



**Improvement of Market  
Efficiency by information  
dissemination through display  
of Aggregate Demand and  
Supply Day Ahead curves by  
Power Exchange on their  
website**

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Discussion Paper by CERC Staff

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# **Display of Aggregate Demand and Supply Curves by Power Exchanges on their website for Information Dissemination and Improvement of Market Efficiency**

## **A. Introduction**

Power Exchanges commenced operations in India in August 2008. Power Exchanges are neutral electronic platforms, allow electronic bidding from across the country and undertake price discovery through anonymous competitive bidding mechanism. The price discovery happens for every 15 minute block in the day and reflects the near real time demand and supply.

Price discovered in the day ahead market are now considered benchmark power prices and are closely watched by all power sector stakeholders. At a macro level this has provided signal for investment decisions to investor in the power sector and information to policy makers and planners. Different prices in different regions provide information about demand and supply in different regions, generation capacity and transmission capacity.

Power Exchanges have also played an important role in making open access a reality, which is one of the salient features of the Electricity Act 2003. Presently, over 2000 open access customers spanning different states including Tamil Nadu, Andhra Pradesh, Rajasthan, Gujarat, Punjab use power exchange platform regularly to procure electricity.

Over the last five years the average daily transaction volume on power exchange has been growing from annual volume of 7.08 BU in 2009-10 to 23.5 BU. This is at a CAGR of 50% over three period. Presently, the average transaction volume is around 70 – 80 MU daily.

Overall the policy of development of power markets has helped to attract private investment in the power sector, increased generation capacity and the availability of power for the consumers. This has increased the well being of the consumers.

## B. Present Practice

The present price discovery mechanism used in day ahead market is double sided closed bid auction with an uniform market price and market splitting in case of transmission congestion. Closed bid auction means that a market participant is not aware of the bids of other participants during the auction process. After the auction and completion of price discovery, the unconstrained price and volume, the constrained price and volume for all bid areas is displayed on the website of the power exchanges for every 15 minute time block of the day. The process and the timelines followed for auction, price discovery and display of information on website of the power exchange are as follows:

Sl No	Particulars	Time Line
1.	Auction window closure	12.00 hrs
2.	Provisional price discovery	12.55 hrs
3.	Publishing of Provisional Results	13.00 hrs
4.	Data exchange with POSOCO for transmission corridor	13.00 hrs
5.	Receipt of Report From POSOCO	14.00 Hrs
6.	Final price discovery	14.55 hrs
7.	Intimation to market	15.00 hrs
8.	Publication of final price on website	16.30 hrs

## C. The Proposal

It is being proposed that the aggregate demand and supply curves for the final cleared markets be also displayed on the website of the power exchange after the completion of auction and final price discovery, for each 15 minute time block of the day. In case the market splits due to transmission congestion, the aggregate curve for the split regions shall be displayed. This information will be over and above prices presently being displayed for the day ahead markets.

Hence the cleared prices, volumes as well as the aggregate demand and supply curves to arrive at these prices will be displayed on the website of the power exchanges. It is noteworthy to mention that in line with spirit of anonymous bidding in Day Ahead market, the use of data at aggregate level would keep the participants' identity anonymous and would insulate the participants from sharing their commercial sensitive data in public domain.

#### **D. Advantages of the proposal**

The proposal is based on the principle of “greatest good for the greatest number”.

##### **Information Dissemination**

The aggregate demand and supply curves will provide a plethora of information to all market participants, for instance a complete picture of demand and supply in day ahead market, elasticity and liquidity of demand and supply, quantum of unutilized supply and unmet demand, demand and supply bid patterns in different hours and different seasons to name a few. Apart from this, there could be several other inferences drawn by market participants.

Importantly, from a market design perspective, the day ahead market which can be considered to be the market at the margin or a balancing market, the marginal cost curve and the marginal utility curve of the market will be available in the public domain. This will be of immense interest not just to economists and market analyst but also to engineers since it can be important information input to improve the operational efficiency of the generators in a competitive market.

Presently different market participants have different set of information thereby leading to information asymmetry. Display of aggregate demand and supply curves on Power Exchanges' website will empower the market participants with more information and ensure they are able to take more informed decisions.

##### **Price Transparency**

From a transparency perspective this would create a check and balance on the power exchanges themselves and on large market players. Any abnormal bid patterns can be easily identified by the market and analyzed by the market participants. This achieves the unstated intent of the Commission to decentralize market monitoring and introduces self imposed market monitoring by the market participants. This is particularly relevant since the day ahead auction is a closed bid auction presently.

### **Research and Development**

This will release large amount of primary data in the public domain for research by power market analysts, academia and planners and can help in further development of market.

Additionally, this may also give a fillip to the intra-day market since information about the left over supply and unmet demand along with the indicative prices for aggregate demand & supply after the day ahead market will be known to the market participants.

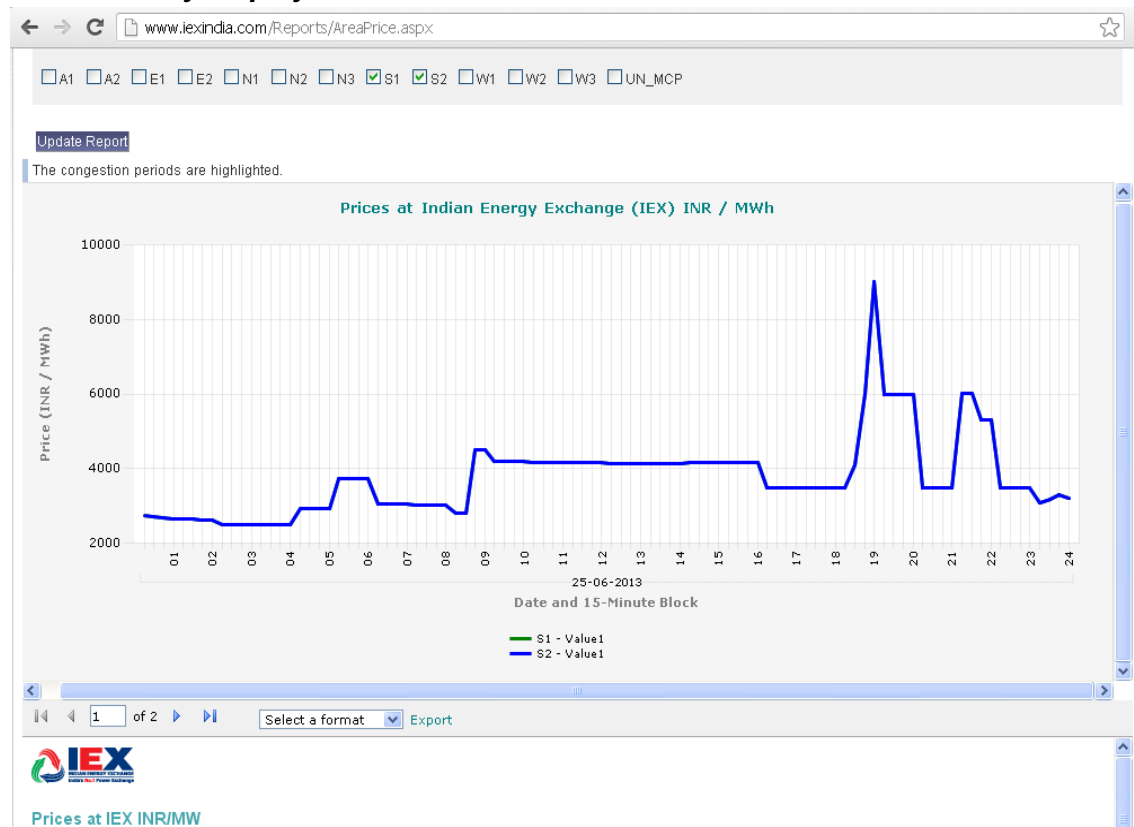
### **E. Sample Graphs**

Sample aggregate curves based on IEX data of particular time block 11:00 - 11:15 am of 25th June, 2013 and graphs (based on data of delivery date of 25th June, 2013) presently displayed on IEX website are shown below. Graphs for various regions taking market-splitting into account are depicted to demonstrate change in region-wise aggregate demand and supply curves and their comparison with the present method of display of data.

1. ***Congested area (Area Clearing Price - South):***  
 a. ***Proposed aggregate demand & supply curve***

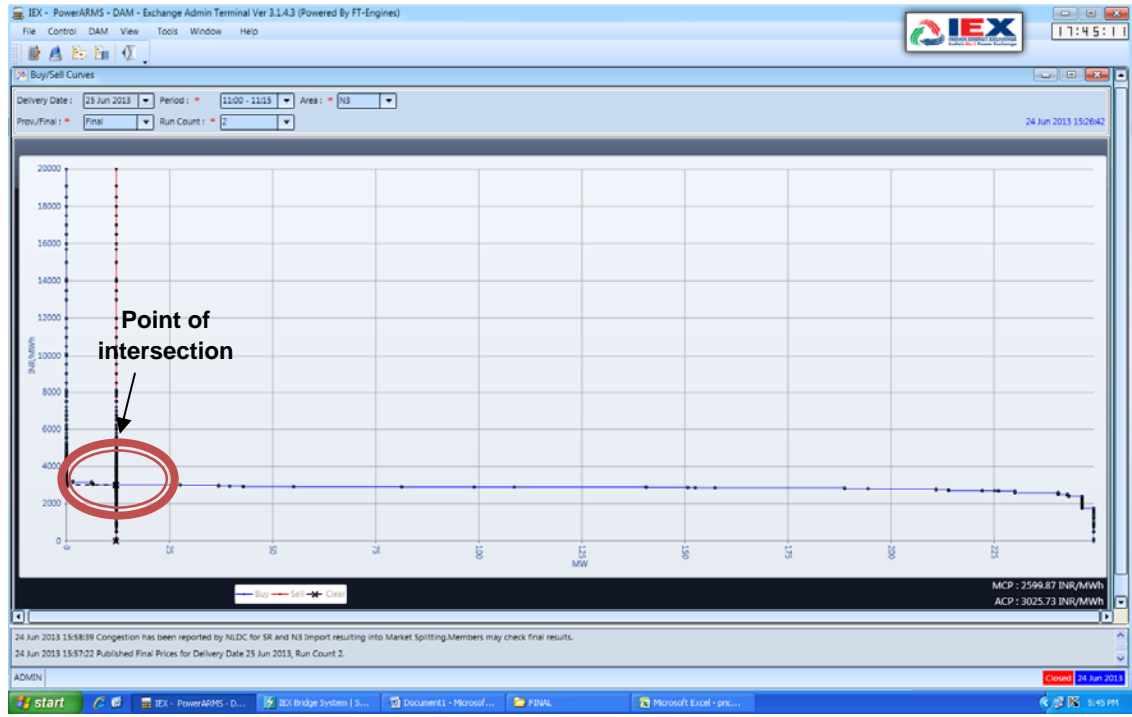


b. ***Presently displayed on IEX website***

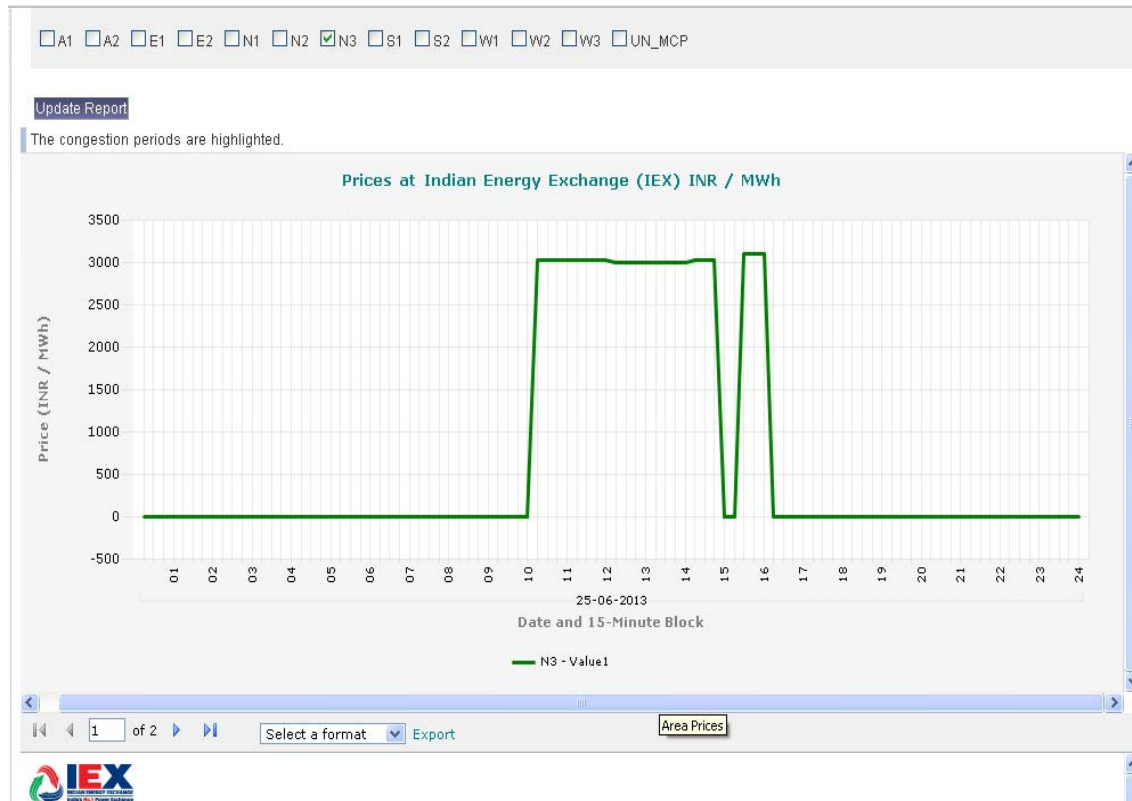


## 2. Congested area (Area Clearing Price - N3)

### a. Proposed aggregate demand & supply curve

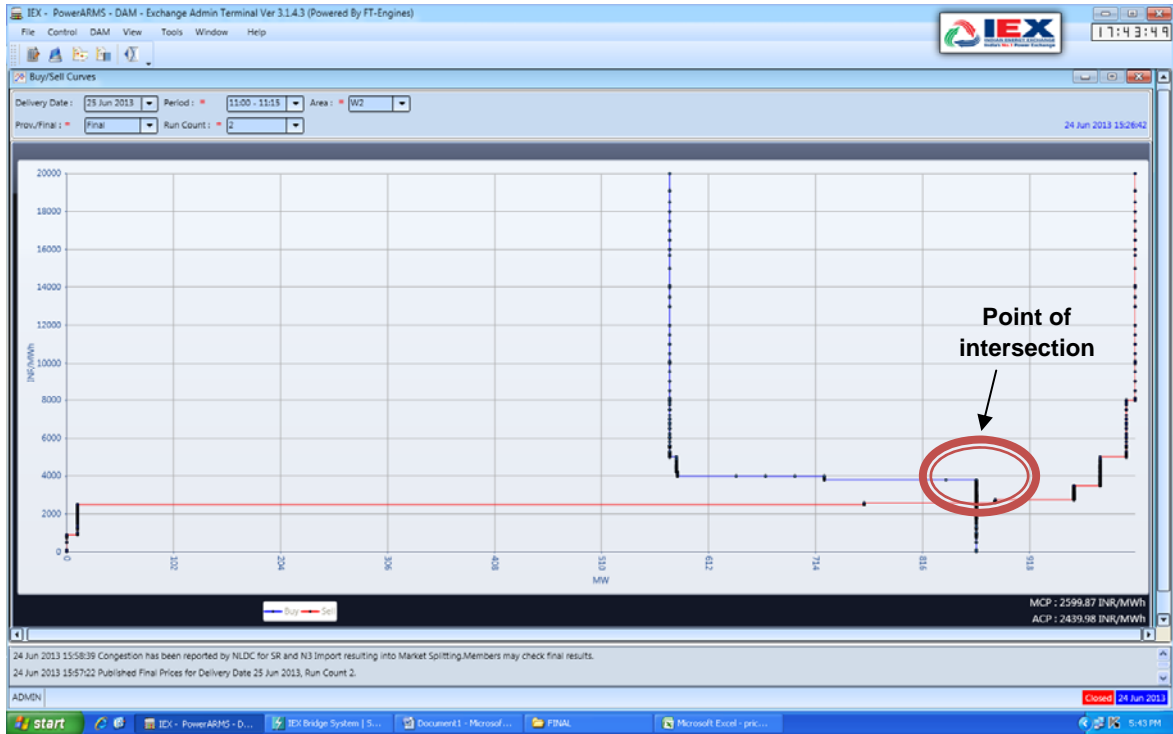


### b. Presently displayed on IEX website

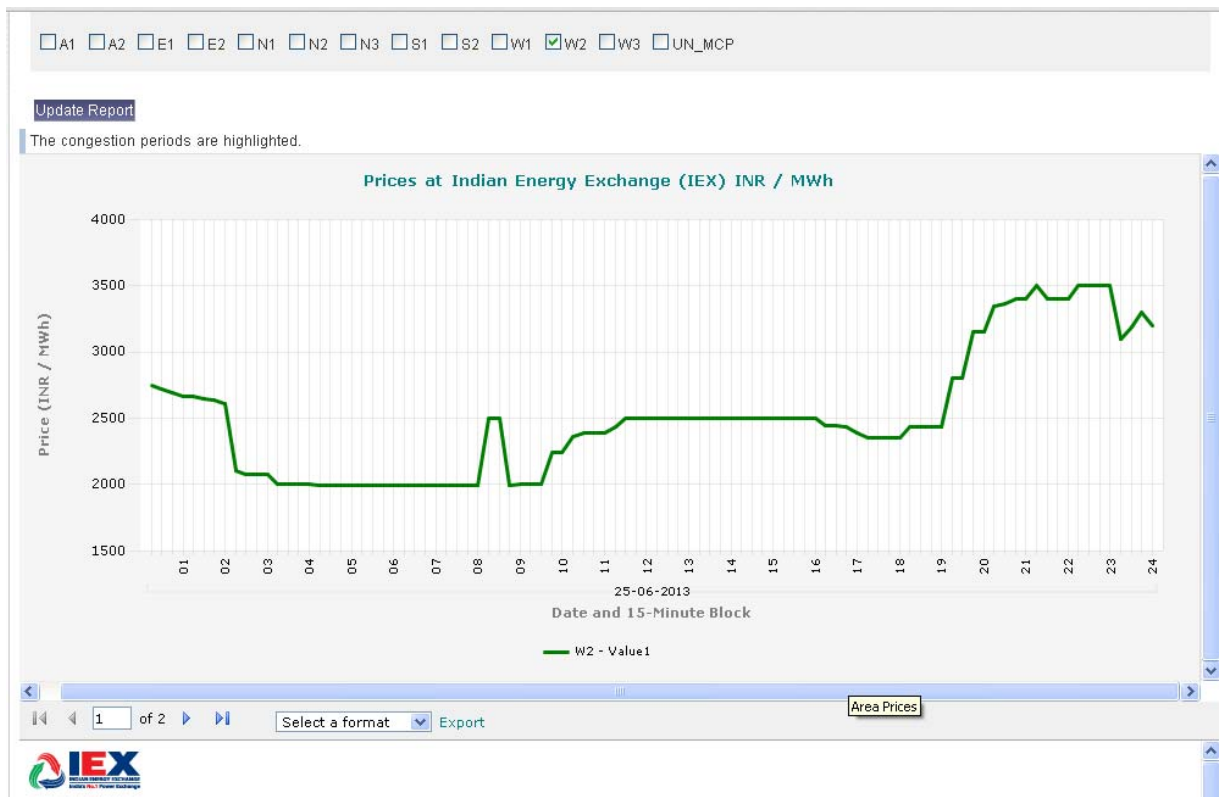




**3. Non-congested area (Area Clearing Price – W2)**  
**a. Proposed aggregate demand & supply curve**

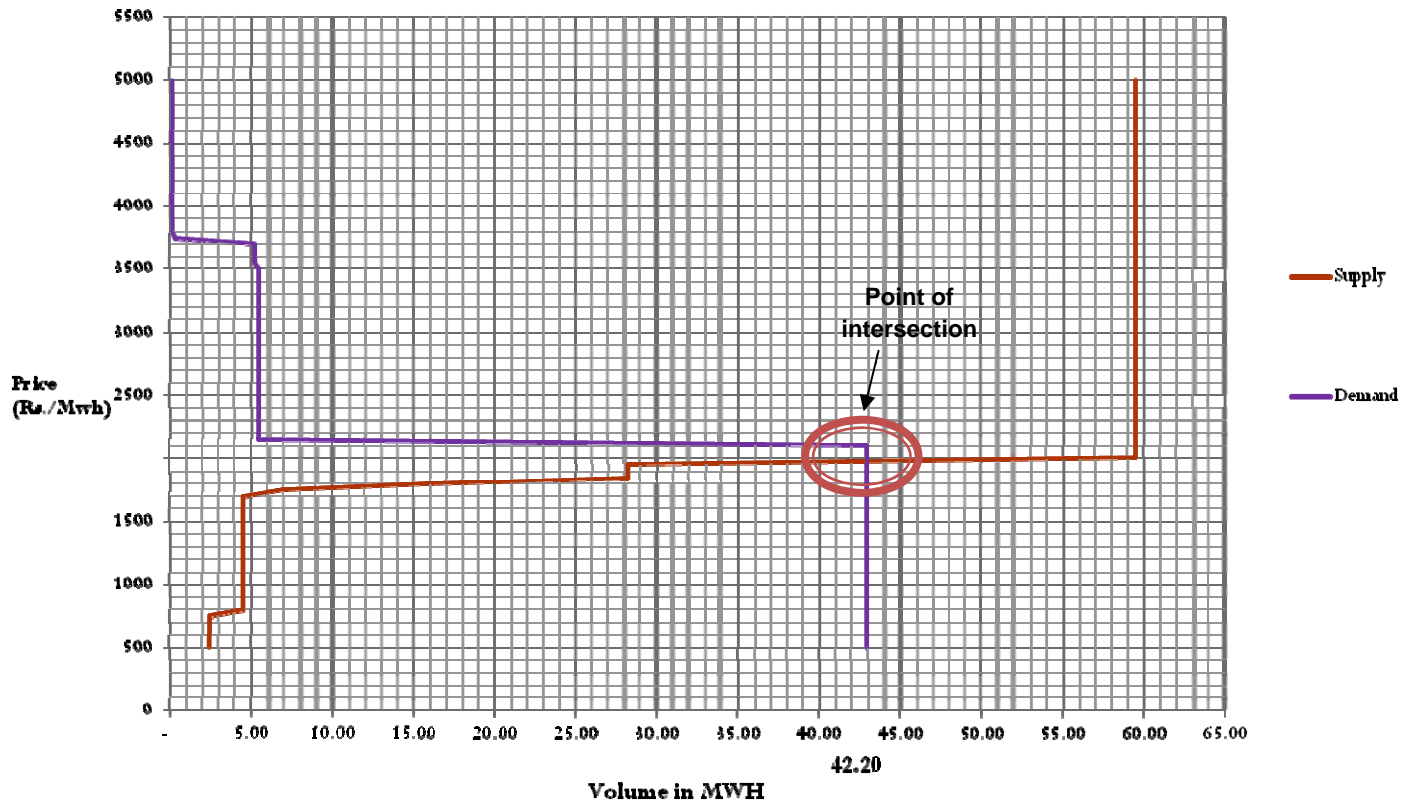


**b. Presently displayed on IEX website**

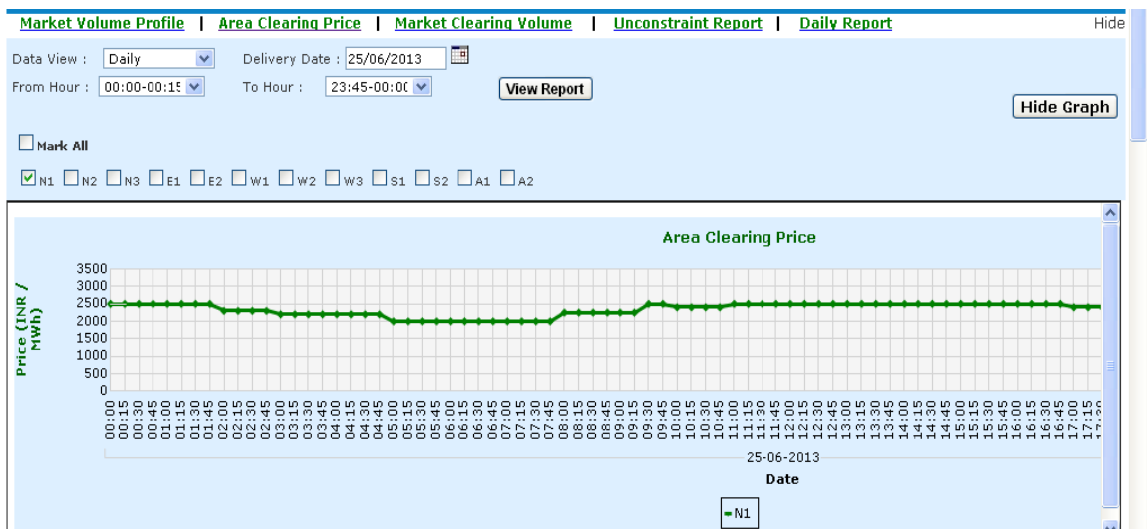


Similar aggregate curves will be displayed by PXIL on its website. The price discovery methodology adopted by PXIL creates step aggregated curves. A sample graph of price formulation in PXIL platform is displayed below.

**a. Proposed aggregate demand & supply curve**



**b. Presently displayed on PXIL website**



As can be seen the aggregate buy curve (demand) has decreasing volume with increasing price and the aggregate sell curve (supply) has increasing volume with increasing price. The intersection point of these two curves gives Market Clearing Price (MCP) and Market Clearing Volume (MCV) which is the equilibrium for price and quantity. Volume quoted by individual participants corresponding to this Market Clearing Price is allocated to them.

As we can further observe, the present way of displaying graphs by both the Exchanges shows only the MCP discovered during the day whereas the proposed method of displaying graph would additionally exhibit demand and supply at various price points for each of the 96 blocks. Further varied information can be drawn from the proposed curves. For example we can see from the aggregate curves shown for N3 region that the demand was fairly price elastic on IEX platform on 25th June, 2013 during 11:00 – 11:15 hrs.

## **F. Pros and Cons of the proposal**

While there are several advantages of the proposition, the question to ask is what could be the fallout of such a proposal? Is there any possibility of abuse of this information and create perverse incentives for market participant? For instance in case a generator observes that the supply curve is inelastic on particular day, could it change its bidding behavior the next day to take advantage of the prevailing situation and try to increase prices ? The general answer to the question is that in a perfectly competitive market, no single player can change prices. Hence generally speaking, knowledge about the bids of other participants cannot be used to ones advantage. In case of Indian Energy Exchange the liquidity is high, approximately 70- 75 MU of power is cleared daily and there are approximately 1000 buys bids and around 85-90 sell bids in a particular time block. Hence there is sufficient competition and a single entity will not be in a dominant position to manipulate prices. In case of Power Exchange of India the liquidity is presently low and there are approximately 25 – 30 purchase bids and 5-6 sell bids in a particular time block. It can be argued that this information would be closely watched by all market participants and competition among the participants will check any kind of abuse.

## **G. Regulatory Framework**

Regulation 57(ii) of the CERC (Power Market Regulation) 2010 stipulates that prices, volume and historical data shall be made available on the power exchange website and should be in downloadable format. The present proposal goes beyond this information dissemination requirement and will need to be incorporated as a part of the regulation through amendment.

## **H. Implications on Day Ahead Market Design**

One question which arises is why not introduce continuous trading in day ahead market instead of closed auction when the aggregate bid curves are to be disclosed eventually? In the continuum of market designs one extreme is closed bid auction with no information dissemination and the other extreme is real time continuous trading with display of price-volume on a real time basis. The idea of continuous trading which can be examined as and when day ahead volumes are very large. The present intent is more information dissemination and higher market transparency. Presently the Commission has consciously chosen a closed bid auction with the intent to aggregate liquidity for robust price discovery and to ensure all buyers and sellers are treated equally. Display of the aggregate curves is being contemplated post the auction and the information displayed remains anonymous and at an aggregate level.

## **I. Theory on Information Asymmetry and Market Efficiency**

Markets with asymmetric information are those situations in which one party in a transaction has more or superior information compared to another. This could lead to a harmful situation because one party can take advantage of the other party's lack of knowledge. Information Asymmetry can lead to two main problems - Adverse selection and Moral Hazards. These then lead to market failure.

It is well established fact that information dissemination reduces information asymmetry, improves transparency and market efficiency. There is a large amount of economic research and literature on this subject. As per Efficient Market Hypothesis theory, a market is efficient if the asset prices fully and correctly reflect all available information

that is relevant for the assets pricing. This requires a medium of information dissemination that has speed as well as accuracy. Electronic exchange platforms and display of market information on the website serve both these purposes. Also the internet has enabled transmission and archiving of bulky information in a ready-to-use format.

When market participation has incomplete information and acquiring information is costly, markets may not function efficiently. Information remains under-supplied because it is the self-interest of its possessor not to supply it. The mandate of providing of information through regulation may then be required.

## **J. Operational Issues with Display of Aggregate Curves**

There are certain operational issues which need to be addressed. They are:-

1. Since there are 96 time blocks for which price discovery happens and there are 12 bid areas presently, the data to be handled is large. However, since exchanges are already handling this size of data successfully through use of electronic platforms, this should not pose any operational data handling problem. Technology should be leveraged to provide this advantage to the market participants.
2. Sufficient liquidity does not exist in PXIL as there are only 25 buy side bids and only 5-6 sell side bids at an average in a time block. While this is a concern, information would be closely watched by all market participants and competition among the participants will check any kind of abuse. From a public interest standpoint, it can be argued that growth of the market and the well being of consumers should not be stymied due to inability or disadvantage to one exchange.
3. Is it sufficient to display the graphs or should data points of the aggregate curve also be made available to be downloaded? What should be the archiving policy and how long should the curves be kept available in the public domain from data size and data management perspective?
4. How would block bids or bids which are contiguous in a few time blocks be displayed?
5. In case of market splitting, it is possible that a seller may come to know that the demand in the region is price inelastic and it may use this knowledge to his advantage

In light of this, should the graphs then be published for unconstrained market or for all bidding regions taking market splitting into cognizance?

## **K. International Practices on Display of aggregate demand and supply curves**

- **APX Endex**

APX Endex is a spot power and gas exchange undertaking transactions for UK, Netherland and Belgian market. They display the day ahead hourly price and volume information in data form and graphically. They also display / provide weekly, monthly and historical data free on the website which is downloadable in excel. However, they also provide paid subscription and bespoke data services on special request. APX Endex displays aggregate demand and supply curves of the UK and the Netherlands markets separately. The details of the information displayed are available at:

<http://www.apxgroup.com/market-results/apx-power-nl/aggregated-curves/#>

- **Nordpool Spot**

Nordpool Spot is the market for Nordic countries and recently integrated Baltic countries with it. It displays day ahead hourly spot prices (Elspot) and Balancing market (Elbas) prices, volume, transmission capacity and flow in / between all its bid areas. However aggregate demand and supply curves are not displayed. The Indian day ahead market design is similar to the Nordpool spot market. The details of the information displayed are available at:

<http://www.nordpoolspot.com/Market-data1/Elspot/Volumes/ALL1/Hourly11>

- **PJM , US**

PJM is a large independent system operator cum market operator in East Coast of US. It makes available a large amount of operational and market data to its users. Among other data, Day ahead and 5 minute real time locational marginal prices in

defined Zones and Hubs is made available. Registered users have the ability to save customized tabs and panels for personal data presentation, while guest users are presented with a set of standardized displays. This is integrated with the Open Access Information System (OASIS). The details of the information displayed are available at:

<http://www.pjm.com/markets-and-operations/etools/edata.aspx>

## **L. Implementation Plan**

Undertaking Power Market development is one of the key objectives of the Central Commission. In view, of this it is proposed that the Power Exchanges display the aggregate demand and supply curve for each 15-minute block for each bidding region. The Power Exchanges should implement this as a pilot for a period of 6 months. During this period, the Exchanges along with the Commission would monitor the market to check market abuse, if any.

## **M. Conclusion**

The proposal of display of aggregate demand and supply curve would significantly contribute towards improving market efficiency and help the markets to mature. In terms of information availability this will be a paradigm changer. In the long run as the transaction volumes in power exchanges increase and its market share increases from 2 % of the total generation the impact will be far reaching.