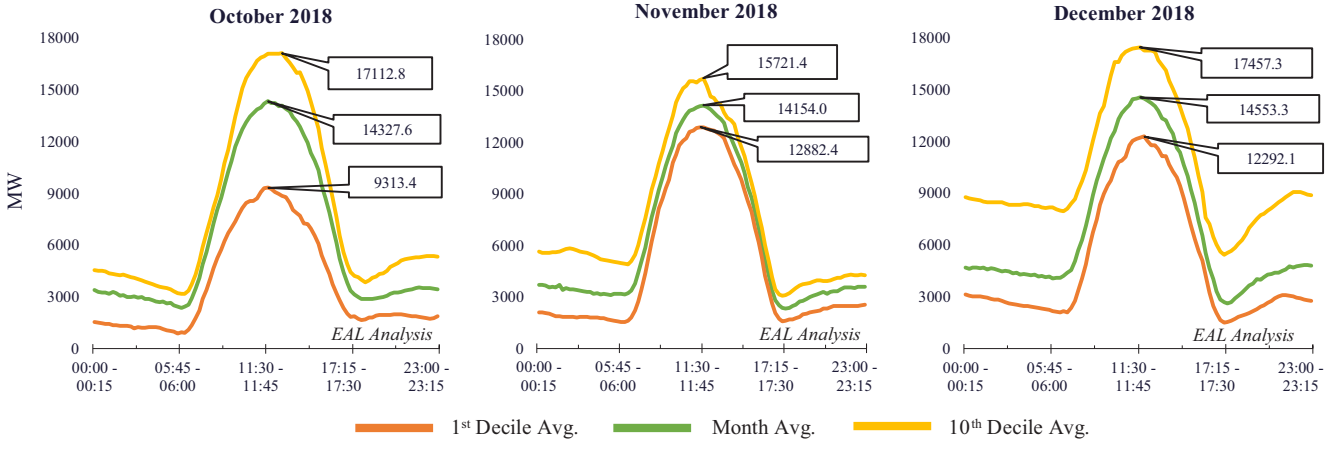
The load profiles of certain pairs of states are complementary in nature. SETI, developed by EAL, gauges such complementarity between pairs of states, for both import and export of power. Chhattisgarh and Kerala show a high tradability index for the October – December quarter. Given adequate transmission capacity and favourable economics, such complementarities indicate opportunities for intra-regional as well as inter-regional trade of URS across states.

State Electricity Tradability Index (October – December 2018)



SETI compares daily demand patterns of a pair of states. An analysis of load profiles of all Indian states through SETI reveals that there is significant scope for re-balancing of their power procurement portfolios. Load profiles of pairs of states with moderate to high SETI should explore avenues for co-optimisation.

All India Renewable Energy (RE) Generation Profile

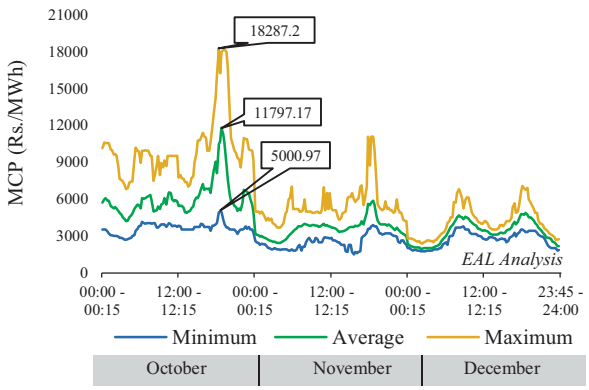


All India RE Generation Profile can be accessed on System Dashboard of EAL web portal.

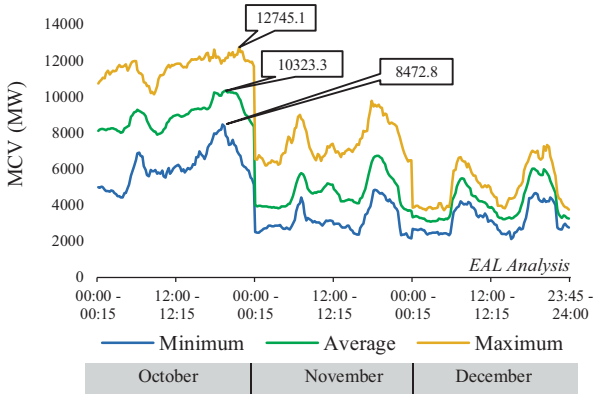
Power Market Overview & Analysis

DAM – Market Clearing Price (MCP) & Market Clearing Volume (MCV)

DAM Monthly Average, Maximum & Minimum MCP

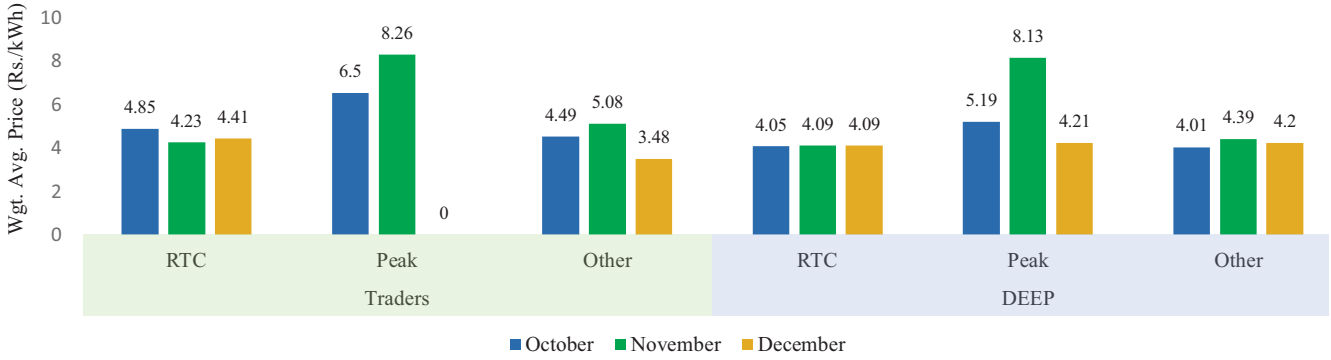


DAM Monthly Average, Maximum & Minimum MCV



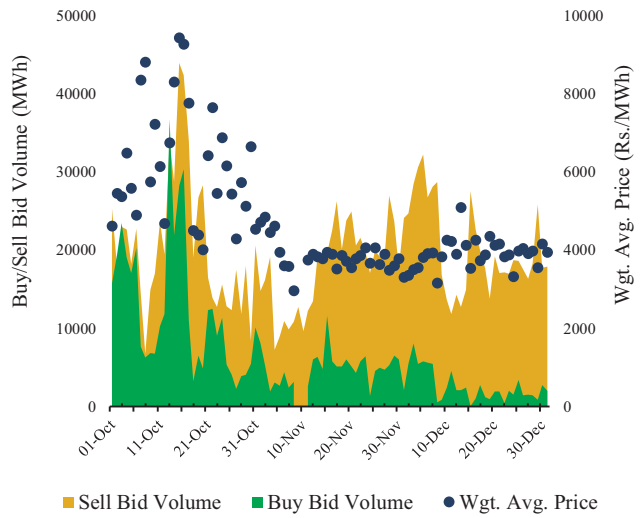
October 2018 experienced a general price rise in DAM, with MCP peaking at Rs. 18287.24 per MWh, on 26th October 2018.

Bilateral Power Transactions

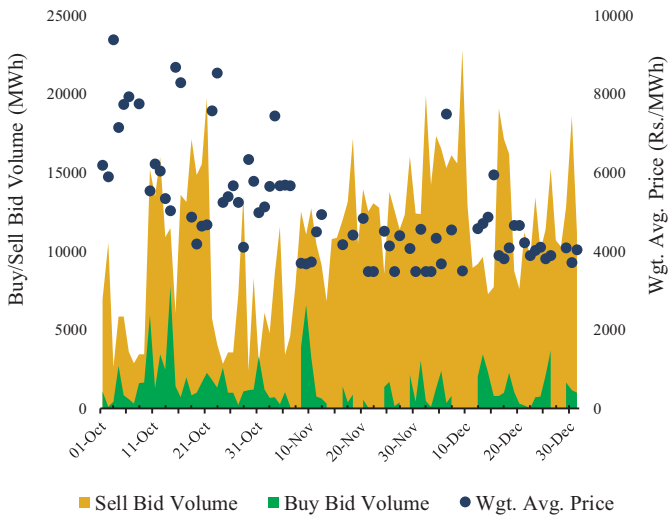


Term-Ahead Market (TAM) Transactions

Daily Average Day-Ahead Contigency Transactions



Daily Average Intra-Day Transactions



Regulatory & Policy Perspective

MBED of Electricity: Re-Designing of DAM in India – A CERC Discussion Paper

Power Purchase Agreements (PPAs) bind Distribution Companies (DISCOMs) to schedule costly power that may result in sub-optimal utilisation of their power procurement portfolio. To address this, CERC released a discussion paper on Market Based Economic Dispatch (MBED) framework in December, 2018.

Overview

- **Scheduling and Dispatch** – DISCOMs would bid in the Power Exchange, a day ahead, instead of scheduling from PPA(s).
- **Bilateral Contract Settlement (BCS)** – In case the MCP is more than the price in the PPA(s), the contracted GENCO would be liable to pay the difference to the contractee(s) (DISCOMs).

  In a case of congestion, the bilateral contract holders participating in DAM would receive the congestion amount if it is in the direction of contract, and vice versa.
- **Participation in MBED** – The participation would be voluntary during a transition period of one year, beyond which all the bilateral contract holders would be mandated to participate in MBED model of DAM.
- **Bidding Mechanism** – All DISCOMs can submit a price inelastic 'Fixed Demand' (limited to quantum contracted bilaterally) in DAM. All other bids would be subject to DAM rules.
- **Interlinking DAM and Real Time Market (RTM)** – Deviation in day-ahead commitments due to unforeseen circumstances (unit tripping or load variation by DISCOM) can be handled by RTM. However, the financial settlement for both the markets will be done separately at their respective MCPs. Any changes in RTM would be handled through Ancillary Services (AS).
- **Market Contracts** – All power entities must periodically demonstrate enough resources to meet the forecasted demand and reserves for contingency.

EAL Opinion

- Expected savings from optimisation over a larger portfolio of procurement contracts need to be weighed against costs associated with the implementation of MBED.
- Relevant sections of Electricity Act, 2003 may need to be amended to facilitate the creation of MBED.
- The proposed price risk hedging mechanism in BCS is asymmetric – allowing DISCOMs to hedge risk when MCP is greater than the price in the PPA(s), while exposing GENCOs to financial risks if MCP is less than PPA(s) price.
- Some generating units may need frequent shut downs, especially in the absence of incentives to generate up to their technical minimum limit, when the system forces low demand or high renewable penetration, thereby affecting the overall market outcome.
- The legal implications of termination of PPA(s) may be significant, given the high financial stakes for investors and lenders.
- A holistic market design should give due consideration to all segments of capacity market, DAM/TAM, Deviation Settlement Mechanism (DSM), RTM, AS, etc. A capacity market to be developed alongside MBED would help ensure long-term resource adequacy.
- The implementation of MBED may witness high fixed costs by GENCOs, with lower variable costs for getting scheduled in DAM. Consequently, technologies like solar photovoltaics (SPV), especially with storage, would be the most viable option.

Proposed Bid (Order) Types in DAM – IEX's petition to CERC

CERC Power Market Regulations, 2010 provide for the following types of contracts on Power Exchanges (PXs):

i. Intra-day/Contingency contracts
ii. Day-Ahead contracts
iii. Term-Ahead contracts
iv. Contracts linked to electricity generated from RE
v. Electricity derivative contracts, futures contracts and other such contracts
vi. Capacity contracts

The first four contract types, in the form of different product types, already exist on PX platforms in India. However, the last two have not been introduced so far. Hence, to increase liquidity in the existing DAM, Indian Energy Exchange (IEX) has proposed several new bid (order) types.

Overview

Minimum Quantity Block (MQB) Bid

- MQB bid would place a parametric constraint on the tradable (minimum) quantum in a block bid. However, the constraint being non-binding may create complications in market clearing besides increasing rigidity in the system.
- This bid type would allow the system constraints (congestion, technical minimum constraints of generators, etc.) to be handled effectively.

Profile Block (PB) Bid

- The PB bid would render the bid quantum for all time blocks in a profile variable, thereby facilitating placement of bids in accordance with varying generation/load.

Load Gradient (LG) Bid

- LG bid type is expected to cater to the ramping requirements of generating stations. However, ramp rate limitations are known to the generator, which should bid accordingly. Fixing a load gradient may limit the ability of a generator to operate at full potential.
- In practice, it is not a single unit that is committed, but a combination of units within the same plant. Thus, the gradient constraint may introduce rigidity in the market by imposing constraints on the system.
- If load gradient is to be introduced in the market design, it should also be included in the Unscheduled Interchange (UI) and/or DSM.
- Ramp rate is of concern to the system operator, who is an independent entity in the Indian power sector. Influence of market clearing on system operation may lead to inefficient market mechanisms.

Flexi Bid (FB)

- Flexibility in price and quantity is the only solution for a perfectly competitive market. The proposed Flexi bid type would introduce flexibility along with uncertainty in the time of delivery.
- Market clearing with uncertainty in the time of delivery, would become a complex mathematical optimisation problem requiring additional conditions and constraints on the search space.
- Flexi bid may jeopardise the market clearing mechanism.

Enhancement of Linked Block Bids

- The existing linked block bids exhibit a hierarchial structure of parent and child bids. The selection of parent bid is a necessary condition for consideration of the child bid.
- The proposed amendment repeals the existing hierarchy while making the selection of parent and child bid combination a function of net gain of the two.
- This will lead to paradoxical rejection and inefficient market operation.

Minimum Income Condition (MIC) Bid

- This bid type would place a functional constraint on the total revenue to be generated from single bids. However, the revenue is proposed to be a function of variable cost, accepted quantum of energy, and operational fixed cost.
- The former two variables would be discovered in the market, but the latter is to be specified by the bidder. Fixed cost realisation in collective PPAs in the existing energy market cannot be easily justified as the market philosophy is based on bidding at marginal cost.

MIC with Schedule Stop Condition

- It is an additional constraint on the MIC bid type to avail schedule stop, by selecting the first unsuccessful bid with subsequent reduction in quantum to zero over the next few time blocks of the generator, in case of rejection of the MIC bid. But this would lead to paradoxical rejection till the unsuccessful bidder (seller) can inject (till the scheduled stop).
- Start-up and shut-down costs are technology dependent and supposed to be borne by the generator itself.

EAL Opinion

- The whole bid system is more favourable to the seller side.
- The constant quoted price of MQB and PB would be compared with average and weighted average MCP respectively of the block for selection. This may lead to paradoxical rejection in individual time block(s) of the profile.
- Bid types such as PB and FB are specifically designed for renewable power plants, but the plant-technology type of bidder, placing such bids may not be known to the market operator. Also, an optimal solution may not be possible if unintended plants use such bids for their own financial benefit.
- Minimum quantity bids and MIC bids are contradictory in nature. The former places a lower bound whereas the latter an upper bound on the selection criterion.
- Similar products should be combined for a less complex system to ease the process of market clearing and settlement.

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