

# Renewable Energy Certificate(REC) Mechanism as an enabler of Renewable energy penetration in India: Looking back and way forward

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**Abstract**—As of 31.05.2022, the Renewable Energy (RE) installed capacity of India is 113 GW whereas Hydro Generation capacity stands at 47 GW, and to meet the target of 500 GW from non-fossil fuel sources to take forward the mission announced by Hon'ble Prime Minister of India Narendra Modi at the COP26 climate conference, approximately 340 GW of RE and Hydro capacity is to be added by 2030. Robust market mechanisms will play an important role to achieve this target. With an impetus on promoting RE, Central Electricity Regulatory Commission (CERC) introduced pan-India market-based Renewable Energy Certificate (REC) Mechanism in the year 2010 to address the mismatch between the availability of RE sources and the requirement of the obligated entities (OE) to meet their renewable purchase obligation (RPO). Recently, it is observed that the cost of power generation from conventional sources is increasing due to a hike in the cost of fossil fuels, however, the cost of power generation from RE sources is witnessing a downtrend. In view of the changes in the market dynamics, CERC notified REC Regulations, 2022. The present paper discusses the decadal experience of implementation of the REC Mechanism by the Central Agency in India, recent regulatory developments, the behavior of the market participants, the role of REC in RPO compliance, challenges, and the way forward.

**Keywords**—REC, RPO, HPO, CERC, SERC, JERC, MNRE, Obligated entity, Electricity Act, Tariff Policy, POSOCO, NLDC, Power Exchanges (PXs), Electricity Traders

## I. INTRODUCTION

REC mechanism has been designed to facilitate the compliance of RPO by the Obligated entities (OEs) and to promote renewable energy through the market-based instrument in India. This mechanism is based on the REC Regulations notified by the CERC on January 14, 2010, and was launched in November 2010 [1][2][3]. The REC mechanism played an important role in promoting investments in RE generation and facilitating the compliance of RPO. The REC mechanism has certain distinct advantages over the physical purchase of RE i.e. it promotes competition within the RE technologies, reduces the transaction costs, and offers flexibility in procurement both in terms of time and quantity. Through REC Mechanism, a pan-India market has been created for the trading of RECs through CERC-approved Power Exchanges (PXs). The energy generated by the renewable energy generator can be considered as having two components- the 'Electricity Component' as a "brown component" and the "Environmental Attribute" as a green component. The environmental attributes can be exchanged in the form of Renewable Energy Certificates (REC). The conceptual framework for the REC mechanism as per REC Regulation 2010 is shown in Fig1.

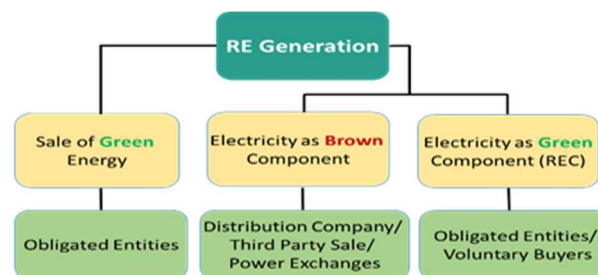


Fig 1: Conceptual framework for REC mechanism

One REC is treated as equivalent to 1 MWh energy injected or deemed to be injected (in case of self-consumption by eligible Captive generating stations) into the grid. The Distribution Licensee (DISCOM) that has purchased RE energy over and above its RPO is also entitled for the issuance of RECs over the excess of RPO quantum. An eligible RE generator including an eligible captive generating plant is also permitted to retain the certificates for offsetting its RPO as an OE subject to certification and verification by the concerned State Agency[4] [5][6].

### A. Carbon Credits Vs Renewable Energy Certificates

Among the various options available before policymakers for encouraging decarbonizing the Energy Sector, Carbon Credits Mechanism and REC Mechanism are proven mechanisms.

Carbon Credits Mechanism allows owners of certificates to emit one tonne of CO<sub>2</sub> or Greenhouse gases, thereby offsetting Greenhouse Gas or CO<sub>2</sub>. Whereas Renewable Energy certificates allow the holders of RECs to offset Units of Energy designated in MWh. REC Mechanism is set in motion by the designated year-wise Renewables Purchase Obligation (RPO) trajectory fixed by the regulatory regime. With REC markets introduced in various geographies has completed their growth stage and entering into maturity stage [7], the prevalent regulatory and policy regimes hold the key to future growth.

With more than a decade in Existence, REC Mechanism in India has provided a level playing field for RE Generators and utilities to arrive at the pricing of Green Credits based on Market principles in fulfilment of RPO.

With Renewable Energy Technologies being cost-competitive and approaching market maturity, other mechanisms are being explored world over, for large-scale penetration of renewables, namely the Contract for Difference (Cfd) mechanism [8], which enables RE Generators to stabilize their revenues by entering into long term contracts with Utilities/Buyers of Electricity, thereby benefitting both RE

Developers and Utilities against short term Volatility in prices, further leading to large scale deployment of renewable generation sources.

**B. The inception of REC Mechanism in India**

CERC, vide order dated January 29, 2010, designated the National Load Despatch Centre (NLDC), as the Central Agency for the implementation of REC mechanism to undertake: (i) registration of eligible entities, (ii) issuance of certificates, (iii) Maintenance and Settlement of accounts in respect of certificates, (iv) repository of transactions in certificates, etc. The processes under the REC Mechanism include Accreditation, Registration, Issuance, and Redemption of REC(s).

Based on the feedback of the Central Agency and other Stakeholders on regular basis, CERC had notified amendments of REC Regulations 2010 from time to time to address the need of the stakeholders as well as to address the changing market dynamics [9] [10]. Recently, CERC notified the REC Regulations 2022, which will be implemented from the date to be notified separately and repealed the REC regulations 2010.

**II. ANALYSIS OF REC MARKET DATA**

As of 31.03.2022, more than 4.5 GW capacity has been registered under the REC mechanism. RE Projects with capacities ranging from 0.1 MW to 50 MW have been registered under REC Mechanism [11].

**A. Analysis of Registration of RE Projects and Distribution Licenses under REC Mechanism**

As of 31.03.2022, a total no. of 1043 RE Projects (with 4.5 GW Capacity) and 4 DISCOMs are registered under REC Mechanism. More than 56% of capacity registered under the REC Mechanism belongs to wind Generators, and more than 22% of capacity registered under the REC Mechanism belongs to solar power plants.

Tamil Nadu state has the highest capacity (more than 1.2 GW) registered under Mechanism. Further, the State-wise registered RE Projects and list of DISCOMs registered with the Central Agency are given below in Table 1:

TABLE I: STATE WISE CAPACITY BREAK UP OF REGISTERED RE PROJECTS & DISCOMS

S. No.	State	No. of RE Projects	Capacity (MW)
1	Andhra Pradesh	26	169
2	Bihar	3	17
3	Chhattisgarh	1	20
4	Gujarat	41	548
5	Haryana	4	12
6	Himachal Pradesh	13	97
7	Karnataka	14	126
8	Kerala	1	1
9	Madhya Pradesh	133	315
10	Maharashtra	343	912
11	Odisha	3	30
12	Punjab	2	15
13	Rajasthan	135	628
14	Tamil Nadu	279	1236
15	Telangana	14	82
16	Tripura	1	5
17	Uttar Pradesh	26	280
18	Uttarakhand	4	21
	<b>Total RE Projects</b>	<b>1043</b>	<b>4512</b>
S. No.	State	No. of Distribution Licensees (DISCOMs)	
1	Andhra Pradesh	1	
2	Himachal Pradesh	1	
3	Maharashtra	1	

4	Uttarakhand	1
	<b>Total DISCOMs</b>	<b>4</b>

The source-wise RE capacity details are given below:

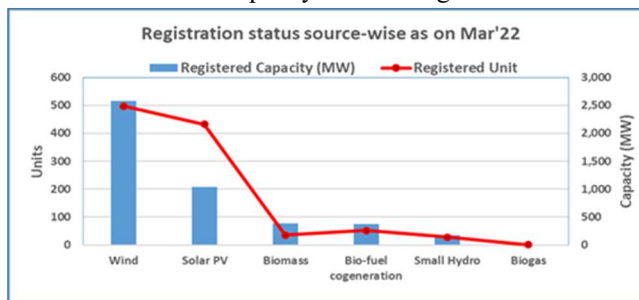


Fig 2: Source Wise Capacity break up of registered RE Projects

**B. Analysis of Issuance and Redemption of RECs**

More than 77 million RECs (approx. 64.4 million Non-solar RECs and 13.3 million Solar RECs) have been issued by Central Agency to eligible RE Projects and Distribution Licensees [12]. These figures translate into more than 77 Billion units (kW-Hrs) of electricity generated through green energy sources, therefore facilitating large-scale decarbonization of the energy sector.

Approximately 68 million RECs (transaction value of more than 10,300 crore Rupees) were purchased by more than 4500 buyers through PXs in 117 monthly trading sessions. Further, more than 2.9 million RECs have been self-retained by RE Generators to offset their RPO. The technology-wise breakup of RECs issued as on 31.03.2022 is shown in Fig 3 and Technology-wise break up of monetization RECs is shown in Fig 4.

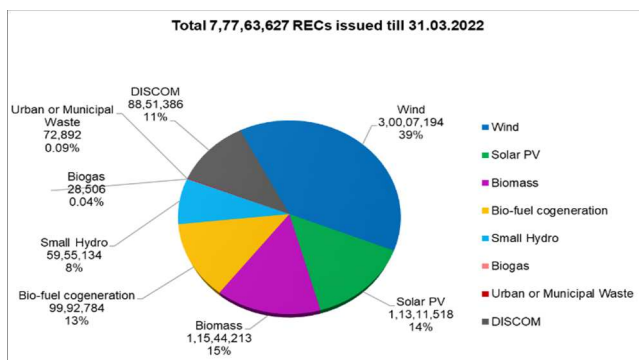


Fig 3: Technology-wise break up of RECs issued

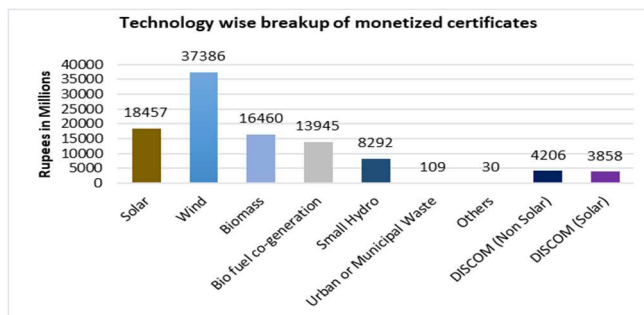


Fig 4: Technology-wise break up of monetization RECs

The REC mechanism has created a pan India market that facilitated the compliance of RPO by the OE which include the DISCOMs, Captive Power Plants (CPPs), and Open Access (OA) consumers as well as voluntary consumers to procure RE without investing capital and is hence positioned

as a key market instrument. Without REC Mechanism, it would have been quite difficult for small OEs like CPPs / OA consumers to comply with the SERC’s RPO Regulations with low transaction costs. Moreover, the Hon’ble Supreme Court/ APTEL/ SERCs have also recognized that RECs may be purchased by the OEs in case of shortfall/difficulty in the purchase of RE power for meeting their RPO.

Since, the inception of the REC Mechanism, 53.9% of REC were purchased by Distribution Licensees, and 45.7 % of RECs were purchased by CPPs and OA consumers. More than 36 million RECs have been purchased by distribution licensees to offset their RPOs and more than 31 million RECs have been purchased by OA consumers and captive power producers. The financial year-wise details of RECs issued by the Central Agency vs Purchased by OEs till 31.03.2022 are given in Fig 5.

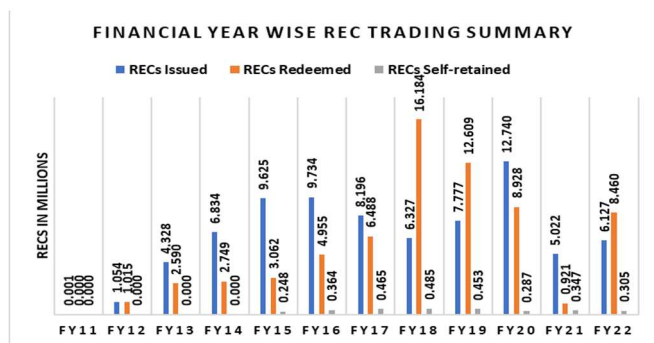


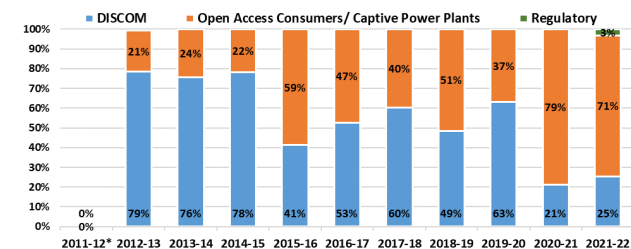
Fig 5: FY wise RECs issued, redeemed at PXs, self-retained by RE generators up to 31.03.2022

As per Deviation Settlement Mechanism (DSM) Regulations notified by CERC/respective SERCs, a new category of OE due to the regulatory requirement is also identified, and NLDC/SLDCs are mandated to purchase RECs as per these regulations[13]. NLDC has purchased 2,62,101 RECs as an OE – Regulatory requirement category. Further, the OE category-wise RECs purchased are shown in Table 2.

TABLE II: OBLIGATED ENTITY CATEGORY-WISE RECS REDEEMED AT PXS UP TO 31.03.2022

Type of REC Buyer	Total	% of total Purchased
Distribution Licensee	3,66,08,490	53.87
OA Consumer / CPP	3,10,59,047	45.70
Voluntary	31,342	0.05
OE- Reg. Requirement (DSM)	2,62,101	0.39
<b>Total</b>	<b>6,79,60,980</b>	<b>100.00</b>

During the initial period of the REC Mechanism, Distribution licensees were the major buyers in the REC Market. However, in recent years OA consumers and CPPs also emerged as major buyers of the REC market[14][15]. Further, the FY-wise participation ratio of DISCOMs, OA Consumers & CPP is shown in Fig 6.



\* Include 424 RECs Purchased by OA/ CPP consumer and Voluntary buyers in March 2011.

Fig 6: FY-wise participation ratio of DISCOMs, OA Consumers & CPPs

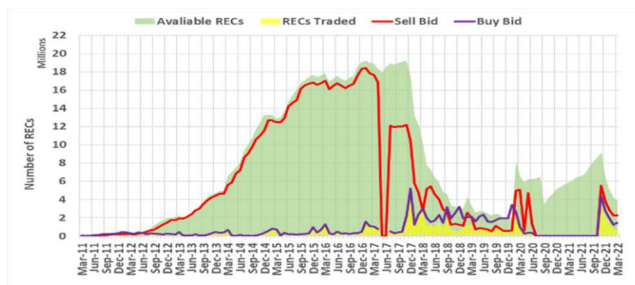


Fig 7: Month-wise RECs available for trade, actual RECs traded, sell bid, and buy bid

Due to the lack of strict compliance of RPO regulations by OEs, approx. 19 million RECs were available for trade (the highest available inventory of RECs) during the FY 2017-18. Further, the month-wise RECs available for trade, actual RECs traded, sell bid, and buy bid is shown in Fig 7.

Moreover, several SERCs emphasized the RPO compliance and, in the REC trading session of Dec’17 approx. 52 million RECs, the highest so far in a month, were purchased by OEs. As of 31.03.2022, more than 3 million RECs are available for trade. Further, the graph indicating the number of Non- Solar and Solar RECs issued, RECs cleared, closing balance, and percentage of RECs cleared over issued RECs is shown in the Figs 8 and 9.

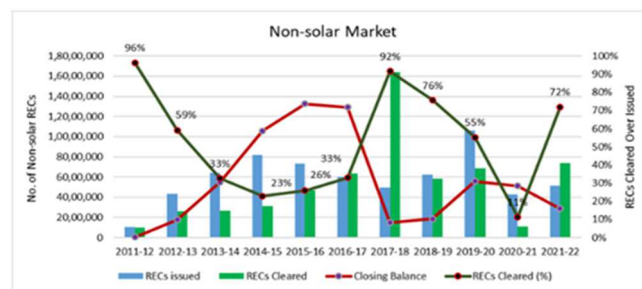


Fig 8: Non-Solar REC Market

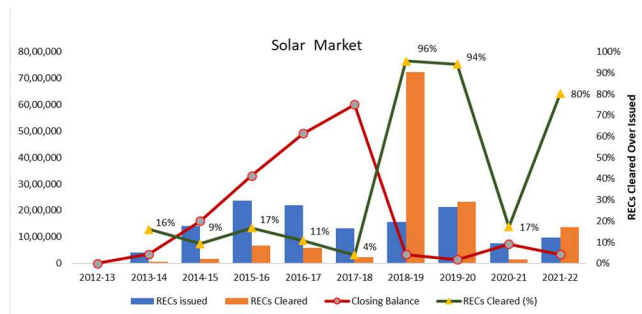


Fig 9: Solar REC Market

### III. REC REGULATIONS, 2022

CERC, based on inputs from various stakeholders and experience of more than a decade, notified REC Regulations, 2022 in May’2022 and repealed the REC Regulations, 2010 and its subsequent amendments. The REC regulations, 2022 will result in the strengthening of the REC mechanism through the following:

- Validity of the registration extended to 25 years
- Enabling perpetual validity to Certificates till they are redeemed,



- Abolished the concept of Floor and Forbearance price for transacting in RECs at PXs instead allowing demand-supply dynamics to determine the price of the REC,
- Permitting Eligible entities to sell Certificates through Trading licensees at mutually agreed prices,
- Along with the DISCOMs, OA consumers are now eligible for issuance of RECs if they have procured Renewable energy over and above their RPO targets,
- Through Fungibility of RECs across different technologies, providing multipliers in the issuance of RECs to promote adoption of newer technologies. The table showing the Certificate Multiplier for the period of three years is given below:

TABLE III: CERTIFICATE MULTIPLIER

Renewable Energy Technologies	Certificate Multiplier
On-shore Wind and Solar	1
Hydro	1.5
Municipal Solid Waste (MSW) and Non-fossil fuel-based cogeneration	2
Biomass and Biofuel	2.5

The key modifications notified in these Regulations are compared with REC Regulations, 2010 and tabulated as below:

TABLE IV : REC REGULATIONS, 2010 VS 2022

S. No.	Salient feature	REC Regulations	
		2010	2022
1	Participation	Participation Voluntary in REC Mechanism	
2	Accreditation of RE Project granted by	State Agency	Intra-state - State Agency, Inter-state - RLDC, DISCOM & OA Consumer - deemed accredited
3	Validity of Registration	5 years and revalidation	25 years
4	REC denomination (1 REC =)	1MWh	1MWh, Certificate Multiplier for Hydro, MSW Biofuel, and Biomass
5	Eligible RE technology	MNRE approved technologies	Central Government recognized or approved technologies
6	Validity of RECs	1095 days from issuance	Valid until Certificates are redeemed
7	Categories	Solar and Non-solar REC(s)	No Categorisation of REC(s)
8	Sellers	Eligible RE Generators / DISCOMs	Eligible RE Generators / DISCOMs/ OA Consumers
9	Buyers	(1) OEs (DISCOM/ CPP / OA Consumers), (2) Voluntary buyers, (3) OE- Regulatory Requirement	
10	Trading platform	CERC approved PXs	CERC-approved PXs and Electricity Traders
11	Trading periodicity	Last Wednesday of the month	Last Wednesday of the month and bilateral trading through Electricity Traders
12	Self-retention	Self-retention of RECs allowed for RPO compliance of consumption units	
13	RECs issued for self-consumption	Trading Allowed	Trading is not allowed, RE generator may utilize for self-retention
14	Banking / Borrowing	Not Allowed	
15	Transfer type	Single transfer only, repeated trade of the same certificate is not allowed	
16	Price of Solar RECs (/MWh)	Floor: Rs 1000. Forbearance: Rs 2400	Discovered in the PXs or as mutually agreed between

17	Price of Non-solar RECs (/MWh)	Floor: Rs 1000 Forbearance: Rs 3000	eligible entities and the electricity traders
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These new measures will help RE generators to optimize their portfolios by offering capacities under the REC mechanism. The REC mechanism would help in meeting the climate targets and provide a market-based and hassle-free approach for migration from the usage of conventional power to Renewable power [7].

Recently notified Electricity (Promoting Renewable Energy Through Green Energy Open Access) Rules, 2022 would usher in an era of sale and purchase of green energy through open access [16]. This will further bolden the REC Mechanism wherein the generator can register the plant for issuance of RECs or buyers of green energy through open access may opt to issue RECs in case they would procure renewable energy over and above their RPO.

#### A. Challenges that may affect REC Framework

- As per the REC Regulations, 2022, the trading of RECs is allowed through electricity traders also. However, the trading of RECs through the PXs is a better solution for ensuring liquidity, transparency without gaming or price volatility, double-side closed bid auction, and payment security.
- Spectacular price collapses were observed in the trading of the Energy Saving Certificates (ESCs) market as there is no provision of a floor price [17]. Experts opined that the REC market may also face the same fate as price protection is not provided through the REC Regulations, 2022.
- REC Regulations, 2022 have proposed to dispense with the categorization of RECs into Solar and Non-Solar, instead multiplier is introduced for different RE technologies. However, in the existing regulatory framework i.e., RPO Regulations notified by SERCs/JERC, the Solar and Non-Solar RPO can be met by Solar and Non-Solar RECs respectively. Further, in line with MoP Trajectory, several SERCs have also notified HPO Trajectory. In this scenario, the OEs would not be able to purchase technology-agnostic RECs to fulfill their Solar/Non-Solar RPO and HPO.

#### IV. RPO COMPLIANCE

REC Mechanism has been one of the earliest initiatives by Govt. of India (GoI), facilitating large-scale integration of renewables into the Electricity Grid. Looking back, it can very well be credited for paving the way for the gradual and seamless integration of renewable energy sources by bridging the gap between demand and availability of renewable resources. REC mechanism acted as an enabler for an incremental increase of green energy resources through the roadmap of renewable purchase obligation as envisaged by policymakers.

As per the provisions of the Electricity Act, 2003, the Ministry of Power in consultation with MNRE has notified long-term RPO Trajectory from time to time. Similarly, respective SERCs/JERC has also notified long-term RPO Trajectories for the OEs of respective States/UTs. Some of the challenges posed are non-uniform RPO targets across India, falling under different Regulatory regimes across the

States. SERCs have notified separate RPO trajectories while a lesser number of SERCs have notified RPO trajectories in line with the RPO Trajectory as notified by the Ministry of Power (MoP), GoI [18]. The latest RPO Trajectory notified by the MoP, GoI on 29.01.2021 is given in table 5:

TABLE V: MOP LONG-TERM RPO TRAJECTORY

Year	Solar RPO (%)	Non-Solar RPO (%)			Total RPO (%)
		HPO	Other Non-Solar RPO	Total Non-Solar RPO	
2019-20	7.20		10.25	10.25	17.50
2020-21	8.75		10.25	10.25	19
2021-22	10.50	0.18	10.50	10.68	21.18
2022-23	To be specified later	0.35	To be specified later		
2023-24		0.66			
2024-25		1.08			
2025-26		1.48			
2026-27		1.80			
2027-28		2.15			
2028-29		2.51			
2029-30		2.82			

The respective SERCs/JERC has also notified RPO Trajectories, and based on the information available on the respective SERCs/JERC websites [19][20], the RPO trajectory for FY 2021-22 is tabulated below:

TABLE VI: RPO TRAJECTORY AS NOTIFIED BY RESPECTIVE SERCS/JERC

S. No.	State	State/UT	Solar	HP O	Other Non-solar	Total Non-solar	Total RPO
1	Chandigarh	UT	8.00	-	9.00	9.00	17.00
2	Delhi	UT	8.75	0.18	10.25	10.43	19.18
3	Haryana	State	8.00	-	3.00	3.00	11.00
4	Himachal Pradesh	State	10.50	0.18	10.50	10.68	21.18
5	Jammu & Kashmir	UT	3.00	-	9.50	9.50	12.50
6	Ladakh	UT		-			
7	Punjab	State	6.50	-	8.00	8.00	14.50
8	Rajasthan	State	8.50	-	9.80	9.80	18.30
9	Uttar Pradesh	State	4.00	3.00	6.00	9.00	13.00
10	Uttarakhand	State	10.50	-	10.50	10.50	21.00
11	Chhattisgarh	State	10.50	0.18	10.50	10.68	21.18
12	DD & DNH	UT	8.00	-	9.00	9.00	17.00
13	Goa	UT	8.00	-	9.00	9.00	17.00
14	Gujarat	State	8.00	-	9.00	9.00	17.00
15	Madhya Pradesh	State	8.00	-	9.00	9.00	17.00
16	Maharashtra	State	6.00	-	11.50	11.50	17.50
17	Andhra Pradesh	State	7.00	-	10.00		17.00
18	Karnataka	State		-			
19	Kerala	State	6.75	-	10.25	10.25	17.00
20	Lakshadweep	UT	8.00	-	9.00	9.00	17.00
21	Puducherry	UT	8.00	-	9.00	9.00	17.00
22	Tamil Nadu	State	10.50	-	10.50	10.50	21.00
23	Telangana	State	7.10	-	0.90	0.90	8.00
24	Andaman & Nicobar	UT	8.00	-	9.00	9.00	17.00
25	Bihar	State	8.00	-	9.00	9.00	17.00
26	DVC	-		-			
27	Jharkhand	State	10.50	-	10.50	10.50	21.00
28	Odisha	State	7.25	0.18	5.82	6.00	13.25
29	Sikkim	State		-			
30	West Bengal	State	4.50	-	10.00	10.00	14.50
31	Arunachal Pradesh	State		-			
32	Assam	State	8.00	-	9.00		17.00
33	Manipur	State	6.00	-	11.50	11.50	17.50
34	Meghalaya	State	1.50	-	5.00	5.00	6.50
35	Mizoram	State	10.50	0.18	10.50	10.68	21.18
36	Nagaland	State	10.50	-	10.50	10.50	21.00

However, Karnataka SERC has notified separate RPO Trajectory for each Distribution Licensee and the same is tabulated below:

TABLE VII: RPO TRAJECTORY AS NOTIFIED BY KARNATAKA SERC

RPO% specified by Karnataka Electricity Regulatory Commission for FY 2021-22				
S. N	DISCOM/Consumers	Solar	Non-Solar	Total RPO

1	Bangalore Electricity Supply Company Limited (BESCOM)	10.5	12	22.5
2	Mangalore Electricity Supply Company Limited (MESCOM)	10.5	13	23.5
3	Chamundeshwari Electricity Supply Corporation Limited (CESC)	10.5	12	22.5
4	Hubli Electricity Supply Company Limited (HESCOM)	10.5	11	21.5
5	Gulbarga Electricity Supply Company (GESCOM)	10.5	8	18.5
6	Hukkeri Society (HRECS)	10.5	11	21.5
7	Captive Consumer	10.5	10.5	21
8	Open Access Consumer	10.5	10.5	21

Regarding RPO fungibility, the Forum of Regulators (FOR) in the 74<sup>th</sup> meeting opined that “solar RPO should be merged with other non-solar RPO (excluding HPO) so that the utilities have the liberty to choose their portfolio of RE power based on economics and availability of renewable power [21].

Moreover, as per REC Regulations, 2022 there is no separate classification of “solar” and “non-solar” REC(s). Hence, it is proposed that the SERCs/JERC may come out with generic RPO targets instead of continuing with the solar and non-solar RPO Target classification. This will be beneficial for the OEs in planning renewable energy/REC procurement.

RPO, as per the SERC Regulations, is an annual obligation on the OEs. It is observed that the RPO regulations are not enforced by the respective SERCs resulting in non-compliance/ under-compliance of RPO. Non-compliance of the RPO Regulations by the OEs and subsequent build-up of the REC inventory is a cause of concern for the investors in the Renewable Energy Sector. Therefore, strict enforcement of RPO compliance is the need of the hour for the vibrant REC market in the country.

RPO targets are a very important part of promoting RE adoption in the country and its compliance process provides a platform to provide information about RE procurement by the OEs. It will be beneficial to include a provision for data reporting and RPO monitoring in the SERC/JERC RPO regulations, given the increase in RPO targets in the respective state/ union territory. The data reporting should be done on a quarterly and annual basis within 30 days of completion of the quarter/financial year and data should be submitted to the appropriate commission. The appropriate commission may place such data in the public domain for broader scrutiny.

## V. CONCLUSION AND WAY FORWARD

In line with its commitments to climate change goals, India has developed an extensive policy framework with specific targets and objectives to reduce its emissions by increasing its deployment of RE technologies. The pursuit and promotion of RE will provide India with more energy security and independence to meet energy demands and growth in the future while simultaneously reducing its GHG emissions.

Recently, the MoP, GoI notified the Electricity (Promoting Renewable Energy Through Green Energy Open Access) Rules, 2022 wherein there is a provision for a uniform renewable purchase obligation on all OEs in the area of a distribution licensee. Further, rules have provisions for Green Hydrogen/Green Ammonia for the fulfilment of RPO by the OEs [17].

RE Certificates (RECs) are a market instrument that endorses RE and its participation in the energy market with the goal of promoting sustainable development in India. The REC mechanism has provided a hassle-free market instrument for OEs to meet the RPO by the purchase of RECs through PXs. To boost the REC market's viability, it's critical to strengthen

RPO enforcement across states and reform distribution companies that can't pay for the power they buy or participate in the REC market [22].

There is a need to encourage OEs to increase RE power purchase, beyond the compliance target of RPO. In case any OE fails to comply with the RPO targets then there is a need to incorporate enough penal provisions in the RPO regulations by the appropriate regulatory interventions. CERC has done away with the Forbearance prices through the REC regulations, 2022. So, the appropriate commission may consider some other measure to determine the amount deposited in case of RPO shortfall. It is suggested in case of RPO surplus/shortfall by DISCOMs the appropriate commission may provide provisions for incentives and penalties for better adoption of RE in the respective state.

It is pertinent to mention that experience gained from the successful implementation of the REC Mechanism has helped in the establishment of the ESCerts Registry by POSOCO [23]. Moreover, this experience will further help in the establishment of a similar mechanism in other sectors of the economy, if required.

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