3 Economics, Regulation, and Implementation Strategy for Renewable Energy Certificates in India

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Introduction

Renewable energy sources (RES) have been promoted through a number of policies including subsidies and fiscal incentives, as well as regulatory provisions. Attractive fiscal policies like higher depreciation and the Renewable Portfolio Obligation (RPO) with Feed-in-Tariff (FiT) have provided significant impetus to growth of renewable energy in the electricity sector in India.[1] Economic efficiency of renewable energy promotional policies like RPO with FiT has been questioned as these do not provide incentive for cost reduction and exploitation of cost-effective resources with appropriate technology (Singh 2009). Tradable Renewable Energy Certificates (RECs) are identified as market-based instruments that can help promote RES in a cost-effective manner (Nielsen and Jeppesen 2003; Morthorst 2000; Voogt et al. 2000).

Renewable Energy Credits or RECs are used as a disclosure, marketing and compliance mechanisms in a number of countries. These are called Renewable Obligation Certificates (ROCs) in the UK and 'green tags' or Tradable Green Certificates (TGCs) across many countries in the Europe, Guarantee of Origin (GO) or Renewable Energy Guarantee of Origin (REGO) is often used in the European Union (EU) as a disclosure mechanism. At least 21 REC schemes were under operation in a number of jurisdictions including the UK, Italy, the Netherlands, Sweden, Australia, and numerous states in the US (Mendonca et al. 2010; Bertoldi and Huld 2006). In the Indian context, Singh (2006 and 2009) discusses the advantages of RECs and proposes its implementation to bring in economic efficiency in promotion of RES. The Central Electricity Regulatory Commission (CERC) has recently issued regulations[2] for introducing a market for RECs in the country (CERC 2010a).

This chapter critically examines the above regulations and identifies areas for improvement. We discuss the impact of market segmentation into solar and non solar RECs, and propose a multiplier scheme. The chapter demonstrates that the high level of floor and forbearance prices translate to a windfall gain and represent a higher implicit price of carbon, and need to be revisited. While presenting a mechanism for price discovery of RECs, it also highlights the importance of a buyout price. The chapter proposes a linkage between the FiT and REC mechanisms. It begins by highlighting the role of RECs

[1] Section 85 (e) of the Electricity Act 2003 empowers the State Electricity Regulatory Commissions (SERCs) to specify a percentage of the total consumption of electricity in the area of a distribution licensee to be procured from RES (RPO). The Act also empowers the SERCs to determine tariffs for the promotion of co-generation and generation of electricity from renewable sources of energy.

[2] Hereinafter, referred to as the REC Regulations.

in promoting RES in an economically efficient manner. We also present a framework for developing a market for RECs, and discuss institutional mechanisms and role of various stakeholders.

Traditional Policy Framework and its Impact on Renewable Energy Development

The Government of India (GoI) has outlined eight missions under the NAPCC as mitigation and adaptation strategies to address climate change. The NAPCC augurs to promote development of renewable energy sources in the country. It sets a target of 5 per cent renewable energy purchase for 2009–10 and which will increase by one percentage point for the next 10 years (GoI 2009a). During the year 2008–9, while renewable energy sources contributed 7.78 per cent of generation capacity its energy contribution was merely 3.49 per cent (estimated from CEA 2009a). This can be attributed to a faulty policy approach that provided tax incentives for investment in capacity addition rather than generation of electricity. This has been addressed to some extent through feed-in-tariff approach and generation-based incentives.

Due to disparity of resource endowments, and the policy and regulatory environment, the development of renewable energy sources varies across states in the country (Figure 3.1). Renewable energy sources, especially wind resources, have been extensively exploited in some of the states in the southern and western regions of the country. Biomass-based plants have made significant contribution in some of the states in the northern and the western regions. States in the eastern region have generally lagged behind in the exploitation of RES. Given the resource disparity and variations in the policy and regulatory environment across states, some states may be able to set and achieve higher RPO targets while others may lag behind. With an increasing share of renewable energy, the cost of power procurement and hence the impact on consumer tariff cannot remain insignificant. Given the existing pressure to reduce costs and the inability to increase tariffs, obligated entities (especially the distribution companies) may find

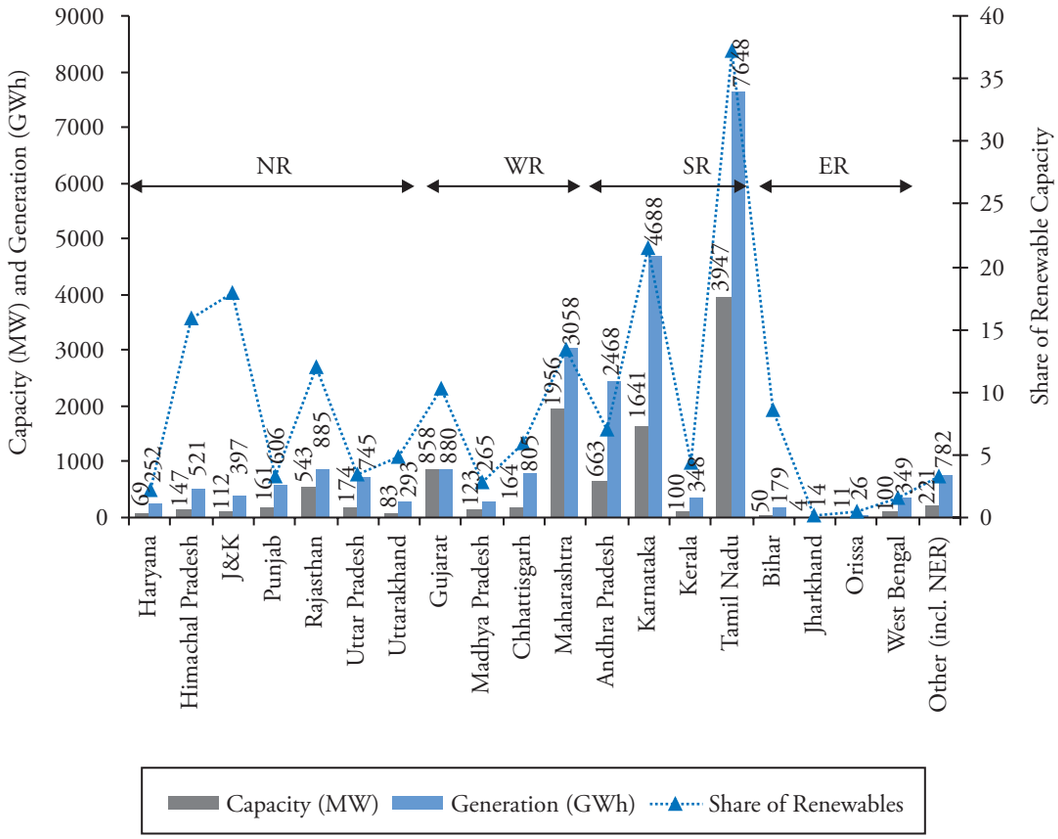

Figure 3.1 Capacity and Electricity Generation from Renewable Energy Sources (2008–9)

Source: CEA (2009a).

it difficult to meet increasing levels of RPO in future. Role of market mechanisms, like the one discussed below, with an appropriate institutional structure could help achieve a higher share of renewable energy in a cost-effective manner.

The RPO targets differ significantly across states. While some SERCs have specified separate RPOs for different RES, others have chosen to specify a common RPO target. RPO targets for all the obligated entities within a state are the same, with the exception of the states like Karnataka and West Bengal. The choice of a level of RPO seems to be influenced by, among other factors, resource endowments, existing capacity as well as policy and regulatory environment. The experience with the implementation of RPO across different states presents some interesting insights (Table 3.1).

Distribution utilities in Tamil Nadu and Karnataka, which have rich wind energy resources, have been able to meet rather ambitious RPO targets. A modest RPO target in Gujarat was achieved but it remained unaccomplished in Punjab. Ambitious targets set up for Chattisgarh, Haryana, Madhya Pradesh, Rajasthan, Uttar Pradesh, and Uttaranchal did not materialize. The obligated entities in most of the other states also fell short of the RPO targets.

Table **3.1** RPO and its Compliance across States

(in percentage)

States	*RES*	*RPO Targets*					*RPO Performance*		
		2007–8	*2008–9*	*2009–10*	*2010–11*	*2011–12*	*2007–8*	*2008–9*	*2009–10*
Andhra Pradesh[#$]		5	5	5	5	5	*4.41*	*3.95*	*4.06*
Bihar[@]				4	5	6	0.82	0.57	NA
Chhattisgarh	Wind		2	2	2		0	0	0
	Biomass		5	5	5		4.02	NA	3.60
	Small Hydro		3	3	3		0.34	NA	0.26
	Total		10	10	10		4.36	NA	3.62
Delhi		1	1	1	1		NA	NA	NA
Gujarat		1	2	2			2.07	NA	2.55
Haryana		3	5	10	10	10	NA	*0.01*	*0.01*
Himachal Pradesh	Small Hydro	20	20	20			NA	NA	NA
Karnataka		7–10	7–10	7–10			*9.30*	*10.80*	*11.04*
Kerala		5	5	5			0.01	0.09	0.51
Madhya Pradesh	Wind		5	6	6	6	0.08	0.07	0.06
	Biomass		2	2	2	2	0	0	0
	Co-generation		3	2	2	2	0	0	0
	Total		10	10	10	10	0.08	0.07	0.06
Maharashtra[$]		4	5	6			3.35	3.36	4.25
Orissa		3	3	4			0	0	1.59
Punjab		1	1	2	3	4	*0.69*	*0.74*	*1.49*
Rajasthan[$]	Wind	4	5	6	6.75	7.50	2.18	3.42	2.74
	Biomass	0.88	1.25	1.45	1.75	2	0.39	1.48	0.49
	Total	4.88	6.25	7.45	8.50	9.50	2.57	4.90	3.23
Tamil Nadu		10	10	13			11.65	12.08	*13.79*
Uttarakhand		5	5	8	9	10	1.4	1.7	*2.18*
Uttar Pradesh		7.5	7.5	7.5			1.25	2.44	2.97
West Bengal		0.95–3.8	2–4.8	4–6.8	7–8.3	10	NA	0–0.37	0-0.34

Note: [#] RPO target of 5 per cent for 2012–13 and 2013–14; [@] RPO target of 7 per cent for 2012–13; [$] The RPO target also applicable to captive and open access consumers; Numbers in italics are projections filed with regulators by the distribution utilities.

Sources: GoI (2009b), Singh (2009), FoR (2008), Bloomberg New Energy Finance (2010), and relevant regulations of SERCs.

This could be attributed to, among others, ambitious RPO targets, slower growth in renewable capacity addition in comparison with conventional fuels, operational constraints due to uncertainty associated with natural resources and the absence of an effective deterrence. The regulatory vacuum to address some of these issues limits the scope for setting up an 'appropriate' RPO target, and provide an effective mechanism and institution to achieve this in a cost-effective manner.

In states like Karnataka and Tamil Nadu, where obligated entities have surpassed RPO targets, there would be additional increase in consumer tariffs as high cost power procurement from renewable energy sources was compulsorily absorbed beyond the RPO targets. A mechanism to 'sell' the additional renewable energy procurement to 'obligated entities' who are falling short of the RPO target would not only lower the burden on consumer tariffs (in Karnataka and Tamil Nadu, in this case) but would also improve compliance with RPO regulations elsewhere in the country. Further, absence of 'banking' in the prevailing RE policies would not permit the two states to take credit of the 'excess' purchase of RE in a year and utilize the same to meet the RPO target for subsequent years.

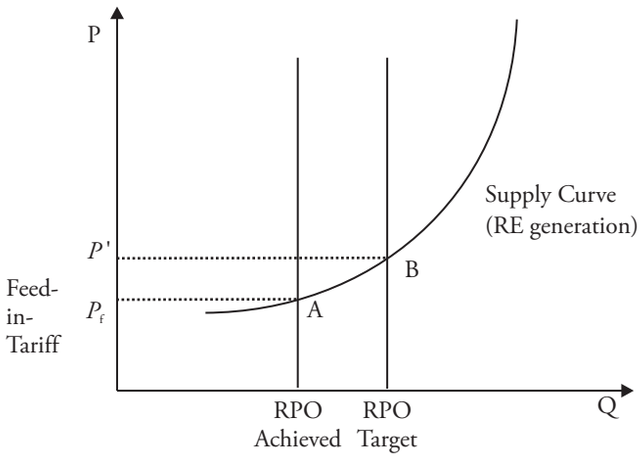

Figure 3.2 Feed-in-Tariff and Shortfall in RPO Compliance

Source: Author.

The RPO targets are not economically related to the prescribed level of FiT in most states, leading to a demand-supply mismatch for electricity generated from RES. This is reflected in the failure of RPO compliance across many states (Figure 3.2). The prevailing RPO regulations across various states specify procurement of electricity generated from RES at a separately specified FiT. Since supply curve is unobservable to the regulators, FiT may not ensure sufficient supply of RE to ensure RPO compliance. Limited RES endowments and absence of a conducive investment climate also withhold growth in supply of RES. Apart from this, variation in natural conditions bring in added uncertainty in generation of electricity from RES. Further, the RPO target is expressed as an inelastic demand curve, thereby providing no economic flexibility to the obligated entities. The National Tariff Policy, issued under the Electricity Act 2003, enables utilities to invite competitive bids for supply of electricity including that from RES. However, such a mechanism has found limited acceptability as attractive FiT tariffs are in place in most states and obligated entities continue to fall short of targets. If the utilities are allowed to procure RE from outside the state, the access to low-cost resources elsewhere in the country would help lower the cost of RPO compliance. However, the benefit of low-cost RES at far off locations would be lost by the cascading transmission charges. Also the challenge in scheduling this power and the concern for transmission constraints may also prevail over the perceived cost advantages.

Need for Effective Regulations and Role of RECs

The traditional approach to regulate and promote RES across most states has proved to be ineffective in meeting the regulatory objectives. The failure in RPO compliance and limited access to electricity generated from RES presents the following challenges to regulators and policymakers:

- How to address underachievement of RPO Target?
- How to address limited endowment of RES in a state (for example, Delhi)?
- How to improve access to 'green electricity' to consumers who want higher share of RES in their energy basket?

Apart from the above, the rigidity of existing RE regulations across the states is also resulting in higher cost of RPO compliance to the extent it is being met in some states. These rigidities, among others, include non-credit for purchase of electricity generated from RES outside the state and the absence of banking. This limits the potential of economically harnessing and trading of 'surplus' renewable electricity across the country. Apart from additional costs due to transmission charges, physical transmission of renewable electricity faces challenges like scheduling and transmission congestion. Alternatively, the economic benefits from trade of renewable electricity can be harnessed by separating 'green attributes' of renewable electricity as 'renewable electricity certificates' (RECs). The RECs can be used towards RPO compliance and can also be traded among the eligible entities. Singh (2009) suggested that a

national market for RECs in India would promote RES in an economically efficient manner and would assist cost-effective compliance of RPO targets. It is expected to address the challenges identified above. The main advantages of a REC mechanism are highlighted below.

- **Flexibility in RPO compliance (Compliance market)**

One of the key characteristics of RECs is to help identify the source of electricity as a renewable one. This is primarily used to assist in compliance monitoring by regulatory institutions. This is often referred to as the compliance market. Apart from this, it also provides a flexibility mechanism wherein obligated entities, instead of procuring electricity generated from RE sources, can meet their RPO targets through purchase of RECs. From the regulators' point of view, RECs assist in accounting towards RPOs. As discussed later in the chapter, the existing REC regulations do not credit RECs for purchases made by the obligated entities under their RPO obligations under a feed in-tariff (FiT) scheme. Providing for this would not only help establish a better compliance mechanism but also encourage participation of such obligated entities in the RECs market and, hence, enhance liquidity for the same.

- **Voluntary purchase of 'Green Electricity' (Voluntary market)**

While the primary goal of the RECs is to address the needs of the compliance market, it can also serve as a useful tool for meeting the 'green electricity' needs of the voluntary market. Such applications include participation by corporate as a part of their Corporate Social Responsibility (CSR) and by philanthropic organizations as well as individuals (Singh 2009). In 2004, voluntary market in the USA was estimated to account for about 3 million MWh of green electricity with an estimated market value of $ 15–45 million. This is projected to go up to 20 million MWh of green electricity with an estimated market value of $ 100–300 million by 2010 (Holt and Bird 2005). RECs for voluntary market are often purchased by the electricity retailers to re-bundle this with 'grey electricity' for sale of 'green electricity' to the retail consumers. Apart from this, large consumers also buy RECs directly to green their electricity consumption.

The increase in voluntary demand for RE by residential and commercial consumers in the US is driven by green products offered by utilities and competitive electricity suppliers, and RECs (Table 3.2). While the compliance market may remain the primary driver for the RECs in India in the initial stage, the scope for voluntary market purchases would remain promising in future.

Table 3.2 Voluntary Purchase of Renewable Energy by Customer Type in the USA

S.No.	*Year*	*2005*	*2006*	*2007*	*2008*
1	Residential (GWh)	3,000	3,200	4,500	5,500
2	Commercial (GWh)	5,500	8,700	13,600	18,800
3	Total (GWh)	8,500	11,900	18,100	24,300
4	Share of Commercial (in per cent)	65	73	75	77

Source: Cook and Karelas (2009).

- **Marketing 'Green Electricity' to final consumers**

Growing consumer awareness for green energy options has led to an increase in demand for such products by electricity consumers across the world. While consumers do have an option to invest in renewable energy facilities like roof-top solar PV or solar thermal systems, their willingness to pay a premium for 'green power' is opening up new opportunities for RECs. The way green attributes are separated and sold as RECs, these can later be recombined with 'grey' electricity and be marketed as 'green electricity' to final consumers (see Figure 3.3). Such a marketing strategy not only helps to expand the market for 'green electricity' beyond utility purchases, but also improves access to the same to utilities in locations not endowed well with RES.

- **Efficiency in investment and choice of appropriate technology**

Unless held by artificial constraints, investment is expected to flow to the opportunity of maximum returns. Under the prevailing FiT scheme, alternate technologies and resources do not compete in a common framework to gain from economic efficiency.[3] Further, depending on the returns perceived by the investors in a state, the respective states may either fall short of the RPO or may overshoot the target (as noted earlier). Given a technology and resource independent single market price of RECs, the incentives would be to develop the cost-effective resources and hence, avoid economically inefficient investment.

[3] This is evident from the fact that states endowed with unfavorable resource endowments generally have higher tariffs for electricity generated from wind energy. For example per unit tariff for wind energy-based electricity generation for the states of Tamil Nadu, Maharashtra, and Madhya Pradesh were Rs 2.75, Rs 3.5, and Rs 3.97 respectively.

- **Incentives for cost reduction and benchmarks for innovation**

Cost of service or rate of return regulation does not provide efficiency for cost reduction. The FiTs are determined as a cost plus tariff on the basis of normative parameters for various cost parameters like capital structure, cost of financing, fuel cost (where applicable), O&M costs, etc. Inability of regulators to overcome the information asymmetry in determining these normative parameters gets translated into lack of incentives of cost reduction, if such norms are lax. A graduate 'sunset clause' (discussed later in the chapter) provides a benchmark for researchers as well as manufacturers to strive for efficiency improvement and cost reductions.

- **Avoiding transmission of electricity**

Being a credit mechanism, a national level RECs scheme does not require transmission of electricity from renewable energy sources, thereby avoiding transmission costs, potential transmission congestion, and operational issues with Load Despatch Centres. Given the challenges faced in operationalizing open access across various states, RECs would help expand the market for electricity generated from renewable energy sources. Due to scheduling constraints with RE-based electricity generating plants, a greater share of RE would bring in additional challenges for the system operator. However, with improved weather monitoring and forecasting tools, some of these concerns are expected to be partially addressed.

- **Efficient implementation of promotional policies by the government**

Under a REC scheme, government support to renewable energy can be transferred through the REC market. By purchasing and extinguishing RECs from the market, the government can help prop up the market price of RECs. The investors' concern for uncertainty in prices of RECs can be addressed by the government by ensuring market intervention if RECs prices fall below a pre-determined level. This would limit the government's role to reducing market uncertainty rather than transfer of resources.

The economics of off-grid RE-based rural and remote electrification projects is often unfavourable and need to be supported through public funding. Such projects can get a shot in the arm through the REC mechanism if these are made eligible to participate in the scheme. Additional revenue from sale of RECs would help support the operation and maintenance cost of such projects, thereby reducing the cost to be borne by beneficiaries of such projects. Certification and verification mechanism for such projects can be managed through local administrative authorities to reduce the associated transaction costs.

A Framework for Implementing RECs in India

The process of implementing and operationalizing a REC framework in India requires new institutions and new role for existing institutions to undertake the following responsibilities: registration of eligible RE plants, verification of the electricity produced, tracking the RECs as their ownership changes till these RECs are ultimately surrendered and extinguished towards RPO compliance (Figure 3.3). Given that India would have a national REC market, there is a greater role of central agencies like the National Load Despatch Centre (NLDC), who could work with state agencies in setting up the certification and the verification process. As trading of RECs would take place only on Power Exchanges (PXs), the national REC registry needs to follow changes in ownership and ensure that there are no duplications of RECs issued RE plant during a period. The REC regulations propose registration of RE generators for the REC scheme only. The registration process should be open to 'non-REC' generators as well. Since a RE plant can potentially shift between a FiT and a REC scheme, it would be prudent to keep track of all RE plants and their performance. The basic information to be sought from 'non-REC' RE plants at the time of registration could include location, capacity, ownership, technology, and fuel/resource. Apart from this, an annual reporting requirement can seek information on changes in capacity, generation, and sale of electricity under the FiT scheme. This would facilitate easy migration of the RE generators between the REC and the FiT mechanism, and would help validation of the plants performance irrespective of its revenue scheme. Availability of such information at a national level would reduce information asymmetry for the regulators and assist in improving policy and regulatory environment for development of RES.

The successful implementation of an REC scheme not only depends on efficient and effective regulation but also on the quality of the institutions managing various stages in the REC process. The REC implementation framework presented in Figure 3.3 also incorporates some of the suggestions presented elsewhere in the chapter. While the primary goal of the REC mechanism is to support the compliance market, a regulatory environment should facilitate the development of a voluntary market as well. The voluntary market includes direct purchase of RECs as well as purchase of 'green electricity'. The RECs can be bundled with 'grey electricity' to market and sell 'green electricity'. A 'green electricity' certification process would

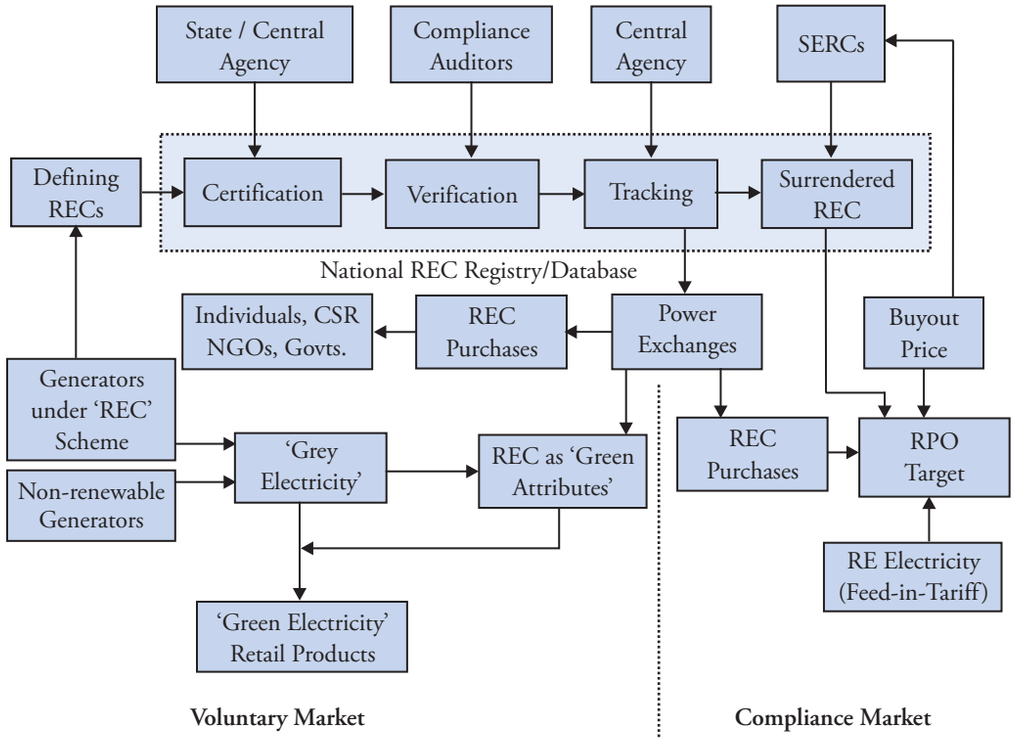

Figure 3.3 A Framework for Implementing Renewable Energy Certificates in India

Source: Author.

be required to establish authenticity of 'green electricity' to be marketed by distribution licensees and electricity retailers in future.

It is understood from the REC regulations that the REC mechanism would involve existing institutions from state as well as from the central level. Given that the institutional practices and the quality of governance vary across states, it would be advisable that CERC develops a common template for agencies to take up various responsibilities at the state level. These templates should include standardized processes for accreditation, de-accreditation, and registration of RE generators, issuance of certificates in dematerialized forms, selection of verification auditors, etc. Standarization of processes would be desirable from the market design perspective since RECs would be traded nationally at power exchanges (PXs). Further, to ensure ease of monitoring and transparency, a common national-level IT platform should be developed to manage the National REC Database. This should include information on registration of RE generators, issuance of RECs in each compliance year, RECs surrendered, and cancellation of RECs due to verification failure, etc. A system of coding the certificate should be inclusive and future-ready so as to include certain additional information, which may not even be deemed important at the moment. A suggested coding scheme may include information on the following: identity of the RE plant, location (by postcode), technology, fuel/resource, installed capacity, vintage, registering agency, verification agency, year of credit, period of credit, date of issue of certificate, status on receipt of public support, if any, and unique certificate number, etc.

CERC's Framework for Introducing RECs in India

On 14 January 2010, the CERC issued[4] final regulations for introducing RECs, called the Central Electricity Regulatory Commission (Terms and Conditions for recognition and issuance of Renewable Energy Certificates for Renewable Energy Generation) Regulations, 2010. The main features of the same are as follows:

- RECs, along with pooled purchase price of electricity, offer a revenue alternative to the feed-in-tariff regime and would operate concurrently with the later.

[4] Under the provisions of sub-section (1) of Section 178 and Section 66 read with clause (y) of sub-section (2) of Section 178 of the Electricity Act, 2003.

- There will be a central level agency to be designated by the Central Commission for registration of the RE generators participating in the scheme and for the issue of REC to RE generators.
- The scheme provides RE generators with two options—either to sell the renewable energy at preferential tariff (FiT) fixed by the concerned Electricity Regulatory Commission or to sell the electricity generated and the environmental attributes associated with RE generation separately.
- On choosing the second option, the environmental attributes can be exchanged in the form of REC, one REC being equivalent to 1 MWh of electricity generated from RES. Compensation of electricity sold to a distribution company would be equivalent to weighted average power purchase cost of the distribution company including short-term power purchase but excluding renewable power purchase cost.
- The regulations propose to issue separate RECs for solar and non-solar RES.
- The REC can be traded only in the Power Exchanges approved by CERC within the band of a floor price and a forbearance (ceiling) price to be determined by CERC from time to time.
- The distribution companies, Open Access consumers, and Captive Power Plants (CPPs) will have the option of purchasing the REC to meet their RPO.

While they are introduced with noble intentions, these regulations have room for improvement. Some of the key aspects of these regulations are critically examined in the following sub-sections, where suggestions for improvement are also outlined.[5]

Eligibility for REC: Scope for Off-grid RE Projects

The eligibility for crediting REC is limited only to electricity generated from grid-connected renewable energy sources and fed into the grid. The REC regulations also stipulate that such generators should not be a part of a prevailing FiT regime in the respective state. This undermines the role of stand-alone RE generation plant supporting remote/rural electrification schemes. Due to geographical disadvantage and lower scale of operations, such projects are often characterized by cost disadvantages, and hence any additional potential support like from revenue from RECs, would have been a shot in the arm for such initiatives in the country. Such examples include the hybrid system operational in the Sundarbans, solar PV-based plants supplying electricity to remote villages in the Durbuk region of Ladakh, etc. The Electricity Act 2003 has enabled licence-free generation and distribution by off-grid projects and the Jawaharlal Nehru National Solar Mission (JNNSM) envisions a significant role for solar energy-based schemes to provide electricity access to remote and rural areas in the country. With the existing form of REC regulations, such stand-alone generators have missed the opportunity to benefit from the same. It should also be highlighted here that, in principle, the CDM process does not exclude stand-alone projects of such nature.

Any operational issue with reference to information asymmetry can be resolved as provided elsewhere in the REC regulations itself. The regulations allow participation of RE generators not covered under scheduling and dispatch procedures. In such cases RECs are to be granted on the basis of 'written communication' of distribution licensee to the concerned State Load Dispatch Centre. A similar approach can be followed to record the number of RECs generated by recognizing written communication from an appropriate local administrative authority or energy agency. In the initial phase, stand-alone RE projects developed by NGOs/government agencies/local bodies, and those registered under the CDM process should be included to benefit from REC credits. This would also ensure effective implementation of government policies to support stand-alone projects. The amount of support available from such agencies may be linked to the RECs generated by such projects.

Category of Certificates: Avoid Market Segmentation

The REC Regulations define two categories of RECs—(i) Solar Certificates and (ii) Non-solar Certificates. There are pros and cons of separate categorization of the RECs depending on the source of energy or the geographical jurisdiction. Solar-specific RPOs are prevalent in 12 states in the US including New Jersey, New York, and Washington DC (Wiser and Barbose 2008). Solar-specific RECs are traded in New Jersey. Given the significant cost difference across the two categories, such a categorization may help in defining and seeking compliance of source-specific RPO, solar RPO in this case. However, this would reduce liquidity and trade in the two separate markets as

[5] A part of the discussion presented herein is based on the submission made by the author to the CERC during a hearing on the subject.

compared to a common market for RECs. As discussed later in the chapter, a unified market for RECs would also bring in more elasticity on the supply side, thereby reducing REC price volatility. While some of the SERCs in India have specified source-specific RPOs (Table 3.1), solar-specific RPOs have recently been introduced in some states. Nevertheless, the objective of providing greater support to solar energy can be achieved through little modification in the proposed regulations by using a multiplier for different sources as described in Singh (2009). A multiplier scheme essentially allows participation of all RES in a common REC market by using a multiplier to define the equivalent number of RECs (as suggested in Table 3.3 below).

A common scheme for multipliers can be set by CERC under the REC regulations in accordance with the resource endowments and the economic viability of various RES.[6] The multipliers can be worked out on the basis of an average benchmarked cost of electricity produced from various RESs.

A multiplier-based mechanism to combine RECs for different energy sources under a single certificate scheme has been adopted in Italy (IEA 2010) and in the UK (Ofgem 2010). Adoption of a scheme of multipliers, which allows for the credit of multiple RECs per unit of electricity generated from different RES towards overall RPO of an obligated entity, may necessitate an amendment in the Electricity Act 2003. Given the benefits of a unified REC market, this initiative merits attention as a market for RECs is yet to roll out in the country. The experience with the existing categorization would also help in taking such a call in future.

Sunset Clause for Technologies Achieving Grid-parity

A sunset clause essentially aims to reduce support for technologies that gradually become economically viable or in other words achieve grid parity in terms of costs. In future, the REC multiplier for maturing technologies can be gradually reduced in line with their cost competitiveness. This would be able to target support only to the technologies with significant cost disadvantage, as the numbers of credits to accrue to such technologies would remain higher as compared to maturing technologies. In fact, a pre-specified schedule of declining multipliers would provide a benchmark for cost reductions to be achieved to remain viable in the changing environment for RECs for the particular technology.

Denomination of Certificates and Expansion of Voluntary Markets

The REC regulations define the denomination of each REC to represent 1 MWh of electricity generated from a renewable energy source and injected into the grid. A higher denomination has the following implications:

i. Exclusion of small RE generators
ii. Limited participation of smaller buyers
iii. Adjustment for quantity less than 1 MWh[7]

By allowing accumulation of electricity generated in quantity less than one MWh in phases, the issues (i) and (iii) have only been partly addressed in the recently issued REC regulations. The voluntary markets can only be exploited by utilities willing to re-bundle RECs with 'grey electricity' for sale of 'green electricity'. Due to higher

Table 3.3 Tariff for Renewable Energy Source and an Illustration of the REC Multiplier

Renewable Energy Source	*Tariff (Rs/kWh)*	*REC Multiplier (xREC)*
Wind (Tamil Nadu)	2.75 and 2.90	1
Biomass (Tamil Nadu)	3.15	1.1
Solar	SERC's FiT + 15 (MNRE)	4–5
Solar PV (Gujarat)	13 (12 yrs.), 3 (next 13 yrs.)	
Solar Thermal (Gujarat)	10 (12 yrs.), 3 (next 13 yrs.)	~3

Source: RE Tariff orders of respective SERCs.

[6] Since the economic viability of various RESs would depend on the resource endowment and state-specific characteristics, separate REC multipliers can also be defined by the respective SERCs under a common framework to be developed by the CERC.

[7] The REC regulations propose this to be included with the credits for RECs for the next period. While this allows for inclusion of parts of one MWh, the credit for the same is delayed by at least a fortnight.

denomination, individual voluntary participation would remain limited.

In order to enhance market participation and to improve liquidity in the market for RECs, the denomination of a single REC should be smaller than 1 MWh. It can perhaps be set in 'units' of 100 kWh. Higher denominations for RECs would be unfavourable to small RE facilities. A smaller denomination (such as the 100 kWh equivalent) would facilitate participation of small buyers as well as small projects across the country.[8]

This would expand the scope of voluntary markets[9] and facilitate the reach of the market to individuals and smaller organizations. Smaller denomination for RECs would be a boon for small solar projects as envisioned under the JNNSM. Roof-top solar PV facilities with net metering can also be credited with RECs in a manner similar to that proposed for larger projects thereby making it a more attractive option for investment.

Absence of Banking of RECs

The REC regulations specify the validity of a REC to be 365 days from crediting. The performance of renewable energy-based electricity generating plants is significantly dependent on the natural conditions like wind speed, solar insolation, rainfall, etc. Even in the case of biomass plants, availability of biomass often influences the operating performance of RE generators. This makes it challenging to dispatch electricity generated from RES. In this context, it would be difficult to project the number of RECs that could be earned and transferred by a generator to the obligated entities. Given such uncertainty, flexible mechanisms such as extended validity to facilitate banking of certificates, and partial rollover of RPO are crucial components of efficient regulatory practices. With banking provisions, obligated entities can procure additional RECs in a given year over and above their current year RPO target[10] and seek credit for the same in a future period. The validity of tradable RECs extends up to two years and five years after the issuance in Italy and Belgium (Flanders) respectively. In the case of UK, Poland, Denmark, and the Netherlands, certificates have unlimited validity. As discussed in a later section, banking of certificates would be an economic solution to reduce volatility in the price of RECs.

Choice of Regulatory Deterrent: Setting a Buyout Price

In the absence of an effective deterrent to failure in meeting the RPO targets, obligated entities do not have enough motivation to pursue such targets diligently. A penalty for failure to meet the RPO, though applicable in Maharashtra and Rajasthan,[11] is yet to test the grounds. In economic terms, the penalty should be higher than P', the minimum price which would ensure long-term investment in RES to assist RPO compliance (see Figure 3.2). Ideally, obligated entities would avoid a 'penalty' and, hence, procure electricity from RES or buy RECs to ensure RPO compliance. Lack of investment in RES in a state is often used to justify shortfall in meeting the RPO targets. With emergence of a market for RECs, this issue would cease to exist under an appropriate regulatory environment.

There are economic as well as legal aspects to a penalty-based deterrence mechanisms.[12] As an alternative to a penalty, regulators can specify a buyout price (BP) or alternative compliance payment (ACP) for RECs. The regulatory body could essentially 'print' and 'sell', to the 'obligated entities', the number of RECs required to make up for the RPO shortfall at a pre-determined buyout price. Hence, the argument for lack of supply would not hold. While delivering the same outcome, this mechanism may avoid the legal complications of implementing a 'penalty'. The uncertainty associated with the market price of RECs may dissuade investors from putting faith in the REC scheme. In economic terms, buyout price should essentially be equal to the marginal social benefit of electricity sourced from RE sources over that from non-renewable sources. In other words, it is the value of the environmental attributes of 'green electricity'. The SERCs

[8] While participation of small buyers would not impose significant transaction costs, smaller buyers may face higher transaction costs unless alternate registration and verification schemes are designed in line with small-scale projects under the Clean Development Mechanism (CDM).

[9] Utility/retailer-based voluntary markets involving sale of re-bundled 'green electricity' would not be influenced by higher denominations due to the scale of operation of such activities in future.

[10] Especially, when REC prices are low.

[11] In Maharashtra, the applicable penalty for 2009–10 is Rs 7 per kWh. In the case of Rajasthan, the penalty was fixed at Rs 3.59 per kWh for 2007–8 (Singh 2009).

[12] Enforcement of a penalty mechanism is often subjected to legal disputes wherein the 'affected' party may need to establish the loss incurred. This time-consuming process often defeats the very purpose of instituting a regulatory penalty.

could specify state-specific buyout price that would represent the value of absence of green attributes of a unit of electricity in the given state. This would also be guided by the resource endowments of the state, the existing and upcoming investment, and the RPO target and historical compliance thereof. A buyout price would essentially function as a forbearance price for the RECs as prescribed under Section 9 of the REC regulations (discussed further in a later section). The prescribed level of BP or ACP in some of the jurisdictions in Europe and the US are given in Table 3.4 below. The ACP that undergo automatic cost recovery in the US states of Maine, Massachusetts, New Hampshire, New Jersey, and Rhode Islands works like a buyout price.

Table 3.4 Buyout Price for RPO Shortfall

Country	*Per 1 MWh equivalent REC*
Belgium (Flanders)	Euro 125 (from April 2005)
Poland	Euro 60 (2005–06)
UK	£30 (2002–03) £37.19 (2009–10)
Australia	Aus $ 40
Maine (USA)	$ 57.12 (2008)
Massachusetts (USA)	$ 58.58 (2008)

Sources: RECs (2005), Ofgem (2010), Rossiter and Singh (2006), and Wiser and Barbose (2008).

A buyout mechanism would also ensure that the payments by obligated entities would go into building a buyout fund rather than paying steep REC prices. This buyout fund could be utilized to support RES in the state, and to increase consumer awareness about RECs and 'green electricity'. Failure to pay buyout price due to insolvency or other reasons can be addressed through a mutualization mechanism as in the case of the UK.[13] In the case of insolvency of an obligated entity to pay the buyout price thus leading to a shortfall in buyout fund, all other entities who have met their obligations make good the shortfall, up to a prescribed limit. While disallowance of the payment towards buyout price in the utilities revenue requirement may seem to be a more effective deterrent, it would work against the interest of the consumers. The utilities would effectively be willing to pay a higher price for RECs, which would be a pass-through, than making buyout payments.

Linking FiT and REC Mechanisms

A standard REC scheme implemented across most of the countries is a standard 'cap-and-trade' mechanism, wherein utilities are required to meet their respective RPOs. Any shortfall can either be covered by purchasing the RECs from other utilities in the market or by paying the buyout price. India is perhaps the only country to have two alternate revenue schemes for investors in RE plants—(i) FiT Scheme and (ii) Renewable Energy Certificate Scheme.

While concurrence of the two schemes poses some challenges for implementation, it also opens new opportunities to derive synergies between the two schemes for, (i) Certifying Guarantee of origin under the FiT Scheme and (ii) Augmentation of REC supply from the FiT Scheme. The 'guarantee of origin' for the existing FiT Scheme across states is based only on the disclosures made by the obligated entities. The registration and verification mechanism built into the REC framework can be effectively extended to perform the above task for the FiT mechanism as well. Since obligated entities include numerous captive and open access consumers, which are expected to grow in numbers in future, the existing self-certification scheme could be strengthened through the registration process built into the REC mechanism. Towards this end, RECs can initially be credited to all electricity generated from RES including those under the FiT scheme. The RECs issued to projects under the FiT scheme needs to be compulsorily surrendered towards RPO compliance. The obligated entities can then be allowed to compulsorily bank and sell excess[14] RECs over and above the RPO target on a power exchange in a subsequent compliance year. If shortfall in RPO targets can be made good through purchase of RECs, the same philosophy should theoretically hold true for excess RECs as well. This would give incentive to the obligated entities to procure RE even in excess of their respective RPO and also lower the financial burden of excess RE procurement as in the case of Karnataka and Tamil Nadu. Such a proposal can be operationalized only if RECs are issued to all RE projects under the FiT scheme. Alternatively, excess RECs can be bought by the buyout fund at a pre-determined floor price, once sufficient funds are accumulated into the same. Most of RECs to be issued under the FiT scheme are expected to be surrendered and extinguished towards RPO compliance. Since the obligated entities in most states fall

[13] See Ofgem (2010) for details.

[14] Note that obligated entities in some of the states like Karnataka and Tamil Nadu excess their RPO targets (Table 3.1).

short of their RPO targets, the supply of excess RECs from the FiT mechanism would help arrest the REC prices in a market expected to witness shortages in the initial stage.

Price Discovery in the Market for RECs

Before discussing the conditions for price discovery, we identify potential stakeholders on the demand as well as supply side in a market for RECs. The demand side would include, (i) Obligated entities with a shortfall in RPO target, (ii) RE generators under REC scheme who are not able to ensure a contractual supply of RECs, (iii) Voluntary demand for RECs (either direct purchases or through re-bundled 'green electricity'), and (iv) Potential government support to REC market. The obligated entities may generally include the distribution licensees, open access (OA) consumers and captive consumers. Given that it is only the distribution licensees who have traditional 'access' to electricity generated from RES, the market for RECs would provide an alternate platform for RPO compliance for the OA and captive consumers. Due to a specified minimum RPO, demand for RECs would be relatively inelastic[15] (Figure 3.4). The demand curve would shift to the right as RPO targets are gradually increased and growth in supplies under the FiT scheme is not able to fill this gap.

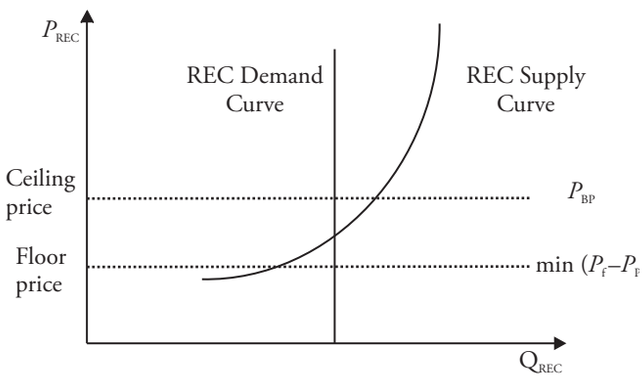

Figure 3.4 Price Discovery for the RECs

Source: Author.

On the supply side, the potential suppliers for RECs include, (i) RE generators under the REC scheme, (ii) Obligated entities with excess RECs, (iii) Banked RECs from projects under the FiT or REC scheme, and (iv) Small RE generators under JNNSM or other such schemes, if made eligible. The supply side of RECs would also be relatively inelastic as marginal cost for most of RES (for example, solar and wind) are very low. The variation on the supply side would be driven by investments as well as seasonal variations. The inelastic nature of the demand and supply side would bring in higher volatility in REC prices. The demand as well as the supply side of RECs could become more elastic through appropriate regulatory interventions.

Introduction of banking of RECs would make the demand more elastic. During the periods of oversupply (and lower prices), obligated entities can make excess purchases and use them later in periods of lower supply. Similarly, RE generators can withhold RECs in a period of oversupply (and lower prices), and sell them in periods of lower supply (and higher prices). A mix of technology would make the supply more elastic than a single technology (as in the case of solar RECs). Further, a cap (forbearance) and a floor price for the RECs can also help in arresting volatility within the two bounds (Figure 3.4). These are discussed in the next section.

The REC regulations allow for price discovery at power exchanges (PXs). However, multiplicity of PXs may be a cause for concern for the liquidity in the market, at least in the initial phase.[16] In the initial stage, the demand for RECs would come primarily from the obligated entities failing to achieve their RPO targets. The captive and open access consumers have relatively lower RE requirements and face higher transaction costs to meet their RPO targets under the FiT scheme. Given reasonable REC prices, such entities may participate actively in the market for RECs.

In the absence of a buyout price for making good the shortfall in RPO target, credible demand for certificates may not materialize in the near future. Due to potential windfall gains, new RE projects in Rajasthan, Tamil Nadu, and Maharashtra would primarily come under the REC scheme. Obligated entities, who overshoot their RPO targets could be a potential net supplier for RECs in the initial stage, if permitted. There is a case for the regulatory changes to enhance the participation of such entities in the market and to offload excess RE procurement through the REC mechanism.

Setting Floor and Forbearance Price for RECs

Under appropriate regulatory environment, the forbearance and the floor price would emerge from the system

[15] In discussing a market for RECs here, we ignore the presence of a FiT mechanism for simplicity.

[16] This concern may not arise in case obligated entities are credited RECs under the FiT scheme and if such entities participate in trading on in RECs.

itself and there would not be a need to specify these separately. The price of RECs would be capped from below by the difference between prevailing FiT P_f and the Average Power Purchase Cost (APPC) P_p. Since both of these differ across states, the minimum level of the difference ($P_f - P_p$) across the states would act as the underlying floor price for the national market[17] (Figure 3.4). This difference is essentially a hedonic price[18] for the 'green attributes' of electricity generated from RES. If the price of REC falls below this level, RE generators are better off selling their output under the FiT scheme, and vice versa. The REC price would be capped from the above by the minimum specified buyout price (P_{BP}) across states.[19] The obligated entities in a state with a minimum buyout price would be the first one to opt to pay buyout price than paying for a REC price higher than this level.

The CERC has recently specified forbearance and floor price for solar and non-solar RECs (Table 3.5). The CERC (2010b) estimated the difference between feed-in-tariff and APPC ($P_f - P_p$) across the states and chooses the maximum level as forbearance price (Rs 3.9 per kWh for non-solar case). Further, a floor price is set to ensure economic viability of RE projects. Due to paucity of space, we do not discuss the relative advantage or disadvantages of the approach to fix the two price limits as proposed in this chapter and that adopted by the CERC. As discussed below, the CERC approach has led to higher floor as well as forbearance prices.

Table 3.5 CERC's Forbearance and Floor Price for RECs

	Non solar REC (Rs/MWh)	*Solar REC (Rs/MWh)*
Forbearance Price	3,900	17,000
Floor Price	1,500	12,000

Source: CERC (2010b).

The choice of maximum difference not only encourages inefficiency in choice of resource and technology but also provides potential windfall gain to technologies which have significant cost advantage. This is also not consistent with the Electricity Act 2003, Section 61(c), which states that determination of tariff by the appropriate commission should be guided by 'the factors which would encourage competition, efficiency, economical use of the resources, good performance and optimum investments'. Further, the National Tariff Policy also states that the 'new capacity addition should deliver electricity at most efficient rates to protect the interests of consumers'. While preferential tariffs and promotion of RES is desirable and should continue, no room should be left to breed inefficiency in investment and operation in the sector.

Tariffs are the most appropriate instruments to ensure efficient choices by producers in choice of technology and appropriate renewable energy source. A higher floor price for REC would not provide incentive for cost reductions and improvement in technology. The prescribed levels of floor and forbearance price provide a room for windfall gain for investors in RES in some states. Table 3.6 illustrates this for non-solar RECs. The effective peak and floor tariff for non-solar technologies in the minimum and the maximum level of revenue investors would make per unit of electricity supplied form RE projects in the respective states. The effective floor tariff works out to be higher than the prevailing FiT in some states. This would clearly increase the cost of RPO compliance and pass on excess burden to consumers in such states. This is in contract the philosophy of the RECs, which are expected to bring down the cost of compliance.

We can note from Table 3.6 that the wind energy projects in Tamil Nadu, Rajasthan, and Maharashtra would find the REC market more lucrative than selling the electricity under the applicable FiT in the respective states, and make windfall gains as compared to the latest FiT. In the case of biomass and co-generation projects in Maharashtra and biomass projects in Tamil Nadu, the FiT scheme would remain the more attractive alternative. Even within the CERC approach, the forbearance and the floor price for RECs should be set at the respective minimum levels observed across the states. This would encourage efficiency and remove room for windfall gain for certain technologies in a few states. Accordingly, these two price limits should not be higher than the equivalent of Rs 1.66 per kWh and Rs 0.29 per kWh, respectively (based on data presented in CERC 2010b).

The electricity generated from RES embodies green attributes that offset carbon emissions on account of use of fossil fuels in electricity generation. Given the floor and the forbearance price of REC fixed by the CERC,

[17] Theoretically speaking, only when the supply of RECs from the state with this minimum difference is exhausted, the floor price would automatically move to the second lowest difference and so on.

[18] Hedonic price is generally used to estimate the economic value of environmental attributes that influence market prices. This is often applied to value local environmental attributes embedded in housing prices.

[19] Theoretically speaking, only when the demand of RECs from obligated entities in the state with the minimum buyout price is exhausted, the forbearance price would automatically move to the second lowest buyout price and so on.

Table 3.6 Forbearance and Floor Price for RECs: Encouraging Inefficiency and Windfall Gains

State	*RES*	*Tariff as per RE Tariff Regulation*	*APPC for 2009–10*	*Difference between RE tariff and APPC*	*Effective Peak Tariff for non-solar*	*Effective Floor Tariff for non-solar*	*Prevailing Feed-in-Tariff*[@]	*Windfall Gain*[#]
(1)	*(2)*	*(3)*	*(4)*	*(5) = (3)–(4)*	*(6) = (4) + P_{FB}*	*(7) = (4) + P_{FL}*	*(8)*	*(9) = (7)–(8) to (6)–(8)*
Rajasthan	Wind	5.63	2.57	3.06	6.47	4.07	3.83	0.24–2.64
Tamil Nadu	Wind	4.17	2.51	1.66	6.41	4.01	3.39	0.62–3.02
Maharashtra	Wind	5.63	2.51	3.12	6.41	4.01	2.86–4.29	0–3.55
Maharashtra	SHP	4.31	2.51	1.8	6.41	4.01	3.14	0.87–3.27
Maharashtra	Biomass	4.76	2.51	2.25	6.41	4.01	4.98	0–1.43
Maharashtra	Co-gen.	4.8	2.51	2.29	6.41	4.01	4.79	0–1.62
Tamil Nadu	Biomass	5.08	2.51	2.57	6.41	4.01	4.66	0–1.75

Notes: All figures are in Rs/kWh. Apart from columns 6–9, the rest of the data is from CERC (2010 b); P_{FB}—Forbearance price for non solar RECs (from Table 3.5); P_{FL}—Floor price for non-solar RECs (from Table 3.5); APPC - Average Power Purchase Cost; [@]—The prevailing feed-in-tariffs are from latest available tariff orders of respective SERCs. [#]—Minimum (maximum) level of windfall gain corresponds to the floor (forbearance) price.

one can infer the implicit carbon value embedded in the RECs. Table 3.7 gives an illustration of the same for solar as well as non-solar RECs. It is based on the assumption that environmental attributes of RECs represent only the carbon displacement from conventional electricity generation. This is achieved by applying the baseline data for the Indian power sector worked out by the CEA (2009b). We use both simple operating as well as combined margins to illustrate our approach.

One can note that the floor and the forbearance price set by the CERC translate to a carbon price of about Euro 25 (Euro 198) and Euro 64 (Euro 281) respectively. In contrast to this, the CERC future price on the European Climate Exchange ranged between Euro 10.88 and Euro 14.45 in 2010. It touched a low of Euro 7.39 in February 2009 and a peak of Euro 23.88 in July 2008. Clearly, the floor and forbearance price of RECs have been set higher and do not conform to the carbon value witnessed in the environmentally conscious regions like the European Union. Additionally, RE generators may also be able to sell CDM credits separately. There is clearly a need for corrective action.

Table 3.7 Floor and Forbearance Price: Implicit Price of Carbon[20]

	Units	*Non-Solar*		*Solar*	
		For Simple Operating Margin (excl. Imports)	*For Combined Margin (excl. Imports)*	*For Simple Operating Margin (excl. Imports)*	*For Combined Margin (excl. Imports)*
Operating/Combined Margin	tCO_2/MWh	1.009	0.859	1.009	0.859
REC floor Price	Rs/MWh	1500	1500	12000	12000
Implicit floor price of carbon	Rs/tCO_2	1486.02	1746.01	11888.20	13968.07
Implicit floor price of carbon	Euro/tCO_2	24.77	29.10	198.14	232.80
REC forbearance price	Rs/MWh	3900	3900	17000	17000
Implicit forbearance price of carbon	Rs/tCO_2	3863.66	4539.62	16841.61	19788.10
Implicit forbearance price of carbon	Euro/tCO_2	64.39	75.66	280.69	329.80

Note: 1 Euro = Rs 60.
Source: Author.

[20] The implicit price of carbon is calculated as the REC floor price divided by the emission factor (obtained from simple operating or combined margin).

Conclusions

The basic principles of market design often flow from economic theory and are then 'tuned' to address market imperfections. Introduction of renewable energy certificates in India brings new opportunities and challenges for various stakeholders. The traditional policy and regulatory framework for promotion of renewable energy sources is based on specification of an RPO for the obligated entities, who need to compensate the RE generators as per the prevailing feed-in-tariff, which varies across states. The demand-supply mismatch is manifested in the shortfall in meeting RPO targets across most of the states in India. The prevailing conditions disregard economic efficiency wherein the most economically viable resources should be utilized first using the appropriate technologies. The variations in resource endowments and RPO targets further complicate the situation. Apart from setting more realistic RPO targets based on techno-economic studies, a market-based mechanism for RECs, seems to offer promise to partly address the prevailing economic anomalies and bring greater participation in the promotion of RES.

The CERC's regulation for developing a market for RECs in the country is a welcome step in this direction. However, the framework for developing a market for RECs brings in new imperfections and does not provide enough incentive for efficient investment and operation. There is clearly a scope for improvement. The chapter highlights many such issues and supports them with economic arguments. The vision for developing a thriving market for RECs needs to imbibe greater economic efficiency and expand the scope for participation. This would help encourage the obligated entities to meet their RPO targets in a cost-effective manner. The existing levels of floor and forbearance price do not encourage efficiency and seemingly provide windfall gain to RE investors in some states. This exercise may be revisited in the line of arguments presented in the chapter. Absence of banking and a buyout price also remain key hurdles to developing an efficient market for RECs. These can be specified at the state level by individual SERCs. The institutional set-up to register and track the RECs would serve a meaningful role in providing similar services for projects under the FiT scheme as well. The chapter also suggests a mechanism for trading excess RE procured by the obligated entities over and above the applicable RPO targets, through the REC mechanism. This opportunity should also be utilized to enhance support to small but socially desirable applications like stand-alone rural electrification schemes and development of a voluntary market.

Adoption of market-based instruments like RECs should be based on principles which encourages choice of cost-effective RES and promotes efficient investment and operation of RE plants across the country. By setting a higher forbearance and floor price for RECs, we seem to have missed this opportunity to effectively use a new market institution to meet the above objectives and to strengthen the ethos established under the Electricity Act 2003 and the National Tariff Policy. The REC regulations leave a room for improvement and the proposed suggestions merit regulatory attention.

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