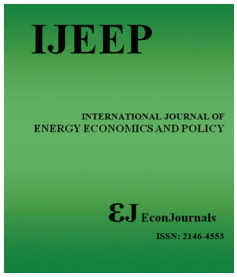

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Renewable Energy Certificate Trading through Power Exchanges in India[1]

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ABSTRACT

Renewable energy certificate (REC) trading through power exchanges commenced in March 2011 in India. The enactment of Indian Electricity Act 2003 along with mandatory obligation of purchasing renewable power for distribution companies imposed by Central Electricity Regulatory Commission and State Electricity Regulatory Commissions has propelled REC trading in Indian Electricity market. In this study we review REC trading in India, role played by power exchanges in facilitating REC trading, policy framework promoting renewable energy, renewable purchase obligation imposed and suggests the possible policy considerations for the regulators in future.

Keywords: Renewable Energy Certificate, Trading, Power Exchanges, India, Renewable Purchase Obligation, Solar Renewable Energy Certificate, Non-Solar Renewable Energy Certificate
JEL Classifications: C22, C53, C01

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1. INTRODUCTION

India is the third largest producer of electricity in the world and one of the largest producers of renewable energy. The All India total installed generation capacity stands at 249488.31 MW as on June 31st 2014 out of which 72422.14 MW of electricity is from renewable energy sources i.e., 29.03% (Central Electricity Authority of India, 2014). Table 1 gives the details of total installed generation capacity of Centre, State and Private sectors based on the mode of electricity generation i.e., electricity generation using thermal energy i.e., by coal, gas or diesel, power generation using hydro, nuclear and electricity generation using renewable energy sources. It is clearly evident that the role played by private players post deregulation and enactment of the Indian Electricity Act 2003 has become critical especially in generating electricity from renewable energy sources.

The enactment of Indian Electricity Act of 2003 paved way for reforms in power sector which have completely transformed the power sector in India (Girish et al., 2013). The Act has created a conducive environment for development of power industry in India, rationalization of electricity tariffs, enhancing and promoting policies which ensure efficiency and are environmental friendly, paved the way for constitution of an independent regulatory commission (Central Electricity Regulatory Commission [CERC] and State Electricity Regulatory Commissions [SERC]) and helped in establishing appellate tribunals for resolving any conflicts/issues related to power sector ensuring and protecting interests of all stakeholders (Girish et al., 2014; Girish and Vijayalakshmi, 2014). The latest development has been renewable energy certificate (REC) trading through power exchanges which commenced in March 2011 in India. In this study we review REC trading in India, the policy framework promoting Renewable energy, role of power

Table 1: All India total installed generation capacity as on June 31st 2014

Ownership	Thermal			Nuclear	Hydro (renewable)	RES	Total
	Coal	Gas	Diesel				
State	54678	6974.42	602.61	0	27482	3803.67	93540.7
Private	47875.38	8568	597.14	0	2694	27888.47	87622.99
Central	45925.01	7065.53	0	4780	10554.09	0	68324.63
Total	148478.4	22607.95	1199.75	4780	40730.09	31692.14	249488.3

Source: Central Electricity Authority of India, RES: Renewable energy sources

exchanges in REC trading and possible policy considerations. The rest of the paper is structured as follows: In Section 2, we give a brief overview of policy framework to promote renewable energy, Indian electricity market and role of power exchange. In Section 3 we take a closer look at what REC's are and analyse REC trading in India. In Section 4 we discuss the possible policy considerations which can further enhance REC trading and conclude our study.

2. POLICY FRAMEWORK AND INDIAN ELECTRICITY MARKET

In order to promote renewable energy, Government of India has taken a vanguard by enacting the Indian Electricity Act 2003 which made it mandatory for all the power distribution public utilities to purchase a certain fixed percentage of their power from renewable energy sources. The National Electricity Policy of 2005 provided financial incentives like feed in tariff; generation based incentive and accelerated depreciation for promoting renewable energy. The tariff policy 2006 prescribed by Power Ministry, Government of India, National Action Plan on Climatic Change and Jawaharlal Nehru National Solar Mission have propelled growth of renewable energy in India (Shereef and Khaparde, 2013). Figure 1 and Table 2 gives the map and structure of Indian electricity market post enactment of Indian Electricity Act 2003 which has ensured that electricity trading is a separate and distinct activity and has paved way for power exchanges including REC trading (Girish et al., 2013; Girish et al., 2014; Shereef and Khaparde, 2013; Aggarwal et al., 2009; Girish and Vijayalakshmi, 2015).

3. REC AND REC TRADING IN INDIA

REC's are exchange tradable, intangible attributes of electricity commodity which represents the attributes of power generated from renewable energy resources (Shereef and Khaparde, 2013). REC represents attributes of electricity which is generated from renewable energy sources. The attributes of REC are unbundled from electricity. The commodity electricity and the REC are brought/sold separately. The producer of green power can sell the electricity generated to a distribution utility at a preferential tariff and also obtain green attributes issued for every 1 MWh for the green energy supplied to the grid (i.e. 1 REC = 1 MWh). The green attributes obtained by generating firm in the form of REC can be separately traded at Indian Energy Exchange (IEX) or Power Exchange India Limited (PXIL) i.e., power exchanges (Girish and Vijayalakshmi, 2015). The salient features of RECs is given in Table 3.

Figure 1: Indian electricity market

Tpvsdf; Girish et al. (2013); Girish et al. (2014);

The REC is traded only in power exchanges which have been approved by CERC within a band/range of a floor price (minimum price) and the forbearance price (maximum price) as and when notified by CERC. From April 1st 2012, CERC's notification states floor price and forbearance price for REC to be as shown in Table 4.

Table 5 gives details of REC's transacted through power exchanges in India in the year 2012-13. The gap found between the volume of buy/sell bids of REC's placed using power exchange platform shows that in general there was more demand for solar REC's when compared to the demand for non-solar REC's.

Tables 6 and 7 gives details about the market clearing volume and price of solar and non-solar RECs transacted in the year 2012-13 on both the IEX and PXIL. We see a general trend of increase in trading volume of solar and non-solar REC's in both the power exchanges i.e., IEX and PXIL for the year 2012-13.

Table 8 gives details about the summary measures i.e., number of REC buy/sell bids, clearing volume, clearing price, total number of participants for both solar REC and non-solar REC month-wise for the year 2014 which were transacted through IEX.

Table 2: Indian electricity market

Particulars	Centre	State/Private	Cities
Policy	Ministry of power	State Government	
Plan	CEA		
Regulations	CERC and CAC	SERC and SAC	
Generation	CGS and mega power projects	Gencos and IPP	Private licensees in Ahmedabad, Kolkata, Delhi, Mumbai, Noida and Surat
System operations	NLDC and RLDC	SLDC	
Transmission	CTU and transmission licensees	STU and transmission licensees	
Distribution	Distribution licensees		
Trading	Power exchanges (i.e. IEX and PXIL) and trading licensees	Trading licensees	
Appeal	Appellate tribunal		

Source: Girish et al. (2013); Girish et al. (2014), CEA: Central Electricity Authority, NLDC: National Load Dispatch Centre, RLDC: Regional Load Dispatch Centre, CERC: Central Electricity Regulatory Commission, CAC: Central Government Appointed Committee, SERC: State Electricity Regulatory Commission, SAC: State Government Appointed Committee, CGS: Central generating stations, Gencos: Generation companies, IPP: Independent power producers, SLDC: State load dispatch centre, CTU: Central transmission utilities, STU: State transmission utilities, IEX: Indian energy exchange, PXIL: Power Exchange India Limited

Table 3: Salient features of REC

Participation in REC market	Voluntary/RPO compliance
REC denomination	1 MWh
Validity of REC	730 days after issuance
Categories of REC	Solar REC and non-solar REC
Trading platform	Power exchanges only
Transfer type	Single transfer only, repeated trade of the same certificate is not possible
Penalty for non-compliance	"Forbearance" price (maximum price)
Price guarantee	Through "Floor" price (minimum price)

Source: Indian Energy Exchange. REC: Renewable Energy Certificate, RPO: Renewable Purchase Obligation

Table 4: Floor and forbearance price of REC from April 1st, 2012 in India

Type of REC	Floor price in Rs/MWh	Forbearance price in Rs/MWh
Solar	9300	13,400
Non-solar	1500	3300

Source: Central Electricity Regulatory Commission. REC: Renewable Energy Certificate

Table 5: RECs transacted through power exchanges in India in the year 2012-13

Particulars	IEX		PXIL	
	Solar	Non-solar	Solar	Non-solar
Total volume (in MWh)	10443	1980546	3570	595255
Volume of buy bid	77277	2435188	12173	655146
Volume of sell bid	14076	9184800	4592	2489921
Market clearing price (in Rs/MWh)	12782	1731	12615	1564

Source: Central Electricity Regulatory Commission. REC: Renewable energy certificates, IEX: Indian energy exchange, PEIL: Power exchange india limited

The Indian Electricity Act 2003 has made it mandatory for all the power distribution public utilities to purchase a certain fixed percentage of their power from renewable energy sources i.e. Public utilities have Renewable Energy Purchase Obligation (RPO). The enactment of Indian Electricity Act 2003 along with mandatory obligation of purchasing renewable power for distribution companies imposed by CERC and SERC's has propelled REC trading in Indian Electricity market. Table 9 gives details about state-wise RPO for the year 2012-13 to 2014-15 where we observe a general trend of increasing RPO further providing impetus for REC trading in India.

Table 6: Volume and price of solar REC's transacted through power exchanges in 2012-13

Month	IEX		PXIL	
	Volume of REC (in MWh)	Weighted average price of REC (in Rs/MWh)	Volume of REC (in MWh)	Weighted average price of REC (in MWh)
April-12	0	-	0	0
May-12	5	13,000	5	13,000
June-12	336	12,750	6	12,506
July-12	93	12,800	86	12,800
August-12	129	12,850	250	12,850
September-12	735	12,500	425	12,900
October-12	820	12,680	971	12,500
November-12	733	12,720	486	12,100
December-12	931	12,620	277	12,100
January-13	2105	12,500	203	12,500
February-13	1924	12,500	310	13,000
March-13	2632	13,400	551	13,000

Source: Central Electricity Regulatory Commission. IEX: Indian energy exchange, PXIL: Power exchange india limited, REC: Renewable energy certificates

Table 7: Volume and price of non-solar REC's transacted through power exchanges in 2012-13

Month	IEX		PXIL	
	Volume of REC (in MWh)	Weighted average price of REC (in Rs/MWh)	Volume of REC (in MWh)	Weighted average price of REC (in MWh)
April-12	62,277	2201	8949	2201
May-12	153,125	2402	15,550	2150
June-12	223,164	2402	13,321	2460
July-12	147,369	2000	10,851	2202
August-12	248,168	1500	25,725	1555
September-12	239,364	1500	25,082	1500
October-12	132,231	1500	90,469	1500
November-12	54,976	1500	77,376	1500
December-12	173,644	1500	100,000	1500
January-13	190,875	1500	2462	1500
Febuary-13	48,093	1500	104,859	1500
March-13	307,260	1500	120,611	1500

Source: Central Electricity Regulatory Commission. REC: Renewable energy certificates, IEX: Indian energy exchange, PXIL: Power exchange india limited

Table 8: Summary of REC's transacted through IEX in 2014

Month	Buy bids (REC)	Sell bids (REC)	Cleared volume (REC)	Cleared price (Rs/REC)	Number of participants
January					
Solar	5517	88,895	5517	9300	172
Non-solar	78,955	2,557,666	78,955	1500	594
February					
Solar	7,816	114,539	7816	9300	176
Non-solar	176,107	2,015,377	176,107	1500	575
March					
Solar	7211	131,759	7211	9300	382
Non-solar	361,842	2,893,896	361,842	1500	902
April					
Solar	823	147,937	823	9300	154
Non-solar	16,798	2,924,976	16,798	1500	524
May					
Solar	469	178,986	469	9300	173
Non-solar	16,142	3,615,695	16,142	1500	592
June					
Solar	636	147,026	636	9300	163
Non-solar	50,743	3,166,863	50,743	1500	546
July					
Solar	498	179,581	498	9300	191
Non-solar	13,609	4,241,244	13,609	1500	602
August					
Solar	367	150,091	367	9300	189
Non-solar	15,736	3,949,016	15,736	1500	563
September					
Solar	264	161,260	264	9300	186
Non-solar	8994	4,342,307	8994	1500	560
October					
Solar	232	187,483	232	9300	183
Non-solar	36,411	4,766,941	36,411	1500	569
November					
Solar	245	241,063	245	9300	200
Non-solar	93,100	4,946,763	93,100	1500	566
December					
Solar	366	235,972	366	9300	206
Non-solar	177,960	5,313,974	177,960	1500	576

Source: Indian energy exchange. REC: Renewable energy certificates

4. CONCLUSION

India as a nation is heading in the right direction as far as renewable energy is concerned and it is strongly believed that Indian Power sector would benefit if there is more backing from policymakers considering the practical aspects of huge capital investment for power projects and long gestation period associated with power projects. Further, evolution of regulations regarding open access, power exchanges and RECs are steps in the right direction. In-spite of many measures taken by Government of India to promote renewable energy, there is still a lot of potential which can be harnessed if: (a) There is clear and consistent policy regarding renewable purchase obligation by considering the existing and estimated renewable energy potential for future in consultation with SERC's and CERC, (b) in order to avoid rush towards the end of financial year, RPO compliance can be made half yearly or quarterly, (c) proper imposition of penalty for non-compliance of renewable purchase obligation, (d) providing incentive for compliance of renewable purchase obligation, (e) extending the validity of REC, (f) long-term pricing for REC and (g) provision for bilateral trading of REC (Shereef and Khaparde, 2013; Girish et al., 2014). The role played by private sector in future will be very crucial and critical.

Table 9: Summary of state-wise RPO in India

State	2012-13 (%)	2013-14 (%)	2014-15 (%)
Andhra Pradesh	4.20	5.60	7.00
Arunachal Pradesh	4.20	5.60	7.00
Assam	4.20	5.60	7.00
Bihar	4.00	4.50	5.00
Chhattisgarh	-	6.25	6.75
Delhi	3.40	4.80	6.20
Goa and UT	3.00	3.00	3.30
Gujarat	7.00	7.00	8.00
Haryana	2.00	3.00	3.25
Himachal Pradesh	10.25	10.25	10.25
Jammu and Kashmir	-	5.00	6.00
Jharkhand	4.00	4.00	4.00
Karnataka	10.25	10.25	10.25
Kerala	3.90	4.20	4.50
Madhya Pradesh	4.00	5.50	7.00
Maharashtra	8.00	9.00	9.00
Manipur	5.00	5.00	5.00
Mizoram and Meghalaya	7.00	15.00	15.00
Nagaland	1.00	1.00	1.00
Orissa	8.00	8.00	8.00
Punjab	5.50	6.00	6.50
Rajasthan	2.90	3.50	4.00
Sikkim	-	-	9.00
Tamil Nadu	9.00	9.00	11.00
Tripura	2.00	-	2.50
Uttarakhand	-	6.05	7.08
Uttar Pradesh	6.00	6.00	6.00
West Bengal	4.00	4.00	4.50

Source: Ministry of New and Renewable Energy, Government of India,
RPO: Renewable Purchase Obligations

REFERENCES

Aggarwal, S.K., Mohan, S.L., Kumar, A. (2009), Electricity price forecasting in deregulated markets: A review and evaluation. Electrical Power and Energy Systems, 31(1), 13-22.

Available from: http://www.cea.nic.in/.

Available from: http://www.cercind.gov.in/.

Available from: http://www.iexindia.com/.

Available from: http://www.mnre.gov.in/.

Girish, G.P., Panda, A.K., Rath, B.N. (2013), Indian electricity market. Global Business and Economics Anthology, 1, 180-191.

Girish, G.P., Vijayalakshmi, S. (2014), Spot electricity price dynamics of Indian electricity market. Lecture Notes in Electrical Engineering, 279, 1129-1135.

Girish, G.P., Vijayalakshmi, S. (2015), Role of energy exchanges for power trading in India. International Journal of Energy Economics and Policy, 5(3), (Forthcoming issue).

Girish, G.P., Vijayalakshmi, S., Panda, A.K., Rath, B.N. (2014), Forecasting electricity prices in deregulated wholesale spot electricity market – A review. International Journal of Energy Economics and Policy, 4(1), 32-42.

Shereef, R.M., Khaparde, S.A. (2013), Current status of REC mechanism in India and possible policy modifications to way forward. Energy Policy, 6, 1443-1451.