

Solar REC Trading in India

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Received: 27.02.2017 Accepted:01.04.2017

Abstract- Renewable Energy Certificate (REC) symbolizes traits of electric power which has been produced by means of renewable energy as a primary source. The traits of REC are unbundled from electric power which is produced and both are sold / purchased separately in India and are traded in a market-place such as Power Exchange of India Ltd (PXIL) or Indian Energy exchange (IEX). REC trading in India via power exchanges as a platform started in 2011. In this study we review Solar Renewable Energy Certificate trading in India using Indian Energy Exchange data which has impelled in the last few years owing to a host of policy initiatives taken by the Central Government of India and State Governments along with the guidelines/norms prescribed by the Electricity Regulatory Commissions particularly from Renewable Purchase Obligation perspective. The study would help power market participants and other stakeholders to develop a perspective based on the nuances associated with Solar REC trading in India.

Keywords Solar, Renewable Energy Certificate (REC), Indian Energy Exchange

1. Introduction

India is the 3rd largest electricity producer in the world after China and USA and the 7th largest producer of renewable energy in the world. The total installed electricity generation capacity in India is 310005.28 MW as on 31st December 2016 out of which 89056.38 MW of installed electricity generation capacity is from Renewable energy sources accounting for approximately 28.72% total installed electricity generation capacity in India [1]. Table 1 elucidates details about total electricity generation capacity in India region-wise i.e. Southern region, north-eastern region, western region, eastern region, northern region and Islands by different players such as Centre, State and Private sectors

on the basis of the mode by which electricity is generated namely thermal energy comprising of coal, diesel, gas or by using hydro power, nuclear power and electricity generation by using renewable energy sources. Today, private producers of electricity in India have surpassed installed generation capacity compared to central or the state which dominated till 2003. Enactment and effective implementation of the Indian Electricity Act 2003 post deregulation and electricity market reforms is playing a significant role in propelling India's electricity generation capacity particularly from renewable energy sources [2-5]

Table 1. All India Total installed Generation capacity (in MW) as on 31st December 2016

Region	Thermal			Total	Nuclear	Hydro	Renewable Energy Source	Total
	Coal	Gas	Diesel					
Northern	46524.5	5781.26	0	52305.76	1620	18382.78	8976.44	81284.98
Western	72833.01	11203.41	0	84036.42	1840	7447.5	15818.49	109142.4
Southern	39102.5	6473.66	842.84	46419	2320	11689.03	20277.82	80705.85
Eastern	30197.87	100	0	30297.87	0	4378.12	564.39	35240.38

North Eastern	310	1723.8	36	2069.8	0	1242	268.72	3580.52
Islands	0	0	40.05	40.05	0	0	11.1	51.15
ALL INDIA	188967.9	25282.13	918.89	215168.9	5780	43139.43	45916.95	310005.3

Source: [1]

The Indian Electricity Act 2003 has facilitated in creating an instrumental setting for strategic progress and development of electricity sector in India, rationalization of tariffs related to electricity, promoting and implementing policies which ensure achieving energy efficiency coupled with being environmental friendly. The growth of Installed Generation Capacity in India in the last decade has been phenomenal with Private producers contributing over 41% of total insalled electricity generation capacity in 2015-16 compared to meagre 13% contribution in 2006-07. The role played by private sector in Indian electricity market post enactment of Indian electricity Act 2003 particularly in Renewable energy resources is appreciable and noteworthy.

Notable progression post-implementation of Indian electricity Act 2003 is setting up of an independent regulatory commission in the form of Central Electricity Regulatory Commission and State Electricity Regulatory Commissions across all the states of the country. Indian power sector has Appellate Tribunal with the purpose of resolving any squabble/issues related to power sector ensuring and protecting interests of all stakeholders [6-9].

2. Indian Electricity Market

The Indian electricity market is broadly divided into Southern region, north-eastern region, western region, eastern region and northern region as seen in Figure 1 [2] [9].



Figure 1. Indian Electricity Market

Source: [2] [9]

The latest assibilation in Indian power sector has been introduction of Renewable Energy Certificate (REC) trading via the mode of energy/power exchanges from March 2011.

In this study we review Solar REC trading in India which has impelled in the last few years owing to a host of policy initiatives taken by the Central and State Governments along with the guidelines/norms prescribed by the Electricity Regulatory Commissions particularly from Renewable Purchase Obligation perspective. The study is intended to help power market participants and other stakeholders to develop a perspective based on the nuances associated with Solar REC trading in India and possible policy considerations. The rest of the paper is structured as follows: In section 2, we give a brief overview of Indian electricity market, the role played by energy/power exchanges. In section 3 we take a closer look at what Solar Renewable Energy Certificate trading is all about. In Section 4 we discuss the possible policy considerations for further accentuating Solar REC trading in India and conclude our study.

In order to promote production and consumption of Renewable energy and certificate trading, Government of India has made it mandatory for all the public utilities (power distribution) to mandatorily buy a fixed percentage of their electricity-mix from renewable energy sources. Policies related to The National Electricity Policy of 2005, The tariff policy 2006 prescribed by National Action Plan on Climatic Change as well as policies such as Jawaharlal Nehru National Solar Mission has spurred the growth of renewable energy sector in India [4] [7] [10].

Figure 2 gives the structure of Indian electricity market after deregulation and implementation of Indian electricity Act 2003 which acknowledged and recognized electricity trading to be a separate and distinct activity which has further resulted in power exchanges embracing REC trading [2-3] [7-8] [11-12].

	Centre	State/Private	
Policy	Ministry of Power		
Plan	Central Electricity Authority (CEA)	State Government	
Regulations	Central Electricity Regulatory Commission (CERC) and Central Government Appointed Committee (CAC)	State Electricity Regulatory Commission (SERC) and State Government Appointed Committee (SAC)	
Generation	Central Generating Stations (CGS) and Mega Power Projects	Generation Companies (Gencos) and Independent Power Producers (IPP)	Private Licensees in Ahmedabad, Kolkata, Delhi, Mumbai, Noida and Surat
System Operations	National Load Dispatch Centre (NLDC) and Regional Load Dispatch Centre (RLDC)	State Load Dispatch Centre (SLDC)	
Transmission	Central Transmission Utilities (CTU) and Transmission licensees	State Transmission Utilities (STU) and Transmission licensees	
Distribution	Distribution Licensees		
Trading	Power Exchanges (i.e. Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL)) and Trading Licensees	Trading Licensees	
Appeal	Appellate Tribunal		

Source: [2] **Figure 2.** Indian Electricity Market Structure

Though India is the 3rd largest electricity producer in the world after China and USA and the 7th largest producer of renewable energy in the world and one of the largest consumers of electricity in the world, it still faces a critical issue of energy deficit. Figure 3 and 4 gives details about Energy deficit situation and Peak Power deficit statistics in India. For the year 2015-16, India faced 2.1% deficit energy and the peak power shortage was 3.2%. This only goes on to show how important promoting Renewable energy is from India’s strategic perspective.

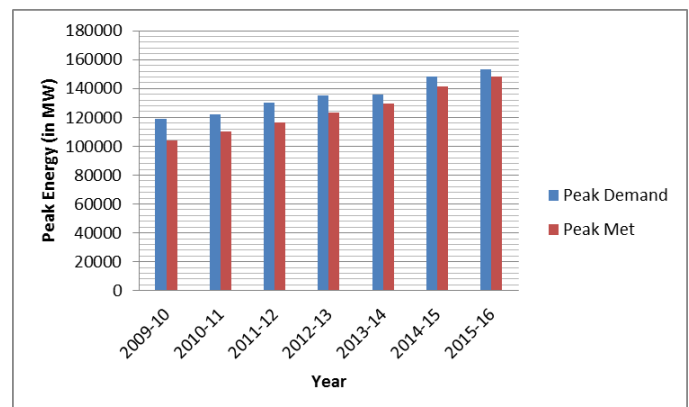


Figure 3.2. Peak Energy Demand and Availability in India

Source: [13]

Owing to prominent role played by Indian Energy Exchange (IEX) and Power Exchange India Limited (PXIL), the prices of electricity traded via exchanges have come down drastically over the years from a high of almost Rs. 7.49 per KWh in 2008-09 to Rs. 2.72 per KWh in 2015-16.

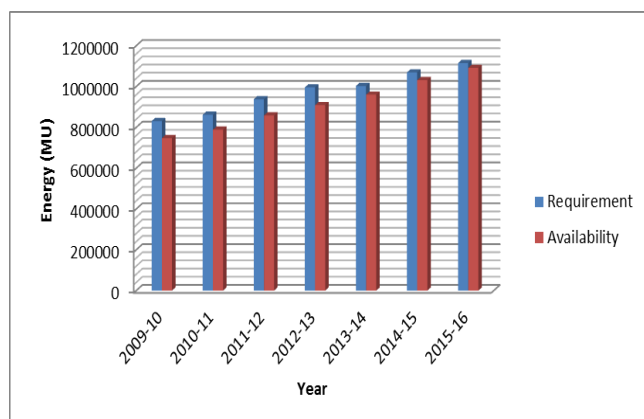


Figure 3.1. Energy Requirement and Availability in India

Source: [13]

3. Solar Renewable Energy Certificate (REC) Trading in India

Renewable Energy Certificate (REC) symbolizes traits of electric power which has been produced by means of renewable energy as a primary source. The traits of REC are unbundled

from electric power which is produced and both are sold / purchased separately in India and are traded in a market-place such as Power Exchange of India Ltd (PXIL) or Indian Energy

exchange (IEX) [4] [7]. REC trading via using power exchanges as a platform started in 2011 in India. REC's are IEX/PXIL tradable [8]. Each Solar REC represents electricity which is generated from Solar energy source. Both electricity

as commodity and Solar REC are brought/sold separately (i.e. 1 REC = 1 MWh) [4]. Some of the features of REC is presented in Table 2. Table 3 presents the details of Solar REC's transacted for the year 2015-16 in IEX and PXIL.

Table 2. Salient Characteristics of Renewable Energy Certificate

Partaking in REC market	Participants take part Voluntarily or with the motive of Renewable Purchase Obligation Compliance mandated by Electricity Regulatory Commissions
Minimum REC Quantity to be Transacted	1 MWh
Validity of REC traded in Exchange	730 Days after issuance
Types of REC traded in Exchange	Solar REC and Non Solar REC
Where Trading takes place?	Power Exchanges only
Transfer Form	Only Single transfer only. Electricity Regulatory Commissions forbid repeated trading of same REC
Consequence for Non-compliance	'Forbearance' Price (Maximum Price) has to be paid
Price Guarantee for REC	Through 'Floor' Price (Minimum Price) is guaranteed

Source: [14] [4]

Table 3. REC's transacted for the year 2015-16 in India

Particulars	RECs transacted on IEX		RECs transacted on PXIL	
	Solar	Non-Solar	Solar	Non-Solar
Buy (Volume)	465456	2673434	182745	1633518
Sell (Volume)	22767196	88991809	9379755	64401356
Buy Volume / Sell Volume	0.02	0.03	0.02	0.03
Market Clearing Volume (MWh)	465456	2673434	182745	1633518
Market Clearing Price (Rs/MWh)	3500	1500	3500	1500

Source: [15]

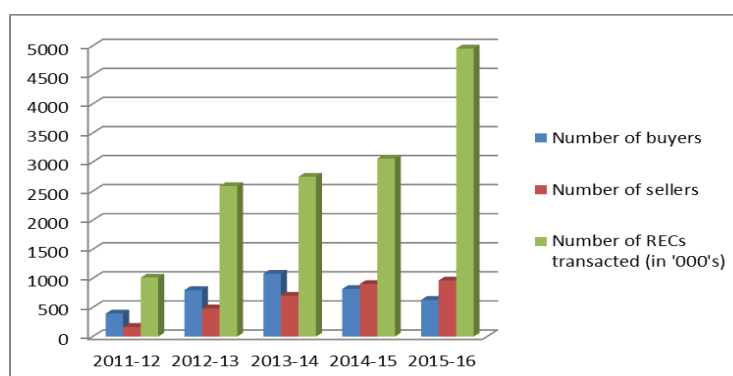


Figure 4. Growth of Renewable Energy Certificates transacted on Power Exchanges

Source: [15]

Figure 2 elucidates details about growth of REC's transacted on Power Exchanges in India year-wise. The number of REC's transacted through power exchanges have increased from 1015000 REC's in 2011-12 to 4955000 REC's in 2015-16. The number Buyers of REC's through power exchanges has increased from 397 participants in 2011-12 to 632 participants in 2015-16. The number Sellers of REC's through power exchanges has increased from 168

participants in 2011-12 to 966 participants in 2015-16. The range of floor price (minimum) is Rs. 3500/MWh and the forbearance price (maximum) is Rs. 5800/MWh for Solar REC to be traded in power exchange as notified by CERC the latest being with effect from 1st March 2015. We find most of the REC's traded in India for the year 2016 has been close to the floor price of Rs. 3500.

Table 4 gives the Volume of Solar REC's transacted through IEX. In India, period from December to February is considered as winter, March to May as summer, June to August as Monsoon and September to November as retreating monsoons. It has been observed that maximum

REC's are purchased/sold/cleared in the summer season owing to Physical properties of Solar renewable energy being generated as well as end of financial year i.e. 31st March to meet Renewable Energy Purchase Obligation (RPO)

Table 4. Volume of Solar REC's transacted through IEX

Year	Avg Vol (REC)	Avg Price (Rs/REC)	No of Participants
2012	472.75	12740.00	20
2013	3264.42	10599.67	149
2014	2037.00	9300.00	198
2015	30881.17	3500.00	332
2016	33174.50	3500.00	524

Source: [14]

The Indian Electricity Act 2003 has made it compulsory for all electric utilities involved in distribution to purchase REC's thereby enforcing electric utilities to adhere to Renewable Energy Purchase Obligation (RPO) as mandated by CERC and SERC. This has accentuated Solar REC trading in India coupled with ambitious State-wise Solar Renewable Power target to be achieved by the year 2022. Table 5 presents the details of State-wise Solar power target as mandated by Ministry of New and Renewable energy, Government of India. Northern region has a Solar Renewable Power target of 31120 MW with maximum contribution of 10697 MW from Uttar Pradesh state. Southern region has a Solar Renewable Power target of 26531 MW with maximum contribution of 9834 MW from Andhra Pradesh and Telangana state combined. Western region has a Solar

Renewable Power target of 28410 MW with maximum contribution of 11926 MW from Maharashtra state. Eastern region has a Solar Renewable Power target of 12237 MW with maximum contribution of 5336 MW from West Bengal state. North-eastern region has a Solar Renewable Power target of 1205 MW with maximum contribution of 663 MW from Assam state. All India Solar Renewable Power target to be achieved by the year 2022 as envisioned by the Ministry of New and Renewable Energy, Government of India is 99533 MW. Achieving this ambitious target would further fuel demand and trading of Solar REC's in years to come [16-17]. Similar Renewable energy policies have been adopted by many developing as well as developed nations around the world to enhance renewable energy generation and energy management [19-26].

Table 5. State-wise Solar Renewable Power target to be achieved by the year 2022

State/UTs	Solar Power (MW)
Northern Region	31120
Western Region	28410
Southern Region	26531
Eastern Region	12237
North Eastern Region	1205
Andaman & Nicobar Islands	27
Lakshadweep Islands	4
All India	99533

Source: [18]

4. Conclusion

The Renewable Energy Certificate (REC) symbolizes traits of electric power which has been produced by means of renewable energy as a primary source. The traits of REC are unbundled from electric power which is produced and both are sold / purchased separately in India and are traded in a market-place such as Power Exchange of India Ltd (PXIL) or Indian Energy exchange (IEX). REC trading via using power exchanges as a platform started in 2011 in India. Renewable energy investments are plagued with huge capital investment and very long gestation periods. Policymakers and market

participants will greatly benefit if the true potential of Solar Renewable energy is harnessed in India by facilitating consistent and relevant policies regarding RPO's by SERC and CERC, making RPO compliance all the year affair instead of year-end process, huge penalty for non-compliance of RPO's to electric utilities, incentives for compliance of RPO's, probable extension the validity of REC's currently traded in India, long-term pricing for REC's and most importantly allowing bilateral purchase/sale of REC's. Post Indian electricity Act, 2003, and for achieving Solar

Renewable Power target to be achieved by the year 2022 the role played by private participants in power sector has got

bigger and even more crucial in years to come.

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