A Perspective of Power Market Development in India – Market Design & Operation

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Abstract: Power Sector reforms in India were initiated with the ultimate objective of restoring reliability of the power industry, promote competition and efficiency, create an environment conducive to private investment, and facilitate sustainable development of the power sector. With the initiation of the reform process, it was considered essential that the sector be regulated by independent institutions. This led to the introduction of Regulatory Commissions at the Central and State levels through the introduction of the Electricity Regulatory Commissions Act 1998. Thus the enactment of the Electricity Act 2003 strengthened the role of Regulatory Commissions and provided for competition and efficiency in the power sector, quality of supply at reasonable prices to the consumers, promotion of non-conventional sources of energy and power market development.

Keywords *- Power Market, Real Time Market, Competitive Electricity Market, Electricity Act 2003*

Introduction: In India the State Electricity Boards are serving the electricity consumers. With initiation of reform process some of the SEBs has been re-structured leading to separation of generation, transmission and distribution. The enactment of Electricity Act 2003, led to development of competitive electricity market in the country. The Act provides for non-discriminatory open access of the transmission and distribution, de-licensing of generation including captive power generation and recognizes trading as a distinct activity. These provisions provide an enabling environment for development of bulk power market in India.

Electricity trading was initially through bilateral contracts, entered into between a seller and a buyer with or without a trader. Then the need was felt for an organized power market to enable price discovery in a transparent manner, thereby facilitating efficient trading among many players. This led to the establishment of power exchange. After development of power exchanges, several forms of electricity trading is taking place similar to that in developed countries like direct bilateral (with or without the help of traders), over-the-counter (OTC) trading, and exchange-based trading in addition to balancing mechanism through Unscheduled Interchange (UI). These four types of trading can coexist and, in fact, competing with each other garnering approximately equal market share. Initially the market structure for the bulk power market was characterized by bilateral contracts between generation plants owned by central and state governments, IPPs, surplus captive generation capacity and the distribution utilities/SEBs. PPAs were signed by the players. In the year 2002 to 2003 all the regions came under the ambit of Availability Based Tariff (ABT). Then in the year 2004 open access was introduced and subsequently the concept of multiple power exchanges was introduced in 2008 as depicted in fig - 1. Approximately 6% of the energy generated in the country is being traded through negotiated bilateral trading arrangements OTC and power exchanges while around 4% of power is drawn as balancing power using UI mechanism of ABT. The transition from a single-buyer model to a multi-buyer multi-seller model has resulted in competition in power market and provide for incentives for new investment while providing affordable and quality power to consumers. A number of steps had already been undertaken in that respect. These include unbundling and rationalization of retail tariffs, adoption of intra-state ABT regime, competitive procurement of renewable energy and adoption of a distance & direction sensitive transmission pricing regime.

The Electricity Act, 2003 had come into force from 10th June, 2003 surpassing all previous acts. In view of a variety of factors, financial performance of the state Electricity Boards has deteriorated. The cross subsidies have reached unsustainable levels. A few States in the country have gone in for reforms which involve unbundling into separate generation, transmission and distribution companies.

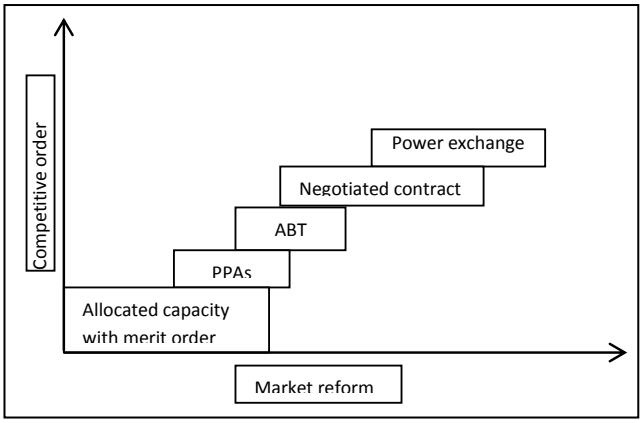

Fig 1: Market Reform Process

To address the problems of the sector, the responsibility of power market development was given to the Regulatory Commissions as per the sections 178 and 181 of the Electricity Act 2003. The National Electricity Policy also states that power market development would need to be undertaken by the Regulatory Commissions and notify regulations encouraging competition in this regard. The new act provides for newer concepts like power trading and open access. Open Access on transmission and distribution has enabled number of players utilizing margins in capacities and transmit power from

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generation to the load centre. This means utilization of existing infrastructure thereby reducing additional investments. The main aim is that the trading is undertaken in a competitive environment.

So far Central Electricity Regulatory Commission (CERC) & State Electricity Regulatory Commission (SERC) have played a significant role in the power sector reform process. Some of their achievements include initiating the process of establishing important data on commercial and technical parameters by the power utilities, introducing the annual revenue requirement and tariff determination process, ensuring that the distribution companies adopt efficient means of power procurement through competitive bidding route, putting in place Grid Codes (by CERC and some of the State Regulatory Commissions) to ensure better grid discipline, introduction of frequency based unscheduled interchange (UI) charges to ensure grid discipline. In spite of all, it is a matter of concern that not much progress has been made in increasing competition in the power market at retail level. Phased open access of the distribution network by respective state utilities provides consumer choice subject to open access regulations including the cross-subsidy surcharge. The National Electricity Policy' 2005 also provides platform for market development. [1]

In India four basic markets are available viz., long term, medium term, short term and balancing markets which are co-existing at a time. The wholesale power market in India is governed by long-term bilateral contracts. These are applicable in inter state and state level. The short term markets are of two sub groups viz., short term through licensed trader or without trader and through power exchange. This platform for anonymous trading of electricity contracts helps in providing efficient price discovery. The UI mechanism under the ABT regime provides balancing market. Development of a long-term futures market would provide efficient signals for investment in new generation capacities thereby reducing investors risk [2].

II Global Power Market Structures

All over the world there are established international exchanges such as Nord Pool, and PJM, which are providing standardized contracts in the form of spot, forwards, futures and options. The power markets operating in different parts of the world can be broadly classified into four basic generic structures.

1. Monopoly model
2. Single-buyer model
3. Third-party or open-access model
4. Power pool (wholesale market or spot market) model.

1. Monopoly model: The monopoly model offers little scope for competition. One idea of natural monopoly is that in some situations competition self-destructs, resulting in a single firm supplying the entire market demand. If the monopoly firm serves a single market, then economies of scale are sufficient for the firm to be a natural monopoly, although other cost characteristics may also result in a single-product firm being considered a natural monopoly. Economies of scale imply that the firm's average cost declines as the firm increases output. If the firm is a monopoly in several markets, more complex cost concepts come into play. Hence the choice centers around the other three models. Each of these generic models may have variations within itself in respect of the agency responsible for management of the market and its governance and regulation.

2. Single-buyer model: In a single-buyer model, a single entity purchases power from all generators on a competitive basis and in turn sells it to the supply entities. This model has some merits. It is simple and has minimum transaction costs. It facilitates design of equitable bulk supply tariff. Planning for capacity addition and strengthening of transmission systems is better coordinated. The single-buyer model makes it possible to shield financiers of generation projects from market risk & retail-level regulatory risk, reducing financing costs or making the investment commercially bankable.

The demerits associated with this model are listed below:

- Competition is limited and merit order is not being followed.
- The single-buyer model responds poorly when electricity demand falls short of projections.
- The single-buyer model hampers the development of cross-border electricity trade by leaving it to the single buyer, a state-owned company without a strong profit motive.

The above drawbacks can be overcome to some extent through the adoption of a competitive bidding system for power purchase by the single buyer and imposition of an appropriate regulatory control. For effective competition, it would be necessary that supply is not constrained. Many developing countries are found to prefer a single-buyer model, especially during the transition phase of the reform. Allowing generators to sell electricity directly to distributors and large consumers eliminates most of the disadvantages of the single-buyer model.

3. Third Party or Open Access Model: Under the open-access model, the generators/sellers are in a position to enter into direct contract with distributors or large consumers without the need of an intermediary buyer. This, however, requires an open access to the transmission system. It is also important that the access to transmission is regulated and pricing policies are compatible, transparent, and efficient. The main merit of this model is that it provides a better platform for competition that would eventually help bring down the cost of supply.

4. Power Pool Model: The power pool model envisages different generators selling to a pool and the distributors or large consumers buying from it. The pool functions as a marketplace for trading. An open access transmission system is a prerequisite for this model too.

Compared to the other models, this one offers the best framework for competition. These pools are designed to maximize competition in generation, compete on price not cost, and remain open to all market participants. These are fundamentally different from the tight power pools that have been operating for many years in the US which were created to improve reliability, minimize operating costs, and facilitate decision making by vertically-integrated utilities. The new type of pools are operating in England and Wales, Victoria (Australia), Alberta (Canada), and Scandinavia (Norway and Sweden), and at least 10 more countries are reportedly planning to operate these successfully.

Although classified together, these pools present many variations regarding complexity of operation, governance, and regulation. The Nord pool which covers the Scandinavian countries and deals in spot and real time trading appears the most complex. The pool operation may get vitiated if the transactions are heavily hedged by bilateral contracts. This is a concern in the case of the pool in England and Wales. [2]

III Design and structure of Indian Power market

Indian bulk electricity market is segregated into long term, medium term and short term markets depending on the period of delivery for which a contract is entered into. As transmission access plays a major role, contracts are entered for duration based on the availability of transmission access. Transmission access is permitted through Open-access for short term (up to 3 months in advance) and medium term (exceeding 3 months and up to 3 years) and long term (exceeding 12 years and up to 25 years). Long term contracts are entered through Power Purchase Agreements (PPA) which is of the order of 12 - 25 years as depicted in fig - 2. Long term and medium term agreements generally take place through competitive bidding according to standard procedures laid down by Central Government. These contracts may be bilateral or multilateral, in many cases involving traders. Short term contracts for longer duration takes place mainly through traders/power exchanges, and considerable quantum is traded directly between buyers and sellers. Power Exchanges have started to provide standardized contracts through its spot market (day ahead and intra-day contracts) and term ahead market (TAM) for longer tenure contracts. Nearly all spot market trades take place through Power Exchanges, mainly through day ahead market (DAM). Trades in DAM, called collective transactions, are scheduled through a procedure developed by NLDC and approved by CERC.

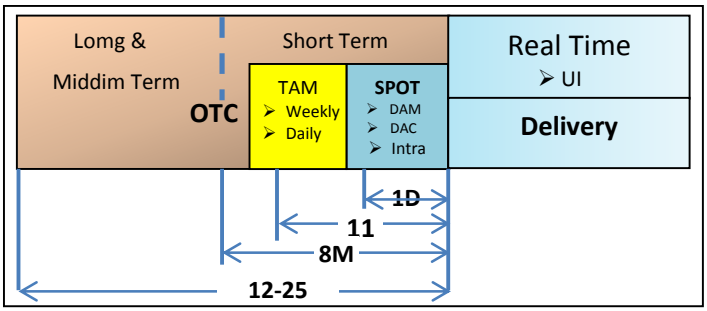

Fig-2: Bulk Power Market Segmentation w.r.t delivery of power

Mode of Power Trading in India:

- Direct Bilateral trading
- Bilateral trading through intermediaries (Traders)
- Power exchanges
- Balancing Market

- **Direct Bilateral Contracts:**

Bilateral contracts refer to mutual contracts where buyers and sellers search and negotiate. These contracts could be long-term, medium-term or short-term. The long-term power purchase agreements (PPA) in India between the Central Generating Stations (like NTPC, NHPC etc.) and Discos are a classic example of a bilateral contract. Direct bilateral are generally characterized by huge search costs, asymmetric information, and lack of transparency.

- **Bilateral trading through intermediaries:**

As liquidity of a market increases, more intermediaries emerge in the form of licensed traders. Power traders reduce search costs by providing market information, matching buyers and sellers and acting as a facilitator in concluding trading arrangements. Some power traders also provide financial services.

Both types of arrangements i.e., direct bilateral and through traders in short term market characterize mutual bargaining process where the price is not disclosed. Bilateral contracts in short term market are flexible and are based on bargaining and negotiation, however, the price discovery process is not transparent.

- **Power exchange**

A Power exchange facilitates equitable, transparent and efficient trading of power. It bridges the demand supply mismatch by bringing bulk market players together for buying and selling in an auction-based system. While maintaining complete anonymity, this mechanism resolves the constraints in the earlier formats, viz., search costs, asymmetric information, transaction costs, and counter-party risk. Moreover PX reduces price risk & volume risk.

- **Balancing market**

In the process of implementation of Availability Tariff, the scheduling mechanism has been established wherein utilities can enter into long-term contracts for supply from identified generating stations, can enter into short-term bilateral arrangements (directly, through a trader, or through an exchange), or can trade power with the pool, i.e. the large electricity grid, at the frequency - linked UI rate, which is synonymous with pool price. This commercial mechanism handles all deviations irrespective of the markets. Other opportunities which opened up once the above market is in place are as follows:-

Merchant Plants: It is now possible to set-up and operates power plants without signing power purchase agreements. The power plants could be set-up with only a part of their capacity covered by PPAs. The remaining capacity could be supplied into the grid as a deviation, at the pool price i.e., UI price.

Default coverage for PPAs: In case a distribution utility which has signed a power purchase agreement (which in turn has enabled an IPP to set up a power plant) defaults in making payments, the IPP would have to sell the power to some other entity. In case the IPP fails to find another buyer on reasonable terms, he can at least sell the power into the grid as UI and get pool price for it from the pool account.

Captive and Co-generation plants: The captive and co-generation plants set up by industries often have surplus idling capacities, which should be harnessed for meeting the system load during periods of shortage. Since the availability of such capacity is uncertain, it may be difficult to have contracted arrangements and schedules for the same. What is readily possible is to absorb such supplies into the grid as deviations from schedule (the schedule being zero), and pay the pool price for energy actually supplied.

Non-conventional / Renewable sources of energy: Wind and solar plants generate power depending upon wind and solar

power availability, and not according to grid requirement. Devising equitable contractual arrangements for them is difficult so it is better to treat their entire supply (as-and-when-available) as a deviation from schedule and pay the pool price for it.

Cross-border transaction: UI mechanism can solve the problem of cross border transaction of electricity. There could be two types of cross-border exchanges. One would be for contracted sale, where the exchange would have to be scheduled on day-ahead basis, and paid for at contracted tariff. The other would be for as-and-when-available energy without any prior commitment. For the latter, instead of a pre-fixed price, the UI rate could be applied. For example, Nepal could supply its hydro power surplus to India at the UI rate on Indian side, in localized manner. On the basis of UI rate and its trend (seen through a local frequency meter), the Nepalese hydro station could decide when to generate how much, to send maximum possible energy to India during low-frequency periods, benefiting both countries. [3] The proposed 125 km transmission line will connect Behrampur - Bheramara, through 400 KV HVDC BTB link which would enable transfer of electricity from the India to the Bangladesh. The line will have an initial transfer capacity of 500 MW, which will later be upgraded to 1,000 MW. Bangladesh would begin the import of electricity from late 2012. Moreover 285-kilometre power transmission link, including submarine cables of 50 km to be built between India and Sri Lanka, is likely to be completed by 2013 which would also enable transfer of surplus power between two neighbors and to bridge their power-generation deficit and also manage their peak demands. Besides, it will pave the way for future trading of electricity between them.

Intra-state open access

As of May 2008, intra-state open access regulations for transmission and distribution have been issued by 21 State regulators of which 19 Regulators have allowed open access to consumers with connected load greater than or equal to 1 Mega Watt (MW) by 1 January 2009, that is, within the time frame specified in the Act. The cross subsidy surcharge has been specified by 18 State regulators. Though 21 State regulators have specified the transmission charges, only 18 have specified wheeling charges, 14 have notified the loss levels for their transmission systems, and 12 have notified loss levels for their distribution systems. The State-wise cross subsidy surcharge applicable on open access, as well as the conformity of the surcharge with the Tariff Policy 2006 (the "Tariff Policy") notified by the Central Government. [4]

In order to develop Intra State Transmission & Distribution Network Availability Based Tariff is to be implemented at the intra-State level and there should be a mechanism for handling imbalances. Moreover clear procedures including the timelines for approval/clearance of intra-state open access need to be clearly defined by the States. Metering, Settlement and Accounting Systems need to be established and streamlined. In fact forum of regulator has already recommended the principles for cross subsidy surcharge which should be as per the Tariff Policy. Charges should be such that it facilitates open access. The State Commission should monitor open access transactions.

IV. Performance & Review of Indian Power market

Allowing access to short-term customers depends on the availability of transmission capacity, and priority in allocating capacity is given to long-term customers. In addition, in the event of unexpected transmission constraints, short-term customers' access will be curtailed first. CERC intends to provide an incentive to long-term customers to declare surplus capacity and allow short-term customers to use any unutilized capacity. Here, "short-term transactions of electricity" refers to contracts of less than one year period, for electricity transacted under bilateral transactions through Inter-State Trading Licensees (only inter-state part) and directly by the Distribution Licensees, Power Exchanges (Indian Energy Exchange Ltd (IEX) and Power Exchange India Ltd (PXIL)), and Unscheduled Interchange (UI).

In volume terms, the size of the short term market in India was about 81.56 billion units in the year 2010-11. As compared to the volume of electricity transacted through short term market in the year 2009-10 (65.90 billion units), this was about 24 percent higher. Majority of this growth in volume of 15.66 billion units was accounted for by growth in transactions through the power exchanges (53.3%), followed by growth in direct bilateral transactions between the DISCOMs (about 26%). Transactions through traders accounted for only about 6.3% of the overall growth of about 15.66 billion units and were lower than the contribution of UI to the overall growth (UI contribution in overall growth of 15.66 billion units was about 14.4%). The volume of UI in the year 2010-11 increased by 8.8% over 2009-10 figure, the share of UI as a percentage of total volume of short term transaction of electricity continued the downward trend of past years and UI volume as percentage of total volume of short term transaction of electricity was about 34% in the year 2010-11 (down from 41% and 39% respectively in the years 2008-09 and 2009-10). [5]

Total Short-term Transactions of Electricity w.r.t Electricity Generation

Total volume of short-term transactions of electricity has increased from 65.90 BUs in 2009-10 to 81.56 BUs in 2010-11. The growth in volume is 15.66 BUs which is about 23.76 percent. Total volume of short-term transactions of electricity as percentage of total electricity generation has also increased from 9% in 2009-10 to 10% in 2010-11 (Table-1).

Total Volume of Short-term Transactions of Electricity with respect to Total Electricity Generation			
Year	Total Volume of Short-term Transactions of Electricity (BU)	Total Electricity Generation (BU)	Total volume of Short-term Transactions of Electricity as % of Total Electricity Generation
2008-09	35.27	691.00	5%
2009-10	65.90	764.03	9%
2010-11	81.56	809.45	10%

Table:1 Elect. Transacted through Trading Licensees & PX

Movement of weighted average price

A comparison of UI rate with the weighted average energy price in the bilateral and collective transactions in the NEW grid reveals that the UI rate has been lower than the negotiated price in bilateral transactions and the discovered price in the Power Exchange as described in fig - 3.

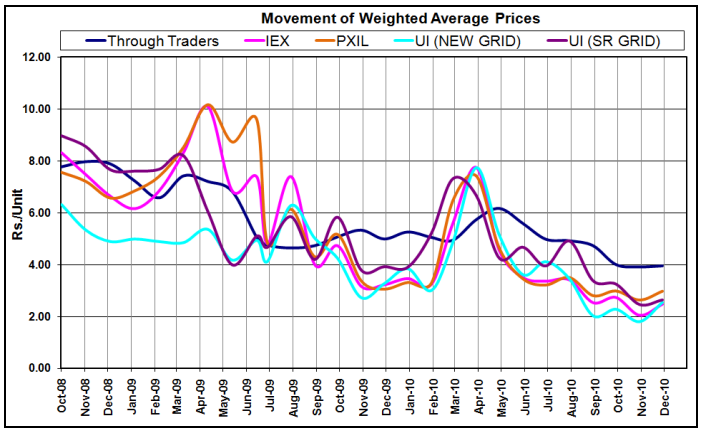

Fig - 3: Trend of weighted Average Prices

This is a positive development and implies that buyers are willing to pay a premium for scheduled interchange that provides higher certainty. Therefore it is desirable to encourage the reliance on scheduled interchange through the available price signals and by enforcement of the UI volumes cap as mandated in the CERC regulations on Unscheduled Interchanges. The SERCs could also consider similar measures.

Impact of volume of unscheduled Interchange

The volume of electricity transacted through inter-state trading licensees and power exchanges has increased from 24.69 BUs in 2008-09 to 43.22 BUs in 2010-11. The share of electricity transacted through trading licensees and power exchanges in volume terms as a percentage of total short-term transactions of electricity in 2010-11 has shown a moderate level of rise (from 51.45% to 53%) over the year 2009-10. The growth in volume for this segment during the year 2010-11 as compared to year 2009-10 thus has been 9.31BUs in absolute terms and about 27.5 in percentage terms. Majority of this growth has come about due to growth in volume of about 6.45 BUs (or 69.3% of total growth) in Day Ahead Market sub-segment, followed by about 1.88 BUs (or about 20.2 % of total growth) in Term Ahead Market sub-segment and about 0.98 BUs (or about 10.5% of the total growth) in the bilateral trader segment.

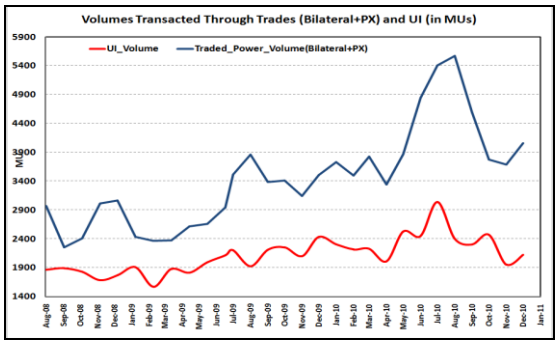

Fig - 4: Volume of Scheduled interchange and UI

A frequency dependent unscheduled interchange mechanism is in place in the Indian grid. A wide operating range of frequency creates room for large volume of unscheduled interchanges. The volume of UI and the Scheduled Interchanges is shown in fig - 4 below. Several market players participate in the Indian market with a highly unbalanced portfolio. The unpredictability in the behavior of such market players has serious implications for grid security. Therefore CERC has taken several initiatives to encourage market players to shift from Unscheduled Interchange to Scheduled Interchange.

V Future scenario of Indian Power market

Open access presupposes the existence of a robust transmission or distribution network. Many of the States are experiencing a high load growth and commensurate augmentation of the transmission and distribution infrastructure inside the States needs urgent attention to accommodate open access transactions.

Clear procedures including the timelines for approval/clearance of open access need to be clearly defined by the States. In order to avoid flip-flop situation, the need for a minimum time period for availing open access was also felt. Metering, Settlement and Accounting Systems need to be established and streamlined at the state level.

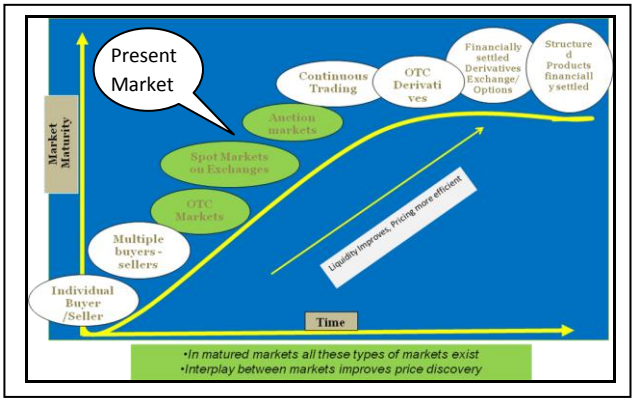

Fig – 5 Maturity of Market (Source: iitk workshop)

The fig – 5 describes the plot of market maturity with time then it is easily understood that as the liquidity of the market improves, the pricing will be efficient. The will be more matured when other products in the market like auction market, OTC derivatives, etc. would come in future and continuous trading would start. The status of present market is shown in fig – 5.

Indian power exchanges are also required to provide standardized contracts in the form of spot, forwards, futures and options. Power trading would facilitate players (especially merchant power plants and captive power plants) to bring surplus power to the grid. The inherent diversity in demand for various states offers ample scope for power trading with seasonal surplus in one region coinciding with deficit in another region. Power trading in India has a great potential for growth because of demand diversities, open access in transmission and distribution, de-licensed generation, and seasonal shortages. [6]

VI Ancillary Services Market & Trading of REC's in PX

In the context of power market development and providing localized solutions of energy supply, to bridge the expanding demand-supply gap, in an environmentally sustainable manner, renewable sources of energy plays a very important role. Considering the environmental advantages associated with renewable sources of energy and the need to augment all viable sources of electricity generation to meet the large unmet and latent demand, it is desirable to harness the renewable energy potential at least to the extent that it is techno-economically feasible. The Electricity Act 2003 explicitly provides for the promotion of renewable and non-conventional sources of energy. Section 86(1.e) of the Electricity Act provides for the State Electricity Regulatory Commissions to specify a percentage of the total power to be procured from cogeneration and generation from renewable sources of energy. It further provides that the Commission will take appropriate measures for grid connectivity for renewable generators. However, despite the encouraging legal provisions and progressive efforts of some of State Regulatory Commissions, achievement of renewable capacity has been about 8% of the total installed capacity (i.e. only about 13% of total renewable potential harnessed so far) and this with low PLFs and infirm power translates into 3-4% of the total generation. Renewable sources often face problems in arranging for transmission facility and opposition in various forms from the Distribution Companies in the host State. [7] Introduction of REC mechanism and trading of REC certificates is facilitated by CERC regulation no L-1/12/2010-CERC Dated 14th January, 2010.

As of now, the no. of Registered RE Projects is 304 with cumulative capacity of 2039 MW. The no. of Accredited RE Projects is 373 with cumulative capacity 2315 MW. The details of month wise REC issued, REC Redeemed are given below:

Month	Opening Balance	REC Issued	REC Redeemed	Closing Balance
Mar'11	0	532	424	108
April'11	108	4503	260	4351
May'11	4351	28270	18502	14119
June'11	14119	27090	16385	24824
July'11	24824	30224	18568	36480
Aug'11	36480	31813	25096	43197
Sep'11	43197	74612	46362	71447
Oct'11	71447	126544	95504	102487
Nov'11	102487	135697	105527	132657
Dec'11	132657	88055	111621	109091
Jan'12	109091	100005	171524	37572

VII. Conclusions and way forward:

The SERCs should prevail upon the State Distribution Utilities to carryout reasonable demand forecasting, formulating concrete programs to meet the forecast demand and review the forecast and programs to meet the same periodically at a gap of 5-7 years. This would equip the States to take more committed and timely decisions in matter of tying up of capacity for meeting the demand and also facilitating planning for transmission capacity. With the implementation of new methodology of transmission pricing, Independent power producer would be encouraged for investing in setup of new power plants as it eliminates pan caking of transmission charges. However there are some key challenges like adequacy and stability of policies and regulation, conducive environment to implement policy reforms, regulatory capacity and maturity along with creation of market base pricing environment and reducing the current price distortion in fuels and power and poor efficiencies of the state owned entities in power sector need to be sorted out.

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Disclaimer

Views expressed in this paper are entirely of the authors and need not necessarily be that of the organization they are working with.

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