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**RENEWABLE ENERGY CERTIFICATES
TRADING IN INDIA: A DECADE IN REVIEW**

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Abstract

India has witnessed significant transformation in the energy mix over the last decade, with renewables accounting for 24% of the installed grid capacity and 10% of the electricity generation today. The achievements, however, fall short in the trajectory towards the ambitious targets set for the years 2022 and 2030. The policy package for renewables included a market-based instrument of tradeable renewable energy certificates (RECs), launched in 2010–11, which provided a channel for an alternative valuation of the *green* attribute of electricity generation in the country. It also provided for spatial flexibility in green power generation in resource-rich areas and compliance with the renewable portfolio obligation through REC purchase by states with shortfalls. This paper analyzes the REC market experience over the last decade and examines the implications of the changes in the trading rules over the years. It highlights that although initially the renewable certification rate rose sharply from 2% in 2011–12 to 15% in 2014–15, it subsequently dropped to 6% during 2017–19 as REC market prices plummeted and the inventory of unsold RECs accumulated. It concludes that problems of target underachievement and noncompliance of state renewable purchase obligations need to be tackled through deep reforms in the functioning of power distribution companies and not the REC mechanism per se.

Keywords: India, renewable energy certificates, renewable portfolio obligation

JEL Classification: Q42, Q48

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1. INTRODUCTION

India, as a non-Annex I country member, has been among the early signatories and ratifying parties of the 1992 United Nations Framework Convention on Climate Change, the 2005 Kyoto Protocol, and the 2015 Paris Agreement.¹ On the domestic front, in order to mitigate climate change, India implemented a major renewable energy drive under the comprehensive National Action Plan on Climate Change (NAPCC) in 2008. Among the eight missions outlined in the NAPCC, one was devoted exclusively to the renewable energy form of solar – namely, the National Solar Mission – that aimed to increase the share of solar energy in the total energy mix of the country, as well as enhancing the scope of other renewables like wind and biomass. To ensure sustained demand for grid-connected renewable-based power, the NAPCC proposed “a dynamic minimum” renewable purchase obligation of 5% of the grid’s total purchases for 2009–10, increasing by 1% each year for 10 years (NAPCC 2008: 44). Thus effectively, 15% of India’s electricity was to be produced from renewable resources by 2020.

Under the Paris Agreement, India’s *Intended Nationally Determined Contribution* (submitted to the UNFCCC in October 2015) committed to reducing the greenhouse gas emissions intensity of its GDP by 33–35% by 2030 from its 2005 level, and specified that by 2030, about 40% of the total installed electricity capacity would be nonfossil fuel based by the year 2030 (INDC 2015). More recently, at the United Nations Climate Action Summit in September 2019 in New York, India announced an ambitious goal of 450 GW installed capacity of renewable energy by 2030 to combat climate change. At home, an interim goal for the cumulative renewable power installed capacity was set at 175 GW by the year 2022, with 100 GW of solar, 60 GW of wind, 10 GW of biomass, and 5 GW of small hydro.

The intent to transform the energy profile of India started much earlier with the ushering in of the requisite regulatory change through the 2003 Electricity Act, which laid out the framework for greening the energy mix in the country (Sawhney 2013). The Act mandated the State Electricity Regulatory Commissions (SERCs) to promote the grid connectivity of electricity generated from renewable sources through tariff regulations and specify a minimum purchase obligation for renewable power. To this end, the 2006 National Tariff Policy stipulated that renewable energy-based electricity would be purchased by distribution companies at preferential feed-in tariffs (FIT)² as determined by the SERCs; and it also provided guidelines to the SERCs for fixing minimum renewable purchase obligations (RPOs) at the state level. Electricity being a concurrent subject in India, it is regulated by both central and state government policies. The RPOs were to be set by SERCs based on knowledge of regional resource availability and the impact on retail tariffs.

The RPO is a critical policy component in changing the profile of energy use and ensures demand for renewable-based electricity. The National Tariff Policy provided for flexibility in the determination of RPOs by SERCs, to allow for regional variations in the renewable generation capacity (lower RPO in renewable resource-poor states), but it was expected that over time the states would step up on the renewable energy mix.³

¹ India ratified these agreements in 1993, 2002, and 2016, respectively.

² Although in the longer run renewable energy would have to be competitive with other sources in terms of full costs (Section 6.4 (2)).

³ Over the years, the tariffs have varied by state and capacity, since CERC tariffs are guidelines and not binding on states. Similarly, the RPO is also set at the state level, much like the tariffs, in order to accommodate the differences in renewable resource endowment for a large federal country like India.

In anticipation of the possible challenges for states in meeting their mandatory RPOs, the NAPCC provided for flexibility in meeting the purchase obligations through tradeable *Renewable Energy Credits or Certificates* or RECs (NAPCC 2008: 44).

A tradeable REC is a market-based instrument that provides flexibility to obligated entities to achieve the RPO in a cost-efficient manner. Under the REC mechanism, a renewable power generator has a choice of either selling green electricity to a distribution company (Discom) or any other obligated entity⁴ at a prescribed preferential tariff or selling the electricity separately from its renewable attribute. Thus, the option to sell the “unbundled” renewable attribute as an REC to obligated entities with locational disadvantage (that are unable to buy green electricity directly) means that renewable power generators can earn a green premium through the REC price realization. Different forms of tradeable RECs have been used around the world: *Guarantee of Origin* certificates in the European Union, *Solar Renewable Energy Certificates* in some states within the US, and more recently in East Asian countries.

In India, the Central Electricity Regulatory Commission (CERC) regulation in 2010 introduced two types of RECs, *solar* and *nonsolar*, with the latter covering renewable sources of wind, biomass, small hydro, municipal waste, geothermal, and biofuel cogeneration. Each REC represents 1 MWh of electricity generated from renewable sources, which could be sold to any obligated entity of any Indian state. If an obligated entity failed to comply with the RPO, it would be liable for a penalty under the 2003 Electricity Act. In states richly endowed with renewable energy sources, the renewable electricity generation was expected to go beyond the required RPO. The expectation was that the RECs (associated with excess power sold at a nonpreferential tariff) generated in renewable-resource-rich states would be available for sale to obligated parties in deficient states, thereby helping them to comply with the RPO.

The vision was to stimulate competition and create a market for renewable power across states through centralized monthly REC trading. The centralized trading was devised to help with the RPO compliance across states through easy access to certificates, as well as enabling price discovery in a national auction market – that could signal the value of *environmental* or *green* attribute in energy generation to potential entrants in renewable power production (Sawhney 2013). Thus, RECs provided the only variable price policy instrument in the gamut of fiscal policy incentives for RE generation in India, albeit with controls of price ceiling and price floor.

Ten years after the launch of the REC mechanism in 2010–11, however, the trading in RECs was suspended in July 2020 by the Appellate Tribunal for Electricity after appeals were filed in protest of the 2020 CERC abolition of a price floor for RECs. The Ministry of Power has now proposed a redesigning of the REC mechanism to the CERC (MOP 2021), in an effort to rejuvenate the REC trading and help reach the renewable energy target for 2030 under the Paris Agreement, as well as the interim target set for 2022.

This paper reviews the performance of the REC market over the last decade and examines the lessons learned for the REC mechanism going forward. The rest of the paper is organized as follows: Section 2 provides a snapshot of India’s policy goal for renewable-based power; Section 3 analyzes the implementation of the REC mechanism and the trading experience over the decade; Section 4 summarizes the assessment of the REC market performance, highlighting the lessons learned; and Section 5 concludes with policy recommendations.

⁴ Obligated entities include distribution companies, open-access consumers, and industries consuming captive power.

2. ENHANCING RENEWABLES IN THE ENERGY MIX IN ELECTRICITY

In order to enhance the share of renewables in the energy mix, India set targets for the installed capacity of electricity, as well as goals for the share of renewable-based electricity generation. The latter are notified as a national-level RPO, defined by technology or renewable form, i.e., solar and nonsolar. While the SERCs are responsible for specifying the minimum purchase obligation of renewable power in their respective states (under the Electricity Act), the national RPO targets are set by the Ministry of Power in consultation with the Ministry of New and Renewable Energy (under the Tariff Policy). The REC market offers the obligated parties across the country a mechanism through which they can achieve cost-efficiency in complying with the RPOs.⁵

2.1 Renewable Energy Mix: Capacity Target Versus Achievement

The share of renewables in the electric power capacity, under India's National Electricity Plan, is envisioned to be 36% by 2022 and 54% of the installed capacity by 2030 (see Table 1). The interim energy mix target for 2022 based on the optimal technology mix (e.g., 100 GW of solar and 60 GW of wind) for the transition to cleaner power by 2030 was reiterated by the Central Electricity Authority of India in its recent report (CEA 2019). It is remarkable that the share of nonfossil fuel-based power for 2030 has been set at 65%, which is far more ambitious than the 40% stated in the Intended Nationally Determined Contribution under the Paris Agreement.

While the interim goal for 2022 is set at 36% power capacity in renewables, by March 2020 (pre-COVID period), the country had achieved 23.5% with 34.6 GW of solar and 37.7 GW of wind (see Table 1). Among the renewables, solar and wind witnessed the fastest growth in installed capacity in recent years. The average annual capacity growth during the five-year period 2015 through 2020 was 162% for solar and 12% for wind (Sawhney 2021), however the achievement so far has not been able to match up to the trend required to reach the capacity targets announced. On the other hand, hydro at 45.7 GW (12.4%) is set to surpass the target envisioned for 2022.

The regional spread in REC capacity registration is concentrated among a small group of seven states, namely Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu – which together account for 79% of the total REC capacity registered in India to date (see Table A1 in the Appendix).

⁵ The REC mechanism has been implemented by the **National Load Despatch Centre (NLDC)**, Power System Operation Corporation Ltd (POSOCO), under the Ministry of Power – including registration of eligible renewable energy generation facilities, issuance of RECs, maintenance and settlement of REC accounts, and being the repository of REC transactions. This is just as well since the NLDC (along with the Regional Load Despatch Centres) is in charge of the integrated operation of regional and national power systems. Sale of RECs was conducted through closed auctions at the national level at two power exchanges.

Table 1: Energy Mix Target in Electricity Installed Capacity Versus Actual Capacity

Technology	Target, 2029–30		Target, 2021–22		Actual Installed, 2020*	
	<i>in GW</i>	<i>% Share</i>	<i>in GW</i>	<i>% Share</i>	<i>in GW</i>	<i>% Share</i>
Thermal capacity	291	35%	243	51%	230.61	62.3%
<i>Of which</i>						
Coal and lignite	266.8		217.3		205.7	55.6%
Gas	24.3		25.7		24.96	6.7%
Nonfossil fuel	540	65%	236	49%	139.5	37.7%
<i>Of which</i>						
<i>Renewable-based</i>	450	54%	175	36%	87.0	23.5%
Solar PV and CSP	300		100		34.6	
Wind power	140		60		37.7	
Bio power	10		10		10.0	
Small hydro			5		4.7	
<i>Nonrenewable based</i>	90	9%	61	13%	52.5	14.2%
Large hydro	73.4		51		45.7	
Nuclear	16.9		10		6.8	
Total	831.5	100%	479	100%	370.1	100%

* As of 31 March 2020.

Source: Compiled from CEA (2020), CEA (2019), and CEA (2019a).

2.2 Renewable-Based Electricity Generation and the RPO Targets

The target RPOs, differentiated into solar and nonsolar technology, for the period 2016–17 through 2021–22 (notified by the Ministry of Power in 2016 and 2018) are summarized in Table 2. The RPO is defined based on the total consumption of electricity by obligated entities (including distribution companies, open-access consumers, and captive power producers) and excludes consumption met from hydro sources of power.

Table 2: Notified RPO Targets

RE Type	2016–17	2017–18	2018–19	2019–20	2020–21	2021–22
Nonsolar	8.75%	9.50%	10.25%	10.25%	10.25%	10.50%
Solar	2.75%	4.75%	6.75%	7.25%	8.75%	10.50%
<i>Total</i>	<i>11.5%</i>	<i>14.25%</i>	<i>17.00%</i>	<i>17.50%</i>	<i>19.00%</i>	<i>21.00%</i>

Source: MOP (2018).

During the last six years, the share of renewable-based power in the total electricity generated has increased substantially from 5.56% in 2014–15 to 9.96% in 2019–20 (see Table 3). However, if one were to gauge this against the vision of the NAPCC, and the RPO targets set by the MOP and MNRE, the share achieved of ~10% is abysmally low and falls short of the goal set at 17.5% for the year 2019–20. The imminent goal of reaching 21% of renewables in the total electricity generated by 2021–22 does not seem achievable.

Moreover, it is disconcerting to note that the double-digit annual growth rate achieved in RE-based power generation during the three years 2016–17 to 2018–19 (of 24%, see Table 3) slumped to 9% in 2019–20. Considering the gamut of fiscal incentives that were built into the policy package to encourage the growth of RE-based electricity, both in terms of installed capacity and actual generation, it does call into question whether these policy instruments were effective, or whether they need to be redesigned. It also brings into question the enforcement of the accompanying regulations that were meant to provide the essential institutional framework within which the market-based policy, like the tradeable REC mechanism, works.

Table 3: Total Grid-Connected RE-Based Electricity Generation (in MU), 2014–20

Year	Total Electricity	Non-RE	RE-based	Annual Growth in RE-based Generation	Share of RE-based in Total Generation
2014–15	1,110,392.15	1,048,672.90	61,719.25	–	5.56%
2015–16	1,173,603.14	1,107,822.28	65,780.86	6.58%	5.61%
2016–17	1,241,689.11	1,160,140.90	81,548.21	23.97%	6.57%
2017–18	1,308,145.68	1,206,306.20	101,839.48	24.88%	7.79%
2018–19	1,376,095.79	1,249,336.70	126,759.09	24.47%	9.21%
2019–20	1,389,120.93	1,250,783.91	138,337.02	9.13%	9.96%

Source: Based on information in CEA (2020: 34).

3. KEY FISCAL INSTRUMENTS FOR RENEWABLE-BASED POWER AND REC TRADING SCHEME

The key fiscal instruments in the renewable energy policy package in India included: (i) installation incentives in the form of accelerated depreciation; (ii) a generation-based incentive or subsidy payout per kWh generated (grid-interactive); (iii) preferential feed-in tariffs (FIT); and (iv) tradeable renewable energy certificates or RECs. Two other fiscal subsidies are the viability gap funding for solar energy and a long-term interest subsidy for distribution utilities. The intent of these policies was to attract investment and offset the high capital costs in renewables-based power projects (through accelerated depreciation), and incentivize the generation of green electricity (through FIT or REC), until economies of scale drove down costs in the sector.

Over the years, however, sudden changes in the conditions of fiscal incentives offered – in particular for accelerated depreciation and generation-based incentives – often led to confusion and policy uncertainty.⁶ In an analysis of the relative cost disabilities of renewable energy vis-à-vis conventional sources, and given the gamut of fiscal incentives with different timelines (accelerated depreciation, viability gap funding, interest subsidy, generation-based incentive), Shrimali et al. (2016) concluded that low-cost long-term debt is the most cost-effective way to make renewable energy cost-competitive – the reason being that the high cost of renewable energy is driven by its higher capital cost rather than the higher variable cost component of conventional energy.

⁶ For instance, the accelerated depreciation scheme was discontinued for wind energy in 2012 as capacity addition was not accompanied by commensurate generation. It was reintroduced in 2014. The accelerated depreciation and the generation-based incentive being national or central assistance instruments, the changes impact the policy environment in all states (unlike FIT, which are determined at the state level).

In order to ensure that the renewable power generator is able to cover the steep cost of renewable technology, the CERC was empowered to set the FIT for grid-connected power under the 2003 Electricity Act, and the National Tariff Policy. The FIT is technology-specific (wind, biomass, small hydro, solar PV, solar thermal), meant to assure the generator of returns with full cost recovery during the debt repayment period for full useful life of the power-generating station, i.e., equivalent to a levelized tariff.

If a renewable power-generating company chooses not to sell power at the preferential tariff, it is eligible to obtain an REC. Eligible generating companies are those selling electricity to the area distribution licensee at a price no higher than the pooled cost of power purchase (average power purchase cost or APPC),⁷ or to any other licensee or open-access consumer at a mutually agreed price or at the power exchange market-determined price.⁸

3.1 The Cost of RE Power Generation, RE Power Tariffs, and REC Price

The cost of RE-based power has witnessed a dramatic reduction globally as well as in India in the last decade. Across the globe, the average levelized cost of electricity (LCOE) of utility-scale solar photovoltaic (PV) declined by 82% and that of onshore wind declined by 39% between 2010 and 2019 (IRENA 2020). In particular, the precipitous fall in the solar PV LCOE was due to lower installation costs – driven largely by the decline in module prices.

The most spectacular reduction in 2019 was recorded for India where average solar LCOE reduced by 85% during 2010–19 (ibid.: 70). This is indeed remarkable and augurs well in the run-up to injecting greater renewable-based (in particular solar, as per the Solar Mission) into the grid at lower tariffs with the decline in the LCOE.

The sharp reduction in the LCOE of solar power, however, has a different implication for the price of solar RECs. A decline in solar LCOE will depress the price premium for producing renewable power over nonrenewable power if the cost of nonrenewable power or APPC does not decline, and in turn will depress the market price of RECs. Indeed, the CERC reduced the price band for REC auctions, particularly for solar RECs in 2015, 2017, and 2020 as solar LCOE declined and competitive bidding led to a dramatic fall in solar electricity tariffs. The average price of solar RECs dropped to Rs2,8750/MWh in 2017 and lower thereafter (see Table A2 in the Appendix), i.e., equivalent to a premium of Rs2.8/kWh of solar power. However, with the average power purchase cost being more than Rs3/kWh, one would expect that an obligated entity would have an incentive to purchase the solar power directly from the generator rather than through the REC route (buying the unbundled power at the APPC and paying separately for the REC). So, the decline in the solar LCOE would tend to have a twofold effect – first, a reduction in the price premium of RECs, thereby depressing its supply, and second, increasing the demand for direct purchase of cheaper solar power, thereby lowering the demand for RECs.

⁷ Defined as the weighted average pooled power purchase price for distribution licensees (without transmission charges) in a state.

⁸ The eligibility criterion requires that the generator has no PPA with the obligated party (directly or indirectly through traders to sell power at the preferential rate) for the purpose of meeting the RPO.

Another factor expected to impact the REC market is the development of power transmission infrastructure aimed at easing the access to a reliable grid power supply. With the completion of the *Green Energy Corridor*⁹ there would be greater access to the renewable power from the eight RE-rich states through the interconnected national grid for the rest of the country. One may expect the role of the REC market to be further diminished, as the RE-poor states would be able to directly purchase green power from the grid rather than go down the REC route to comply with the mandated RPO. For example, whenever there is excess wind power in Tamil Nadu, it would be accessible through the grid thousands of miles away in an RE-poor region.

Indeed, the expectation was that a decline in competitive RE-based power tariffs and a better transmission network would make the purchase of RE power attractive to obligated entities rather than paying the APPC for thermal power. Paradoxically, however, this has not been observed across the Indian states, and noncompliance with the RPO has been rampant.

3.2 Control vs Clearing Price in REC Auction: Signaling Low Value of Green Attribute

The REC mechanism was conceived essentially as a market-based instrument that would reflect the variable premium above the average APPC. The REC scheme was launched in 2010, and the auction began in March 2011 with nonsolar REC trading, while the solar REC auction took off a year later in May 2012. Trading was conducted at two exchanges (as approved by the CERC), namely the Indian Energy Exchange Limited (IEX) in Delhi and Power Exchange India Limited (PXIL) in Mumbai.

To provide price guarantee in the REC auctions for potential REC participants, the CERC mandated a price floor and a price ceiling. Both the APPC and FIT are incorporated in the calculation of the price ceiling and price floor of solar and nonsolar RECs. For example, the *highest difference* between the costs of generation (renewable energy tariff) and the APPC¹⁰ across the states is used to determine the forbearance (ceiling) price of solar and nonsolar technologies (CERC 2011). It is interesting to note here that the CERC, recognizing the linkage between the ceiling price and compliance charge (to deter noncompliance with the RPO as fixed by SERCs), highlighted that lowering the forbearance price could dilute the impact of deterrence (*ibid.*). Of course, the final responsibility of providing “adequate deterrence” against noncompliance with RPO was left squarely to the SERCs (CERC 2011: 6).

The floor price ensures the basic minimum requirement of cost recovery for meeting the target generation under the NAPCC. The viability or feasibility requirement implies that the RE project should be able to cover loan repayment and interest charges, operations and maintenance expenses, and fuel expenses in the case of biomass and cogeneration (CERC 2011: 8). It may be recalled that these are the same cost components considered in the determination of FIT by the CERC. However, while the

⁹ The *Green Energy Corridor*, implemented by the eight RE-rich states of Andhra Pradesh, Gujarat, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Rajasthan, and Tamil Nadu, is expected to integrate thermal and renewable energy and help in transmitting the latter to consumers located thousands of kilometers away. The mega intra-state and inter-state transmission network system, nearing completion, began in 2017 (initiated under the 12th Plan, 2012–17) and is expected to evacuate about 20,000 MW of large-scale renewable power (MNRE website: <http://164.100.94.214/green-energy-corridor>).

¹⁰ According to the CERC order, the average power purchase cost for a state represents the weighted average pooled power purchase by distribution licensees (without the transmission charges) in the state.

CERC's preferential FITs are differentiated by each technology type, in arriving at the nonsolar REC price floor, the dispersion of costs across different nonsolar technologies and across states is not considered. While wind, biomass, cogeneration, and small hydro have different viability costs, these get clubbed together in the determination of the nonsolar REC floor price.

Although REC trading took place through double-sided closed-bid auctions in the national exchanges (IEX and PXIL), the clearing price for the two types of RECs hugged their respective CERC-imposed price floors, with selling bids consistently more than buying bids at the auctions. It is important to note that the REC trading scheme became a highly regulated program, with periodic revisions in the price brackets for auctions. The prices mandated for REC exchange by the CERC over the years are summarized in Table 4.

Over the years the validity of the RECs underwent revisions. While RECs were valid originally for a year, i.e., 365 days, in view of the unsold inventory of RECs, the CERC extended the validity to 730 days in 2013 to prevent expiry of the unsold RECs. As the excess supply persisted and REC inventories piled up, the CERC extended the validity of RECs further to 1,095 days in 2014, and also allowed for self-retention of certificates by generators to offset their RPO.

Table 4: REC Price Controls as Set by CERC,* 2010–20

Year	Price Control	Solar	Nonsolar
2010–12	Floor	Rs12,000/MWh	Rs1,500/MWh
	Forbearance	Rs17,000/MWh	Rs3,900/MWh
2012–17	Floor	Rs9,300/MWh	Rs1,500/MWh
	Forbearance	Rs13,400/MWh	Rs3,300/MWh
2015–17 Revised for solar	Floor	Rs3,500/MWh	
	Forbearance	Rs5,800/MWh	
2017–20	Floor	Rs1,000/MWh	Rs1,000/MWh
	Forbearance	Rs2,400/MWh	Rs3,000/MWh
2020–21	Floor	0	0
	Forbearance	Rs1,000/MWh	Rs1,000/MWh

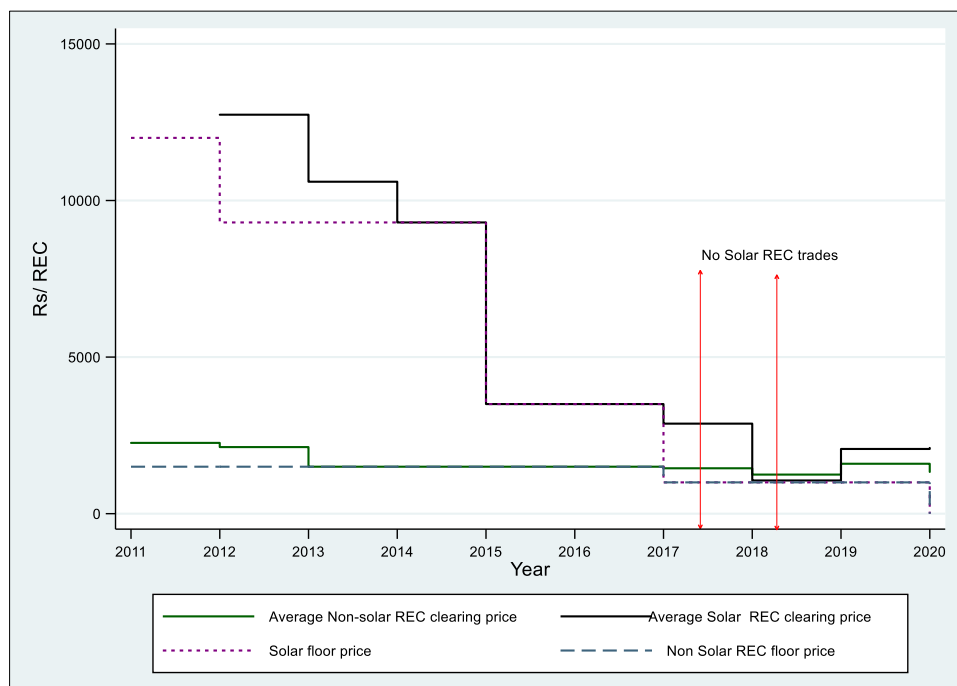
* Based on CERC Orders dated 1 June 2010, 23 August 2011, 30 December 2014, 30 March 2017, and 17 June 2020.

The sharp reduction in mandated prices notified by the CERC in 2017 was challenged in the court, resulting in the suspension of REC trading in May 2017. While trading of nonsolar RECs resumed after two months, that of solar RECs resumed only in April 2018. The event reflected the market dissatisfaction with the RE-based power generators who failed to realize the premium they had expected to earn on the green attribute of electricity generated.

Moreover, with the decline in LCOE of RE-based power, the CERC lowered the price band over the years, especially for solar RECs. In the latest REC revision in June 2020, the CERC removed the floor price (effectively 0) for both solar and nonsolar RECs, which led to petitions in protest and resulted in the suspension of REC trading by the Appellate Tribunal for Electricity.

The average clearing prices for solar and nonsolar RECs over the years in the Indian Energy Exchange are summarized in Table A2 in the Appendix. Tracking the REC transactions in the IEX, Figure 1 depicts how the clearing prices of nonsolar and solar RECs have closely followed the floor price over the years. During the initial years, transactions reflected a higher price of *solar* RECs compared to *nonsolar* RECs, however the clearing price of solar RECs declined faster than that of nonsolar RECs (reflecting the underlying LCOE reduction of solar power and solar FIT).

Figure 1: Annual Average Clearing Price of Solar and Nonsolar RECs at IEX, 2011–20



Looking at the annual volume of transacted RECs in the last decade reported in Table 5, we find that since 2017 the redemption of RECs has dipped substantially. Since trading in solar RECs was halted during May 2017 through March 2018, the spike in the sale of solar RECs in 2018 merely reflects the clearing of a large inventory of these certificates from previous months and years (given REC validity of three years). The inventory of unsold RECs peaked in 2018 (see column headed *Closing Balance* in Table 5), with the largest inventory of unsold RECs being in wind, followed by biomass and solar.

The low demand (*buy bids*) for RECs that has persisted over the years shows that there is little regard for complying with the RPO across the states in the country. Due to the consistent low demand for RECs and the subsequent erosion in the market value of RECs, the incentive for producing RECs as a by-product of RE-based energy was also waning. Not surprisingly, the sell bids plummeted after 2018 for solar RECs. The *sell bids* for nonsolar RECs collapsed in 2018 to almost a tenth of the sell bids in 2016.

Table 5: REC Redemption through Power Exchanges and Unsold RECs, 2011–2021

Year	RECs Issued	RECs Redeemed through Exchanges	RECs Retained by RE Generators	RECs Revoked/ Deleted	Closing Balance (Unsold RECs) [®]
2011–12	1,054,243	1,015,698	0	0	38,545
2012–13	4,328,198	2,589,814	0	0	1,776,929
2013–14	6,834,276	2,748,694	0	0	5,862,511
2014–15	9,624,866	3,061,922	248232	0	12,177,223
2015–16	9,733,840	4,955,153	363942	0	16,591,968
2016–17	8,195,763	6,487,739	465313	0	17,834,679
2017–18*	6,326,816	16,184,151	485059	0	7,492,285
2018–19	7,777,341	12,608,795	452848	0	2,207,983
2019–20 [#]	12,739,554	8,927,850	286728	0	5,732,959
2020–21	5,022,099	920,761	346967	3,623,895	5,863,435
Total	71,636,996	59,500,577	2,649,089	3,623,895	5,863,435

[®] Closing balance = RECs issued – RECs redeemed through exchanges – RECs self-retained by generator – RECs revoked.

* No trade in solar RECs during May 2017 – March 2018, no trade in nonsolar RECs during May–June 2017.

[#] No REC trade since July 2020 to date (June 2021).

Source: Compiled by author from monthly data from <https://www.recregistryindia.nic.in/index.php/publics/recs>.

3.3 Tracking the REC Market and CERC Interventions

Since the first REC auction in 2011 until June 2020, only 59.5 million RECs – representing 59.5 GWh of green power – have been transacted at the exchanges. The lackluster demand for RECs at the auctions led to a huge inventory pile-up of unsold RECs, especially during 2014 through 2017. During the last three years the inventory of unsold RECs declined but so did the REC issuance (see Table 5). The expectation of a rapid growth of RE-based power generation in resource-rich states, and robust purchase of RECs by resource-poor states (to fulfill their RPOs), has not been realized. In this regard, the participation of states, and in particular of Discoms, in the REC transactions during 2011–18 is showcased in Table 6.

Discoms purchased just about 61% of all the RECs sold, while the rest were purchased by captive power plants and open-access consumers. But the total purchase of RECs was far less than that required to cover the shortfall in RPO across the states, reflecting widespread noncompliance. Little, however, was done to boost the demand for RECs.

Table 6: State-wise RECs Issued to Generators and RECs Purchased (until March 2018)

State	RECs Issued	% Share in Total RECs Issued	RECs Purchased	% Share in Total RECs Purchased	DISCOM Purchase
Andhra Pradesh	1,310,977	2.84	608,315	1.64	
Assam			411,393	1.11	300,320
Bihar	185,835	0.40	1,706,195	4.61	1,705,855
Chandigarh (U.T.)			271,381	0.73	271,381
Chattisgarh	1,829,519	3.97	1,115,029	3.01	208,040
Dadra and Nagar Haveli			725,451	1.96	603,000
Daman and Diu			421,122	1.14	362,104
Delhi	92,492	0.20	2,561,300	6.91	2,519,934
Goa			262,000	0.71	262,000
Gujarat	3,500,481	7.59	4,932,926	13.32	2,966,710
Haryana	185,935		87,906	0.24	
Himachal Pradesh	2,144,866	4.65	118,202	0.32	3,863
Other	447,278	0.97			
Jharkhand			1,525,767	4.12	800,923
Karnataka	1,035,865	2.25	642,862	1.74	
Kerala	177,366	0.38	126,104	0.34	100,000
Madhya Pradesh	2,316,114	5.02	1,631,555	4.40	
Maharashtra	6,240,463	13.54	11,378,415	30.72	9,928,328
Manipur			3,997	0.01	3,997
Meghalaya			32,690	0.09	2,375
Mizoram			3,160	0.01	3,160
Nagaland	278,084	0.60			
Odisha ^a	839,626	1.82	2,244,102	6.06	
Puducherry			432,734	1.17	430,949
Punjab	832,342	1.81	1,246,548	3.37	897,100
Rajasthan	4,363,417	9.47	2,305,280	6.22	
Tamil Nadu	12,119,543	26.29	706,540	1.91	
Telangana	214,470	0.47	154,576	0.42	
Tripura	13,365	0.03	297	0.00	297
Uttar Pradesh	7,098,583	15.40	152,351	0.41	
Uttarakhand	871,381	1.89	431,946	1.17	326,620
West Bengal			803,027	2.17	803,020
India total	46,098,002	100	37,043,171	100	22,499,976

^a In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This document reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

Source: Compiled from Tables 23, 41, and 43, POSOCO (2018).

The Indian REC market has overwhelmingly been a story of control of supply as well as price – as the CERC focused on changing supply features of the certificates (including eligibility and validity) and the trading price band:

- (i) In the face of unsold or unredeemed RECs, the CERC periodically extended the life of RECs, first from 365 to 730 days in 2013, then to 1,095 days in 2014, and now to perpetuity in 2021.

- (ii) Mandating lower REC prices did little to boost the demand for RECs, and instead signaled that there is little premium to be realized for the “green attribute” of electricity for generators.
- (iii) The Discoms were made eligible for issuance of RECs when they purchased renewable energy over and above their RPO obligation under the Second Amendment to the REC Regulation in 2013. While the CERC considered this as a financial incentive for distribution licensees to go beyond their RPO, it flew in the face of the essence of REC issuance for premium price discovery by renewable power generators.

3.4 Persistent Low Demand for RECs, RPO Noncompliance, and Discoms

The stated objective of the REC mechanism, namely the need to enable rising RPOs in states with low renewable generation potential, has not been served as the shortfall states chose simply not to raise their RPOs or enforce those in place. Even renewable resource-rich states have a poor record of renewable RPO compliance. Few Indian states comply with the RPO set by the respective SERCs. For instance, during 2010–14, only six Indian states¹¹ were found to be RPO-compliant. Even in the state of Maharashtra, which has one of the largest registered capacities for RECs (see Table A1), the generation of RE power has been less than the required RPO for several years, and the RPO backlog has been waived for state and private utilities (CSE 2019: 120).

Analysts have long drawn attention to the problem of noncompliance with the RPO and the need for an enforcement-inducing penalty for obligated entities (Shereef and Khaparde 2013; Shrimali and Tirumalachetty 2013). So, unless RPO compliance is enforced seriously across the states, the nature of interventions pursued so far in the REC market would not help revive the scheme.

The continuing noncompliance with the RPO across the states, with a few exceptions, has led to low demand for RECs year after year. As noted in the previous section, non implementation of RPO has been overlooked or waived in many states. Thus, despite the steady reduction in the REC price, obligated entities have had little incentive to purchase RECs. Consequently, the REC mechanism has had a negligible role in RPO compliance, as observed by the audit report on renewables. The last audit report noted that during 2010–2014, only 4.77% of RPO compliance was done through RECs, while 95.23% of RPO compliance was achieved through direct purchase of RE electricity (CAG 2015).

Obligated entities for purchasing RECs, in particular the state Discoms, have long complained of being in dire financial straits, and in bad repair for major reforms. The Discoms have outstanding dues to power suppliers – for example, in 2019, they owed Rs32 billion to renewable power generators (Nirula 2019: 9).

Moreover, Discoms are constrained due to existing long-term power purchase agreements with large thermal plants, which makes it difficult for them to switch over to renewable power purchase even when RE power is cheaper (Sreenivasan 2019). The poor financial state and nonenforcement of RPO in the states then leave the Discoms little room to participate in the REC market. Not surprisingly, the distribution companies

¹¹ Himachal Pradesh, Karnataka, Meghalaya, Mizoram, Tamil Nadu, and another northeastern state (CAG 2015).

are considered to be the weakest link in the electricity supply chain and continue to present hurdles in the growth of renewables.

4. ASSESSING THE PERFORMANCE OF THE REC MARKET

In an ideal REC market, the premium value of “green energy” would be realized through a free market price as long as the supply and demand reflect the true underlying costs. The REC market price would tend to be zero when RE-based power is cost-competitive with thermal energy, and the system has moved towards largely RE-based power. However, an REC price collapse even when the system is predominantly non-RE based, while RE-based power is getting more cost-competitive, is indicative of a failure in the market takeoff. This is paradoxically the case in India, as the country has experienced one of the lowest generation costs for utility-scale solar-based power (leading to a dramatic reduction in the average levelized cost of electricity of utility-scale solar PV), yet its uptake has faltered.

It is important to remember too that REC power projects are not all comparable to utility-scale power projects, as the former often have low capacity. Thus, the CERC-mandated price calculations based on attracting buyers may have missed providing the premium REC-registered renewable electricity generators expected. This is especially true of unsold RECs from earlier years (when the cost of RE-based power was higher) but whose bankability is lowered. Not surprisingly, REC project registrations started declining after the initial growth spurt (CAG 2015).

An important indicator of the REC mechanism would be its certification rate over the years. A robust and healthy REC mechanism would be characterized by an increasing certification rate of renewable-based electricity, since it would reflect the pulse of the RE power generators expecting good returns in the certificate trading, and therefore registering their RE power generation under the REC scheme. The calibration of the *certification rate* shows that we have witnessed a steady decline in the rate of certification of RE power for RECs since 2015–16.

Table 7: Renewable Power Certification Rate[@]

Year	RE-based Power (BU)	RECs Issued (MWh) [#]	RE Power Certification Rate
2011–12	51.2	1,054,243	2.06
2012–13	57.4	4,328,198	7.54
2013–14	53.1	6,834,276	12.87
2014–15	61.7	9,624,866	15.60
2015–16	65.8	9,733,840	14.79
2016–17	81.5	8,195,763	10.06
2017–18	101.8	6,326,816	6.21
2018–19	126.8	7,777,341	6.13
2019–20	138.3	9,115,659*	6.59*
2020–21**	111.9	4,078,652	3.64

[@] RW power certification rate is calibrated as = $100 \times (\text{quantum of electricity issued RECs in year } t) / (\text{total renewable-based energy generated in the country in year } t)$.

[#] Note 1 REC corresponds to 1 Mwh of RE-based electricity injected into the grid.

* Initially 12,739,554 were issued, but 3,623,895 were later revoked. So, effectively 9,115,659 were issued to RE generators, implying a certification rate of 6.59%

** Data until December 2020.

Source: Author’s calculations based on data from MOP (2021b) and the REC registry.

We find that the RE power certification rate increased rapidly in the initial years, from 2.06% in 2011–12 to 15.6% in 2014–15 (see last column, Table 7), indicating that RE power generators were upbeat in the initial years and opted for REC registration and issuance of RECs. However, the certification rate began to decline after 2014–15, and it may be recalled from Figure 1 that 2014–15 was also the year that witnessed a sharp decline in the auction price of solar RECs. Table 7 shows that the share of REC certification of RE-based power in the total RE-based power generated witnessed a sharp drop from approximately 14.8% in 2015–16 to 10% in 2016–17 and then plummeted to 6% during 2017–20.

This highlights the fact that policy interventions in the form of revisions in the REC validity period (in 2013 and 2014) to deal with the issue of the unsold REC inventory that has been accumulating over time were rather ad hoc and ineffective.¹² The intervention increased the bankable period for the RECs but not their bankability, as it failed to enhance REC market transactions and REC prices continued to decline.

Moreover, there are incentive inconsistencies in the policy of awarding RECs to distribution licensees as a financial incentive (when they go beyond their RPO). Such a financial instrument flies in the face of the essence of REC issuance for premium price discovery by renewable power generators and increases the supply of RECs in a market that is overloaded with unsold inventories. The latter further aggravates the problem of excess supply in the REC market.

The major challenge for the REC market has been the lack of demand faced by renewable-based power generators from obligated entities. Yet there has been no concerted effort to rectify the long-standing demand problem emanating from pervasive RPO noncompliance. There is an urgent need to create a vibrant demand for RECs in order to realize the potential benefits of the tradeable REC mechanism when auctions are reopened.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Despite holding the promise of flexibility and the green premium on renewable-based power generation, the REC mechanism in India has faltered since its launch in 2010–11. The decline in REC price did not stimulate demand over the years, as noncompliance with the RPO remained widespread across the states. Moreover, for a country that has achieved a spectacular reduction in the generation costs of RE-based power (e.g., in utility-scale solar-PV power), its uptake has fallen short due to constraints faced by the purchasing obligated entities, such as distribution companies that are locked in long-term thermal power purchase agreements.

Our review and assessment of the REC mechanism over the last decade highlighted that, although the RE power generators were upbeat during the initial years of RECs as tradeable assets, and increasingly chose to register for REC issuance of their power projects, after 2015 the certification rate dropped sharply. This coincided with the

¹² The same approach has been adopted in a recent amendment to redesign the REC mechanism (MOP 2021), approved by the Ministry of Power in September 2021, that proposes to further increase the current REC validity of 1,095 days to perpetuity until its sale. There would also be no price ceiling or price floor in the market. *MOP Press release*: <https://pib.gov.in/PressReleasePage.aspx?PRID=1759300>.

To prevent hoarding of RECs and price malpractice by the RE generators in REC trading, the MOP proposed that the CERC would introduce monitoring and surveillance. However, this will add monitoring and surveillance costs on the supply side to a system that has long been languishing, and could likely disincentivize the RE generators from participating in the REC trading or registering of REC projects.

precipitous fall in the average auction price of solar RECs and the mounting inventory of unsold RECs (solar and nonsolar). The decline in the certification rate reflects that the underlying REC market sentiments among renewable power generators were low, and they opted to stay out of a mechanism under which returns were decreasing and uncertain.

The trading in RECs in India has been an overly regulated program and policy-heavy on the supply side, and could not provide the expected premium for the “green” attribute of RE-based electricity to the generators. The abysmally low demand for RECs from obligated entities, particularly state distribution companies, signifies the rampant RPO noncompliance across the Indian states. Essentially, insufficient demand led to the accumulation of unsold RECs, and price declines failed to clear the market.

Over the years the CERC essentially responded to the market crisis by extending the validity of the certificates and/or lowering the price band for auction. Neither of these helped in rectifying the low demand for RECs and enhancing transactions. The interventions increased the bankable period of the tradeable asset but not its bankability. As the auction value of RECs declined, it eroded the bankability of the certificates since the future revenue stream of RECs is seen to be dwindling.

To increase the vibrancy of the REC market, it is pertinent to intensify enforcement of the RPO across the states and reform the Discoms, which are unable to pay for power they purchase or participate in the REC market. According to the most recent data, in 2019–20, the overall share of RE-based electricity was 10.77%, compared to the target of 17.5% (Table 1). Only the six states of Andhra Pradesh, Himachal Pradesh, Karnataka, Rajasthan, Sikkim, and Tamil Nadu were RPO-compliant (MNRE 2021). Even large states with significant renewable energy development like Gujarat and Maharashtra have been seen to be falling short.

The policy effort now needs to focus on creating a stronger demand for renewable energy-based power and enforcing RPO compliance in the country, instead of more supply-side interventions of the REC mechanism, or reclassification of large-hydro-based power as renewable in order to reach the target set for 2022 and 2030. While the recent modification in the classification of renewable power may improve the RPO compliance record of states,¹³ it is unlikely to enhance the demand for RECs or help in making the market robust when it is reopened. Therefore deep systematic appraisal of the distribution companies and addressing the failure to participate in the REC market are required at this time.

¹³ Under a new order of the Ministry of Power, large-hydropower projects commissioned after 8 March 2019 and up to 31 March 2030 would be interpreted as RE power (MOP 2021a). Moreover, a shortfall in solar RPO (of up to 15%) could be met by an excess of nonsolar energy; and a shortfall in other nonsolar energy RPO (of up to 15%) could be met by excess solar or hydro energy (ibid.).

APPENDIX

Table A1: Spread of REC-accredited Installed Capacity in MW across India, 2021*

State	Wind	Solar PV	Small Hydro	Biomass	Bio-fuel Cogeneration	Others	Total
Tamil Nadu	764	181	–	101	10	–	1,056
Maharashtra	610	116	29	16	160	2	933
Rajasthan	390	225	–	–	–	–	615
Gujarat	583	6	–	4	18	–	611
Madhya Pradesh	6	280	16	–	–	–	302
Andhra Pradesh	126	28	12	6	–	3	175
Karnataka	107	–	10	10	–	–	127
Uttar Pradesh	–	–	–	195	499	–	694
Himachal Pradesh	–	–	90	–	–	–	90
Telangana	–	59	24	–	–	–	83
Odisha ^a	–	5	–	25	–	–	30
Bihar	–	–	–	–	29	–	29
Uttarakhand	–	–	–	10	17	–	27
Chhattisgarh	–	–	–	20	–	–	20
Punjab	–	–	–	10	5	–	15
Haryana	–	–	–	10	3	–	13
Delhi	–	8	–	–	–	–	8
Tripura	–	5	–	–	–	–	5
Kerala	–	1	–	–	–	–	1
India total:	2,586	914	181	407	741	5	4,834

* As of 10th June 2021.

^a In 2011, the Government of India approved the name change of the State of Orissa to Odisha. This document reflects this change. However, when reference is made to policies that predate the name change, the formal name Orissa is retained.

Source: REC registry website <https://www.recregistryindia.nic.in/index.php/publics/recs>.

Table A2: Annual REC Bids and Average price of RECs at the Indian Energy Exchange (IEX), 2011–2020

Nonsolar RECs					
Year	Floor Price	Clearing Price[@]	Buy Bids	Sell Bids	Cleared Volume
2011	1,500	2,261	13,02,820	6,58,910	4,02,862
2012	1,500	2,127	29,36,049	56,04,813	19,82,614
2013	1,500	1,500	12,00,591	219,03,968	12,00,591
2014	1,500	1,500	10,46,397	447,34,718	10,46,397
2015	1,500	1,500	26,93,510	856,36,055	26,93,510
2016	1,500	1,500	25,75,976	916,52,179	25,75,976
2017*	1,000	1,450	92,24,465	850,46,784	92,24,465
2018**	1,000	1,249	88,98,208	97,59,224	50,08,743
2019	1,000	1,595	97,96,338	61,93,904	46,40,492
2020 [#]	0	1,333	24,93,987	99,53,839	18,89,254
Total					306,64,904
Solar RECs					
Year	Floor Price	Clearing Price[@]	Buy Bids	Sell Bids	Cleared Volume
2011	12,000		30,559		
2012	9,300	12,740	36,342	5,112	3,782
2013	9,300	10,600	83,644	2,59,747	39,173
2014	9,300	9,300	24,444	19,64,592	24,444
2015	3,500	3,500	3,70,574	188,74,807	3,70,574
2016	3,500	3,500	3,98,094	281,23,532	3,98,094
2017*	1,000	2,875	2,86,163	142,32,235	2,86,163
2018**	1,000	1,061	68,01,851	140,15,848	39,60,742
2019	1,000	2,067	66,30,913	20,87,255	13,46,287
2020 [#]	0	2,100	25,07,770	13,37,629	11,81,468
Total					76,10,727

[@] Average clearing price (Rs/REC) is the simple average price for traded months only.

* No trade in Solar RECs during May 2017–Dec 2017, no trade in Nonsolar RECs during May–June 2017.

** No trade in Solar RECs during January–March 2018.

Nonsolar RECs issued before April 2017 had an average clearing of Rs 1,501 and Rs 1,771 during 2018 and 2019, are not included in the figures reported here.

[#] Corresponds to data until June 2020, as REC trades have been suspended since.

Source: Compiled from Indian Energy Exchange (IEX) data, <https://www.iexindia.com/marketdata/recdata.aspx>.

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