# Policy Instruments for Promotion of Renewable Energy Generation: Development of a Suggestive Framework for Indian REC System

**Thesis**

*by*

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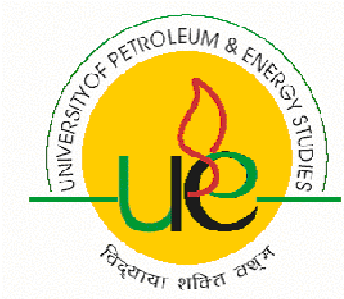


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*to*

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I dedicate this work to my late mother whom I lost during this period.

***(Sushanta Kumar Chatterjee)***

# DECLARATION

I hereby declare that this submission is my own work and that, to the best of my knowledge and belief, it contains no material previously published or written by another person nor material which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgment has been made in the text.

**(Sushanta Kumar Chatterjee)**
October, 2013

UNIVERSITY OF PETROLEUM & ENERGY STUDIES

(ISO 9001 : 2008 & ISO 14001 : 2004 Certified)

## CERTIFICATE BY THE THESIS SUPERVISOR

This is to certify that the thesis titled **"POLICY INSTRUMENTS FOR PROMOTION OF RENEWABLE ENERGY GENERATION: DEVELOPMENT OF A SUGGESTIVE FRAMEWORK FOR INDIA RENEWABLE ENERGY CERTIFICATE (REC) SYSTEM"** submitted by Shri Sushanta Kumar Chatterjee for the award of the degree of Doctor of Philosophy is a bona fide record of the research work carried out of him under our supervision and guidance. The content of the thesis, in full or parts have not been submitted to any other Institute or University for the award of any other degree or diploma.

Place: Dehradun
Date: 20.09.2013

**Dr. Anirban Sen Gupta**
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RESEARCH SUPERVISOR

PLACE : NEW DELHI
DATE :

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DATE : 20.09.2013

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# EXECUTIVE SUMMARY

In India, renewable energy (RE) generation sources have been encouraged traditionally through various financial and fiscal incentives, followed by preferential tariff and renewable purchase obligation (RPO) determined by the Electricity Regulators. In 2010, a new instrument called Renewable Energy Certificate (REC) mechanism was introduced.

The Renewable Energy Certificate (REC) mechanism was introduced in India with a lot of promise for promotion of renewable energy. But today it faces real challenges that seem to be vitiating the investment climate in RE sector in general and wind and solar segments in particular. It is in this backdrop that this research has been undertaken seeking to identify various issues and options to make REC a market mechanism in true sense to facilitate large scale RE capacity addition.

Renewable energy is mainly concentrated in a few states, and within a state, is confined to a few pockets. Uneven distribution of RE resources has its own implication. For instance, the state commissions in RE resource deficit states can not specify higher Renewable Purchase Obligation (RPO). On the contrary, resource rich states where there is high potential of RE resources are reluctant to harness RE potential beyond the fixed RPO because of the high cost of RE generation. The introduction of Renewable Energy Certificates (REC) is an attempt to address this problem - arising from gap between the availability of and demand for RE resources to fulfill RPO. Under the REC framework, an RE generator can sell electricity component, say to the local distribution licensee at its (discom's) average pooled power purchase cost (APPC) and associated environmental attributes in the form of RE Certificates to obligated entities or voluntary purchasers.

India has gained experience of REC transaction for over two years now. Several important milestones have been reached in the trading sessions for non-solar and solar RECs. A total of 4,022MW of Renewable energy generators have been accredited for REC out of which 3,632 MW of capacity have got registered as on 1st July 2013 (REC Registry, 2013).

Even as the registrations are substantial and the initial volume growth has been encouraging, the trend in terms of volume and price of REC over the period presents a not-so-promising future for REC in India. There is huge unsold inventory in the REC market. Of the total RECs offered for trading, less than 5% are redeemed. This leads the researcher to probe on the question as to what could be the reasons for such sentiments in REC market. The research therefore proceeds to study the REC market in India in greater depth and to suggest a way forward for the further progress of this market in the country.

Literature survey as also the experience shared by the stakeholders reveals primarily the constraints and challenges in the way of promotion of renewable energy generation sources in India, in general and REC in particular. The following specific gaps are revealed from literature review, in the context of REC framework in India: Indian REC framework has not been reviewed with very specific problems. It is also observed from the literature survey that REC framework has been studied in isolation. There is a need to benchmark the REC mechanism with international framework on REC.

Some broad suggestions have been made in various reports, for overcoming the constraints and challenges in some cases. But no in-depth study or research has

gone into addressing the issues holistically and suggesting a viable and feasible way forward. The research gap, therefore, is obvious. It is in this context that the present research has been undertaken to identify various factors responsible for the present state of performance of REC and to develop a suggestive framework for REC scheme in India.

The research starts with understanding of factors based on literature and goes on to validate them by engaging with stakeholders through questionnaire. The study then analyses the behavior of important stakeholders like buyers, sellers, investors, financial institutions to reinforce the understanding of the factors. Subsequently, comparison with international experience with focus on UK model of ROC has been done to identify the gaps in the Indian REC scheme. The gaps so identified have been further validated through survey of opinion of senior level functionaries associated with the process. Based on such detailed process of identification of factors and analysis, the study has recommended a framework which provides a win-win situation for all major stakeholders. The recommendations define the processes in implementation of the suggested framework by outlining the desirable policy and regulatory interventions at macro and micro levels and in the short/medium and long term time horizon.

To start with, a detailed analysis of the trend of REC trading has been undertaken. This analysis reveals that the obligated entities (the distribution licensees etc) are not coming forward in the market for buying RECs. Only two distribution companies are reported to be buying RECs in June, 2013 to meet their RPO partly. Also, of the total RECs traded, discoms' share in terms of purchase of REC is less

than 50%. The reasons as to why the obligated entities are not participating in the REC market have been analysed.

The available data reveals two possible reasons for this. At one level it is due to the lack of RPO compliance and enforcement by State Electricity Regulators. RPO compliance in most States falls short of the target set. As per regulations in most states, when the obligated entity does not meet its RPO targets during a year, the Commission may instruct the obligated entity to pay into a fund (which is created and maintained by the State Agency) an amount equivalent to shortfall in quantum of RPO equivalent of energy multiplied by the forbearance price of REC. In the absence of strict enforcement of RPO the obligated entities have the least interest to participate in the REC market. This seems to have shattered the confidence of the investors on the REC scheme. The research finds declining trend of accreditation and registration of RE projects under REC mechanism, especially since April, 2012. The MW capacity accredited (1345 MW) during 2012-13 is almost half the capacity (2328 MW) accredited during 2011-12. Thus, the initial enthusiasm of investors for investment through REC route is on the wane.

Worldwide experience shows that a stable and long-term RPO trajectory and strong deterrent against non-compliance of RPO have been used as important interventions of promotion of renewable energy. India lacks on both the fronts. Section 86 (1) (e) of the Electricity Act, 2003 doesn't specify national level RPO. It has been left to the State regulators to specify the same. RPO is specified by the States based on the resources available in their states. Moreover, the maximum penalty amount specified in the Act is Rs. 1 Lakh only, which is too little to deter against non-compliance of RPO.

The above analysis reveals that absence of proper enforcement of RPO is one of the major factors responsible for non-participation of distribution companies in the REC market. However, this is not the only reason.

At another level, the reason for non-participation of distribution companies could be attributed to – their Poor financial health; REC not being a viable option for resource rich states; REC providing only electronic certificates and not energy; reluctance due to infirm nature (and consequently of less value). According to the report of the high-level Shunglu Committee on Financial Position of Distribution Utilities, financial losses of electricity distribution licensees touched about Rs. 70,000 crore in 2010-11. The poor financial health of the distribution companies restricts their ability to purchase the desired quantum of power, more so the otherwise expensive power from renewable energy sources or for that matter the REC. Quite often they resort to load shedding to avoid purchase of power. This factor needs to be addressed any way for viability of power sector in general and as one of the solutions to bring the distribution licensees in the REC market for creating the demand for RECs.

Analysis of data also reveals that cost of RPO compliance of RPO by procuring power at FiT is cheaper than the cost of RPO compliance by purchasing REC for resource rich states. Therefore, distribution licensees in these states may not necessarily come to REC market for RPO compliance. Similar comparison of RPO compliance cost has been done for the resource deficit states of Punjab and Delhi, which reveals that the REC route is attractive for resource deficit states only if RECs are available at Floor Price. Therefore, such states may prefer to fulfill their

RPO target by procuring power through FiT route instead of REC route the moment REC price exceeds the threshold level of floor price.

RECs are sold in the form of electronic certificates without physical electricity. There being shortage of power supply (e.g. during May, 13 energy shortage was reported as 5.7% and peak shortage 6% as per Central Electricity Authority), purchase of RECs does not meet the need of the distribution companies in terms of power procurement. They are, therefore, generally reluctant to buy RECs which are not accompanied by physical energy.

Analysis has also been done from the RE generators' perspective to understand how the RE generators view REC as an option for investment. In India, there is a real concern about the bankability of renewable energy projects under REC route because of high risks perceived by financiers. The key constraint identified is the lack of visibility of pricing and regularity of cash-flows. There is uncertainty due to shorter visibility of REC price band as the current floor and forbearance price determined by the Central Commission are valid only until FY 2016-17. There is no visibility of REC revenue after FY 2017. Another source of revenue under the REC mechanism is sale of electricity component to local distribution licensee at the Average Pooled Power Purchase Cost (APPC). In the event of the licensees' insistence on purchase of electricity at a rate lower than the APPC, there could be a viability gap for the RE projects, especially if the REC price discovered in the Power Exchange(s) is close to Floor price. Thus, the cash flow on both counts (APPC and REC) becomes uncertain in the current scheme of things.

After the analysis of the secondary data, questionnaire (Likert's scale) based survey has been undertaken to elicit views of the stakeholders on the issues and challenges facing the REC implementation in India. The responses so collected have been scrutinized using the tool of Factor Analysis. This yielded the factors affecting the REC framework in India. Next level of analysis has been done in terms of comparison between India and UK model of REC/ROC to understand the gaps and suggest the way forward for India. Parameters (basis) for comparison have been identified based on the secondary data research.

Both Renewable Energy certificates (RECs) in India and Renewable Obligation Certificate (ROC) in UK represent the green attributes of electricity generated from renewable energy sources. Currently, REC framework in India doesn't specify sunset clause which is specified in the ROC framework of UK up to 2037. There is no long term visibility of REC mechanism in India. In India, there is no long term national level RPO specified in the Act. In UK, there is a clear mandate in the law itself to achieve 20% RPO target by year 2020. In the REC mechanism, there is a separate categorization of the RECs based on source of energy i.e. Solar REC and Non-solar REC. On the other hand, in UK there is a unified market of ROCs using a multiplier for different sources. Current categorization of REC mechanism in India has the potential of reducing liquidity and trade in the two separate markets as compared to a common market for ROCs. Currently, trade in REC is allowed only at the exchange platform. In UK, forward market in the ROCs framework, is a common phenomenon, wherein bilateral 'over-the-counter' (OTC) trade takes place, where sellers and buyers agree to enter into a mutually agreed trade of ROCs. Buyers could be obligated entities, market makers and traders. This provides

liquidity in the market. In UK, in case the obligated entity fails to fulfill its obligation, it has to pay a penalty in the form of buyout price to the regulator. This fund collected from the entities which did not fulfill their obligation is then redistributed back to the entities which have fulfilled their obligation. Such mechanism of redistributing the funds encourages more participation as it acts as an incentive to those entities which fulfill their renewable obligations. The buyout price in UK was fixed in 2001 and linked with the Retail Price Index which always has an increasing trend. In India, the forbearance price is the highest difference between the Cost of Generation/ RE Tariff and the APPC. In India, there are currently two alternate revenue schemes available for investors in RE projects-(i) FiT Scheme and (ii) Renewable Energy Certificate Scheme. The present scheme of REC does not allow certificates being issued to those projects which are registered under FiT mechanism. In UK, ROC is the primary instrument for fulfillment of RPO. Current mechanism of REC requires determination of floor price and forbearance and RECs are required to be traded between these two price bands. In UK, there is no floor and forbearance price. In UK, the buyout price is set as the difference between the electricity cost and anticipated value of marginal cost.

An expert opinion survey was conducted on the basis of gaps identified from the comparative analysis of ROC and REC models of UK and India. 38 Leading experts from the Government, Regulatory Commissions, National Load Despatch Centre, Central Electricity Authority, Generating Companies, Distribution Companies, NGOs, Industry Associations, and Financial Institutions were interviewed and their responses were recorded. According to experts changes required in the existing REC framework and issues required to be addressed, to achieve its objectives are:

Incentive for buyers for fulfillment of RPO; Strong Enforcement of RPO; Penalty for non-compliance of RPO; Applicability of RPO on large consumers; Giving clarity for post 2017 REC price; Allowing financial institution to take position of RECs; Creation of Voluntary market for REC

The above analysis has led to the following recommendations and conclusions:

Sentiment in REC market in India today is at its lowest ebb. Investment climate in RE segment especially in wind is on the decline. In order to reinstate confidence among the investors as well as the financing institution there is an urgent need for policy and regulatory interventions.

As the first level of intervention, incentive should be provided to induce the buyers to come to REC market. Analysis has revealed that one of the reasons why the buyers are not coming forward is that REC in its present form is not a viable proposition for them. In the Indian context, there should be an incentive mechanism to encourage States to set and fulfill higher RPO target. Incentive level could be different for RE resource rich states and RE resource deficit states. Incentive for resource rich States should be designed to take care of need for creation of transmission infrastructure and for setting up flexible generation to balance variability of RE resources. Incentive for deficit States should take care of higher cost of compliance.

Incentive is a short term measure. In the long run, there is a need for a policy framework to make REC a win-win proposition for the buyers as well as the sellers. A framework should be designed whereby REC is credited to every unit of RE generation irrespective of whether the said generation has been sold through

preferential tariff (regulated tariff) or otherwise. The buyers (distribution companies in this case) purchasing RE generation through preferential tariff could get REC credit along with the energy. The RECs earned by the buyers in this manner can be used to meet RPO and surplus REC if any can be sold by them in the market to mitigate high cost of their RE purchase. This will also address the present concern of the discoms that REC is only an electronic certificate and does not come with physical energy, and help overcome the consequent resistance from the energy hungry discoms. This framework would, however, imply a paradigm shift in the existing policy design for promotion of RE in general and REC in particular.

Once we have been able to develop a framework of REC which presents a win-win proposition for the buyers as well as the sellers, it would be desirable to set appropriate levels of RPO for generating demand for RE generation and consumption. At the same time, the Regulators should ensure compliance of the RPO by all the obligated entities. A clear message should be given that non-compliance of RPO will attract penalty. It is equally important that we have clarity and policy certainty about continuation of REC framework and visibility of revenue on longer time horizon. CERC should specify in its REC Regulation that the REC will be issued to the eligible RE generators at least for 15 years (12 years loan period plus additional three years). CERC should review extension of the REC scheme based on experience. This clarity is required to give comfort to the financial institution and bankers for REC revenue visibility and investment certainty.

The next level of suggested intervention relates to the REC design issues. Longer visibility of REC price is the first important requirement for guaranteeing certainty

of revenue stream for a project opting for REC route. CERC has determined floor and forbearance prices. The floor and forbearance prices are valid up to 2017. This creates uncertainty in terms of revenue stream (cash flow) estimation for a project which is expected to have life of 25-35 years. It is suggested that REC prices in India should be determined based on the difference between projected incremental conventional power purchase cost and current cost of conventional power. REC price so determined should be indexed to inflation (WPI and CPI).

Another important lesson from UK experience is the concept of banding or multiplier. In India, we have a segmented market for solar and non-solar REC. Such segmentation restricts market for the respective technologies. REC market should be unified and technologies like solar which need support in the present phase of its development should be given higher REC credit (more than one REC for one megawatt hour of electricity generated). Technology and vintage based multiplier should be introduced in India.

It is equally important to allow traders and other intermediaries to participate in REC trade. This is not allowed presently. Introduction of traders and other intermediaries will bring depth in the market while at the same time taking care of risks that go with the present scheme of REC. There is at the same time a strong need for development of voluntary market. This can supplement market making which today is dependent only on mandatory market through obligated entities.

REC system has a lot potential in terms of promotion of renewable energy in general and wind and solar in particular. In fact, this mechanism was introduced to address inter alia the problems of these two segments (wind and solar) – the

problems arising out of their infirm nature and constraints in terms of inter-state transfer of power from these RE sources. It did start off well but is today saddled with challenges. The above suggested policy and regulatory prescriptions are the minimum level of interventions required to revitalize the RE segment and in particular the wind and solar sources of energy. The earlier the initiatives are taken the better for the sector.

The unique theoretical contribution of this work lies in its novel and holistic perspective to identify various parameters from different papers, reports and documents and from international experience of REC scheme. In this study, broad parameters have been identified in the context of REC. The parameter identification is the important contribution of this study.

This study also seeks to contribute to the discipline of Policy Design by articulating the need for factoring in the behavioral aspects right at the stage of conceptualization and design of any policy. Behavior and possible response of REC system on the users and service providers have been analysed before recommending policy prescriptions in the context.

# ABBREVIATIONS

| | |
|---|---|
| ACP | Alternative Compliance Payment |
| APPC | Average Pooled Power Purchase Cost |
| BP | Buy-out Price |
| CEA | Central Electricity Authority |
| CERC | Central Electricity Regulatory Commission |
| CPP | Captive Power Plant |
| CUF | Capacity Utilization Factor |
| CWET | Center of Wind Energy Technology |
| DNI | Direct Normal Incidence |
| EPS | Energy Power Survey |
| FiT | Feed-in Tariff |
| GBI | Generation Based Incentive |
| GDP | Gross Domestic Product |
| GHG | Green House Gas |
| ITC | Investment Tax Credit |
| JNNSM | Jawaharlal Nehru National Solar Mission |
| LBNL | Lawrence Berkeley National Laboratories |
| MNRE | Ministry of New and Renewable Energy |
| MTOE | Million Tonnes of Oil Equivalent |
| MTPA | Million Tons Per Annum |
| MW | Mega Watt |
| MWh | Mega Watt hour |
| NAPCC | National Action Plan on Climate Change |

| | |
|---|---|
| NLDC | National Load Despatch Center |
| NREL | National Renewable Energy Laboratories |
| OFGEM | Office of the Gas and Electricity Market |
| PTC | Production Tax Credit |
| PV | Photo Voltaic |
| REC | Renewable Energy Certificate |
| RE | Renewable Energy |
| RET | Renewable Energy Technology |
| RO | Renewable Obligation |
| ROC | Renewable Obligation Certificates |
| RPO | Renewable Purchase Obligation |
| RPS | Renewable Portfolio Standards |
| TERI | The Energy Resource Institute |
| TREC | Tradable Renewable Energy Certificate |
| UK | United Kingdom |
| UNEP | United Nations Environment Programme |

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# CHAPTER 1
# INTRODUCTION

## 1.1 BACKGROUND

Energy security is a matter of great concern for India. Given the current state of energy access, shortages and the expected needs for energy in the future, meeting energy needs and providing adequate and quality supply of energy to all, poses a real challenge.

There are projections that we need to increase, by 2031 our primary energy supply by around 3- 4 times and our power generation capacity by 5 to 6 times of the 2003/04 levels (World Bank, 2010). The Planning Commission (2006) estimates that India's total energy requirements would be between 1351-1702 Million Tonnes of Oil Equivalent (MTOE) under an 8% GDP growth scenario, as reflected in **Table 1.1.** India's domestic coal production could be in the range of 600 MTPA, with the current coal production technology. As regards oil production, it has stagnated at the level of around 33 MT in the past few years. It is not expected to increase significantly. In the last decade or so, generation of electricity from natural gas has emerged as a clean energy option. However, there is uncertainty about the level of its indigenous availability. It is estimated that by 2031-32, oil (up to 90%), natural gas (up to 50%) and coal (between 11–45%) would need to be imported to meet India's energy needs for economic growth rate of 8% per annum (Planning Commission, 2006). This has been reflected in **Table 1.1**.

**Table 1.1: Energy Requirement of India by 2031-32**

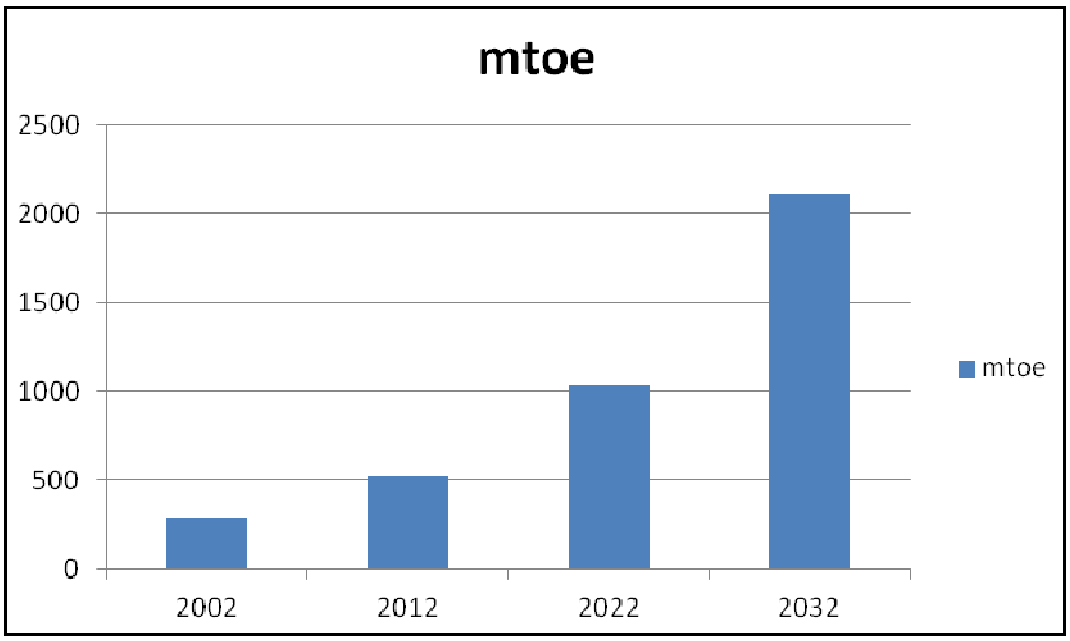
| Fuel | Range of Requirement in Scenario | Assumed Domestic Production | Range of Imports* | Import (%) |
|---|---|---|---|---|
| | (R) | (P) | (I) | (I/R) |
| Oil (Mt) | 350-468 | 35 | 315-451 | 90-93 |
| Natural Gas (Mtoe) including CBM | 100-197 | 100 | 0-97 | 0-49 |
| Coal (Mtoe) | 632-1022 | 560 | 72-462 | 11-45 |
| TCPES | 1351-1702 | - | 387-1010 | 29-59 |
| Range of imports :<br>Lower bound = Minimum requirement – Maximum domestic production<br>Upper bound = Maximum requirement –Minimum domestic production | | | | |

Source: Planning Commission of India, Integrated Policy Report (2006)

Here (in Table 1.1), the range of imports (I) has been derived based on the difference between range of requirement (R) and Domestic Production (P) and Import in percentage terms has been deduced from Import and Requirement (I/R).

TERI (2007) presents another projection about energy needs. It indicates the increasing trend of commercial energy requirement in India over the period – from 2002 to 2032 - and avers that the energy needs would increase to 2108 mtoe by 2031-32 under 8% GDP growth scenario given the current policies of the Government. This is reflected in **Figure 1.1**.

**Figure 1.1: Commercial Energy Requirement of India**




Source: India's Energy Security Report, TERI, 2007

The above figure 1.1 shows how commercial energy requirement of India has been increasing over the last decade and how it would grow upto 2032.

We, therefore, find the increasing trend in the energy requirements of India and given that our domestic production is limited we tend to increasingly depend on import to meet the energy demands in the country.

Considering the fact that availability of conventional sources of energy is limited, promotion of renewable energy generation sources is a key focus area. Renewable Energy (RE) Sources primarily constitute wind, solar, small hydro (upto 25 MW), biomass, bio fuel and cogeneration. According to Ministry of New and Renewable Energy (MNRE, 2013), as of 31 July 2013, total share of grid connected renewable energy was 28,905.21 MW, which represents approximately 12% of India's total installed electric generating capacity. India has around 90,000 MW of renewable

energy potential from wind, small hydro and biomass sources. The potential for solar is estimated to be around 50 MW /$Km^2$ under open, shadow free area.

Various policy initiatives have been introduced in the form of both non-market and market based instruments for promoting RE in India. Some of the non-market based initiatives include financial incentives such as Capital subsidy/grant (for promotion of renewable energy technologies like: Small Hydro Plants, Biomass based rankine cycle power plants, Bagasse based co-generation plants, Biogas and Biomass Gasifier based projects etc.); accelerated depreciation (at the rate of 80% on a written down value basis for various renewable energy items);Preferential Tariff (i.e. the guaranteed tariffs fixed by the electricity regulators on preferential terms) for electricity generated from RE Sources; Generation Based Incentive (GBI) (incentive linked to actual generation of electricity from specified RE sources); excise duty exemption, sales tax exemption, income tax exemption for 10 years, etc. Market based instruments tried in India include Auction/Competitive Bidding (for instance, solar projects under Jawaharlal Nehru National Solar Mission (JNSMM) were based on reverse auction) and Renewable Energy Certificates (REC), a concept that separates the electricity component and green attributes of renewable energy generation and requires the RE generator to sell these products in the market independently.

Given the increasing importance of renewable energy, especially in the context of energy security and climate change needs, tracing various policy instruments deployed for promotion of renewable energy sources is highly topical. It is all the more contextual to probe into the latest policy and regulatory initiative of REC, to understand how it gels with and to what extent it needs to be refined to align with the larger objective of green energy development.

## 1.2 CONTEXT: BUSINESS PROBLEM

In India, renewable energy generation sources have been encouraged traditionally through various financial and fiscal incentives, followed by Preferential Tariff and Renewable Purchase Obligation (RPO) determined by the Electricity Regulators. Preferential tariff is the tariff determined on preferential terms for power generation based on RE sources. RPO implies the obligation to procure certain specified percentage of the total power purchase need in a distribution area from the Renewable Energy Source. The Electricity Act, 2003 (Ministry of Law and Justice, 2003) empowers the State Electricity Regulatory Commission (SERCs)/Joint Electricity Regulatory Commission (JERCs) to specify RPO. Distribution companies, captive generating plants (CGP) and Open Access consumers are the obligated entities. Traditionally, the obligated entities purchase RE generation to meet their RPO. In 2010, a new instrument called Renewable Energy Certificate (REC) mechanism was introduced providing an alternative route to the obligated entities to comply with their RPO. This framework also sought to encourage renewable energy generators by providing another avenue (-other than preferential tariff route) for sale. REC scheme aims to encourage the renewable energy generation capacities in the States where there is potential for renewable energy generation by creating a national level market for such renewable energy generators to recover their cost of generation. Under the REC framework, an RE generator can sell electricity component to the local distribution licensee at its (discom's) average power purchase cost (APPC) or sell electricity under third party sale at mutually decided rate, or sell electricity at power exchanges at market determined rate. RE generator can sell associated environmental attributes in the form of RE Certificates to obligated entities or voluntary purchasers.

Since the introduction of REC framework in 2010, about 3700 MW of RE generation capacity has been registered through this (REC) route (REC Registry, 2013). Empirical experience as also literature survey, however, reveals that the initial enthusiasm in terms of investment through REC route has been waning. As per the information available in the website of the REC's central agency (NLDC), there is huge unsold inventory of REC. In August 2013, a total of 4,88,824 Non-solar RECs were issued. Combined with the 27,09,391 Non-solar RECs that remained unredeemed in July 2013, a total of 33,59,617 Non-solar RECs were available for trading during August 2013. However, only 40,889 Non-solar RECs were sold/redeemed and an inventory of 31,57,326 Non-solar RECs remained unsold. Of the total Non-solar RECs offered for trading, about 1.37 % were redeemed. Similar is the market trend of Solar REC. In the month of August 2013, a total of 12,890 Solar RECs were issued. Combined with 19,651 Solar RECs that remained unredeemed in July 2013, a total of 32,541 Solar RECs were available for trading during August 2013. However, only 2,359 Solar RECs were sold / redeemed and an inventory of 30,182 Solar RECs remained unsold as of August, 2013. Of the total Solar RECs offered for trading, about 7.8 % were redeemed. Demand for RECs is very low – on an average 50,000 to 1 lakh non solar RECs are sold per month. With this rate of sale, RECs are lapsing/likely to lapse due to limited validity period of 365 (presently 730) days. Around 2100 MW RE capacity was registered under REC in the initial year (2011-12), while in the 2012-2013 only 1253 MW were registered. The investment climate in the REC market has thus dampened substantially posing a question mark to the efficacy of the REC system. This calls for immediate intervention through appropriate policy and regulatory framework.

## 1.3 MOTIVATION FOR RESEARCH

The REC mechanism was introduced with a lot of promise but today it faces real challenges that seem to be vitiating the investment climate in RE sector in general and REC market in particular. There are various factors affecting the policy processes and some of the factors have been studied by some experts in isolation. For instance, lack of RPO compliance is cited as the reason for poor implementation of REC framework in India. It has also been reported that the buyers are not coming forward in the REC market. Based on the factors identified desirable corrective measures have been suggested in some reports. However, most of these recommendations stand alone without relating to the totality of the problem. It is in this context that this research is being undertaken with a view to bringing out all possible factors responsible for the present state of REC scheme in India. The research seeks to analyse the behavior of important stakeholders like buyers, sellers, investors, financial institutions to reinforce the understanding of the factors. The objective is to bring a 'total' view of the problem at hand.

In this backdrop, detailed research is being undertaken to identify various issues and options to make REC a market mechanism in true sense to facilitate large scale RE capacity addition in the long run. It is also proposed to review the experience gained by other countries with the tradable renewable energy certificate system for example in UK. Renewable Obligation (RO) was introduced in UK in 2002 (OFGEM Renewables Order, 2002) for over 5 Megawatt (MW) renewable electricity projects. The UK renewable energy targets the growth from 6.6 % in 2009 to 9% in the third quarter of 2011. RO has played a major role in harnessing renewable energy sources in UK, effectively to broaden energy and climate change

objectives of UK, including Greenhouse Gas (GHG) emissions reductions, de-carbonizing of the UK grid and energy security. The ROC mechanism has unique features like: Banding, Banking, Buyout price as a penalty for non-fulfillment, inbuilt incentive mechanism for the obligated entities for fulfillment of RPO, Secondary and forward market mechanism etc.(OFGEM, Renewables Obligation Order 2009) These features are not available in the current REC mechanism in India. It would be desirable to compare these facets of UK model of ROC with that of REC in India.

The motivation behind this research is also to provide a theoretical construct of how effectiveness of alternatives available should be explored and understood, before policy decision. In this study, the researcher also seeks to contribute to management practices, especially in the emerging field of green energy and sustainable development.

## 1.4 STRUCTURE OF THESIS

The Thesis covers seven chapters including the present Introduction Chapter.

**Chapter 2: Overview of Power Sector and Renewable Energy Sources in India**

This chapter presents overview of power sector and outlines various renewable energy resources and technologies available in India. It discusses renewable energy potential and achievement so far, growth trend during the Plan periods and future capacity addition plan. It also traces the factors especially the policy interventions contributing to achievement of RE potential so far and highlights the importance of these policy instruments in bridging the gap between the potential and achievement of RE sources in India.

**Chapter 3: Literature Review**

Having introduced the need and importance of the policy instruments for promotion of RE sources in Chapter 2, this chapter discusses international and Indian experience of using various instruments for promotion of generation based on renewable energy. It discusses in detail the issues and challenges in India in promotion of renewable energy in general and REC scheme in particular, which is the central theme of the research. Literature review also covers UK experience on Renewable Obligation Certificate (ROC) and highlights the gaps in REC scheme in India. This chapter presents the rationale behind the research by discussing the various policy instruments, highlighting the issues and challenges and by identifying the gaps in Indian REC system.

**Chapter 4: Research Methodology**

The context of research having been established in the previous chapter, this chapter goes to explain the approach and methodology of undertaking the research. It explains the research design, the statement of the research problem/gap, research questions, objectives of the study, the research methodology, sampling process, data collection, variables derived through literature survey and tools for analysis of primary and secondary data.

**Chapter 5: Analysis and Results**

This chapter deals with the analysis to find answers to the research questions. Analysis has been done using the methodology highlighted in the previous chapter. This chapter discusses in depth comparison of REC framework in India and UK. It also covers analysis of results of responses through questionnaire and identifies various factors affecting existing Indian REC framework including analysis of

results of opinion survey on gaps identified in Indian REC framework. Results of the analysis have been evolved in this chapter in the form of suggestive framework.

**Chapter 6: Conclusions and Theoretical Contribution**

This chapter gives the findings, conclusions and recommendations of the study. It also highlights the theoretical contribution of the research.

**Limitations and Future Study**

It covers limitations and future Scope of study.

The construct of the research is depicted below in **Table 1.2:**

**Table 1.2: Structure of Thesis**

| | |
|---|---|
| **Phase 1: Research Context**<br>This phase explains context of research and introduces the topics relevant to research | **Chapter 1**<br>Introduction |
| | **Chapter 2**<br>Overview of Power Sector and Renewable Energy Sources in India |
| **Phase 2: Research review**<br>Extensive review on journals, Reports, other relevant literature has been carried out in this phase | **Chapter 3**<br>Literature Review |
| **Phase 3: Research problem development and Research Design**<br>Based on the Phase 2 Review, research problem/gap has been identified in this phase. The researcher has at this Phase drawn insights from the data and defined objective of the research and the methodology to achieve the objective. | **Chapter 4**<br>Research Methodology |
| **Phase 4: Data Analysis**<br>Questionnaire survey is the main research methodology used for primary data collection and Factor analysis tool has been used to analyse the data so collected. Secondary data has been analysed using various statistical tools. Parameters have been developed. Comparison has been done between two systems based on the parameters. Results of the analysis have also been highlighted at this Phase. | **Chapter 5**<br>Analysis and Results |
| **Phase 4: Discussion and conclusions**<br>Findings are discussed and contributions to research and theory are highlighted. Directions for future work are also mentioned. | **Chapter 6**<br>Conclusion and Theoretical Contribution |
| | Limitation and Future Scope of Study |

# CHAPTER 2

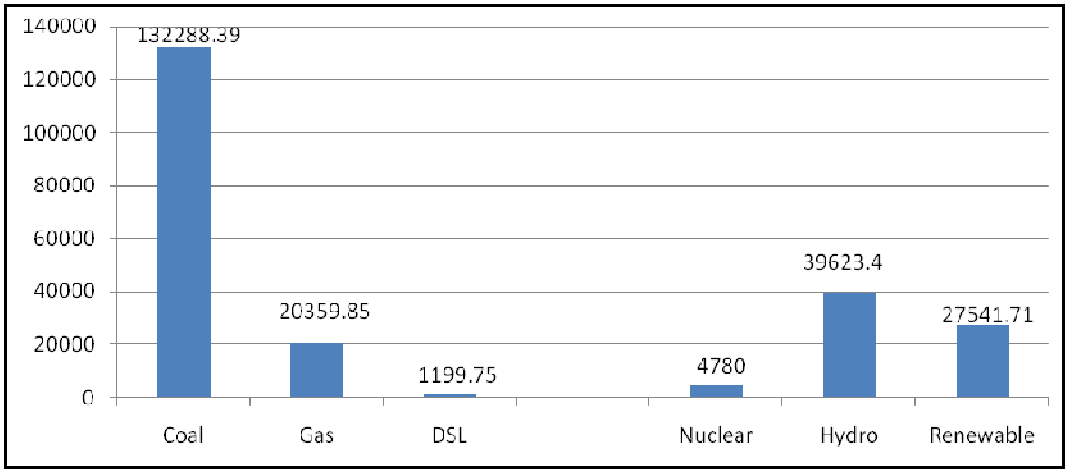
# OVERVIEW OF POWER SECTOR AND RENEWABLE ENERGY SOURCES IN INDIA

## 2.1 OVERVIEW OF POWER SECTOR

Power Sector is pivotal to economic development of any country. The industrial and commercial activities in the country have gained momentum since liberalization. This is expected to result in growth in power demand. Development of the Power Sector, therefore, has to match with the overall economic development of the country.

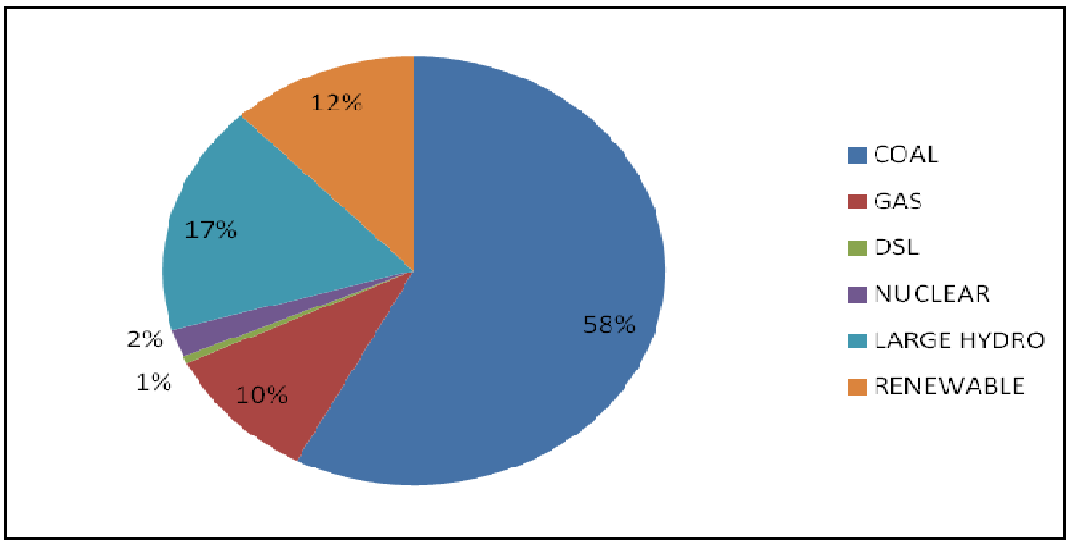
Indian power sector has witnessed substantial progress in terms of power generation since independence. The installed generation capacity has augmented to about 2, 25,793.10 MW at the end of July 2013(Central Electricity Authority, 2013), as reflected in **Figure 2.1 and Figure 2.2.**

**Figure 2.1: All India Generation Installed Capacity (MW) as on 31.07.2013**




Source: Central Electricity Authority, 2013

**Figure 2.2: Overall Generation Mix as on 31.07.2013**




Source: Central Electricity Authority, 2013

The above figures (Figure 2.1 and Figure 2.2) reflect that India's power sector is largely dependent on coal based power plants. The Installed Capacity comprising 1,32,288.39 MW (58%) is based on coal, followed by gas based generation comprising 20,359.85 MW (10%), diesel generation 1200 MW (1%), hydro 39,623MW (17%), nuclear 4,780 MW (2%) and RE sources 27,541.71MW (12%).

There has been significant capacity addition in generation, transmission and distribution over the last sixty years. However, demand for power exceeds generation. We have peak and energy shortages of varying magnitude. During 2012-13, the energy shortage was to the tune of 70,232 MU (6.7%) and peak shortage was of the magnitude of 3261 MW (2.3%) (Central Electricity Authority, 2013).

During 12$^{th}$& 13$^{th}$ five year Plans, energy requirement and peak load requirement projected by the working Group on Power, are as reflected in the following **Table 2.1:**

**Table 2.1: Demand Adopted for Generation Planning Studies**

| Plan Periods | Energy Requirement (BU) | Peak Load (MW) |
|---|---|---|
| | **9% GDP Growth rate (0.9/0.8 Elasticity in 12th/ 13th Plan)** | **9% GDP Growth rate (0.9/0.8 Elasticity in 12th/ 13th Plan)** |
| 2016-17 (12th Plan end) | 1403 | 1,97,686 |
| 2021-22 (13th Plan end) | 1993 | 2,89,667 |

Source: Ministry of Power, 2013

The above projections (Table 2.1) – increasing trend of energy requirement (1403 BU to 1993 BU) and peak load requirement in terms of capacity (1,97,686 MW to 2,89,667) by 13th Plan end) show that energy is crucial for growth of economy. Traditionally, we have been dependent on conventional energy sources to meet our requirements. The use of such resources poses challenge as these resources cannot be renewed. This demands that we modify our energy mix and lay emphasis on renewable resources to meet energy needs. Promotion of renewable energy can help address our energy security concerns, mitigate the adverse impacts on environment and contribute to sustainable development.

## 2.2 RENEWABLE ENERGY GENERATION SOURCES

Renewable Energy (RE) Sources primarily constitute wind, solar, small hydro (upto 25 MW), biomass, bio fuel and cogeneration. Generation projects based on such RE sources can be classified under the following broad categories:

2.2.1 Grid Connected

2.2.2 Off-grid

2.2.3 Decentralized Systems

### 2.2.1 Grid Connected RE Generation Projects

Grid-interactive renewable power projects are based on wind power, biomass, small hydro and solar. Major share of renewable power capacity addition in India during the year has come through this route.

### 2.2.2 Off-Grid RE Generation Projects

Distributed/decentralized RE projects using biomass, wind, hydro and hybrid systems are established to meet the electricity requirements of communities located in isolated areas which are not going to be electrified in the near future.

### 2.2.3 Decentralized Systems

Renewable energy generation systems are generally suitable for distributed generation and supply of electricity, and they have the potential to provide a secure and reliable energy supply in the absence of grid extension as a supplement to grid power. Over 40 Crore people in India, covering 47.5% of those living in rural areas, still do not have access to power. Renewable energy can offer a viable means of providing reliable power to such groups.

## 2.3 ESTIMATED POTENTIAL OF RENEWABLE ENERGY IN INDIA

According to the Ministry of New and Renewable Energy, India has around 90,000 MW of renewable energy potential from wind, small hydro and biomass sources (MNRE, 2013). The potential for solar is estimated to be around 50 MW/ $Km^2$ of open, shadow free area.. Estimated potential of renewable energy resources are as depicted in **Table 2.2** below:

**Table 2.2: Estimated Potential of Renewable Energy in India**

| S.No. | Resource | Estimated Potential (In $MW_{eq.}$) |
|---|---|---|
| 1 | Solar Energy | 30-50 MW/sq.km. |
| 2 | Wind Power | 49,000 |
| 3 | Small Hydro Power (SHP) | 15,000 |
| 4 | Bio-Power | |
| 5 | Agro-Residues | 17,000 |
| 6 | Cogeneration - Bagasse | 5,000 |
| 7 | Waste to Energy:<br>Urban/Municipal Waste to Energy<br>Industrial Waste to Energy | <br>2,600<br>1,300 |
| | **Total Estimated Potential** | **89,900 (Excluding Solar)** |

Source: Ministry of New and Renewable Energy, 2013

The above table (Table 2.2) depicts potential estimated by MNRE for renewable energy generation based on various sources. Clearly, the highest potential is of wind (49, 000 MW), followed by biomass (Agro residues and cogeneration totaling 22, 000 MW), SHP (15, 000 MW) etc.

India receives solar radiation of more than 4.4kWh/$m^2$/day. India is also blessed with more than 300 sunny days in a year. Considering 1% usage of land to harness solar energy at an overall efficiency of 10%, there is a potential of generation of 5 trillion kWh of electricity per year as compared to actual power generation of 0.811 trillion kWh/year in 2010-2011 (Forum of Regulators, 2011).

Regarding wind energy potential, the Lawrence Berkley National Laboratory did a detailed analysis recently. As reported by LBNL (LBNL, 2011), the total wind

energy potential in India ranges between 748 GW (80m hub-height) to 976 GW (120m hub-height). It also states that off-shore potential in India is in the range of 2,37,964 MW (at 100m hub-height).

In the next section we would assess the achievement so far against the RE potential in the country discussed in the preceding sections.

## 2.4 RENEWABLE ENERGY IN INDIA: ACHIEVEMENT SO FAR

According to MNRE, as of 31st July 2013, total share of grid connected renewable energy was 28905.21 MW, which represents approximately 12% of India's total installed electric generating capacity. About 907 MW is off-grid renewable energy systems. The wind energy sector has achieved the highest success in India with total installed capacity of 19661.15 MW as on 31.72013. The country has 3,706.75 MW of small hydro plants (with sizes of less than 25 MW each) , 2337.43 MW of grid-connected bagasse based co-generation plants, and 1,264.80 MW of biomass based power (agro residues). Municipal waste-to-energy projects contribute about 96.08 MW. Off-grid RE power capacities of 486.84 MW from biomass cogeneration, biomass gasifier based generation projects of 158 MW, waste-to-energy projects of 116 MW, Solar PV projects of 132 MW, and 2.14 MW from hybrid systems are available. Indian government has recently announced Jawaharlal Nehru National Solar Mission (JNNSM) and is planning to harness its solar resource potential. As of July 2013, total Solar power projects had reached a cumulative generation capacity of 1839 MW (MNRE, 2013). This is summarized in the table below.

**Table 2.3: Achievement of Renewable Energy in India**

| Renewable Energy Programme/ Systems | Target for 2013-14 | Deployment during July, 2013 | Total Deployment in 2013-14 | Cumulative achievement up to 31.07.2013 |
|---|---|---|---|---|
| **A. GRID-INTERACTIVE POWER (CAPACITIES IN MW)** | | | | |
| Wind Power | 2500 | 96.20 | 608.20 | 19661.15 |
| Small Hydro Power | 300 | 20.50 | 74.50 | 3706.75 |
| Biomass Power | 105-300 | - | - | 1264.80 |
| Bagasse Cogeneration | | - | - | 2337.43 |
| Waste to Power – Urban | 20 | - | - | 96.08 |
| Solar Power (SPV) | 1100 | 79.56 | 152.56 | 1839.00 |
| **Total** | **4325.00** | **196.26** | **835.26** | **28905.21** |
| **OFF-GRID/ CAPTIVE POWER (CAPACITIES IN $MW_{EQ}$)** | | | | |
| Waste to Energy - Urban - Industrial | 10.00 | - | - | 115.57 |
| | | | | |
| Biomass (non-bagasse) Cogeneration | 80.00 | 12.00 | 15.69 | 486.84 |
| Biomass Gasifier -Rural - Industrial | 1.00 | | 0.10 | 16.892 |
| | 9.00 | | 1.30 | 142.88 |
| Aero- Generators / Hybrid systems | 1.00 | 0.03 | 0.03 | 2.14 |
| SPV Systems (>1kW) | 40.00 | - | 7.19 | 131.86 |
| Water mills/micro hydel | 500 Nos. | - | - | 10.65 (2131 nos) |
| Bio-gas based energy system | 2 | - | - | - |
| **Total** | **143.00** | **12.03** | **24.31** | **906.83** |
| **OTHER RENEWABLE ENERGY SYSTEMS** | | | | |
| Family Biogas Plants (No. in lakhs) | 1.10 | - | - | 46.55 |
| Solar Water Heating - Coll. Areas (Million m2) | 0.60 | 0.07 | 0.07 | 7.07 |

Source: Ministry of New and Renewable Energy, 2013

The above (Table 2.3) depicts the cumulative achievement of RE generation capacity up to July, 2013. In the next section, we would discuss the achievement of RE generation capacity addition over the various plan periods.

### 2.4.1 Achievement over the Plan Periods

The following table (Table 2.4) depicts the achievement of RE capacity addition against the targets set during various plan periods. RE capacity addition (6802 MW) during the 10th plan was nearly twice the cumulative capacity added till 9th Five year plan (3453MW).

**Table 2.4: Plan wise Growth of Renewable Power Generating Capacity**

| Sector | Cumulative Capacity in MW | | | |
|---|---|---|---|---|
| | **Beginning of 10th Plan (April 2002)** | **Beginning of 11th Plan (April 2007)** | **Beginning of 12th Plan (April 2012)** | **Cumulative Achievement Upto 31.07.2013** |
| Wind | 1,628 | 7,092 | 17,352 | 19661 |
| Small hydro | 1,434 | 1,976 | 3,395 | 3707 |
| Bio Power | 389 | 1,184 | 3,225 | 3602 |
| Solar | 2 | 3 | 941 | 1839 |
| **Total** | **3,453** | **10,255** | **24,914** | **28,905** |

Source: MNRE Annual Report 2012-13

As shown in the above Table 2.4, renewable energy witnessed a sea change during the 11th Plan period with the total installed capacity reaching about 29 GW with an annual growth rate of 23% from the 2002-03 level. During the 11$^{th}$ Plan 14.66 GW of renewable energy capacity got added in the system as against the 11$^{th}$ plan target of 12.23 GW. Wind power contributed over 10 GW during the 11$^{th}$ Plan period and was the highest among all renewable energy technologies, followed by bio power

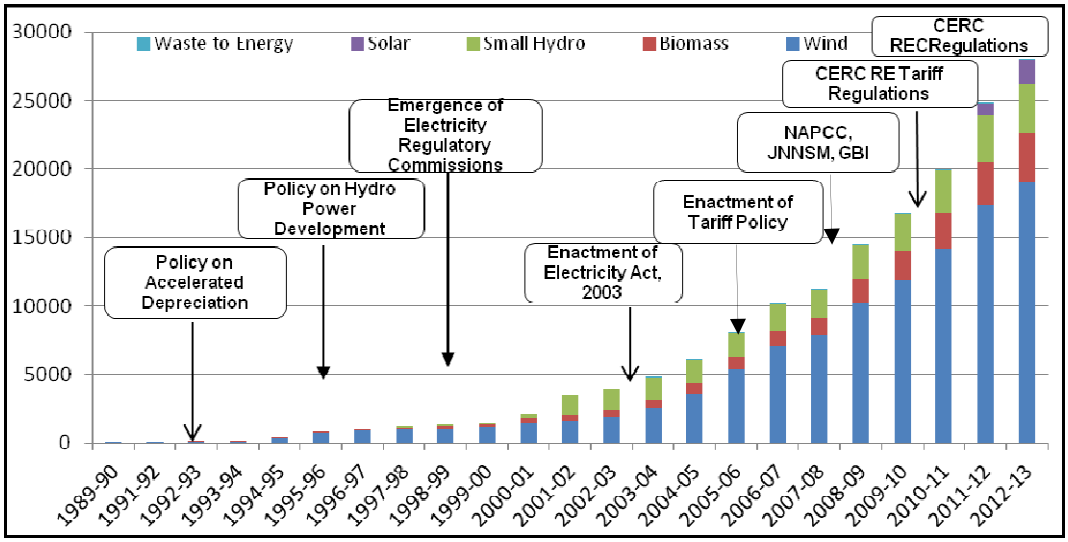
contributing around 2 GW. Significant achievement was made in solar capacity addition during the 11th Plan, with 938 MW solar capacities added during the period.

While we have discussed so far the potential and achievement of RE generation capacity up to 11th Plan Period, we would in the subsequent sections deal with the enablers that have helped achieve the targets in the previous years.

## 2.5 ENABLERS TO ACHIEVEMENT OF RE CAPACITY ADDITION

The following chart shows the historical growth of RE (including wind, biomass, cogeneration and SHP) since 1993-94.

**Figure 2.3: Renewable Energy: Year wise Installed Capacity**




Source: Ministry of New and Renewable Energy, 2013

Over the period, various policy and regulatory interventions have helped achieve this growth trend. Initial push has come through the policy on accelerated depreciation (AD) benefit extended to the wind generators. AD benefit introduced in the year 1993 (TERI Report to CERC on Pricing of power from Non-

Conventional Sources, 2008) provided incentive to the investors by saving their corporate income taxes. Figure 2.3 shows that the growth in capacity addition has been consistently witnessing an upward movement since 1993. During this period, another policy initiative that encouraged capacity addition was capital subsidy which was introduced in 1994. This provided the initial relief on otherwise high level of capital expenditure and encouraged investors to invest in RE segment. The other major fillip came through the regulatory interventions of Renewable Purchase Obligation (RPO) and Preferential Tariff introduced through the Electricity Act, 2003. RPO required the entities like distribution companies to purchase certain specified quantum of their total procurement from renewable energy sources. This helped generate demand. At the same time preferential tariffs provided the desired supply push in terms of attracting investors to the RE segment. The growth trend since 2003 as reflected in Figure 2.3 clearly shows the role played by these instruments in encouragement of RE generation in the country. The latest intervention has come through the mechanism of Renewable Energy Certificate (REC) mechanism introduced in 2010. This has provided an alternate route of investment for the investors.

Having discussed the achievement of RE generation capacity over the previous plan periods and also the enablers aiding such achievement, the next section presents overview of the target of RE generation capacity addition in the future years and also tries to assess the feasibility of achievement of such targets.

## 2.6 TARGET OF RE GENERATION CAPACITY ADDITION FOR 12TH PLAN

The capacity addition targets for the 12th Plan period aim at faster, sustainable, and more inclusive. MNRE's Working Group Report on New and Renewable Energy for the 12th Plan (MNRE, 2012) highlights that one-third of the total 1,00,000 MW capacity addition requirement shall be contributed by renewable sources.

**Table 2.5: 12th Plan Capacity Addition (in MW)**

| Resource | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 | 12th Plan |
|---|---|---|---|---|---|---|
| Wind | 2500 | 2750 | 3000 | 3250 | 3500 | 15000 |
| Solar | 1000 | 1000 | 2000 | 2500 | 3500 | 10000 |
| Biomass | 350 | 625 | 825 | 950 | 1300 | 4050 |
| Small Hydro | 350 | 400 | 400 | 450 | 500 | 2100 |
| Waste to Energy | 40 | 60 | 100 | 100 | 200 | 500 |
| Tidal/Geo thermal | 1 | 2 | 3 | 4 | 4 | 14 |
| **Total** | **4241** | **4837** | **6328** | **7254** | **9004** | **31664** |

Source: Working Group Report on New and Renewable Energy for the 12th Plan, 2012

The Table 2.5 above indicates that the 12th Plan period targets for grid-connected renewable capacity addition are to the tune of 32000MW (approximately). While this is the official target notified by the nodal Ministry (MNRE), the Government of India has also come out with a vision statement in the form of National Action Plan for Climate Change (NAPCC) providing vision of increasing the share of renewable energy in the country and envisages national level RPO. The NAPCC has recommended minimum share of renewable energy in the national grid to be set at 5% in 2009-10, subsequently increasing by 1% every year during the next 10 years to reach 15% by 2020 (NAPCC, 2008). Going by this vision of the

Government, generation capacity of 97,000 MW (approximately) would be required by 2020 (Wise, 2011).

Further, Jawaharlal Nehru National Solar Mission (JNNSM) has been launched by the Government of India in 2009 to promote large scale deployment of solar energy. The mission proposing development of grid-connected solar power under the three phases are as follows: Phase 1: 1,000 to 2,000 MW by 2013; Phase 2: 4,000 to 10,000 MW by 2017; Phase 3: 20,000 MW by 2022 (MNRE, 2009).

Given the success rate during the last two plan periods the targets of 32000 MW (during the 12$^{th}$ Plan) or for that matter intent of 82, 000 MW by 2020 and the target of solar power to the tune of 20, 000 MW, does not seem ambitious. However, projection based on the CAGR of the previous periods may not be correct as the market dynamics have been changing over the period. Despite significant capacity addition during the last decade, the share of RE capacity is only to the tune of 12% today. Going forward as the share increases, it will throw external challenges especially in terms of grid management because of the infirm nature of RE sources like wind and solar. Evacuation infrastructure also needs strengthening. Biomass sector faces challenges in terms of fuel availability. Tariffs of RE technologies are not commensurate with the cost in all states. RPO target setting and enforcement is also perceived to be very weak at present. REC mechanism introduced in 2010 does not seem to enthuse the buyers and the investors. The 12$^{th}$ Plan capacity addition target, JNNSM target or the NAPCC target, therefore, can be achieved only if policy and regulatory interventions are more focused and address the issues that the RE sector faces (CRISIL, 2012).

In the next chapter under Literature Survey, therefore, the researcher seeks to trace the various policy and regulatory interventions used so far, with focus on the instrument of REC (which is the central theme of Research), for promotion of renewable energy sources in the country.

# CHAPTER 3
# LITERATURE SURVEY

Discussion in the previous chapter revealed the importance of policy and regulatory interventions for promotion of renewable energy. Such interventions are the essential pre-requisites for achievement of the target for generation capacity addition in RE segment. Literature survey has accordingly been carried out with this background in mind. The policy instrument of Renewable Energy Certificate (REC) being central to the theme of research, this framework has been probed in greater detail in the international and Indian context.

Literature survey has been done under three broad categories to understand the (i) Policy Instruments for promotion of RE generation capacity, (ii) REC framework in India and (iii) International Experience on REC with focus on UK experience on Renewable Obligation Certificate (ROC).

## 3.1 POLICY INSTRUMENTS FOR PROMOTION OF RENEWABLE ENERGY

There is a wide range of policy instruments around the world to support renewable energy development. These instruments can be classified under two broad categories viz., Financial /Non-market based and market based instruments. We will discuss these instruments in the following sections.

### 3.1.1 Financial/Non-market based Instruments for Promotion of RE: International Experience

The following financial or non-market based instruments have been used in different countries for promotion of renewable energy sources.

**(i) Production Tax Credit**

Tax credits reduce tax liability and are typically calculated based on percentage of project cost or on project output (e.g. $/kWh). The Production Tax Credit (PTC) reduces the income tax of qualified tax-paying investors of grid connected RE projects. The federal US government has so far heavily relied on financial incentives to promote renewable energy, which include PTC for privately or investor owned utilities. The rules governing the PTC vary by resource and facility type (DSIRE, 2013).

**(ii) Investment Tax Credit**

The Investment Tax Credit (ITC) reduces income tax liability for qualified tax-paying investors of RE projects depending on capital investment in such projects.

In US, ITC was first created by the Energy Policy Act of 1992 and allowed commercial facilities to take a tax credit of up to 10% of their investment for purchase and installation of solar energy station. The credit was further extended by the American Recovery and Reinvestment Act of 2009, enacted in February 2009 (DSIRE, 2013).

**(iii) Capital Subsidy: Rebates and Grants**

Rebates and grants are typically lump-sum incentives based on system capacity or cost that are provided to a generator at or near the beginning of project operation,

rather than over time based on electricity generation. Rebates and grants are usually cash payments and the incentive amount provided to generators is administratively determined.

Grants and rebates have been used in many developed and developing countries around the world (REN21, 2011). Although their usage varies, they are often selected to support emerging or less mature technologies. A drawback of grants and rebates is that they are not performance-based. Developers therefore have less incentive to design efficient systems that perform over the long-term.

**(iv) Accelerated Depreciation**

Accelerated Depreciation allows an investor who invests in machinery and equipment for power generation using renewable sources to rapidly depreciate its investment, reducing operating profits and tax payments.

In Canada, the Accelerated Capital Cost Allowance allows owners of the specified energy efficiency and renewable energy projects having tax liability to write off at accelerated rate of 30%.

In Japan, under the 1993 Energy Conservation and Recycling Assistance Law, an accelerated depreciation allowance equal to 30% of the acquisition cost is available for investments in solar power systems, small- and medium-size hydro generators, etc (UNEP, 2011).

The Netherlands also provides the Accelerated Depreciation on Environmental Investment program (VAMIL).

**(v) Net metering**

Net metering broadly refers to the practice of crediting onsite generators at the retail rate for electricity they produce and compensating for the excess electricity they produce. Net metering typically involves an electricity bill credit at the retail or wholesale levels, rather than an incentive payment or electricity sale contract (Mitchell et al., 2004).

**(vi) Loan Guarantee**

A loan guarantee means a loan or security on which the government has reduced lenders' risk by pledging to repay interest and principal in the event of default.

U.S. Department of Energy's Loan Guarantee Program includes eligible renewable energy technologies like: Solar Thermal Electric, Solar Thermal Process Heat, Photovoltaic, Wind, Hydroelectric, Geothermal Electric, Fuel Cells, Daylighting, Tidal Energy, Wave Energy, Ocean Thermal, Biodiesel, Fuel Cells using Renewable Fuels (DSIRE, 2013).

**(vii) Feed in Tariff**

A feed-in tariff (FIT) is a policy instrument to encourage investment in renewable energy technologies. It offers long-term contracts to RE generators. The Fit reflects cost of generation of each renewable energy technology. Technologies such as wind power, for instance, are awarded a lower per-kWh price, while technologies such as solar PV and tidal power are offered a higher price, reflecting higher costs.

FiTs typically include three key provisions:

- Guaranteed grid access
- Long-term contracts for the electricity produced

- Purchase prices based on the cost of generation
- Under a feed-in tariff, eligible renewable electricity generators are paid at their cost of generation.
- It enables development of various renewable energy technologies such as wind, solar, geo thermal, tidal, biogas etc. It also enables investors to earn a reasonable return on such investments made. This principle was first propounded in Germany.

The fact that the payment levels are performance-based puts the onus on producers to maximize the overall output and efficiency of their project. As of 2010, feed-in tariff policies have been enacted in more than 50 countries in the world, In early 2012, in Spain, the Feed-in tariff was suspended for new projects (UNEP, 2011).

### 3.1.2 Market based Instruments for Promotion of RE: International Experience

The following market based instruments have been used in different countries for promotion of renewable energy sources.

#### (i) Auction/Tendering

Under competitive tender or auction processes, developers bid for the right to sell electricity at a given price. There are many approaches to structuring competitive processes that range in complexity from requests for proposals (RFPs) that result in a single, low-bid winner to multi-round clock auctions with multiple winners(Cunha et. al., 2012).

**(ii) Feed-in Premium**

Feed-in Premium policies offer a premium over the average real time electricity market price. This policy instrument is different from the fixed FiT payment policy instrument. Here electricity generated from RE sources is typically sold on the spot market, and producers receive a FIT premium above the market price.

It was introduced in Spain in 1997 through Electricity Power Act and has been recently modified. The new Spanish FIT scheme provides a range within which the premium varies. It is applicable to all renewable energy technologies except solar PV (Sijm, et. al., 2002).

**(iii) Tradable Renewable Energy Credits viz., REC/ROC**

Tradable renewable energy credits (RECs) were first developed in the US as a compliance mechanism for the first wave of state-level RPS policies in the late 1990s (Rader et. al., 1996). An REC represents a measured unit of electricity and can be unbundled from the electricity itself and sold as a separate and tradable commodity. Utilities purchase RECs from eligible renewable generators in order to demonstrate compliance with renewable energy mandates or targets. Under US FITs, for example, RECs are bundled with electricity as part of the fixed price.

When traded, RECs are unbundled from electricity and sold on the spot market or via short-term agreements. Prices can vary according to supply and demand and based on any alternative compliance payment rates or fines. The variability in REC prices creates significant investor risk and many lenders discount the projected value of tradable RECs when evaluating investments. Because RECs are sold separately from electricity, generators are exposed to the added risk of having to

negotiate and enter into multiple contractual arrangements with often different entities (Mitchell et. al. 2004).

**(iv) Renewable Portfolio Standards and Quota Systems**

Renewable Portfolio Standards (RPS) and quota systems require an entity (usually the utility) to procure a desired amount of renewable energy. An RPS typically places a requirement upon retail electric suppliers to supply a designated portion of their retail load with eligible sources of renewable energy. This requirement typically increases over time until it reaches a specified level (Char et.al.2006). RPS policies have evolved steadily during the past twenty years since they were first introduced in the United States (Linden et. al., 2005). RPS policies often require the use of Renewable Energy Credits (RECs) to demonstrate compliance with national or state targets. Competitive tenders and credit trading are two of the primary mechanisms through which RECs are procured.

### 3.1.3 Financial Incentive/Non-market based Instruments for Promotion of RE – Indian Experience

Various initiatives have been taken in the form of non-market based policy instruments for the promotion of renewable energy in India. Some of the non-market based initiatives include financial incentives such as tax waivers, accelerated depreciation, Preferential Tariff (i.e. the guaranteed tariffs fixed by the electricity regulators on cost plus basis) for Renewable Energy based generation, Generation Based Incentive (GBI), excise duty exemption, sales tax exemption, income tax exemption for 10 years, etc. These instruments have been discussed in the following section.

**(i) Capital Subsidy**

In India, Capital Subsidy/Grants are available for promotion of renewable energy technologies like: Small Hydro Plants, Biomass based rankine cycle power plants, Bagasse based co-generation plants, Biogas and Biomass Gasifier based projects etc.

**(ii) Accelerated Depreciation**

The Central Government presently allows accelerated depreciation at the rate of 80% on a written down value basis for various renewable energy items under section 32 Rule 5 of the Income Tax Act, 1961. Investors, for tax purposes, can take advantage of accelerated depreciation which provides a way of deferring corporate income taxes by reducing taxable income in current years, in exchange for increased taxable income in future years (IREDA, 2013).

**(iii) Generation Based Incentive (GBI)**

In December 2009, the MNRE announced a scheme for implementation of the GBI for Wind Power Projects which are not able to avail Accelerated Depreciation benefits. The GBI aims at attracting large Independent Power Producers (IPPs) and Foreign Direct Investors (FDIs) to the Wind Energy Sector by creating a level playing field between all classes of Investors. IREDA is designated as implementing agency for GBI implementation.

**(iv) Banking Facility**

Several States have allowed banking of electricity from wind energy in their state policies for the promotion of wind energy in their States. Banking facility means wind energy generator utilize the banked energy during any time at a later date even when such energy was injected into the system during off-peak hours.

**(v) Renewable Purchase Obligation (RPO)**

In order to promote consumption of electricity from renewable energy sources, as mandated under the Electricity Act, 2003, the State Electricity Regulatory Commissions (SERCs) specify Renewable Purchase Obligations (RPO) targets as a percentage of the total energy consumption of electricity that must be procured from renewable sources. The RPO targets take into consideration the existing potential of renewable energy sources in the concerned State. For example, the States like Delhi does not have enough RE potential, and as such the Delhi State Electricity Regulator has specified RPO of 3% for the distribution utilities in the State. Some states like Karnataka and Tamil Nadu have very high renewable energy potential and their State Electricity Regulators have specified a higher RPO target at 10.25% and 10% respectively. Since, in such states, there are sufficient resources available for harnessing the renewable energy even beyond the RPO level fixed, the actual purchase of renewable energy exceeds the RPO levels (Soonee et. al., 2012).

**(vi) Preferential Tariff**

Under the preferential tariff, the distribution utilities are obliged to buy renewable at the price determined by the regulators using cost-plus approach. This approach enables development of different RE technologies and owners to obtain a reasonable return on their capital investments.

Every state has defined its own preferential tariff for different renewable technologies. The Central Electricity Regulatory Commission has determined generic preferential tariff for various renewable energy sources for generation of electricity by inter-state generating companies.

**(vii) Concessional Interest Rate**

An interest concession is a reduction in the interest rate as compared to commercial interest rates applicable on a long term loan taken. Such concessions are generally provided by the government or as a government grant to the bank (David Nelson, 2012).

**(viii) Grid Connectivity Support**

Under the Electricity Act, 2003 the responsibility of facilitating grid connectivity has been entrusted on the regulators. The National Electricity Policy stipulates that the Appropriate Commission shall promote generation of electricity from renewable energy sources by providing inter alia suitable measures for connectivity to the grid.

The Central Electricity Regulatory Commission has facilitated grid connectivity of renewable energy projects with the transmission network of the Central Transmission Utility.

### 3.1.4 Market based Instruments for Promotion of RE – Indian Experience

Various initiatives have been introduced in the form of market based instruments for the promotion of renewable energy in India. Some of such initiatives include Renewable Energy Certificate (REC), Competitive Bidding etc. These instruments have been discussed in the following section.

**(i) Renewable Energy Certificates (REC)**

The concept of REC addresses the mismatch between availability of renewable energy sources and the requirement of the obligated entities to meet their RPO. It is expected to encourage the RE capacity addition in renewable energy resource rich States. The REC framework creates a national level market for RE generators.

Under the REC framework, an RE generator can set up generation facility in the state where there is potential. To overcome reluctance of the local distribution company to buy power from such RE sources because of high cost, the RE generator can sell the electricity generated from his renewable plant at average pooled power purchase cost of the distribution company. However, this may not be sufficient to meet his cost of generation. He is, therefore, issued a certificate (which represents green attribute) called Renewable Energy Certificate (REC) which he can sell in the power exchange. It is expected that the revenue generated from sale of electricity component and green attributes viz., RECs would be sufficient to enable the generator to recover his full cost of generation.

Apart from overcoming the geographical constraints, REC mechanism also helps the obligated entities in the resource deficit states to meet their RPO. The obligated entities in such RE resource deficit states can meet their RPO by purchasing RECs.

**(ii) Auction/Competitive Bidding**

The allocation of solar PV projects in Phase-1 of Jawaharlal Nehru National Solar Mission (JNNSM) in India was done in two batches over two financial years – 2010-2011 and 2011-2012 through competitive bidding - through reverse bidding. Bidders were asked to quote discount viz-a-vis reference tariff i.e. CERC determined Tariff.

## 3.2 REC FRAMEWORK IN INDIA

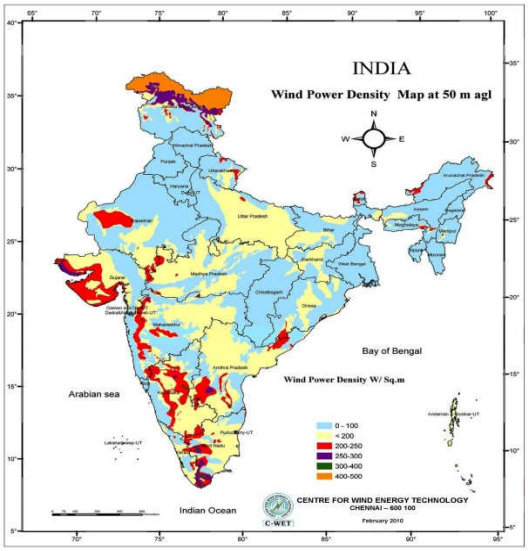
### 3.2.1 REC – Context and Scheme

Renewable energy is mainly concentrated in a few states, and within a state, is confined to a few pockets. Geographical distribution of wind farms, which are not

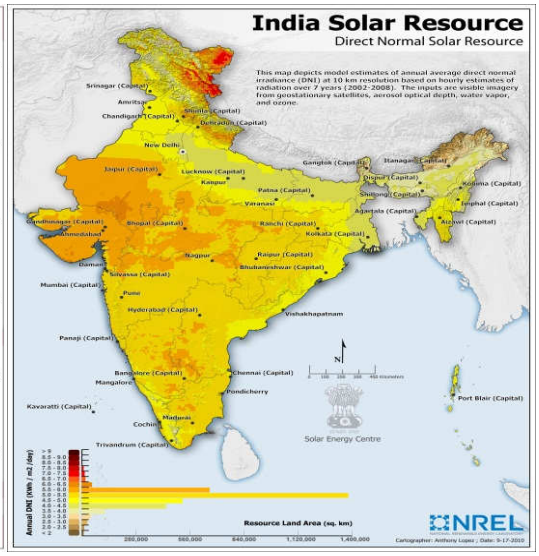
pooled, results in greater variability of resource and causes problems in integrating renewable energy in to the grid. As is represented in **Figure 3.1**, wind resource is primarily confined to the states of Rajasthan, Gujarat, Maharashtra, Karnataka, Tamil Nadu and Andhra Pradesh (shaded in red in wind map in Figure 3.1).

**Figure 3.1: Unevenly Distributed Generation**

Wind Potential in India




Solar Potential in India




Source: Ministry of New and Renewable Energy, 2013, Centre for Wind Energy Technology, 2013

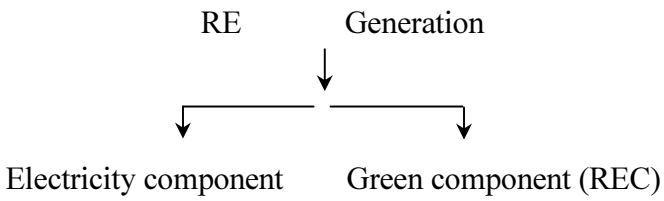
As regards solar resource, Rajasthan and Gujarat have the highest potential (shaded in orange in solar map in Figure 3.1). Because of supply concentration, there arises a need, depending upon demand-supply scenario, for strengthening/developing intra-state network (if power can be consumed within the state) and inter-state network (if power cannot be consumed within the state).

Uneven distribution of RE resources has its own implication. For example, Delhi is the state where the RE resource is not significant due to which the state commissions can not specify higher Renewable Purchase Obligations (RPO). On

the contrary, states like Rajasthan and Tamil Nadu enjoy very high potential of RE resources and in such states there are opportunities for coupling the RE potential even beyond the fixed RPO. But cost of RE generation causes resistance in the local distribution entities of the RE resource rich States from buying RE certificates, more than the targets set by the State Commission. This is more so because of the weak financial conditions of distribution players. Estimates show that the financial losses of these distribution licensees reached about Rs 70,000 crore in 2010-11 (Planning Commission, 2011).

The introduction of Renewable Energy Certificates (REC) is an attempt to address the problem arising from gap between the availability of and demand for RE resources to fulfill RPO. Under the REC framework, an RE generator can sell electricity component, say to the local distribution licensee at its (discom's) average pooled power purchase cost (APPC) and associated environmental attributes in the form of RE Certificates to obligated entities or voluntary purchasers. The conceptual framework of REC has been depicted in **Figure 3.2**.

**Figure 3.2: Conceptual Framework: CERC REC Regulation**




For the operational framework of REC, the Central Electricity Regulatory Commission (CERC) provides directive on terms and conditions for according and

issuance of Renewable Energy Certificate. Salient features the framework are as under:

- REC is a policy instrument to facilitate RE market and enable compliance of renewable purchase obligations (RPO).
- RE project operators are being provided two alternatives: One, trade electricity generation and environmental features concerned with RE generations and second, trade the renewable energy at preferential tariff.
- One REC is equal to 1 MWh of electricity generated and fed into the grid from renewable energy sources.
- Under section 86 (1) (e) of the Electricity Act, 2003, the obligated entity has to meet RPO. Purchase of REC is considered as purchase of RE for fulfillment of RPO compliance.
- Grid connected renewable energy technologies approved by the Government, are eligible.
- A Central Agency carries out function of registration, issuance of RECs, repository of Certificates, and implements REC framework at national level.
- Only accredited projects can register for REC at the Central Agency.
- REC can be traded only in the CERC approved power exchanges.
- REC is traded within the floor and forbearance price as may be determined by CERC from time to time.

### 3.2.2 REC Operational Framework

The Central Electricity Regulatory Commission (CERC) regulations on Renewable Energy Certificate provide the operational framework for REC.

#### 3.2.2.1 The Operational Framework of REC

REC scheme broadly involves the following operational steps:

- Accreditation - by State Agency
- Registration - by Central Agency
- Issuance of REC - by Central Agency
- Trading and Redemption of REC - in power exchange

An RE generator has to get itself accredited at the State level. For this it has to apply to the Agency designated for this purpose at the State level. The RE generator has to meet the pre-specified eligibility criteria for accreditation. It is only after the generator gets accreditation that it can go to the next stage, i.e. the stage of registration. Registration for REC is done at the Central level by the Central Agency designated for this purpose. The Central Agency acts on the recommendation of the State Agency for registration of an eligible generator. After registration the RE generator becomes eligible for issuance of REC. The Central Agency is empowered to issue RECs based on the energy injection report of the State Load Despatch Centre (SLDC). The RECs so issued can be traded in the power exchanges.

These processes are specified in the Regulations and Detailed Procedure approved the Central Electricity Regulatory Commission (CERC) (CERC, 2010). The institutional framework and the procedures are discussed as under:

**(i) State Agency: Functions**

The State Commission is required to designate an agency as State Agency for accreditation of the renewable energy projects and submission of quarterly status in

respect of compliance of RPO by the obligated entities. State Agencies have been designated in almost all States.

**(ii) Central Agency and its Functions**

The Central Commission has designated National Load Despatch Centre (NLDC) as the Central Agency to undertake following functions:

- Registration of eligible entities under REC framework,
- Issuance of REC,
- Maintaining accounts in respect of REC,
- Repository of RECs, and other related functions for implementation of REC mechanism.

**(iii) Categories of Certificates**

There are two categories of RECs, viz., solar RECs issued to eligible solar energy based generators and non-solar RECs issued to eligible renewable energy generators based on RE sources other than solar. The solar RECs are sold to the obligated entities having solar purchase obligation, and non-solar certificates are sold to the obligated entities having non- solar obligation, (CERC, 2010).

**(iv) Eligibility and Registration for Certificates**

An RE generator is eligible to apply for registration, issuance of and dealing in RECs if it fulfills the following conditions:

- it is required to obtain accreditation from the State Agency
- it should not have any power purchase agreement (PPA) to sell electricity at regulated tariff determined or adopted by the Regulatory Commission

- it should sell the electricity component either to the local distribution licensee, at the APPPC, or to any open access consumer or other licensees at a mutually decided rate, or at market determined rate through power exchange.
- it should not sell the electricity by purchasing which the buyer complies with its RPO.

Captive Power Producers (CPP) based on renewable energy sources are also eligible for REC for the entire energy generated from such plant including self-consumption subject to the condition that such CPPs have not availed or do not propose to avail benefits like concessional/promotional transmission or wheeling charges, banking facility benefit.(CERC, 2010)

The eligible generating company applies for registration to the Central Agency. The Central Agency is required to accord registration within fifteen days from the date of application.

**(v) Revocation of Registration**

The Central Agency may revoke registration of the eligible entity under the following circumstances

- on willful and extended default in compliance;
- on its breaking the terms and conditions of accreditation or registration; etc

**(vi) Denomination**

Each Certificate issued represents one (1) MWh (Megawatt hour) of electricity generated and injected into the grid from renewable energy source. (1 REC = 1 MWh)

**(vii) Issuance of Certificates**

The eligible entities have to apply to the Central Agency for issuance of RECs within six months after corresponding generation from its projects.

The Central Agency after verification of all the conditions for issuance of Certificate issues the certificates.

The Certificates are issued to the eligible entity on the basis of the electricity generated and injected into the Grid.

**(viii) Dealing in the Certificates**

The Certificates are dealt only through the Power Exchange at present.

**(ix) Pricing of Certificate**

The price of Certificate is discovered in the Power Exchange. The Central Commission specifies the floor price and forbearance price separately for solar and non-solar Certificates.

The Central Commission while determining the floor price and forbearance price is guided by the following principles:

- Variation in cost of generation of different renewable energy technologies;
- Variation in the Average Pooled Cost of Purchase across States in the country;
- Expected electricity generation from renewable energy sources including:
    - Expected renewable energy capacity under preferential tariff
    - Expected renewable energy capacity under REC mechanism;
    - RPO targets set by various State Commissions.

**(x) Validity and extinction of Certificates**

The Certificate is valid for seven hundred and thirty (730) days from the date of its issuance.

**(xi) Fees and Charges**

The Central Commission notifies the fees and charges to be payable by the eligible entities under REC scheme. These include registration fees, annual fees, the transaction fees for issuance of RECs and fees for dealing in the certificate. The Central Agency collects the fee. This is used for meeting the expense towards remuneration payable to the officers, employees, consultants and the compliance auditors to perform the various functions.

**(xii) Appointment of Compliance Auditors**

The Commission appoints compliance auditors to investigate and to report the compliance of the REC Regulations.

### 3.2.3 Issues and Challenges

Since the introduction of REC framework in 2010 about 3600 MW of RE generation capacity has been registered through this (REC) route. Empirical experience (as also literature survey), however, reveals the following issues around REC framework in India.

(Soonee, 2010) and (Pandit, 2009) have described REC mechanism as an instrument for the promotion of renewable energy and recommended to make it more beneficial for all the stakeholders. Few reports like (CERC, 2010), (Forum of Regulators, 2009), (CERC, 2010) and (CERC, Petition No. 99/2010, 2010) have mentioned about functions, roles and responsibility of the different entities

involved, timelines, fees and charges and consequences in case of event of default, regulators' guidelines and methodology used in calculation of floor and forbearance price for REC etc.

(Gireesh Shrimali, 2012) has analyzed the market design and performance of the Indian REC market to conclude that the plan of the REC framework seems to be sufficient; but the performance of the market has not been up to the level of satisfaction. The author believes, it is premature to make suggestions for the REC system, especially, when uneven participation and states' regulatory policies have been significant contributor to the relative ineffectiveness of the REC market. Paper identified certain design flaws like dependence on state policies and compliance and lack of long term trajectory etc. contributing to the weak performance of RECs. (Klaus Vogstad, 2002) explains models of trading TGC market and simulates the results. It concludes that in order to avoid costly mistakes and to reduce the effect of various buy and sell approaches, a combination of experimental economics and system dynamics should be studied.

(Purohit, 2013), (Gireesh Shrimali, 2012), (Singh, 2010), (Wind Independent Power Producer Association (WIPPA), 2012), (CERC, 2010), (RE Connect Energy Solutions, 2011) have raised the issues and challenges the REC framework is facing in India. Trading in RECs is limited to Power exchanges recognized by CERC. It hampers the bilateral trade as well as it creates inabilities in the distribution companies for long term decision making in the REC market; the floor and forbearance price currently fixed for solar and non-solar REC are valid till FY 2017. Therefore, visibility of revenue from sale of REC is upto 2017. It has been observed

that RE developers/lenders (Banks and Financial Institutions) seek a long term visibility of price so as to take business decisions in the REC market. Under the present framework, as soon as the transaction takes place at the power exchanges, RECs are extinguished. There is no role for intermediaries who typically act as market makers. Banks/ lenders cannot acquire and then sell RECs.

Absence of eligibility of off -grid RE projects for REC also hinders REC market growth, Absence of effective RPO compliance and Enforcement, Absence of a sunset clause have been cited as factors affecting REC system. Further, banking of RECs is not allowed at present. With banking provisions, the obligated entities can procure additional RECs in a given year over and above their current year RPO target and adjust that against obligation seek credit for the same in a future period.

In case of oversupply of RECs in the market, there is no remedy available in the prevailing REC framework. Minimum Guarantee price should be offered to unsold RECs, which may be 50-70% of floor price, through Clean Energy Fund.

Currently, voluntary REC market is absent in the country. There is a need for pushing awareness among corporate, individuals and NGOs of Voluntary market purchases. In the US, Voluntary Markets are estimated to be as large as Compliance Markets. MNRE could launch a scheme for certifying the 'Green Companies' who set-off their total carbon emissions through purchase of Renewable Power or RECs.

The literature survey discussed above covers issues and challenges in REC mechanism in India. In addition to this, an effort has been made in the subsequent section, to review the international experiences on market based instruments for

promoting RE generation sources, with special focus on UK model of Renewable Obligation Certificate (ROC).

## 3.3 REC FRAMEWORK: INTERNATIONAL EXPERIENCE WITH FOCUS ON UK EXPERIENCE ON ROC

The international experience on REC has been studied with reference to experience in USA, Australia etc in general and UK in particular. UK has long experience of implementation of ROC and the intent being to benchmark Indian system of REC with that of UK, detailed survey has been made separately in respect of UK.

### 3.3.1 International Experience in General

The United States led the world in renewable energy development. A certificate is issued for every unit of power generated which can be sold in combination with the underlying power or independently to suppliers. In some cases, these credits are bankable. The diversity in the handling and functioning of RECs, integration of state and federal programs has been important issue in the country (Eric Martinot, 2007).

Compliance and voluntary markets are the two markets for RECs in the US Renewable Portfolio Standard (RPS) policy. In the Compliance Market, the entities purchase RECs in compliance of regulation and the in the voluntary market customers like Corporate and households, choose to purchase RECs so as to meet their desire to use RE. This report has also mentioned about the different rates for two different segments like cheaper price for voluntary users than the compliance market (Holt, 2007).

As per this report, Australia is one of the pioneering countries which created national RE market. A new tradable renewable energy certificate market got established with the help of legislative and regulatory framework. These certificates are tradable across the country. The mandated target is expected to significantly boost renewable energy generation in Australian market (David Rossiter, 2007).

(Garrett Martin, 2008) explains the current best practices, national trends of RPS program and the impacts of structuring an RPS program. He concludes that it is necessary for decision makers to explain the significance of policy objectives which a program targets, to attain the suitable RPS element options.

In countries such as US and Australia, RECs are created and defined by statue as part of Renewable Portfolio Standard (RPS), and or as a part of Quota schemes in countries such as UK. From the literature it is found that there have been many discussions on effectiveness of RECs in achieving Quotas in an economical way. REC is also compared with the non-market instrument like Feed-in Tariff (FiT) mechanism to draw final conclusion of its relative effectiveness (Atle Midttun, 2007).

Since 1990, the UK Government has readjusted its renewable energy generation policies several times to improve delivery and outcomes. In United Kingdom, the Renewables Obligation (RO) is designed to promote qualified renewable energy for power production. RO was announced and introduced in England and Wales in April 2002 (OFGEM, 2012). It has replaced Non-Fossil Fuel Obligation (NFFO) which was in existence from early nineties. This placed a requirement on all licensed electricity suppliers in UK to supply a specified and growing proportion of their sales from renewable sources. In 2011/12 RO was 12.4 %. Initially, in the year

2002-03, the set target was 3% which increased to the level of 15.4% in the year 2015-16. The term for RO was decided till 2037. Since its introduction the RO has achieved significant success - contribution in total UK supply reached at 7.0% in 2010 from 1.8%. (OFGEM, Renewables Obligation Order, 2009).

In the context of experience of Brazil, the long-term auctions are the main tool to promote NCRES in the country. Auctions appear as an effective mechanism to stimulate competition between investors, to provide price disclosure while managing the right amount of investment and reducing risk aversion with long-term contracting. The product offered will depend on the auction's main objective and is key to the auction's success. Its main challenges include the definition of criteria to select the quotas for each NCRES, the design of a relevant set of guarantees (financial, technical and operational) and the attraction of competition, which is the ultimate condition for the success of an auction (G. Cunha, 2012).

Paper on 'Feed in Systems in Germany and Spain and a comparison, 2005' found that in spite of many differences between the Spanish and the German Feed-in system there are significant common features in the schemes. The comparative study of feed-in schemes in the two countries has shown the maximum growth of RES-E matched to all other EU Member States. These systems have attracted significant investments in RE and have contributed to developing the markets for RES technologies (Dr. Mario Ragwitz, 2005).

Paper focuses on the renewable energy policies. Its main objective is to address issues like policy designing and its effectiveness and efficiency. It defines GEP and policy design modeling and explains it using a case study. It concludes proposing a

bi-level optimization model for preparing incentive policies to encourage RE in a generation capacity planning problem. The insights gained from the results are: efficiency of incentive policies will depend upon inverse optimization model, merging taxes and subsidies in an incentive policy, fall in renewable investment costs, increase in non-renewable generation costs and the addition of transmission lines (Zhou, 2010).

### 3.3.2 UK Experience of Renewables Obligation Certificate (ROC)

The Renewables Obligation (RO) was introduced in England and Wales in April 2002. This placed an obligation on the licensed electricity suppliers in Great Britain to supply a specified and growing proportion of their sales from renewable sources. RO was initially set at 3% for the period 2002/03 with the target to rise to 15.4% by the period 2015/16. RO runs until 2037 (National Renewable Energy Action Plan, 2009). The obligated suppliers comply with their RO through the instrument of Renewables Obligation Certificate (ROC).

A ROC is the green certificate issued for renewable electricity generated by the eligible generators within the United Kingdom. ROCs are issued by Office of the Gas and Electricity Markets (OFGEM), the regulator in UK. OFGEM is responsible for accrediting generating stations for the purpose of ROC; issuing ROCs; maintaining a Register of ROCs; compliance monitoring; calculating buy-out price annually; collecting buy-out payments and redistributing the same; collecting late payments and redistributing the same; and disclosing information of compliance by publishing an annual report (OFGEM Renewable Order, 2002).

The following renewable energy sources are eligible for ROCs:

- Biogas from anaerobic digestion
- Biomass
- Hydro electric
- Tidal power
- Wind power
- Photovoltaic cells
- Landfill gas
- Sewage gas
- Wave power
- Co-firing of biomass

Salient features of ROC of UK are as under:

**Banding**

One ROC generally represents one megawatt-hour (MWh) of generation form eligible generator. Some technologies are given higher credit and some receive less. For instance, offshore wind generation is given 2 ROCs per MWh; onshore wind installations are accorded 1 ROC per MWh and sewage gas-fired based projects get half an ROC/MWh. (Collins, 2010)

There are four bands:

- Technologies in Established Band get 0.25 ROCs/MWh;
- Technologies in Reference Band are given 1 ROC/MWh;
- Technologies in Post-Demonstration Band get 1.5 ROCs/MWh;
- Technologies in the Emerging Technologies Band are accorded 2 ROCs/MWh.

**Banking and Borrowing (B & B)**

Under this scheme, suppliers comply with part of their RO by using ROCs issued in previous time periods (banking) or subsequent time periods (borrowing). This facility is extended as an insurance against volatility in ROC prices. However, restrictions are imposed to avoid manipulation of the market. For instance, banking limit is set at 50% of suppliers' obligation in the concerned time period. Borrowing is restricted to 5% of a supplier obligation target in any given time period.

**Buyout Payment: Alternative Way of Discharging Renewables Obligation**

An obligated electricity supplier may, instead of producing certificates, comply its RO by paying OFGEM at buy-out price. Principles followed in fixing the buyout price are described as under:

**Determination of Buyout Payments**

The buyout price is fixed based on the basis of the additional amount that suppliers would be likely to pay green energy in excess of the market value of the electricity. The buyout price is, therefore, fixed to cover the difference between "market value of electricity" and the "anticipated value of the marginal projects required to meet the demands of the Obligation".

In 2001-02 (first period of the Obligation), the market value of electricity was between 1.8 and 2.5p/kWh. With due consideration of the marginal cost of generation, the buyout price was fixed at 3.0 p/kWh (£30/MWh). The Government had no intention to reduce this level (OFGEM Renewable Order-2002). It was to be adjusted for inflation linked with Retail Price Index. Buyout price determined for last 10 years are shown as under:

**Table 3.1: Buy-Out Prices by Year**

| Obligation Period | Buyout Price (£) |
|---|---|
| 2002/03 | 30.00 |
| 2003/04 | 30.51 |
| 2004/05 | 31.39 |
| 2005/06 | 32.33 |
| 2006/07 | 33.24 |
| 2007/08 | 34.30 |
| 2008/09 | 35.76 |
| 2009/10 | 37.19 |
| 2010/11 | 36.99 |
| 2011/12 | 38.69 |
| 2012/13 | 40.71 |
| 2013-14 | 42.02 |

Source: Government of UK website, 2013

**Payment of Buyout Funds and its Allocation**

The aggregate of the amounts received in respect of an obligation period (together with any interest thereon) is referred to as "the buy-out fund". The OFGEM pays out the buy-out fund as explained below. The buy-out fund is divided proportionately amongst each of those designated electricity suppliers who, has fulfilled (wholly or partly) its RO by producing ROCs to the OFGEM.

**Mutualisation: Payments In**

Failure to pay buyout price due to bankruptcy or any other reasons is addressed through a mechanism called mutualization. Failure to pay the buyout price in case of insolvency of an obligated entity leads to a shortfall in buyout fund. In such an event all other RPO compliant entities meet such shortfall and this is called mutualisation.

**Penalty in Case of Failure of Payment**

If a person required to make a payment fails to make such payment, its licence to supply electricity can cease to exist. ..

**Mutualisation: Payments Out**

The mutualisation fund relating to a shortfall period is divided amongst the compliant suppliers so that each such compliant supplier receives a proportion of the mutualisation fund calculated (OFGEM, 2009).

The literature survey done in this chapter was centered around the theme of the research. It gave an understanding of the various policy instruments tried in India and other countries for promotion of renewable energy sources. Detailed study was undertaken on the REC framework in India, the central subject of the research and the issues and challenges facing the scheme. Survey of the international experience on REC, especially the detailed review of the ROC system of UK provided a perspective of how this market based instrument is designed and operated in that country. It also brought an insight into the possible reasons for the present not-so-satisfactory state of REC implementation in India. Enlightened by the literature survey on all these aspects, analysis has been made in subsequent chapters (Chapter 5) of the market trend of REC trading in India, with a view to identifying the factors responsible for the current status of implementation. Indian REC system has been benchmarked with ROC scheme of UK and finally way forward has been suggested for effective implementation of REC mechanism in India. In the next chapter, the Research Methodology used for such analysis has been discussed and in the subsequent chapter (Chapter 5), analysis has been done and suggestive framework has been evolved based on such analysis.

# CHAPTER 4
# RESEARCH METHODOLOGY

Literature survey done in the previous chapter has widened the understanding about REC mechanism in India. This chapter discusses the research methodology used for analysis of the issues revealed by the literature survey.

## 4.1 RESEARCH NEED

The REC mechanism was introduced with a lot of promise but today it faces real challenges that seem to be vitiating the investment climate in RE sector in general and REC market in particular. It is, therefore, proposed to undertake detailed research to identify various issues and options to make REC a market mechanism in true sense to facilitate large scale RE capacity addition in the long run. It is also proposed to review the experience gained by other countries with the tradable renewable energy certificate system for example in UK. Renewable Obligation (RO) was introduced in UK in 2002 (OFGEM Renewables Order, 2002) for over 5 Megawatt (MW) renewable electricity projects. The UK renewable energy targets the growth from 6.6 % in 2009 to 9% in the third quarter of 2011. RO thus has played a major role in harnessing renewable energy sources in UK effectively to broaden energy and climate change objectives of UK, including Greenhouse Gas (GHG) emissions reductions, de-carbonizing of the UK grid and energy security.

The ROC mechanism has unique features like: Banding, Banking, Buyout price as a penalty for non-fulfillment, inbuilt incentive mechanism for the obligated entities for fulfillment of RPO, Secondary and forward market mechanism etc (OFGEM, Renewables Obligation Order 2009). These features are not available in the current REC mechanism in India. It would be desirable to compare these facets of UK model of ROC with that of REC in India, to identify the gaps in Indian REC system. It is also important to engage with cross-section of stakeholders like buyers, sellers, investors, financial institutions to understand their perspective and based on analysis of their responses as also on critical examination of the data available in secondary literature, to suggest a holistic policy design for effective implementation of REC framework in India.

## 4.2 RESEARCH GAP

In the current literature, assessment of REC system has been done and the challenges facing the Indian REC system, have been highlighted (Purohit, 2013). Various literatures have highlighted the policy performance and associated issues. From the literature it was found out that there are various factors affecting the policy processes and some of the factors have been studied in isolation. For instance, the pre-dominant view emerging from the literature survey is that lack of RPO compliance is the reason for poor implementation of REC framework in India. Again there are literatures that present data and statistics to establish that the buyers are not coming forward in the REC market. Based on the factors identified each such literature gives its recommendation in terms of desirable corrective measure.

However, most of these diagnoses and recommendations stand alone and do not necessarily examine the factors in totality.

Some broad suggestions have been made in some reports, for overcoming the constraints and challenges in some cases. But no in-depth study or research has gone into addressing the issues holistically and suggesting a viable and feasible way forward. The research gap, therefore, is obvious.

The following specific gaps are revealed from literature review, in the context of REC framework in India:

- Indian REC framework has not been reviewed with very specific problems.
- It is also observed from the literature survey that REC framework has been studied in isolation.
- There is a need to benchmark the REC mechanism with international framework on REC.

## 4.3 RESEARCH PROBLEM/QUESTION

In the light of the above discussion the research questions that arise are as follows:

- What are the strengths and weaknesses of the existing REC framework in India and how does it compare with international experiences (specifically UK experience of ROC)?
- What are the critical factors affecting the performance of existing REC framework?
- What modifications are required in the light of above identified factors, in existing Indian REC framework with the purpose of achieving its objectives?

## 4.4 RESEARCH OBJECTIVES

The objectives of the research are as under:

1. To critically analyze the existing Indian REC framework and compare it with international experiences (specifically ROC of UK), to find its strengths and weaknesses.
2. To identify the critical factors affecting the existing Indian REC framework.
3. To develop a suggestive framework for Indian REC.

## 4.5 RESEARCH METHODOLOGY

For Objective 1, analysis has been carried out in two different steps:

**Step I: A critical analysis has been carried out for existing Indian REC scheme based on the data collected through literature survey**

**Sources of data:** Secondary information related to national experience are given as References and include inter alia sources of Ministry of Power, Government of India; Ministry of New and Renewable Sources of Energy, Government of India; Central Electricity Authority; Government of India; Central Electricity Regulatory Commission, India; National Load Despatch Centre, India; REC Registry, India; Planning Commission, India; State Electricity Regulatory Commission, India; The Energy Research Institute (TERI) (TERI, 2006); Other relevant papers/reports/ documents publicly available and shown in the References section.

**Tools used for analysis:** Data have been tabulated and represented through various charts to examine the problems areas in Indian REC scheme. Appropriate statistical tools, like Descriptive analysis, Pictorial presentation etc have been used for the analysis. Various quantitative approaches such as cost benefit analysis and cost effectiveness have been used.

**Step II: International experience of REC scheme with special reference to UK experience of ROC, has been examined**

**Sources of data:** Secondary information related to international experience are given as References and include inter alia sources of Websites of US and UK regulators; United Nations Environment Programme (UNEP, 2011); Lawrence Berkeley National Laboratories (LBNL), USA; National Renewable Energy Laboratories (NREL), USA; Other relevant papers/reports/documents publicly available and shown in the References section.

**Tools used for analysis:** Parameters for comparison of Indian REC system and UK ROC system have been developed based on literature survey. The identified parameters are listed below:

- Structural (Design)/ Institutional Parameters
    - Linkage between preferential tariff and REC (structural/Design parameter)
    - Role of different stakeholders/institutions (institutional parameter) – in terms of
    - Policy and regulatory certainty and homogeneity about REC design setting (clarity about sunset clause)
    - RPO target setting and Compliance mechanism
    - Eligible Entities for REC (institutional parameter)
    - Denomination of REC (structural/Design parameter)
    - Categorization of REC based on technology/RE source (structural/Design parameter)
    - Technology or vintage based REC multiplier (structural/Design parameter)
    - Shelf life of REC/banking of REC (structural/Design parameter)

- Operational parameters
  - REC trading platforms
  - Secondary market
  - Voluntary market
- Commercial parameters
  - REC pricing
  - Floor and forbearance price
  - Long term visibility of REC pricing

Analysis has been carried out using appropriate statistical tools, like Descriptive analysis, Pictorial presentation etc. Based on the analysis, gaps in Indian REC scheme have been identified.

**Objective 2: Methodology for addressing second objective**

For identification of critical factors affecting REC framework in India, the following sources of information and tools of analysis have been used:

**Sources of data:** Secondary sources as highlighted above as well as primary sources of information have been used for identification of critical factors.

**Tools used for analysis:** In order to accomplish the second objective surveys were carried out using questionnaires. The factors affecting REC mechanism in India were identified with the help of a questionnaire. The reliability of the questionnaire has been verified (Chronbach Alpha test) for the responses received from the pilot study with a sample of 30 respondents comprising various renewable energy generators, the distribution utilities, regulators, and other government officials. This

questionnaire was designed on a likert scale ranging from one to five. Detailed methodology is explained below:

**Variable Identification**

The following probable variables were identified through primary and secondary source of information for designing the questionnaire:

Renewable Purchase Obligation, Competitive bidding, Premium based market, Linkage between Preferential tariff and REC, Impact of REC on cost of procurement of power for buyers, Impact of REC on revenue for RE generators, Eligibility for REC, Pricing of REC, Trading arrangement for REC, Factors like RPO and its compliance, transmission infrastructure and need for addressing variability of RE sources etc.

**Designing Questionnaire**

Questionnaire was designed on 5 point likert scale as given below:

Strongly Disagree / Disagree/Can't say/Agree/Strongly Agree

**Sampling Plan & Sample Size**

Method of stratified proportional sampling has been used for collecting the primary data. Sample has been selected from a finite population size N as different stakeholders and divided into different strata and a proportion has been drawn from the strata depending upon the population size.

The total sample size of 198 (sample size based on Simplified Formula for Proportions provided by Yamane with 7% precision – is 166 out of the population

of 900. Here sample size of 198 has been taken) proportionately distributed across different players in the ratio of the total number of stakeholders

**Table 4.1: Overall Sample Size**

| Source | No. | % of Sample | Sample size |
|---|---|---|---|
| Government Senior Officers (Ministry of Power and MNRE)/Individual Experts | 100 | 15% | 15 |
| NGOs | 10 | 20% | 2 |
| Electricity Regulators | 30 | 30% | 10 |
| RE Generators* | 600 | 23% | 135 |
| Financial Institutions | 50 | 13% | 7 |
| Distribution Companies | 70 | 30% | 21 |
| Load Despatch Centers | 30 | 15% | 5 |
| Power exchanges | 3 | 30% | 1 |
| RE Association/Individual | 10 | 20% | 2 |
| **Total** | **900 (approx.)** | | **198** |

*The sample size under RE Generators category was further distributed across the 2 categories of RE technologies viz. solar and non-solar as reflected in following table.

**Table 4.2: Sample Size under RE Generators Category**

| | No. | % of Sample | Sample size |
|---|---|---|---|
| **Solar** | | | |
| | 20 | 60% | 12 |
| **Non-solar** | | | |
| Wind | 450 | 24% | 107 |
| Small Hydro Project (SHP) | 20 | 20% | 4 |
| Biomass and Bagasse based Cogeneration | 120 | 10% | 12 |
| **Total** | **600** | | **135** |

**Data Collection**

Primary information related to stakeholder's views has been collected through questionnaire method from different sources given below:

Leading experts on the subject and senior executives in Power industry, both public and private (Government, Non-Governmental Organizations, Regulators, Generators, Distribution Companies, Load Dispatch Centers, State Nodal Agencies, Power Exchanges, Renewable Energy Associations, and Financial Institutions).

Though the questionnaires were sent to 400 respondents, responses from 198 persons (filled questionnaires) were received. This data was further analyzed using the SPSS 16 software.

Statistical tools used: In order to identify the major factors affecting the performance of the REC mechanism, factor analysis was used as the parameters used in the study were large in numbers of which some were correlated. The data need to be reduced to a manageable level for achieving the second objective. The best way for this data reduction was through factor analysis.

**Objective 3: Methodology for addressing third objective**

For this objective, analysis has been carried out based on the results of Objective 1 and Objective 2 and, opinion survey, as part of empirical research done on the gaps identified from comparison of international experience with Indian REC framework.

**Tools used:** The results of Objective 1 yielded a critical analysis of Indian REC system and comparison with international experience on REC mechanism specially

the comparison with UK model of ROC. The results of Objective 2 highlighted critical factors affecting REC scheme in India.

Based on the above results, gaps in Indian REC framework were identified with specific reference to comparison with UK experience of ROC.

Questionnaires were designed based on the identified gaps and opinion survey was carried out. Twelve open ended questions were designed. The questions in this segment of analysis were different in format from the questionnaire designed (based on Likert scale) earlier for eliciting views of stakeholders in general. Leading experts from the Government, Regulatory Commissions, National Load Despatch Centre, Central Electricity Authority, Generating Companies, Distribution Companies, NGOs, Industry Associations, and Financial Institutions were interviewed and their responses were recorded.

The research methodology discussed in this chapter has been used in the next chapter for analysis of REC market trend in India, for indentifying the factors responsible for present state of REC market, for comparison and benchmarking of Indian REC system with that of UK, for identifying the gaps in, and suggesting way forward for effective policy design of REC mechanism in India.

# CHAPTER 5
# ANALYSIS AND FINDINGS

The previous chapter discussed the research methods used in the context of the research. In this chapter an attempt has been made to analyse the issues and challenges in Indian REC system by using the said research methods and based on the analysis to evolve suggestive framework for REC system in India. In this regard, Analysis of the issues identified based on literature survey which covers REC market in India based on inventory, demand and supply; trade in terms of volume and price of REC; possible factors influencing the market trend as revealed from the above analysis (analysis from the perspective of buyers) etc. It also covers analysis from the stakeholders' perspective like generators' and distributors' perspective; comparison of REC framework in India and UK; analysis of results of responses through questionnaire; analysis of results of opinion survey on gaps identified in Indian REC framework etc. Finally, based on analysis and identification of factors affecting existing Indian REC framework and a suggestive framework has been evolved to achieve the study objectives.

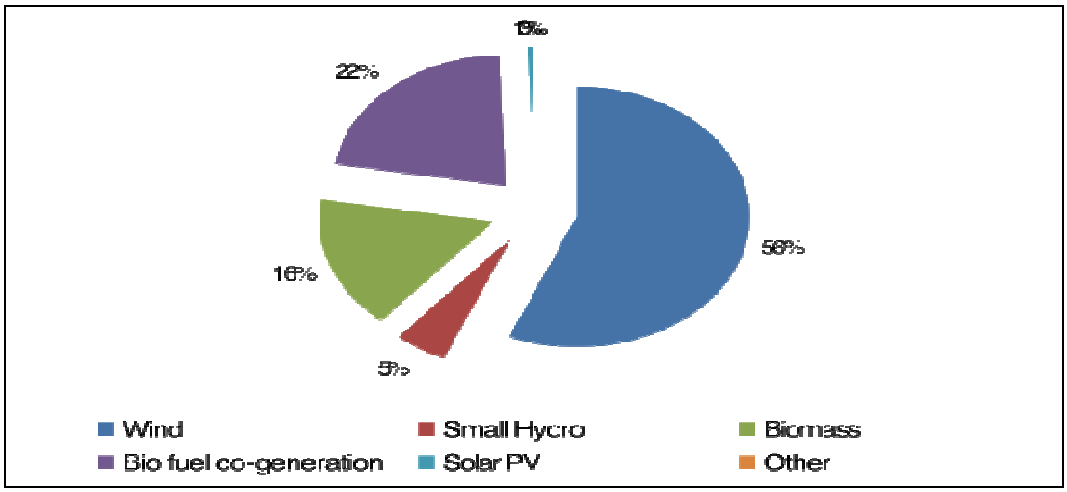
## 5.1 ANALYSIS OF THE ISSUES IDENTIFIED BASED ON LITERATURE SURVEY

### 5.1.1 Analysis of REC Market in India based on Inventory, Demand and Supply, Trade in Terms of Volume and Price of RE

India has gained experience of REC transaction for over two years now. Several important milestones have been reached in the trading sessions for non-solar and solar RECs.

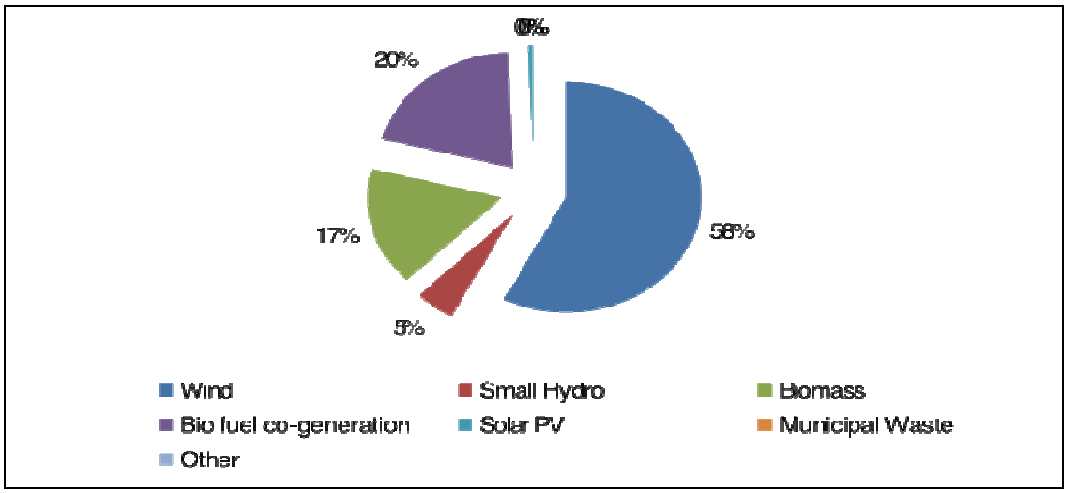
A total of 4,022MW of Renewable energy generators have been accredited for REC out of which 3,632 MW of capacity have got registered as on 1st July 2013 (REC Registry, 2013). The **Figures 5.1 and 5.2** present technology-wise break-up of capacity accredited and registered respectively under REC mechanism till 1st July 2013.

**Figure 5.1: Capacity Break-up of Accredited Projects under REC Scheme**




Source: Processed data from NLDC, 2013

**Figure 5.2: Capacity Break-up of Registered Projects under REC Scheme**




Source: Processed data from NLDC, 2013

After the introduction of REC mechanism on 14th January 2010, nearly 7,500MW of Renewable Energy capacity has been commissioned as of March 2013 (MNRE, 2013). Out of this, 2,256MW (30%) of new generation capacity which got commissioned after 14th January 2010 were registered under the REC scheme as shown in the **Table 5.1.**

**Table 5.1: Status of REC Registered Projects as of March, 2013**

| S. No. | Energy Source | OLD projects (Commissioned prior to 14.01.2010) and registered under REC | | NEW Projects (Commissioned after 14.01.2010) and registered under REC | | Total | |
|---|---|---|---|---|---|---|---|
| | | No. of projects | Capacity | No. of projects | Capacity | No. of projects registered under REC | Capacity |
| 1 | Wind | 117 | 281.08 | 391 | 1632.92 | 508 | 1914 |
| 2 | Bio-Cogen | 46 | 532.68 | 24 | 150.32 | 70 | 683 |
| 3 | Small Hydro | 5 | 47.50 | 17 | 140 | 22 | 187.5 |
| 4 | Biomass | 29 | 293.60 | 29 | 269.4 | 58 | 563 |
| 5 | Solar PV | | | 20 | 62 | 20 | 62 |
| 6 | Others | | | 1 | 1.7 | 1 | 1.7 |
| | **Total** | **197** | **1155** | **482** | **2256** | **679** | **3411** |

Source: Processed data from REC Registry, 2013

Even as the registrations are substantial and the initial volume growth has been encouraging, the trend in terms of volume and price of REC over the period presents a not-so-promising future for REC in India. The following table illustrates this.

**Table 5.2: Non-Solar REC Trading Summary**

| Month, Year | Opening Balance | REC Issued | REC Redeemed | Closing Balance | MCP in Rs./REC | Amount Transacted in Rs. Crore |
|---|---|---|---|---|---|---|
| | Non Solar | Non Solar | Non Solar | Non Solar | Non Solar | Non Solar |
| March,2011 | 0 | 532 | 424 | 108 | 2,818 | 0.12 |
| April,2011 | 108 | 4,503 | 260 | 4,351 | 1,500 | 0.04 |
| May,2011 | 4,351 | 28,270 | 18,502 | 14,119 | 1,500 | 2.78 |
| June,2011 | 14,119 | 27,090 | 16,385 | 24,824 | 1,505 | 2.47 |
| July,2011 | 24,824 | 30,224 | 18,568 | 36,480 | 1,554 | 2.89 |
| August,2011 | 36,480 | 31,813 | 25,096 | 43,197 | 1,789 | 4.49 |
| September,2011 | 43,197 | 74,612 | 46,362 | 71,447 | 2,300 | 10.66 |
| October,2011 | 71,447 | 1,26,544 | 95,504 | 1,02,487 | 2,710 | 25.88 |
| November,2011 | 1,02,487 | 1,35,697 | 1,05,527 | 1,32,657 | 2,891 | 30.51 |
| December,2011 | 1,32,657 | 88,055 | 1,11,621 | 1,09,091 | 2,950 | 32.93 |
| January,2012 | 1,09,091 | 1,02,348 | 1,71,524 | 39,915 | 3,051 | 52.33 |
| February,2012 | 39,915 | 2,00,736 | 2,06,188 | 34,463 | 3,065 | 63.19 |
| March,2012 | 34,463 | 2,03,819 | 1,99,737 | 38,545 | 2,907 | 58.07 |
| April,2012 | 38,545 | 1,22,369 | 71,226 | 89,688 | 2,201 | 15.68 |
| May,2012 | 89,688 | 2,30,448 | 1,68,675 | 1,51,461 | 2,379 | 40.12 |
| June,2012 | 1,51,461 | 2,58,801 | 2,36,485 | 1,73,777 | 2,405 | 56.88 |
| July,2012 | 1,73,777 | 3,82,384 | 1,58,220 | 3,97,941 | 2,014 | 31.86 |
| August,2012 | 3,97,941 | 4,74,594 | 2,73,893 | 5,98,642 | 1,505 | 41.23 |
| September,2012 | 5,98,642 | 5,68,124 | 2,64,446 | 9,02,320 | 1,500 | 39.67 |
| October,2012 | 9,02,320 | 6,14,478 | 2,22,700 | 12,94,098 | 1,500 | 33.41 |
| November,2012 | 12,94,098 | 3,92,485 | 1,32,352 | 15,54,231 | 1,500 | 19.85 |
| December,2012 | 15,54,231 | 3,82,391 | 2,73,644 | 16,62,978 | 1,500 | 41.05 |
| January,2013 | 16,62,978 | 3,04,238 | 1,93,337 | 17,73,879 | 1,500 | 29.00 |
| February,2013 | 17,73,879 | 3,14,917 | 1,52,952 | 19,35,844 | 1,500 | 22.94 |
| March,2013 | 19,35,844 | 2,68,323 | 4,27,871 | 17,76,296 | 1,500 | 64.18 |
| April,2013 | 17,76,296 | 2,59,299 | 44,459 | 19,91,136 | 1,500 | 6.67 |
| May,2013 | 19,91,136 | 2,49,221 | 52,968 | 21,87,389 | 1,500 | 7.95 |
| June,2013 | 21,87,389 | 2,92,928 | 72,486 | 24,07,831 | 1,500 | 10.87 |
| July,2013 | 24,07,831 | 4,62,962 | 1,61,402 | 27,09,391 | 1,500 | 24.21 |
| August,2013 | 27,09,391 | 4,88,824 | 40,889 | 31,57,326 | 1,500 | 6.13 |
| September, 2013 | 31,57,326 | 18,59,38 | 0 | 33,43,264 | | |
| **Total** | | **73,06,967** | **39,63,703** | | | **778.05** |

Source: NLDC REC Registry website, 2013

In August 2013, a total of 4,88,824 Non-solar RECs were issued. Combined with the Non-solar RECs of 27,09,391 that remained unredeemed in the month of July 2013, a total Non-solar RECs of 33,59,617 were available for trading in the month of August 2013. However, only 40,889 Non-solar RECs were sold/redeemed and an inventory of 31,57,326 Non-solar RECs remained unsold. Of the total Non-solar RECs offered for trading, about 1.37 % were redeemed. Similar is the market trend of Solar REC. Of the total Non-solar RECs offered for trading, about 5.62% were redeemed. This clearly indicates that there is poor demand for RECs. So is the case with the solar REC as is reflected in the following table.

**Table 5.3: Solar REC Trading Summary**

| Month, Year | Opening Balance | REC Issued | REC Redeemed | Closing Balance | MCP in Rs./REC | Amount Transacted in Rs. Crore |
|---|---|---|---|---|---|---|
| | Solar | Solar | Solar | Solar | Solar | Solar |
| March,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| April,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| May,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| June,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| July,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| August,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| September,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| October,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| November,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| December,2011 | 0 | 0 | 0 | 0 | 0 | 0 |
| January,2012 | 0 | 0 | 0 | 0 | 0 | 0 |
| February,2012 | 0 | 0 | 0 | 0 | 0 | 0 |
| March,2012 | 0 | 0 | 0 | 0 | 0 | 0 |
| April,2012 | 0 | 0 | 0 | 0 | 0 | 0 |
| May,2012 | 0 | 249 | 10 | 239 | 13,000 | 0.01 |
| June,2012 | 239 | 324 | 342 | 221 | 12,746 | 0.44 |
| July,2012 | 221 | 328 | 179 | 370 | 12,800 | 0.23 |
| August,2012 | 370 | 190 | 379 | 181 | 12,850 | 0.49 |

| Month, Year | Opening Balance | REC Issued | REC Redeemed | Closing Balance | MCP in Rs./REC | Amount Transacted in Rs. Crore |
|---|---|---|---|---|---|---|
| | Solar | Solar | Solar | Solar | Solar | Solar |
| September,2012 | 181 | 1,443 | 1,160 | 464 | 12,647 | 1.47 |
| October,2012 | 464 | 1,412 | 1,791 | 85 | 12,582 | 2.25 |
| November,2012 | 85 | 1,603 | 1,219 | 469 | 12,473 | 1.52 |
| December,2012 | 469 | 992 | 1,208 | 253 | 12,501 | 1.51 |
| January,2013 | 253 | 3,306 | 2,308 | 1,251 | 12,500 | 2.89 |
| February,2013 | 1,251 | 1,882 | 2,234 | 899 | 12,569 | 2.81 |
| March,2013 | 899 | 2,917 | 3,183 | 633 | 13,331 | 4.24 |
| April,2013 | 633 | 2,444 | 2,217 | 860 | 12,093 | 2.68 |
| May,2013 | 860 | 3,973 | 1,703 | 3,130 | 11,186 | 1.91 |
| June,2013 | 3,130 | 2,802 | 1,479 | 4,453 | 9,300 | 1.38 |
| July,2013 | 4,453 | 17,227 | 2,029 | 19,651 | 9,300 | 1.89 |
| August,2013 | 19,651 | 1,2890 | 2,359 | 30,182 | 9300 | 2.19 |
| September, 2013 | 30,182 | 5,968 | 0 | 36,150 | - | - |
| **Total** | | **59,950** | **23,800** | | | **27,89** |

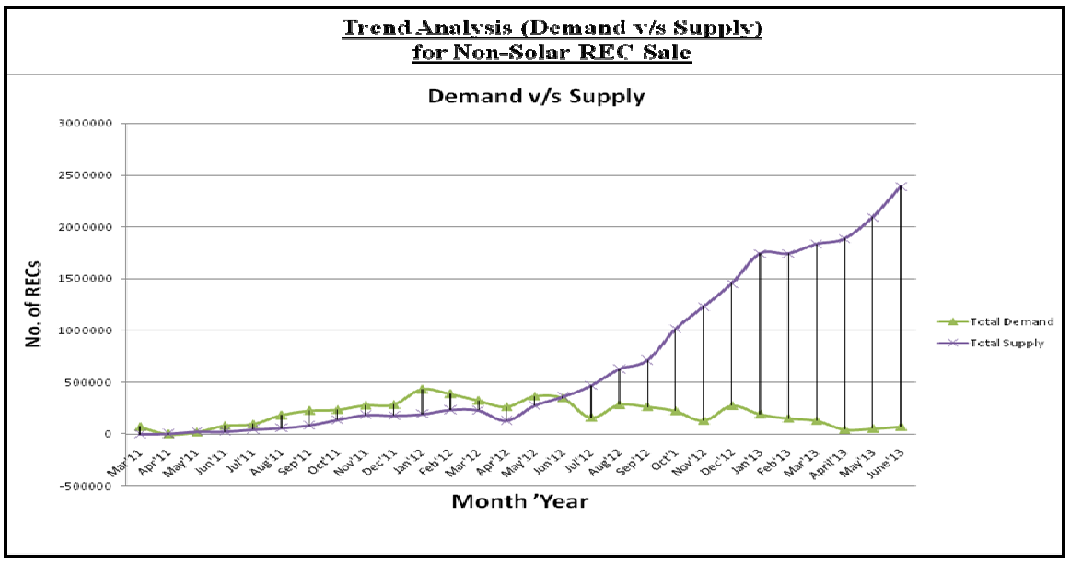
Source: REC Registry Website

In the month of August 2013, a total of 12,890 Solar RECs were issued. Combined with 19,651 Solar RECs that remained unredeemed in July 2013, a total of 32,541 Solar RECs were available for trading during August 2013. However, only 2,359 Solar RECs were sold / redeemed and an inventory of 30,182 Solar RECs remained unsold as of August, 2013. Of the total Solar RECs offered for trading, about 7.83 % were redeemed. This clearly indicates that there is poor demand for Solar RECs.

**REC Demand and Supply Scenario**

In June, 2013 trading session, total sale bid volume was 23.94 lakh RECs, out of which only 73,965 RECs were traded/cleared. The demand-supply gap remains a major issue in the REC market in India, especially in non-solar REC category since June, 2012 as is evident from the following Figure.

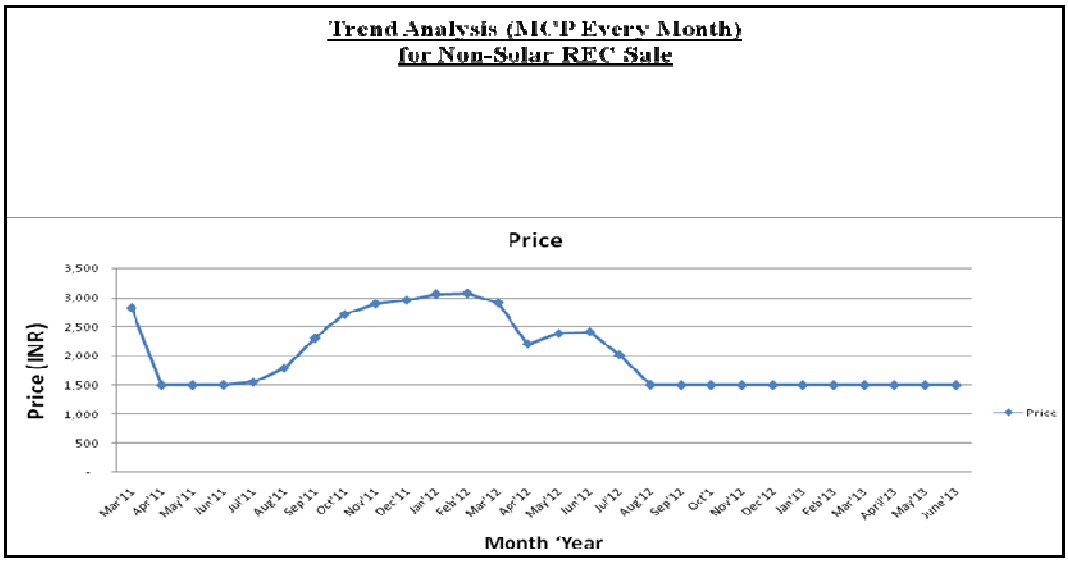
**Figure 5.3: REC Demand-Supply Scenario at End of June, 2013**




Source: Data collected from Power Exchanges, 2013

The clearing ratios were 2.57% in Indian Energy Exchange (IEX) and 3.67% on Power Exchange of India Limited (PXIL) Power Exchanges in the month of June, 2013(IEX, 2013 and PXIL, 2013). The market clearing prices for Non- Solar RECs remained at the floor level (Rs 1500/REC) on a continuous basis since June 2012. This is evident from the following figure.

**Figure 5.4: Non-Solar REC Market Clearing Price**




Source: Data collected from Power Exchanges, 2013

The above figures reveal very low demand and consequent low prices of REC. This leads the researcher to probe on the question as to what could be the reasons for such sentiments in REC market. The researcher, therefore, proceeds to study the REC market in India in greater depth and to suggest a way forward for the further progress of this market in the country.

### 5.1.2. Analysis of Possible Factors Influencing the Market Trend as Revealed from the above Analysis

The discussion in the preceding sections revealed that the current REC market is characterized by low demand. Given the fact that demand for REC is created by the RPO for the obligated entities, the obvious reason for low demand is that the obligated entities (the distribution licensees etc) are not coming forward in the market for buying RECs. This is also borne out by the data in **Table 5.4**.

**Table 5.4: Buyers: June 2013**

| Sl. No. | Name of Buyers | Type of Obligated entity | Nos. of RECs Purchased | % |
|---|---|---|---|---|
| 1 | Electricity Department, Chandigarh | Distribution Licensee | 2000 | 3% |
| 2 | Tata Power, Maharashtra | Distribution Licensee | 30200 | 41% |
| 3 | Others- 464 entities | Open Access and Captive users | 41765 | 56% |
| | **Total RECs** | | **73965** | **100%** |

Source: (Processed data from REC Registry, 2013)

The above table reveals that only two distribution companies purchased RECs in June, 2013 to meet their RPO partly. Also, of the total RECs traded, discoms' share in terms of purchase of REC was less than 50%.

The reasons as to why the obligated entities are not participating in the REC market have been analysed. The available data reveals two possible reasons for this.

(I) At one level it is due to the lack of RPO compliance and enforcement by State Electricity Regulators, as is revealed by the data in the following table.

**Table 5.5: RPO compliance (Non Solar) 2012-13**

| Sl. No. | States | Total Procurement (MU) | Total RE Procured (MU) | RPO Compliance | RPO Target (%) FY 2012 |
|---|---|---|---|---|---|
| 1 | Andhra Pradesh | 87,381 | 2,934 | 3.36% | 4.75% |
| 2 | Assam | 6,211 | 7 | 0.12% | 2.80% |
| 3 | Bihar | 11,676 | 144 | 1.23% | 2.50% |
| 4 | Chhattisgarh | 22,603 | 737 | 3.26% | 5.00% |
| 5 | Delhi | 26,674 | - | 0.00% | 0.00% |
| 6 | Goa | 3,740 | 119 | 3.18% | 1.70% |
| 7 | Gujarat | 77,864 | 2,883 | 3.70% | 5.00% |
| 8 | Haryana | 37,298 | 28 | 0.08% | 1.00% |
| 9 | Himachal Pradesh | 7,085 | 1,494 | 21.09% | 10.00% |
| 10 | Jharkhand | 7,085 | 244 | 3.44% | 2.50% |
| 11 | Karnataka | 60,611 | 5,149 | 8.49% | 9.75% |
| 12 | Kerela | 18,535 | 65 | 0.35% | 3.05% |
| 13 | Madhya Pradesh | 38,060 | 42 | 0.11% | 2.10% |
| 14 | Maharashtra | 118,094 | 5,441 | 4.61% | 6.75% |
| 15 | Manipur | 499 | - | 0.00% | 2.75% |
| 16 | Meghalaya | 1,066 | - | 0.00% | 0.45% |
| 17 | Mizoram | 483 | - | 0.00% | 5.75% |
| 18 | Nagaland | 439 | - | 0.00% | 6.75% |
| 19 | Orissa | 23,489 | 300 | 1.28% | 1.20% |
| 20 | Punjab | 43,792 | 237 | 0.54% | 2.37% |
| 21 | Rajasthan | 50,672 | 2,558 | 5.05% | 5.50% |
| 22 | Tamil Nadu | 69,653 | 6,976 | 10.02% | 8.95% |
| 23 | Uttar Pradesh | 73,962 | 3,174 | 4.29% | 4.50% |
| 24 | Uttarakhand | 9,423 | 384 | 4.08% | 4.50% |

Source: Processed data from SERCs, 2013

The above table demonstrates that RPO compliance (column 5) in most States (except Tamil Nadu, Orissa, Jharkhand, Himachal Pradesh and Goa) falls short of the target set (column 6).

As per regulations in most states, when the obligated entity does not meet its RPO targets during a year, the Commission may instruct the obligated entity to pay into a fund, maintained by the State Agency, an amount equivalent to shortfall in quantum of RPO equivalent of energy multiplied by the forbearance price of REC (Forum of Regulators, 2013). However, enforcement of these provisions is weak. Most State Commissions fail to monitor and ensure that the obligated entities are complying with the provisions of their regulations and duly purchasing renewable energy certificates to meet their obligations (Forum of Regulators, 2013). For example, the Chhattisgarh State Electricity Regulatory Commission (CSERC, 2013) in its order dated 18th June, 2013, assessed the level of compliance of renewable purchase obligation for distribution licensees for the year 2010-11. The CSERC in its order stated that the overall RPO met by the State was around 4.3% against the target of 4.75% (non-solar), and 0% for solar. The CSERC (CSERC, 2013), however, did not impose any penalties on the Discoms – it merely asked all the three Distribution licensees to share the burden. In states like Maharashtra, Punjab and Gujarat, shortfall in RPO have been carried-forward to future years. In the absence of strict enforcement of RPO the obligated entities have the least interest to participate in the REC market. This seems to have shattered the confidence of the investors on the REC scheme, as is evident from the Table 5.6 and Table 5.7.

**Table 5.6: Status of Accreditation**

| Sl. No. | Period | RE projects Accriditated MW | RE projects Accriditated Nos. |
|---|---|---|---|
| 1 | 14/1/2010 to 31/3/2011 | 172 | 46 |
| 2 | 1/4/2011 to 31/3/2012 | 2328 | 400 |
| 3 | 1/4/2012 to 31/3/2013 | 1345 | 301 |
| 4 | 1/4/2013 to 5/8/2013 | 213 | 75 |
| | **Total** | **4022** | **816** |

Source: (Processed data from REC Registry, 2013)

**Table 5.7: Status of Registration**

| Sl. No. | Period | RE projects Registered MW | RE projects Registered Nos. |
|---|---|---|---|
| 1 | 14/1/2010 to 31/3/2011 | 109.9 | 14 |
| 2 | 1/4/2011 to 31/3/2012 | 2108 | 346 |
| 3 | 1/4/2012 to 31/3/2013 | 1273 | 325 |
| 4 | 1/4/2013 to 5/8/2013 | 212 | 80 |
| | **Total** | **3632** | **759** |

Source: (Processed data from REC Registry, 2013)

Above tables show the declining trend of accreditation and registration of RE projects under REC mechanism, especially since April, 2012. The generation capacity accredited (1345 MW) during 2012-13 is almost half the capacity (2328 MW) accredited during 2011-12. So is the case with registration – only 1273 MW got registered during 2012-13 as against the capacity of 2108 MW registered during 2011-12. From this, it can be inferred that the initial enthusiasm of investors for investment through REC route is on the wane.

Worldwide experience shows that a stable and long-term RPO trajectory and strong deterrent against non-compliance of RPO have been used as important interventions of promotion of Renewable energy. India lacks on both the fronts. Section 86 (1) (e)

of the Electricity Act, 2003 doesn't specify national level RPO. The relevant provision of the law is quoted below:

*"86. The State Commission shall discharge following functions, namely… (e) promote cogeneration and generation of electricity from renewable sources of energy by providing suitable measures for connectivity with grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of total consumption of electricity in the area of distribution licensee."*(Ministry of Law and Justice, 2003)

It has been left to the State regulators to specify the same. RPO is specified by the States based on the resources available in their states. Moreover, the maximum penalty amount specified in the Act is Rs. 1 Lakh only, which is too little to deter against non-compliance of RPO. The relevant provision of the law is quoted below:

***"142. Punishment for non-compliance of directions by Appropriate Commission.***
*In case any complaint is filed before the Appropriate Commission by any person or if that Commission is satisfied that any person has contravened any of the provisions of this Act or the rules or regulations made thereunder, or any direction issued by the Commission, the Appropriate Commission may after giving such person an opportunity of being heard in the matter, by order in writing, direct that, without prejudice to any other penalty to which he may be liable under this Act, such person shall pay, by way of penalty, which shall not exceed one lakh rupees for each contravention and in case of continuing failure with an additional penalty which may extend to six thousand rupees for every day during which the failure continues after contravention of the first such direction."* (Ministry of Law and Justice, 2003)

The Central Electricity Regulatory Commission has given statutory advice (CERC, 2011) to the Ministry of Power (MOP) advising inter alia that (i) National Electricity Policy (NEP) and Tariff Policy (TP) should provide a national level long term RPO trajectory at least of 5 to 10 years, (ii) the Electricity Act, 2003 should

mandate SERCs to fix RPO in accordance with the provisions of NEP and TP, (iii) SERCs should be empowered to impose penalty in addition to the provisions made in Section 142 of the Act. MOP has accordingly constituted a Committee for initiating legislative & policy changes for accelerated development of renewable energy (Ministry of Power, Government of India, 2012).

The above analysis clearly reveals that absence of proper enforcement of RPO is one of the major factors responsible for non-participation of distribution companies in the REC market. However, this is not the only reason.

(II) At another level, the reason for non-participation of distribution companies as revealed from the analysis of the study include the following

(i) Their poor financial health

(ii) REC not being a viable option for resource rich states

(iii) REC providing only electronic certificates and not energy

(iv) Reluctance due to infirm nature (and consequently of less value).

**Poor Financial Health of Distribution Licensees**

According to the report of the high-level Shunglu Committee on Financial Position of Distribution Utilities, financial losses of electricity distribution licensees touched about Rs. 70,000 crore in 2010-11(Shunglu Committee Report, 2011). The poor financial health of the distribution companies restricts their ability to purchase the desired quantum of power, more so the otherwise expensive power from renewable energy sources or for that matter the REC. Quite often they resort to load shedding to avoid purchase of power. This factor needs to be addressed any way for viability

of power sector in general and as one of the solutions to bring the distribution licensees in the REC market for creating the demand for RECs.

**REC not a Viable Option especially for RE Resource Rich States**

For the resource rich states, cost of fulfillment of RPO through feed in tariff (FiT) route and REC route constitutes the following components:

**Table 5.8: Components of Cost of Fulfillment of RPO through FiT Route and REC Route**

| Parameters | FiT Route | REC Route |
|---|---|---|
| FiT | Yes | - |
| Average Power Purchase Cost (APPC) | - | Yes |
| REC Cost | - | Yes |
| Transmission cost | Yes | Yes |
| Transmission losses | Yes | Yes |
| Incremental Power Purchase Cost (IPPC) | - | Yes |
| Cost of balancing power (power required to address variation in RE generation) | Yes | Yes |

Source: (Forum of Regulators, 2012)

Further the following tables compare the cost of RPO compliance under both the routes for the resource rich states of Rajasthan and Karnataka:

**Table 5.9: RPO Compliance: Cost Economics Comparison for Rajasthan**

*All fig in Rs/Kwh*

| | APPC including Transmission Loss | Transmission Cost | Total APPC Cost (A) | REC Price (B) | Energy Cost (FiT) including Transmission & Balancing Cost (C) | (A)+(B)-(C) |
|---|---|---|---|---|---|---|
| REC @ Floor Price | 3.68 | 0.43 | 4.11 | 1.50 | 5.22 | 0.38 |
| REC @ Av. Price | 3.68 | 0.43 | 4.11 | 2.4 | 5.22 | 1.28 |
| REC @ Forbearance Price | 3.68 | 0.43 | 4.11 | 3.3 | 5.22 | 2.18 |

Source: FOR Study Report on Incentive, December, 2012

**Table 5.10: RPO Compliance: Cost Economics Comparison for Karnataka**

*All fig in Rs/Kwh*

| | APPC including Transmission Loss | Transmission Cost | Total APPC Cost (A) | REC Price (B) | Energy Cost (FiT) including Transmission & Balancing Cost (C) | (A)+(B)-(C) |
|---|---|---|---|---|---|---|
| REC @ Floor Price | 3.46 | 0.50 | 3.97 | 1.50 | 4.59 | 0.87 |
| REC @ Av. Price | 3.46 | 0.50 | 3.97 | 2.40 | 4.59 | 1.77 |
| REC @ Forbearance Price | 3.46 | 0.50 | 3.97 | 3.30 | 4.59 | 2.67 |

Source: FOR Study Report on Incentive, December, 2012

From the above tables it appears that cost of compliance of RPO by procuring power at feed-in Tariff (refer C in the tables) is cheaper than the cost of RPO compliance under REC route (refer A+B in the tables). Therefore, distribution licensees in the resource rich states may not necessarily come to REC market for RPO compliance.

**REC Viable Option Especially for RE Resource Deficit States only at Floor Price**

Similar comparison of RPO compliance cost has been done for the resource deficit states of Punjab and Delhi. For such states, REC route implies cost of REC plus the cost of procurement of equivalent energy (referred to as incremental power purchase cost or IPPC) as shown under:

**Table 5.11: Cost Comparison for Resource Deficit State Punjab under IPPC+REC and FiT Route**

| Particulars | IPPC+REC Rs/Kwh (A) | FiT Rs/Kwh (B) |
|---|---|---|
| IPPC | 3.34 | - |
| REC (floor price) | 1.50 | - |
| FiT | - | 4.63 |
| Transmission cost | 0.14 | 0.24 |
| Transmission loss | 0.04 | 0.12 |
| Sub-total | 5.02 | 4.99 |
| Balancing energy cost | - | 0.29 |
| **Total Cost** | **5.02** | **5.28** |
| Diff between A and B at: | | Rs/Kwh |
| - REC @ Floor Price (1.50)……(X) | | (0.25) |
| - REC @ Av. Price (2.50)……..(Y) | | 0.65 |
| - REC @ Forbearance Price (3.40)….(Z) | | 1.55 |

Source: FOR Study Report on Incentive, December, 2012

**Table 5.12: Cost Comparison for Resource Deficit State Delhi under IPPC+REC Route and FiT Route**

| | IPPC+REC Rs/Kwh (A) | FiT Rs/Kwh (B) |
|---|---|---|
| IPPC | 3.34 | - |
| REC (floor price) | 1.50 | - |
| FiT | - | 4.63 |
| Transmission cost | 0.10 | 0.23 |
| Transmission loss | 0.04 | 0.14 |
| Sub-total | 4.98 | 5.00 |
| Balancing energy Cost | - | 0.33 |
| **Total Cost** | **4.98** | **5.33** |
| Difference between A and B at: | | All fig in Rs/KWh |
| - REC @ Floor Price (1.50) ……(X) | | (0.35) |
| - REC @ Av. Price (2.50) ……(Y) | | 0.55 |
| - REC @ Forbearance Price (3.40) ……(Z) | | 1.45 |

Source: FOR Study Report on Incentive, December, 2012

From the above cost comparison we find that the REC route is attractive for resource deficit states only if RECs are available at Floor price (Reference X, Y and Z in both the tables). Therefore, such states may prefer to fulfill their obligation by purchasing renewable energy through FiT route as against REC route the moment REC price exceeds the threshold level of floor price.

Since renewable energy is generally variable in nature and seen to be a costly energy, both resource rich and deficit states are generally unwilling to increase their RPO obligation beyond current limits, as RPO compliance would result in:

- Additional balancing power cost to be incurred by the resource rich state utility to handle the variation in variable renewable energy generation.
- Additional expenditure in establishing transmission infrastructure for transmitting the new renewable capacity and the balancing capacity which needs to come up to handle the variable nature of RE

Forum of Regulators (FOR) in its study report on "Preparing Incentive Structure for States for fulfilling Renewable Purchase Obligation (RPO) target" suggested that there was a need for an incentive framework to encourage setting of reasonable RPO targets and enabling obligated entities to fulfill their RPO obligations for resource rich and resource deficit States.

**REC: Only an Electronic Certificate without Physical Electricity**

RECs are sold in the form of electronic certificates without physical electricity. There being shortage of power supply (e.g. during May, 13 energy shortage was reported as 5.7% and peak shortage 6% as per Central Electricity Authority),

purchase of RECs does not meet the need of the distribution companies in terms of power procurement. They are, therefore, generally reluctant to buy RECs which are not accompanied by physical energy. Instead they would be willing to pay for electricity that is produced on their behalf using cleaner, renewable sources of generation. As such, they often prefer to go in for FiT route of RE procurement over procurement of REC for meeting RPO. The arguments that purchase of REC amounts to contributing to efforts at mitigating risks of climate change and energy security do not ring the ears of the power hungry and financially battered distribution companies in India.

### 5.1.3 Analysis from RE Generator Perspective

In the preceding section the REC market data was analysed from the perspective of the buyers (mainly the distribution companies). In this section, analysis is being done from the RE generators' perspective. Attempt has been made to analyse the question as to how the RE generators view REC as an option for investment.

**Bankability: Financing Risk**

In India, there is a real concern about the bankability of renewable energy projects under REC route because of high risks perceived by financiers. The key constraint identified is the lack of visibility of pricing and regularity of cash-flows. There is uncertainty due to shorter visibility of REC price band as the current floor and forbearance price determined by the Central Commission are valid only until FY 2016-17. There is no visibility of REC revenue after FY 2017. Another source of revenue under the REC mechanism is sale of electricity component to local distribution licensee at the Average Power Purchase Cost (APPC). CERC

Regulations provided that the electricity component can be purchased by the local licensee at a price 'not exceeding' the APPC (recently amended to 'at APPC'). This left discretion with the local licensees to negotiate price of electricity component lower than APPC. For example, the distribution licensees in the State of Gujarat have been signing power purchase agreement for electricity component with wind energy generators at Rs. 2.70/kWh fixed for 10 years as against the actual APPC of Rs. 3.00/kWh. Very few SERCs have specified APPC for purchase of electricity component from the REC based projects. Some of the States which have declared APPC are listed below:

**Table 5.13: APPC declared by States for FY2012-13**

| **States** | **APPC in FY12-13** |
|---|---|
| Gujarat | 3.18 |
| Himachal Pradesh | 2.17 |
| Haryana | 3.27 |
| Karnataka | 3.07 |
| Maharashtra | 3.42 |
| Rajasthan | 2.75 |
| Orissa | 2.32 |
| Punjab | 2.90 |
| Madhya Pradesh | 2.38 |
| Uttar Pradesh | 2.83 |
| Kerala | 2.26 |
| A.P | 2.80 |

Source: (Processed data from SERCs, 2012)

In the event of the licensees' insistence on purchase of electricity at a rate lower than the APPC, there could be a viability gap for the RE projects, especially in the event of the REC price discovered in the Power Exchange(s) being close to Floor price. Thus, the cash flow on both counts (APPC and REC) becomes uncertain in the current REC framework in India.

**Limited Liquidity in the Market**

The REC markets currently trade once a month. As the market matures, this is likely to become a constraint, as relying on once a month opportunity to realize cash flows may lead to depressed pricing and act as a road block to bankability.

**Limited Shelf-Life of RECs**

RECs are valid for one year(recently extended to two years by CERC) once they are issued. Many market participants believe that this adds to liquidity, and is therefore a good check. However, banks are uncomfortable with the idea, as limited shelf life of RECs fails to assure guaranteed cash flow, more so in the wake of the dampening sentiment of the distribution companies towards REC market. The apprehension gets further heightened in view of the fact that there is no "buyer of last resort" that is, there is no system of purchase of unsold RECs even at a discounted price by any designated agency. Thus, the RECs not sold during the validity period lapse. This poses a major challenge to bankability of REC based projects.

**Absence of Sunset Clause**

There is no sunset clause specified in the REC mechanism. One does not know how long the policy framework of REC will last. This causes uncertainty for Investors/Banks/Financial institutions. For investment decision, one needs certainty

of existence of the framework over a longer time horizon to enable the investor recover his investment. Absence of sunset clause creates business risk and banks refrain from financing such projects.

The above concerns haunt the minds of investors at present. This also explains why the interest is waning amongst the investors in the REC mechanism. This calls for appropriate policy and regulatory intervention to address the concerns.

The above sections dealt with analysis of the possible factors responsible for present state of REC market in India – analysis based on the secondary data available in the context. Backed by the understanding developed through this analysis, an attempt has been made in the subsequent section to understand as to whether we can get solutions to the challenges of Indian REC system, in the international experience – to be specific, in the UK experience of ROC. Parameters have been developed to compare Indian REC system with ROC system of UK and to identify the gaps in Indian REC mechanism.

## 5.2 ANALYSIS BASED ON COMPARISON OF REC FRAMEWORK IN INDIA AND UK

Analysis has also been done based on the international experience of implementation of OC/REC framework, especially the experience of UK where more than ten years' experience is there on this market based instrument. Comparison has been done between India and UK model of REC/ROC to understand the gaps and suggest the way forward for India. Following broad Parameters (basis) for comparison have been identified based on the secondary data researches which are as follows:

- Structural (Design)/ Institutional Parameters
  - Linkage between preferential tariff and REC (structural/Design parameter)
  - Role of different stakeholders/institutions (institutional parameter) – in terms of
  - Policy and regulatory certainty and homogeneity about REC design setting (clarity about sunset clause)
  - RPO target setting and Compliance mechanism
- Eligible Entities for REC (institutional parameter)
  - Denomination of REC (structural/Design parameter)
  - Categorization of REC based on technology/RE source (structural/Design parameter)
  - Technology or vintage based REC multiplier (structural/Design parameter)
  - Shelf life of REC/banking of REC (structural/Design parameter)
- Operational Parameters
  - REC trading platforms
  - Secondary market
  - Voluntary market
- Commercial Parameters
  - REC pricing
  - Floor and forbearance price
  - Long term visibility of REC pricing

The table below compares the Indian REC system with ROC system of UK based on the above parameters:

**Table 5.14: Comparison of REC Framework in India and UK**

| **Parameter: Co-existence of Renewable Obligation Certificate(ROC)/ Renewable Energy Certificate (REC) and Feed-in Tariff (FiT)** | |
|---|---|
| **United Kingdom** | **India** |
| Micro-generation technologies producing less than 50 kilowatt of electricity are eligible only for Feed-in Tariff (FIT) from April 1 2010.<br>Others get ROC credits | Developers have a choice to select between both the schemes i.e. REC and FiT |
| **Parameter: Institutions Involved** | |
| **United Kingdom** | **India** |
| • Institution involved in ROC mechanism is Office of the Gas and Electricity Markets (OFGEM), the regulator in UK<br>• Following are the functions performed by it-<br>o Accrediting generating stations;<br>o Issuing and revoking ROCs;<br>o Establishing & maintaining a Registry of ROCs;<br>o Compliance monitoring;<br>o Annual buy-out price calculation;<br>o Buy-out payments collection and redistribution of the buy-out fund; | • Institutions involved in REC mechanism are:<br>o Central Electricity Regulatory Commission (specify REC framework)<br>o State Electricity Regulatory Commission (recognise REC as valid instrument of RPO compliance)<br>o State Agencies (accreditation)<br>o Central Agency (registration, issuance of REC). |
| **Parameter: Sunset clause of ROC/REC Scheme and long term visibility** | |
| **United Kingdom** | **India** |
| • ROCs cannot be issued beyond 31 March 2037.<br>• RE generator can be issued ROCs for 20 years only. | • There is no specific sun set clause specified for which RECs are issued. |
| **Parameter: Renewable Purchase Obligation (RPO) target** | |
| **United Kingdom** | **India** |
| • As per RO Order-2009, the Obligation size is set by a series of fixed annual targets that increase linearly to 15.4% in 2015/16.<br>• End date of the RO target extended to 2037 from 2027, in April 2010 in order to provide long-term certainty to new projects and to ensure continued capacity addition of renewable energy to meet the target of 2020 and beyond<br>• Under the current RO mechanism, the Obligation size is capped at 20% of electricity supplied. | • Each State Commission specifies RPO target for its own State.<br>• No national level RPO target specified in the Act.<br>• RPO is fixed based on the resources available in the States.<br>• RPO across the country varies in the range of 1.5% to 10%<br>• RPO is specified for the maximum period of 3 to 5 years only<br>• No long-term certainty for investors |

| Parameter: RPO monitoring and compliance | |
|---|---|
| **United Kingdom** | **India** |
| • The RO Order mandates licensed electricity suppliers to fulfill RO target<br>• RO target to be fulfilled by supplying eligible renewable sources to consumer;<br>• Penalty to be payable on non fulfillment of RO target<br>• RO is administered by OFGEM<br>• Obligated suppliers to meet their obligation on or before 1 September following the obligation period.<br>• The Orders allow suppliers to meet their RO by either presenting ROCs or paying an equivalent amount into the buy-out fund.<br>• All buy-out payments received are redistributed to suppliers who met their obligation<br>• Such redistribution is done in proportion of ROCs that each supplier has presented<br>• Suppliers failing to make buyout payments by 31st August are liable for late payment charge. The late payment period starts from 1st September to 31st October. | • State Commission specifies RPO for obligated entities (distribution licensees, open access users, Captive power consumers<br>• RPO is administered by State Commission<br>• Regulations provide that if the obligated entities do not meet their RPO targets, which may create shortfall in the units of RPO and in such cases, the Commission may instruct the obligated entity to pay into a fund an amount equivalent to shortfall in quantum of RPO equivalent of energy multiplied by the forbearance price of REC.<br>• These provisions of the regulations are not strictly enforced |
| **Parameter: Eligibility** | |
| **United Kingdom** | **India** |
| • ROCs issued to an accredited generators for generating and supplying RE within UK | • Renewable energy generators not having Power Purchase Agreement under tariff determined by the regulator is eligible for REC. |
| **Parameter: Denomination** | |
| **United Kingdom** | **India** |
| • One (1) ROC is issued for one (1) MWh of renewable energy generated. | • One (1) REC is issued for one (1) MWh of eligible renewable energy generated and injected into the grid. |
| **Parameter: Banding/ of REC** | |
| **United Kingdom** | **India** |
| Various RE technologies categorised in 4 bands are as under:<br>• Established technologies will receive 0.25 ROCs per MWh;<br>• Technologies falling under the Reference Band will receive 1 ROC per MWh;<br>• Technologies under the Post-Demonstration Band will receive 1.5 ROCs per MWh;<br>• Technologies falling under the Emerging Technologies Band will receive 2 ROCs per MWh. | • RECs are divided into two categories<br>o Solar RECs<br>o Non Solar RECs<br>• No technology specific banding is provided |

| Parameter: Categorization of ROC | |
|---|---|
| **United Kingdom** | **India** |
| • Hydro-electric; Onshore Wind; Offshore Wind; Wave; Tidal Stream; Solar Photovoltaic; Geothermal; Geo-pressure; Landfill Gas based generation; Sewage Gas based generation; Energy from waste with CHP; Gasification/ Pyrolysis; Anaerobic Digestion; Co-firing - of Biomass, of Energy crops, of Biomass with CHP, of Energy crops with CHP; Dedicated Biomass; Dedicated Energy Crops | • Non-solar RE Technology:<br>Wind; Small Hydro Plant; Biomass; Bio fuel based cogeneration; Municipal Solid Waste<br>• Solar Technology:<br>Solar PV and Soar Thermal |
| **Parameter: Shelf life of ROC** | |
| **United Kingdom** | **India** |
| • ROC's have a shelf life of 1 year from April 1 to March 31 of every year and suppliers can only meet 25% of their quota target with banked ROCs. | • REC's have a shelf life of 365 days (now 730 days) from the date of issuance |
| **Parameter: RoC Trading** | |
| **United Kingdom** | **India** |
| • ROCs can be sold directly to suppliers (Bilateral /OTC market)<br>• ROCs can also be traded separately from electricity<br>• REC market is characterised by obligatory market as well as voluntary market | • RECs are traded separately from electricity<br>• RECs can be traded only through power exchanges.<br>• Voluntary market is negligible |
| **Parameter: ROC Pricing** | |
| **United Kingdom** | **India** |
| • ROC market sets the price of ROC reflecting the difference between percentage of RE electricity generated and the RO percentage | • The price of one ROC is set by the market and to be traded between the floor and forbearance price<br>• Central Commission specifies Forbearance and Floor price for non-solar and solar RECs |
| **Parameter: Visibility of pricing** | |
| **United Kingdom** | **India** |
| • The ROC Buy out price was set at 30€ in 2002. This was set keeping in view the difference between the electricity cost and the anticipated value of marginal cost. It is adjusted to RPI every year. | • REC floor and forbearance prices have been set for 5 years i.e. up to FY 2017.<br>• There is no price visibility beyond FY2017. |

Source: CERC RE Tariff Regulations-2012, CERC REC Regulations2010, RO Order 2002, OFGEM

### 5.2.1 Discussion on REC mechanism in India and UK

Some of the key aspects of the CERC, REC regulations have been critically examined in comparison with the ROC mechanism of UK to analyze and identify key challenges facing the growth and success of REC markets in India.

- Both Renewable Energy certificates (RECs) in India and Renewable Obligation Certificate (ROC) in UK represent the green attributes of renewable electricity generated. Such green attributes are unbundled from the physical form of electricity. These attributes are embodied in certificates and the two products—the renewable energy certificates and the physical electricity—to be traded separately. These are currently used by the obligated entities to fulfill their RPO.
- Currently, REC framework in India doesn't specify sunset clause which is specified in the ROC framework of UK upto 2037. There is no long term visibility of REC mechanism in India. In India, there is no long term national level RPO specified in the Act. In UK, there is a clear mandate in the law itself to achieve 20% RPO target by year 2020.
- In the REC mechanism, there is a separate categorization of the RECs based on source of energy i.e. Solar REC and Non-solar REC. On the other hand, in UK there is a unified market of ROCs using a multiplier for different sources. The objective is to provide greater support to emerging technologies using a higher multiplier than for matured technologies. The value (in terms of multiplier) is gradually reduced in line with their cost competitiveness. A pre-specified schedule of declining multipliers provides a benchmark for cost reductions to be achieved to remain viable in the changing environment for RECs for the particular technology. Current categorization of REC mechanism in India has

the potential of reducing liquidity and trade in the two separate markets as compared to a common market for ROCs.

- Currently, trade in REC is allowed only at the exchange platform. In UK, forward market in the ROCs framework, is a common phenomenon, wherein bilateral 'over-the-counter' (OTC) trade takes place, where sellers and buyers agree to enter into a mutually agreed trade of ROCs. Buyers could be obligated entities, market makers and traders. This provides liquidity in the market.
- The REC regulations in India specify the validity of REC to be 365 days(now 730 days) from the date of issuance. There is no safeguard in case of oversupply of RECs. In case of UK, ROC mechanism facilitates banking of certificates. Banking of certificates could also be an economic solution to reduce volatility in the price of RECs.
- In India, if the obligated entity fails to fulfill its obligation, it has to pay a penalty at the rate of Forbearance price. The funds collected in this process can be used to buy the REC's from the open market. In UK, in case the obligated entity fails to fulfill its obligation, it has to pay a penalty in the form of buyout price to the regulator. This fund collected from the entities which did not fulfill their obligation is then redistributed back to the entities which have fulfilled their obligation. Such mechanism of redistributing the funds encourages more participation as it acts as an incentive to those entities which fulfill their renewable obligations.
- The buyout price in UK was fixed in 2001 and linked with the Retail Price Index which always has an increasing trend. In India, the forbearance price is the highest difference between the Cost of Generation/ RE Tariff and the APPC.

In India, there are currently two alternate revenue schemes available for investors in RE projects-(i) FiT Scheme and (ii) Renewable Energy Certificate Scheme. The present scheme of REC does not allow certificates being issued to those projects which are registered under FiT mechanism. In UK, ROC is the primary instrument for fulfillment of RPO.

- Current mechanism of REC requires determination of floor price and forbearance and RECs are required to be traded between these two prices. In UK, there is no floor and forbearance price.
- In UK, the buyout price is set as the difference between the electricity cost and anticipated value of marginal cost.

The above comparison identifies the gaps that exist in Indian REC system. The gaps so identified have been validated through interaction with relevant stakeholders in the subsequent sections. So far, analysis has been done based on the secondary data – national and international. In the following sections, the issues, challenges and gaps identified in Indian REC system have been validated through primary data sources. First, likert scale based questionnaire was developed on the identified parameters and responses were solicited from the relevant stakeholder 'organisations'. Responses so received have been analysed to identify the factors affecting the REC system in India. Secondly, the gaps identified from the comparison with UK model of ROC have been validated through 'open ended' questions to the 'experts'. Responses received from the opinion survey have been analysed to re-validate and conclude on the factors that need to be addressed to make REC achieve its objectives of promotion of green energy in India.

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## 5.3 ANALYSIS OF RESULTS OF RESPONSES THROUGH QUESTIONNAIRE AND IDENTIFICATION FACTORS AFFECTING REC SCHEME IN INDIA

### 5.3.1 Analysis of Responses through Questionnaire

As stated above, likert scale based questionnaire was developed on the identified parameters and responses were solicited from the relevant stakeholder 'organisations'. The questionnaire designed has been shown in **Appendix-I**.

The responses received back from the sample are being analyzed in this section to identify the factors affecting REC Scheme in India.

**Validity**

Face Validity and Construct Validity[1] approaches have been used to establish validity of factors. Under these approaches, various factors were identified first based on literature survey. The factors so identified were used to deign

[1] **Face Validity** ascertains that the measure appears to be assessing the intended construct under study. The stakeholders can easily assess face validity. **Construct Validity** is used to ensure that the measure is actually measure what it is intended to measure (i.e. the construct), and not other variables. Using a panel of "experts" familiar with the construct is a way in which this type of validity can be assessed.

questionnaire. A small sample of 30 people was interviewed to start with to understand whether the factors derived from literature survey are valid. Therefore, validity of the factors was ascertained from secondary as well as primary data.

**Reliability**

Before starting the analysis the reliability of the scale was checked using Cronbach's Alpha (Statistical Tool). The value greater than 0.7 is considered to be highly reliable. The results achieved by this statistical test are portrayed below:

**Table 5.15: Reliability Statistics**

| Cronbach's Alpha | N of Items |
|---|---|
| 0.786 | 38 |

The scale is highly reliable as the Cronbach's Alpha value is above 0.7. As the scale was accepted, factor analysis was used to reduce the data by grouping the similar parameters (variables) to a few manageable factors.

**Adequacy**

The Kaiser-Meyer-Olkin (KMO) statistic was used to evaluate whether the sample size used for study was adequate so as to ensure the precision of factor analysis. The value of KMO statistic greater than .6 is considered to be adequate. The results achieved by this statistical test are portrayed below:

**Table 5.16: KMO and Bartlett's Test**

| Kaiser-Meyer-Olkin Measure of Sampling Adequacy | | .729 |
|---|---|---|
| Bartlett's Test of Sphericity | Approx. Chi-Square | 2809.490 |
| | Df | 703 |
| | Sig. | .000 |

The value of KMO statistic is greater than 0.6. As such, the sample size is considered to be adequate and the aptness of factor analysis is ensured.

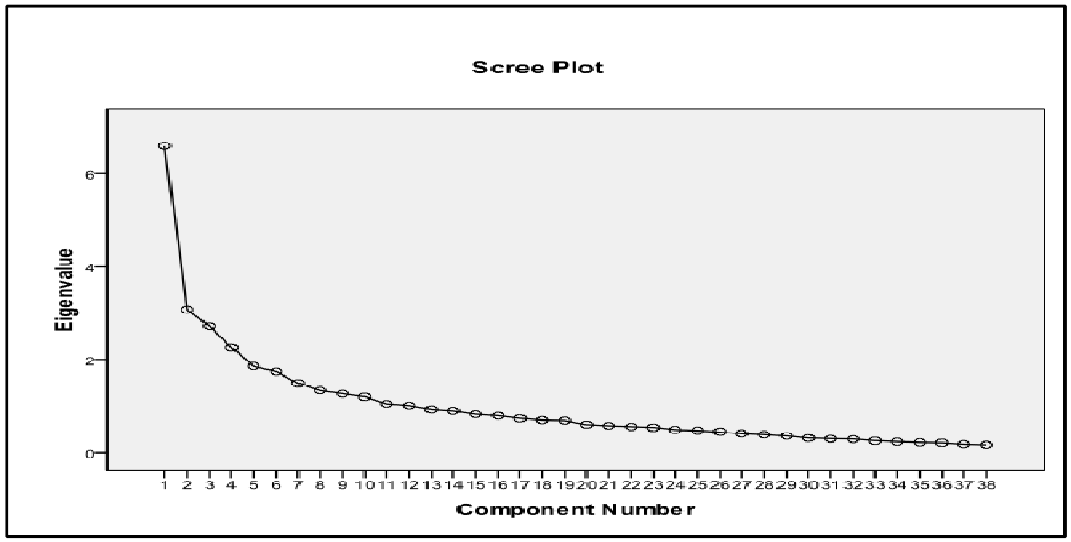
The Principle Component Analysis method was used to analyze these 38 parameters/variables. In this Principle Component Analysis Eigen Value Method and Scree Plot Method were used to determine and justify the factors.

### 5.3.2 Factors Affecting REC Scheme in India

Using Principle Component Analysis, 7 factors were determined whose cumulative percentage of variances is explained by 67.30%. **Figure 5.5** portrays the Scree plot which was drawn.

After determining the seven factors, the factor matrix was prepared which loaded 29 variables on the factors. Thereafter factor rotation matrix was prepared by rotating the factors using Varimax procedure which is an orthogonal method of factor rotation. Cronbach's Alpha of each of 7 factors was calculated to establish the internal consistency and it was found to be 0.840, 0.758, 0.740, 0.747, 0.752, 0.657 and 0.752 respectively for the studied factors and is found to be consistent.

**Figure 5.5: Scree Plot**



By the application of factor analysis, 29 identified variables were reduced to 7 major factors which act as the critical factors affecting REC Scheme in India. The significant factor loadings of each identified variable, the total variance explained for each factor and the Cronbach's Alpha for each factor is shown below:

**Table 5.17: Cronbach's Alpha for Each Factor**

| | | | |
|---|---|---|---|
| Policy and External factors (Cronbach Alpha: 0.840) | F1 | 0.547 | There should be clarity and certainty about continuation of REC framework on longer time horizon (need for sunset clause) |
| | F3 | 0.656 | In the event of sale of RE generation to the obligated entity at preferential tariff, REC credit should also be transferred to the obligated entity. |
| | F30 | 0.585 | There is a need for a standard and enforceable mechanism for compliance monitoring of REC purchase |
| | F37 | 0.777 | There should be an incentive mechanism to encourage States to set higher RPO |
| | F38 | 0.784 | Host states should be compensated for the evacuation infrastructure and balancing power needed to integrate RE |
| | F34 | 0.680 | Transmission infrastructure for evacuation of RE generation is crucial for success of REC |
| | F36 | 0.802 | Success of REC also depends on how balancing power requirements of host states are addressed |
| Supply side concerns of REC (Cronbach Alpha: 0.758) | F27 | 0.549 | There should be a legislative mandate (provision in the Act itself) for longer and stable RPO trajectory |
| | F28 | 0.547 | Non-compliance of RPO should attract penalty which the regulator should enforce effectively |
| | F11 | 0.553 | Older projects could be given more RECs, to insulate such projects from adverse impact of reduction in floor price in future |
| | F12 | 0.564 | Shelf life/validity of REC should be higher than current validity period of 365 days |
| | F17 | 0.624 | Final trade and extinction of REC happen only through Power Exchange |
| | F21 | 0.680 | There should be a longer visibility for REC price band |
| | F6 | 0.530 | Off-grid RE generations should also be made eligible for REC |
| Pricing of RECs (Cronbach Alpha: 0.740) | F20 | 0.652 | Current method of fixing floor and forbearance price based on APPC and RE tariff should be reviewed |
| | F22 | 0.709 | Average Pool Power Purchase Price (APPC) determination methodology needs to be standardized at the national level |
| | F23 | 0.674 | National level RPO should be evolved and adopted by all States |
| | F26 | 0.720 | RPO of Discom should exclude RE purchase requirement corresponding to consumption of such large consumers |

| | | | |
|---|---|---|---|
| Liquidity of RECs (Cronbach Alpha: 0.747) | F2 | 0.788 | All RE generation (whether sold at preferential tariff or otherwise) should be given the REC credit. |
| | F4 | 0.762 | Obligated entity should be entitled to sell the RECs left surplus after meeting its RPO compliance |
| | F13 | 0.672 | There is a need for a guarantee fund to buy out unsold RECs at discounted price, for certainty of revenue to investors |
| Trading Mechanism (Cronbach Alpha: 0.752) | F15 | 0.681 | There should be more trading sessions, instead of the current framework of once-in-a-month only trading session |
| | F16 | 0.825 | REC trade should be allowed through traders, direct bilateral trade between discoms, financial institutions |
| | F19 | 0.769 | There is a need for Floor price for REC till RE generation achieves grid parity |
| Eligibility for REC Cronbach Alpha: 0.657 | F7 | 0.559 | Eligibility criteria for REC should be defined at central level by CERC and it should not vary from State to State |
| | F10 | 0.474 | Nascent technology could be given credit of higher number of RECs based on the same level of generation |
| | F32 | 0.638 | REC is a viable option for a discom in power surplus state |
| Demand side of REC (Cronbach Alpha: 0.752) | F24 | 0.851 | There should be longer term RPO trajectory |
| | F25 | 0.868 | Large consumers (say 1 MW and above) should be obligated to meet RPO separately |

**Discussions**

**Factor 1:** The variables which have been loaded in factor 1 showcase need for *policy* clarity on long term existence of REC framework, policy/regulatory framework to make obligated entities eligible for REC in the event of their purchase of RE at FiT. Also included in factor 1 are the variables highlighting need for addressing the *external* factors like transmission infrastructure for evacuating renewable energy generated, need for balancing power to accommodate variable /infirm renewable energy and incentive mechanism; such factors. Hence factor 1 has been termed as policy and external factors.

**Factor 2:** Factor 2 has been termed as supply side concern of REC as the variables loaded in this factor relate to the concern of the investors making/seeking to make investment in RE market. Variables like absence of long term visibility of REC

price and consequently, of revenue from sale of RECs, lack of enforcement of RPO, shorter validity period of RECs etc. create uncertainty for investors. Financial institutions also do not come forward to finance projects with such uncertainty of revenue. This affects investment climate and in turn supply of RECs in the market.

**Factor 3:** The variables which have been loaded in factor 3 include determination of floor and forbearance price, mechanism of determining APPC. These are related to the pricing and determination of price of REC. APPC and the REC price together constitute the revenue stream for an investor investing through REC route. These pricing related factors have a direct impact on the investors.

**Factor 4:** Factor 4 has been termed as Liquidity of RECs as the variables loaded in this factor showcase the need for addressing the issues as also measures for increasing the liquidity of REC in the REC market. The variables like issuance of RECs to all RE generation, allowing sale of RECs by obligated entities and need for guaranteed price for unsold RECs have the potential of increasing liquidity in the market.

**Factor 5:** The variables which have been loaded in factor 5 relate to frequency of trading sessions and allowing bilateral trading and secondary market of RECs. All these variables deal with the trading and related matters of REC. Hence factor 5 has been termed as trading mechanism. These issues affect the trading transactions and behavior of the persons participating in the trading of RECs.

**Factor 6:** The variables under this factor relate to eligibility of REC, for instance, criteria for eligibility under the REC mechanism being a national level should not vary from state to state, nascent renewable energy technology should be eligible for higher number of credits and REC as a viable option for discoms in power surplus states; Hence factor 6 has been termed as Eligibility for REC.

**Factor 7:** Factor 7 has been termed as demand side of REC as the variables loaded in this factor include issues relating to creation of demand for REC, for instance, variables like need for notifying long term RPO trajectory by SERCs and applicability of RPO directly on large consumers of distribution licensee. These issues have the potential of boosting demand for REC.

## 5.4 ANALYSIS OF RESULTS OF OPINION SURVEY

This is the second level of primary data analysis done in the study. Based on literature survey and parametric comparison between UK and Indian model of ROC/REC, gaps were identified and opinion survey was conducted. Twelve 'open ended' questions were designed. The questions in this segment of analysis were different in format from the questionnaire designed (based on Likert scale) earlier for eliciting views of stakeholder organisations. Leading experts (38) from the Government, Regulatory Commissions, National Load Despatch Centre, Central Electricity Authority, Generating Companies, Distribution Companies, NGOs, Industry Associations, and Financial Institutions were interviewed and their responses were recorded. Opinion of the experts was sought on the following broad parameters:

- The strengths of Indian REC framework
- The critical factors affecting the REC framework in India
- Way forward on RPO compliance, monitoring and enforcement
- Desirability of eligibility of all RE generation for REC
- Future trend of RE capacity addition through REC route
- Reasons for lack of interest of distribution companies in REC market
- Desirability of large consumers being obligated to meet RPO separately

- Desirability and implication of secondary or over the counter (OTC) market for REC trade
- The financing constraints for an RE project opting REC route
- The specific challenges for solar REC
- Need for addressing external factors to make REC a success
- Changes required – in terms of policy and regulatory interventions - in the existing REC framework to achieve its objectives

A sample of the questionnaire has been shown in **Appendix-II.** Responses received from the experts have been analysed in this section. Analysis of the experts' opinions is as under:

Stakeholders opined that the **strength of Indian REC framework** depends on the RPO specified by all States, credible power exchange system as trading platform, and mix of business models that can be executed with RECs. India is a diverse country with different States at different phases of development. Despite disparity, the fact remains that all States have stipulated RPO in their respective States. The greatest strength of Indian REC system lies in its operation being electronic and managed at the pan India level through the global web portal and transacted through a robust and anonymous platform of Power Exchange.

The **critical factors affecting the REC framework** in India are absence of visibility of REC revenue in the long run, non-existence of Over The Counter (OTC) and bilateral trading mechanism, weak state of enforcement of the RPO policy, financing of REC projects, lack of evacuation infrastructure of power generated and poor financial status of discoms. They include internal and external

factors. RPO enforcement is critical to creating demand and in turn to sustaining interest of investors in this vital segment of power sector. The regulators at the State level need to act and act earnestly to ensure that REC system does not collapse. Equally important is the need for the central regulator to review the pricing mechanism of REC and provide price and consequently revenue visibility longer than the present scheme of REC price validity of five years. This has been affecting the confidence of the financial institutions in projects opting for REC route.

Mixed opinion was received regarding **eligibility criteria for REC** and it being the only instrument to meet renewable obligation. Some of the experts were of the view that a market with various instruments can adopt a mix of business models to extract the maximum ROE while adapting to various conditions of the business environment. Majority view, however, was in favour of making REC a win-win proposition for both buyers and sellers. For this, buyers should have the option of purchasing RE generation in bundled form (energy plus REC together) or in unbundled form (energy and REC separately) which is absent today.

Regarding **future of REC mechanism**, many stakeholders have opined that with the current trend, the REC market seems to be on a decay path. Hence regulators need to intervene to set RPO on longer time horizon, monitor and enforce compliance. REC scheme in its present form cannot sustain for long. The REC design itself needs to be reviewed to address the concerns of stakeholders, especially the buyers, and sellers and financial institutions. For the buyers REC should make a viable proposition, for sellers REC scheme should ensure guarantee of recovery of their investment and for financial institutions this framework should provide for certainty of revenue stream from the project.

According to some stakeholders **reasons for distribution companies not opting for REC route** could be poor financial status of Discoms and ineffective implementation of penalty for non-fulfillment of RPO. In fact, poor financial health of the discoms is at the root of all the malaises of the power sector in India and is equally responsible for the poor demand in the REC market today. There should be a two-pronged strategy – one, of restoring the health of the discoms and the other the enforcement of deterrence against non-compliance of RPO.

Regarding **applicability of RPO on large consumers** (say 1 MW and above) experts have opined that ideally the DISCOM should be made responsible for procuring power from RE sources on behalf of the large consumers as this is one of the core competencies of the discom and not of the consumers. However, RPO could be made applicable directly to large consumers. This will make the RPO compliance process simpler and relieve the burden of the discoms.

Regarding allowing **secondary market or over the counter (OTC) market in REC trade**, majority of the experts opined in favour of OTC market for increasing depth in REC market and also suggested that it should be done with checks and balance in terms of proper tracking and monitoring of transactions and with safeguards against speculation and artificial price volatility for REC. This is a common phenomenon of the market in other countries. Monitoring of transactions is an issue but this should not deter the regulators from introducing the feature of the market as it has the potential of bringing in more virtues than vices if implemented with proper safeguards. This will also address the concerns around financing of REC based projects.

Experts suggested to take specific steps to address the **financing constraints for an RE project opting REC route** like: Floor-Forbearance price visibility, Clarity about sunset clause of REC mechanism, strong enforcement of RPO by regulators, levy of penalty for non -compliance and provision for Buy-out fund as security payment mechanism. At this phase of development of REC market, the concept of buy-out fund is highly desirable to sustain interests of the investors.

There was a strong feeling about the need for **development of voluntary market**. This can supplement market making which today is dependent only on mandatory market through obligated entities. Going forward the compliance market will take time to revive especially due to poor financial health of the discoms. So, greater emphasis should be laid on creating a sustainable voluntary market for RECs.

The **specific challenges for solar REC** could be (from generator perspective): Financing of solar REC project, long term visibility of floor and forbearance price of solar REC, power evacuation, timely payments from the discoms, lack of enforcement by regulator on obligated entities to buy RECs. From Discom's perspective it could be high current solar REC prices.

**External factors** required to be addressed to make REC a success could be RPO targets, enforcement of RPO with strict penalties, creation of transmission infrastructure and balancing power need of RE resource rich states and financing from banks. These affect the RE capacity addition in general and REC market performance in particular. These factors have to be attended to make REC realize its core objective of investment promotion in the RE segment.

According to experts changes required in the existing REC framework and issues required to be addressed, to achieve its objectives include inter alia the following:

- Incentive for buyers for fulfillment of RPO
- Strong Enforcement of RPO
- Penalty for non-compliance of RPO
- Applicability of RPO on large consumers
- Giving clarity for post 2017 REC price
- Allowing financial institution to take position of RECs
- Creation of Voluntary market for REC

## 5.5 SUMMARY OF ANALYSIS

Analysis of REC market in India was done based on inventory, demand and supply, trade in terms of volume and price of REC. This revealed lack of demand for REC and consequent decline in REC prices discovered in the market. Subsequently, analysis was carried out to understand the possible factors influencing the market trend. This analysis was done based on secondary as well as primary data, and from the buyers' as well as sellers' perspective. Primary data analysis was carried out based on questionnaire. Responses received through questionnaire were analysed using factor analysis tool. Further, comparison of REC framework in India was made with the ROC mechanism in UK. This revealed gaps in Indian REC mechanism. Opinion survey was carried out based on the gaps so identified in Indian REC framework.

The above analysis – based on secondary data and primary data led to identification of factors affecting existing Indian REC framework. This also led to the understanding that various policy and regulatory interventions are required to

address the issues afflicting the REC framework in India. The interventions could range from macro to micro levels. The suggested way forward, therefore, has been arrived under the broad categories of 'levels' representing desirable policy and regulatory interventions at macro and micro levels.

## 5.6 SUGGESTIVE FRAMEWORK

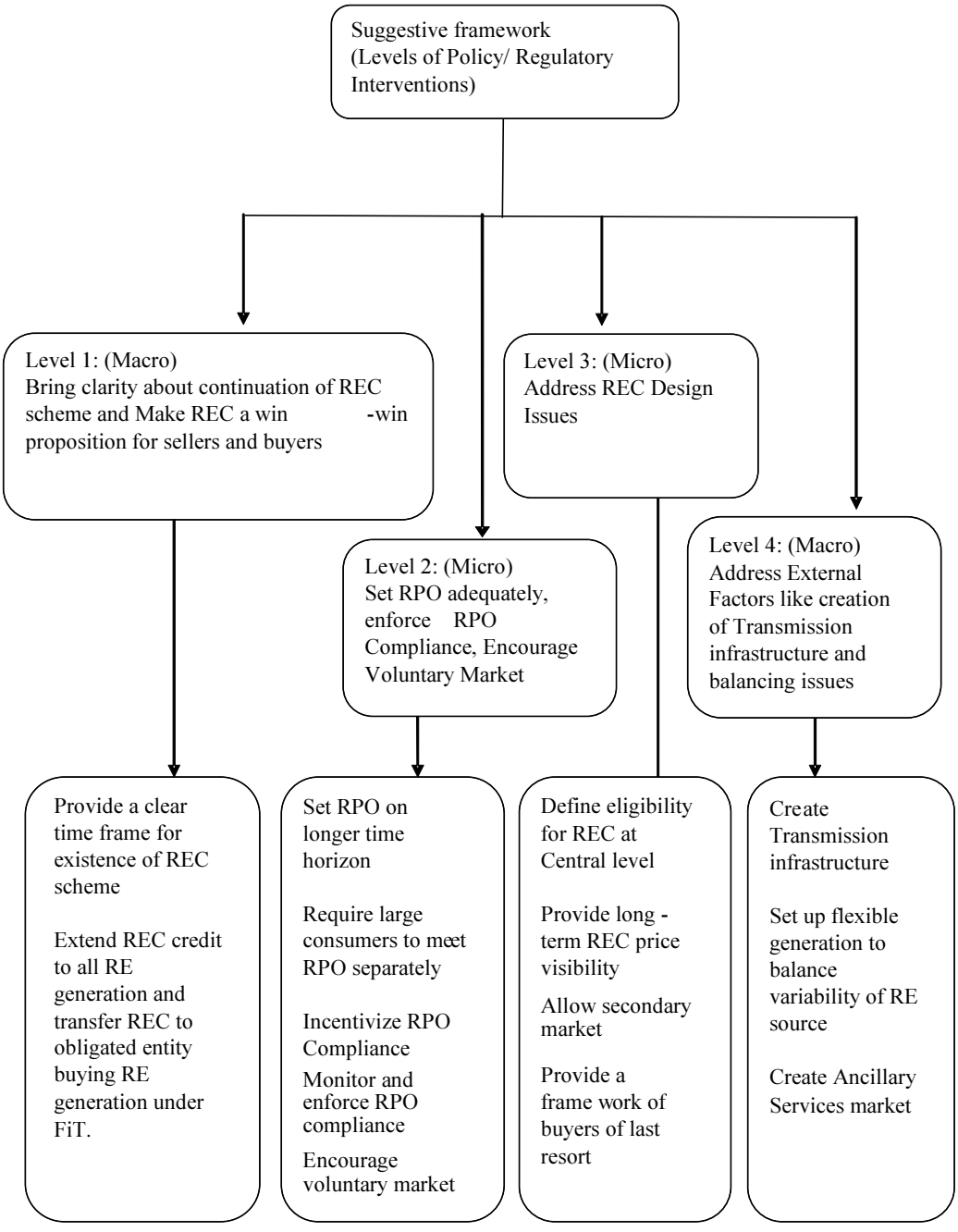
This study has brought to the fore all possible factors responsible for the present state of REC scheme in India.

To start with, an attempt was made to understand the issues and challenges based on literature survey. The factors responsible were identified and validated through questionnaire. Then, the behavior of important stakeholders like buyers, sellers, investors, financial institutions were analysed to reinforce the understanding about the factors. This brought a holistic view of the problems at stake. Subsequently, comparison with international experience with focus on UK model of ROC was done to identify the gaps in the Indian REC scheme. The gaps so identified were further validated through survey of opinion of senior level functionaries associated with the process.

Based on stakeholders' perspective, benchmarking and gap identification from international experiences, factor identification, expert opinion survey on the gaps as well as identified factors, a suggestive framework has been recommended in this section, for further development of REC market in India. Recommendations have been made under four broad levels representing desirable policy and regulatory interventions at macro and micro levels. Macro level interventions are suggested on the longer time horizon as long-term solutions to the problems at stake. Micro level interventions are meant for immediate implementation over shorter time horizon.

These suggested measures are considered important to make REC scheme achieve its true objective of promotion of RE generation and enabling RPO compliance by the obligated entities. These policy interventions can be undertaken simultaneously and not necessarily in sequence. The suggestive framework is represented as under:

**Figure 5.6: Suggestive Framework**



**Level 1: Clarity on REC Framework**

**There should be clarity and certainty about continuation of REC framework on longer time horizon**

In UK, Renewable Obligation (RO) Order initially set the Renewable Purchase Obligation Target at 3% for the period 2002/03 with the target to raise it to 15.4% by 2015/16. (RO Order, 2002). On 1 April 2010, the scheme was extended from 2027 to 2037 (NREAP, 2010). Thus, in UK an investor knows in advance the time period during which RO (and consequently ROC which is part of RO scheme) would continue to exist. An investor is therefore, in a position to take a conscious decision of investment keeping in mind the debt servicing and payback period of such investment. Such policy clarity is considered essential for investment as well financing of projects. In India, we do not have any such clarity in terms of the time period during which REC would be in existence. It is, therefore, suggested that the Electricity Act, 2003 and National Electricity Policy (NEP) and Tariff Policy (TP) should make a clear provision empowering Central Electricity Regulatory Commission (CERC) to decide time horizon for continuation of REC. CERC should specify in its REC Regulation that the REC will be issued to the eligible RE generators at least for 15 years (12 years loan period plus additional three years). CERC should review extension of the REC scheme based on experience. This clarity is required to give comfort to the financial institution and bankers for REC revenue visibility and investment certainty.

**There is a need for a policy framework to make REC a win-win proposition for the buyers as well as sellers**

The distribution companies, the potential buyers of REC have poor financial health and already fall short of meeting their energy requirement. As such, they have inherent resistance against purchase of RECs which are only electronic certificates and do not accompany with energy. This was found to be a strong sentiment amongst the discoms as also in some state regulators, given the present state of distribution business in the country. Resentment against the existing REC scheme also stems from the fact that in some cases, especially the firmer sources like co-generation plants are reported to be selling electricity component at a rate higher than the APPC and at the same time are eligible for REC. REC mechanism is seen in such cases to be a potential source of super normal profit. Coupled with this, what further rubs the feeling of the local distribution company is the fact that such generators are not willing to sell the RE generation to the local distribution companies even at preferential tariff as REC route is more profitable to such generators. This increases the cost of compliance for the local distribution companies as they have to buy REC from the power exchange to meet their RPO and also separately buy the energy to meet the demand in their area of supply. The combined cost of compliance under such a scenario often becomes higher than their earlier cost of RPO compliance through preferential route. This sentiment underscores the need for creating a framework whereby the REC scheme gains legitimacy by its very design instead of depending on external support to sustain itself.

To overcome this resistance, it is suggested that in the long run, the policy framework of REC should be re-designed allowing sale of RE generation in bundled as well in unbundled form. Today RECs are sold only in unbundled form - that is, electricity component is sold separately to the local discom at APPC or to the market at market price and REC is sold separately in the power exchanges at a market discovered price. A buyer wanting to meet RPO through REC route can buy RECs without the electricity component, because the generator is not allowed to sell RE generation and REC together in bundled form through an agreement with a specific buyer.

It is suggested that, every unit of RE generation irrespective of whether the said generation is sold through FiT or otherwise, should be given REC credit. The buyers (distribution companies in this case) purchasing RE generation through FiT could get REC credit along with the energy. The RECs earned by the buyers in this manner can be used to meet RPO and surplus REC if any can be sold by them in the market to mitigate high cost of their RE purchase.

The above suggested framework would have inter alia the following advantages:

- Acceptability of distribution licensees would increase, as it would help mitigate their cost burden in the event of their purchasing RE beyond their RPO;
- Resource rich States would be encouraged to accommodate more renewable energy in the system by procuring renewable energy beyond the RPO target fixed by the appropriate Commission;
- Energy accounting for issuance of RECs would be simple, as all the generation would qualify for REC;

- Monitoring and enforcement of RPO would be easier and transparent as the obligated entities would be surrendering quantifiable electronic REC for fulfillment of RPO.
- Settlement of RPO in cases involving inter-state sale of power would be easier, as sale of energy would settled as per energy accounting procedure and RPO settlement would be done separately based on RECs issued on such generation.
- Compliance of RPO by obligated entities like: open access consumers, CPPs etc. would be facilitated.
- Bankability of project selling electricity component and REC in bundled form would increase, as long-term PPA can be entered in such form;

This framework would, however, mean a paradigm shift in the policy on RE generation in general and REC scheme in particular. Implementation of this would have implications in the existing power purchase agreements and would, therefore, need careful calibration.

The caveats for implementation of this framework include inter alia the following:

- Local distribution licensees may force the renewable energy generators to sell energy under preferential tariff only, thereby restricting their choice;
- Currently, almost half of the renewable energy capacity in the country is under the captive consumption route. They are enjoying concessional wheeling/ transmission charges and/or banking benefit and also getting set off against the utility tariff. If such projects are made eligible for RECs, it would mean wind-fall profits for them;

- There are many old renewable energy projects which have already recovered their cost of generation. Such projects if made eligible for RECs would have super normal profits at the cost of the distribution companies and the consumers;
- Moreover, the market will be flooded with the such zero/very low cost RECs which can distort the market clearing prices;

The above caveats, however, are more of operational nature and can be sorted out through suitable adjustments of the REC policy design, which are being discussed in the subsequent sections. The advantages discussed above far outweigh the possible fallouts of the proposed framework. The researcher is, therefore, convinced that in the long run, a framework like this is THE WAY FORWARD for mainstreaming RE generation in India.

**Level 2: Setting Demand Side Right: RPO Related Issues**

**RPO target setting should be strengthened**

Once a policy framework is evolved which is equitable to both buyers and seller, the RPO regime should be enforced strictly. It is suggested that a national level RPO should be evolved and adopted by all States. According to the Act, State Electricity Regulatory Commissions (SERCs) are mandated to specify RPO in their States. Today different states have different RPO ranging from 1% to 10.25% for a period of 3 to 5 years. Further, the regulators set RPO keeping in view RE resources available within the state and not factoring the resources available in the country as a whole.

There should be a legislative mandate (provision in the Act itself) for longer and stable RPO trajectory like in UK. SERCs should follow the national level RPO as provided in the NEP/TP or as developed by the Forum of Regulators.

There should be longer term RPO trajectory - at least for 12-15 years which can give regulatory certainty.

The above measures are required to give comfort to investors about demand for RECs.

**Need for incentive scheme for RPO**

In UK RO Order obligated entities (suppliers) meet their RO by either presenting ROCs or paying an equivalent amount into the buy-out fund as penalty. All such buyout payments are redistributed to suppliers who have presented ROCs against their obligation in proportion with the number of ROCs that each has presented. It also serves as incentive for those who had fulfilled the RPO targets.

In India, there is no such incentive to buyers for RPO compliance. Here, incentives are targeted only to the investors. Not that, such incentives are not required, what is recommended is the need for a policy framework incentivizing the buyers to comply with their RPO. It is suggested that there should be an incentive mechanism to encourage States to set and fulfill higher RPO target. Incentive level could be different for RE resource rich states and RE resource deficit states. Incentive for resource rich States should be designed to take care of need for creation of transmission infrastructure and for setting up flexible generation to balance variability of RE resources. Incentive for deficit States should take care of higher cost of compliance. Such incentive schemes are also required considering the financial health of distribution utilities and their consequent resistance against compliance of RPO.

**Need for separate RPO for large consumers**

Currently, obligated entities are not coming forward in large number to buy RECs. Majority of the obligated entities are the Government owned distribution licensees and have developed resistance against REC purchase for RPO compliance because they do not find REC as viable and cost effective option. It is suggested that the large consumers (say 1 MW and above) be obligated to meet RPO separately. Such measures would bring demand of REC in the market which is absent today and would reduce financial burden on distribution utilities.

There are two ways in which this can be done – one, by requiring such large buyers to meet RPO on their own and thereby making discoms responsible for RPO compliance only on consumption of consumers other than such large consumers; and the other, by requiring the large consumers to bear the direct cost (as against the existing system of average cost) of procurement of power from renewable sources. One argument against this prescription is that it would increase cross subsidy burden on the already subsidizing large consumers. True, but this can be justified on the ground that the large consumers contribute to carbon emission more as a result of their higher level of consumption and as such should bear higher burden on this account.

Direct obligation for RPO compliance is likely to improve the compliance of RPO on the whole and boost the REC markets. It is important to ensure right kind of monitoring and compliance processes for the implementation of such direct obligations in a fair, transparent and cost effective manner. Also, responsibilities of various entities in this regard need to be defined and articulated in an appropriate manner.

**Need for a standard mechanism for compliance monitoring**

The success of renewable energy capacity addition programme largely depends on enforcement of Renewable Purchase Obligation (RPO). The responsibility of setting RPO rests with the State Electricity Regulatory Commissions (SERCs). However, presently monitoring and compliance of RPO target is very weak.

It is suggested that a mechanism be put in place for strict monitoring of RPO compliance. The State Agencies can play an important role in monitoring RPO targets set for different obligated entities. The SERCs should ideally entrust on the State Agency the responsibility of RPO monitoring.

**Quarterly compliance requirement (instead of current annual compliance requirement) will help to develop REC market**

Currently, compliance is annual. As a result, there has been very little demand for RECs during initial part of the year and also prices were low during most part of the year. It is necessary to create smooth demand curve to reduce price volatility by providing shorter compliance.

Quarterly compliance of RPO (instead of the present requirement of annual compliance) can address this issue.

**Need for strong enforcement of RPO**

Varying and very low RPO levels set by many SERCs and utility finances do not permit RPO compliance. Risk of non-compliance by state utilities is affecting investments. It is suggested that non-compliance of RPO should attract penalty which the regulator should enforce effectively.

There are salutary provisions of non-compliance charge in the model RPO Regulations evolved by the Forum of Regulators, as also in the regulations framed by the SERCs. This should be enforced by the state regulators. It is also suggested that the Act should be amended to provide for separate penalty for non-compliance of RPO. The existing general penalty provision and penalty limit of rupees one lakh is not considered adequate. CERC has already advised the Ministry of Power in this context.

**Encourage creation of voluntary market**

Voluntary markets for RECs have been developed in many countries in response to energy users' preferences for green electricity. Retail, commercial and industrial energy users can meet voluntary renewable energy goals and support the deployment of green power through the purchase of RECs. (REConnet, 2011) reports that 70 of the Fortune 500 companies purchase Green Power, aggregating to approximately 9 billion units or 46% of total use of these companies. 14 of these companies use 100% green power. This is achieved through a combination of wheeling renewable power where possible (for example, to manufacturing plants) and/or procuring RECs for the rest. The purchase of RECs on a voluntary basis to meet corporate social responsibility and sustainable development goals is a part of the larger voluntary carbon markets internationally. This was worth $424 million in 2010. Many organizations have detailed goals for sustainability and use of green power.

In India voluntary buyers should be encouraged to participate in the REC market. This can immediately revive the sentiment in the REC market. For this, there is a need for aggressive marketing and changes in procedures for REC market

operation. Procedures have to be simplified. Intermediaries or professional members in the Power Exchanges can be allowed to aggregate demand from voluntary buyers, take position on their behalf.

**Level 3: REC Design Issues**

**Eligibility: Eligibility criteria for REC should be defined at central level by CERC and it should not vary from State to State**

Some of the State regulators have deviated from the CERC REC Regulation in terms of defining eligibility conditions. This has created confusion in the minds of investors, as a renewable energy generator eligible under the State REC Regulation may not be eligible for issuance of RECs under CERC REC Regulations. The REC scheme as evolved clearly demarcates the responsibility of CERC and SERC. REC is a national level framework and jurisdiction in terms of 'eligibility criteria' for participation in REC scheme, registration of RE generators, issuance of REC etc., should clearly vest with CERC. The role of SERC should be to recognise REC as a valid instrument for RPO compliance.

It is, therefore, suggested that eligibility criteria for REC should be defined at central level by CERC and it should not vary from State to State.

**Obligated entity should be entitled to sell the RECs left surplus after meeting RPO compliance**

Distribution utilities from resource rich states would be willing to procure renewable energy beyond their RPO levels, but the burden on the retail consumers due to higher contribution of renewable energy needs to be reduced through an alternative mechanism.

For this, while in the long run, it would be desirable to give REC credit to all RE generation and allow transfer of REC to the obligated entities (especially the distribution companies) purchasing RE generation through FiT or otherwise, it is suggested that in the short run, the obligated entities should be given REC credit for procuring RE beyond the RPO target set by the appropriate commission.

It can also provide the right incentive structure for promotion of Renewable energy in States which are naturally endowed in this respect and are ready to implement progressive policy in the larger interest of the nation.

This would help reduce project financing risk of Project Developer, by selling renewable power at the tariff determined by the State Commission for RE resources.

**There should be a longer visibility for REC price band**

In order to balance the interests of the RE generator and the obligated entity, CERC has determined floor and forbearance prices. The floor and forbearance prices are valid up to 2017. This creates uncertainty in terms of revenue stream (cash flow) estimation for a project which is expected to have life of 25-35 years. As a result, financing of the project becomes difficult. There is, therefore, an urgent need for longer visibility of REC pricing.

In UK the buyout price is set as the difference between the electricity cost and anticipated value of marginal cost. Once set in 2002, this price is escalated year on year with reference to the WPI.

It is suggested that REC prices in India should be determined based on the difference between projected incremental conventional power purchase cost and

current cost of conventional power. REC price so determined should be indexed to inflation (WPI and CPI).

**There should be more trading sessions, instead of the current framework of once–in-a-month only trading session**

In accordance with the Rules/Byelaws approved by the CERC, monthly auction of RECs is undertaken for discovery of REC price on Power Exchange(s). All valid and eligible offers for RECs received for dealing on Power Exchanges are considered for Auction carried out on the last Wednesday of every month.

It is suggested that the frequency of auctioning be reviewed and changed from monthly to fortnightly or weekly basis in due course depending on volume of REC transactions/number of participants on Power Exchange(s). REC price risk will be reduced if more trading sessions are allowed.

**REC trade should be allowed through traders, direct bilateral trade between discoms, financial institutions**

RECs at present face bankability issues since they are exchange traded and REC prices are volatile. It is a normal practice to securitize such revenues, but the present exchange traded mechanism is widely perceived to be incompatible to the same. To promote market making, reduce price volatility and better price discovery, it is suggested that traders could be permitted to contract in advance, subject to reporting requirements, which could be part of their license conditions. The introduction of traders will reduce the risk of price volatility for generator through benefits of aggregation by traders.

Currently, REC market allows REC transaction only through power exchanges. The reasons for allowing REC transaction only through power exchanges might be efficient price discovery mechanism and easy monitoring and verification of the authenticity of the trade. However, forward markets are common place in international REC as well as emissions markets.

REC trading in India started from March 2011, and volumes are steadily picking up. The market is primarily being accessed by those RE projects that have existing generation assets, and happen to qualify for RECs based on the eligibility criterion. However, the primary objective of the mechanism is to encourage new investment in RE. There is a real concern about the bankability of renewable energy projects opting for REC mechanism because of high (real and perceived) risks by financiers. The key constrain identified is the lack of visibility of pricing and regularity of cash-flows. Banks and financial institutions are unsure of the future REC pricing and the cash flows from the market. A primary reason for this could be the low liquidity in the market, which might be result of several factors like: current practice of once-a-month trading, nascent markets etc. The volume of trading is expected to increase with more participation and regular enforcement. It is very important to overcome these obstacles, as without the participation of banks and financial institutions, new RE capacity will continue to remain out of the REC mechanism. One of the possible solutions is the forward market.

A forward market, where forward sale and bilateral sale of RECs is allowed can help overcome the above referred problems. In other words, if an RE project developer is allowed to sell RECs to an obligated entity at a mutually negotiated

price over a longer time horizon, it can address the following constraints and issues: (i) the project developer can have access to bank finance because of visibility of REC revenue and (ii) the obligated entity can lock-in its RPO costs. Thus, a forward contract on RECs can solve the 'bankability' problem, and also help the obligated entity manage its costs – a win-win arrangement.

Forward market can work in the form of bilateral 'over-the-counter' (OTC) market – where sellers and buyers agree to enter into a mutually agreed trade of RECs. Buyers could be obligated entities, market makers and traders. Market makers and traders would provide bids and offers, providing critical liquidity in the market.

Following are the advantages and disadvantages of introducing intermediaries (traders) in the market:

a. Advantages: Traders
    i. Can play a market making role and promote investments in RE projects (may also make proprietary investments);
    ii. Can take risks and provide visibility of revenues to RE developers;
    iii. Can Facilitate processes;
    iv. Can help induce obligated entities towards RPO compliance by managing the processes for them and assisting in compliance;
b. Disadvantages: Traders
    i. May not necessarily address the fundamental issue of buyers remaining off market. If the buyers are not in the market, the traders would also not be interested;

ii. Can induce speculation – this point needs to be specifically analysed in detail to see (a) the possible degree of speculation and (b) the adverse impact of the same, if any;

iii. May affect transparency of market;

iv. Could increase (or reduce) transaction cost depending on design. This would need to be specifically addressed;

v. Could encourage market concentration and market power.

Forward transaction also exists in the Indian conventional electricity markets. However, the risks and issues relating to the REC markets could be different. Possible risks in allowing forward transaction could be as under:

a. Ineligible projects may sell RECs in the forward markets;

b. Trades are not independently verifiable, and RPO compliance may be misreported;

c. Market information on accounting for trades at a national level may not be possible;

d. The floor and forbearance price limits are breached.

Above referred possible risks can be mitigated in the following ways in the forward markets:

a. The risk of selling of RECs by ineligible projects in the forward market can be mitigated if as in the present REC mechanism, renewable energy generator is mandated to go through the process of accreditation, registration and issuance process even in cases of transactions though OTC market. In this way, eligibility of the RE project will be ensured and accounting for trades will be possible since only issued RECs will be transacted.

b. RECs should be allowed to be sold to a trader at a price not exceeding the forbearance price.

c. Even as bilateral trading is permitted, for effective price reporting and monitoring of REC trades, the certificates should only be extinguished through the Power Exchanges as per applicable procedures.

d. All transactions to an electricity trader should be reported to Central Agency within specified time frame from the date of trade and title of such certificates should be transferred to the trader and records should be updated accordingly.

e. However, for price certainty, the final trade and extinction of REC should happen only through Power Exchange.

**Banking of REC: RECs purchased beyond RPO should be allowed to be banked for fulfillment of target in next year**

Currently, banking is not allowed in the REC market. It is suggested that banking should be allowed in the REC market. If the cost of procuring the REC is lower than the projected cost of purchasing an REC at a future date, obligated entities might buy RECs in advance and bank them to meet RPO in future. The banking can also optimise the inter-temporal market if the demand for renewable generation is higher than the interim targets in any particular year and lower than the target in the latter years. The effect of banking in terms of REC prices will depend on the level of banking and the costs avoided from creating surplus RECs.

**There is a need for a guarantee fund to buy out unsold RECs at discounted price, for certainty of revenue to investors**

Visibility and certainty of revenue realisation from the RE project is essential for bankability of a project opting for REC route. There are two sources of revenue

under REC mechanism. One of it is sale of electricity at APPC or market determined rate and the other on account of sale of REC. Revenue from the former can be estimated with fair degree of certainty. However, revenue from sale of RECs is fraught with price and volume risks. In the absence of demand, RECs if not sold lapse at the end of validity period. There is a need of "Buyer of Last Resort" or a "buyout fund" to guarantee purchase of unsold RECs. This is required to give certainty to the investors. The Government should, at least for a limited period create such a fund for purchase of unsold RECs at some discounted rate and the RECs so purchased can be sold in future when demand exceeds the supply of RECs.

**There is a need for making off-grid generation eligible for REC**

The existing REC framework does not recognize off-grid generation as eligible entity for REC. The Government of India has been encouraging distributed and off-grid generation in rural areas as extension of grid in such areas is time and cost intensive. Off-grid generation also has the potential of replacing the high cost diesel generation in rural areas and improving the quality of life and should be encouraged with right earnest. Investment in this segment does not come because of uncertainty of recovery of cost and high capital cost involved in setting up such projects. Making such off-grid generation eligible for REC will definitely boost investment as this will mitigate cost burden of the investors to a great extent. There are issues like monitoring and tracking of such generation, which need to be addressed but this should not deter bringing distributed generation to the fold of REC. This will require change in the denomination of REC.

**There is a need for introducing multiplier concept in REC**

Today, REC market is divided into non-solar and solar segments. This was considered necessary to encourage and safeguard high cost investment in solar projects. The tariffs of generation from solar projects were substantially higher than those of non-solar generation and hence could not be clubbed together.

While the intent of the policy is sound, its implementation procedure needs rethinking. Instead of segmenting the market, emerging and high cost RE technology can be encouraged by according higher RECs for the same level of generation. This is similar to the scheme of banding or multiplier in UK.

Similar concept can be extended to recognize vintage of the projects. The present form of REC framework envisages that the floor and forbearance prices reduce in future with the emergence of low cost renewable energy technologies. It doesn't offer a viable alternative for the investor who made investment earlier. This is particularly true in the case of Solar where all the investment is made up front and the project has negligible operational costs. The REC framework needs to recognize that the investments already made in renewable energy projects, particularly in Solar PV projects, cannot take advantage of the low cost technologies. Therefore, it is suggested to introduce vintage based multiplier concept to the REC certificate recognizing the vintage of a project as and when floor price is reduced.

Capital cost for solar projects is rapidly reducing and it will drive down the floor and forbearance prices of solar based RECs. In this emerging scenario, the solar RECs for projects setup in initial years would not be in a position to compete with the projects which would get commissioned after a few years on account of

significant cost differential. Moreover, average pooled power purchase cost of a local distribution licensee is also likely to increase in future due to increasing cost of fossil fuels and that will again decrease the floor and forbearance price of RECs. Therefore, the projects installed earlier will be at a disadvantage. It is suggested that the project set up in the initial years should be entitled to higher number of certificates for same value of electricity generated in comparison to the project coming up later and this valuation would have to be carried out every year based on the viability of tariff required for each year.

It is therefore, suggested that the regulatory framework in India be modified to accommodate technology and vintage based multiplier of REC. This would benefit both non-solar and solar (or such other emerging technologies) by way of larger market base and greater liquidity.

**Level 4: External Factors**

**Transmission infrastructure for evacuation of RE generation is crucial for success of REC**

In order to evacuate power generated from RE generating station, necessary transmission infrastructure is required to be put in place. For large scale integration of renewable energy and generation of RECs for fulfilling RPO, it is essential to create transmission infrastructure for evacuation of RE in advance with the perspective long term transmission planning.

**Success of REC also depends on how balancing power requirements of host states are addressed**

Total renewable energy capacity in India currently stands at around 29000 MW. Out of this, around 70% is contributed by wind energy which is an intermittent source of

energy. In the12th Plan period, the Government has plans to add around 32000 MW of RE capacities in the grid. Considering the huge wind energy potential available in the country it is expected that wind energy will play a major role in future. Solar PV energy in India is currently in the nascent stage of development. But due to drastic reduction in the solar PV based power plant cost in last two years it is expected that now onwards solar PV generation will also constitute a major share of RE portfolio. Both wind and solar generation are variable in nature. Moreover, such resources are available only in a few states. Due to infirm nature and also due to high cost of generation, the resource rich states may not like to purchase and promote such high cost intermittent power beyond their RPO. To take care of the variation in generation, such States may have to arrange for balancing power (power required to balance the variation in RE generation). Therefore, forecasting and scheduling is a must for development of large scale integration of wind and solar energy. Such variability can be addressed with flexible generation available in the state. Flexible resources available in other states should also be encouraged through suitable incentivisation.

**Ancillary market should be created to take care of balancing requirements for RE**

Large scale integration of renewable energy would need spinning reserve of generation capacities for balancing variation in RE generation. Ancillary Services that is, services meant to support grid frequency variation due to variation of RE generation may need to be facilitated to mainstream RE generation in general and make REC in particular, a success.

The aforesaid suggestive framework charts out the policy and regulatory interventions required to make REC mechanism more effective. Interventions have been suggested

in various stages/levels. There are some broad or macro level measures while there are others which are micro in nature. Each of the suggested measures is important as it addresses one or the other challenge facing the REC system in India. The way in which the existing REC policy design should be calibrated has been explained in the next chapter.

# CHAPTER 6
# CONCLUSION

Sentiment in REC market today is at its lowest ebb. In order to reinstate confidence among the investors as well as the financing institution there is an urgent need for policy and regulatory interventions.

Literature survey, interaction with stakeholders, comparison with UK model of ROC and opinion survey of experts based on the gaps identified through the comparison reveal some fundamental constraints around the REC framework in India. It underscores the need for a policy design to take care of the concerns of buyers as well as sellers. Recommendations in terms of policy and regulatory interventions are accordingly being made to address the critical issues around buyers and sellers.

**Recommendations to take care of buyers' concern**

As the first level of intervention, incentive should be provided to induce the buyers to come to REC market. Analysis has revealed that one of the reasons why the buyers are not coming forward is that REC in its present form is not a viable proposition for them. There should be an incentive mechanism to encourage States to set and fulfill higher RPO target. Incentive level could be different for RE resource rich states and RE resource deficit states. Incentive for resource rich States should be designed to take care of need for creation of transmission infrastructure and for setting up flexible generation to balance variability of RE resources.

Incentive for deficit States should take care of higher cost of compliance. Traditionally, in India incentives have been targeted only to the investors. Not that, incentives are not required for the investors; what is suggested is that the irritants from the buyers point of view should be recognised and corrective policy decisions should be taken to address them. Incentivising and inducing the buyers would in turn also help the investors in the long run. For example, RE generation facility (and consequently investment in RE segment) can come up only in the States rich in RE resources. But higher penetration of RE generation, especially the wind and solar – which are variable and uncertain in nature – brings with it challenges for the host State in terms of grid management and arranging balancing power to match the variability of the infirm RE sources. This causes operational and financial stress on the distribution companies (buyers) of the host state, and coupled with their present debilitating financial health develops in them a resistance against RE generation. Unless these issues are addressed through suitable policy interventions including incentive schemes, promotion of RE in general and sustenance of REC framework and wind and solar industry in particular would remain at stake as at present. Incentive could be graded and linked to gradual achievement of national level RPO. Award scheme for best performer in terms of RPO compliance could be also be considered.

Incentive is a short term measure. In the long run, there is a need for a policy framework to make REC a win-win proposition for the buyers as well as the sellers. A framework should be designed whereby REC is credited to every unit of RE generation irrespective of whether the said generation has been sold through preferential tariff (regulated tariff) or otherwise. The buyers (distribution companies

in this case) purchasing RE generation through FiT or competitive tariff could get REC credit along with the energy. The RECs earned by the buyers in this manner can be used to meet RPO and surplus REC if any can be sold by them in the market to mitigate high cost of their RE purchase. This will also address the present concern of the discoms that REC is only an electronic certificate and does not come with physical energy, and in turn help overcome the consequent resistance of the energy hungry discoms. This framework would, however, imply a paradigm shift in the existing policy design for promotion of RE in general and REC in particular. This suggestive model is based on the international experiences especially UK experience but customized to meet the specific needs of India. In UK, RE generators generally participate in the power market for sale of electricity component and get credit in the form of ROC for every one megawatt hour of electricity generated. For India, the first part is not recommended, that is, it is not suggested that the wind and solar plants be asked to compete with conventional sources in the power market for sale of electricity component. Long-term contracting either through cost plus regulated regime or through competitive bidding can continue as at present for these RE sources. This is considered necessary for investment certainty over the longer time horizon for such infirm sources of power. However, the second component of UK ROC system is recommended for India. All RE generation should get the REC credit and in the event of a buyer contracting such RE generation, the REC credit should be transferred to him along with energy. At the same time, freedom should be there with the generator to sell his electricity in either bundled or unbundled form.

**Recommendations to take care of seller'/investors' concern**

Once we have been able to develop a framework of REC which presents a win-win proposition for the buyers as well as the sellers, it would be desirable to set appropriate levels of RPO for generating demand for RE generation and consumption. At the same time, the Regulators should ensure compliance of RPO by all the obligated entities. A clear message should be given that non-compliance of RPO will attract penalty. In addition, compliance should also be ensured through appropriate commercial mechanism like setting non-compliance charge to be paid by the obligated entity for their failure to meet the desired level of RPO.

It is equally important that we have clarity and policy certainty about continuation of REC framework and visibility of revenue on longer time horizon. The Electricity Act, 2003 and National Electricity Policy (NEP) and Tariff Policy (TP) should make a clear provision empowering Central Electricity Regulatory Commission (CERC) to decide time horizon for continuation of REC. CERC should specify in its REC Regulation that REC will be issued to the eligible RE generators at least for 15 years (12 years loan period plus additional three years). CERC should review extension of the REC scheme based on experience. This clarity is required to give comfort to the financial institution and bankers for REC revenue visibility and investment certainty.

The next level of suggested intervention relates to the REC design issues. Longer visibility of REC price is the first important requirement for guaranteeing certainty of revenue stream for a project opting for REC route. In order to balance the interests of the RE generator and the obligated entity, CERC has determined floor and forbearance prices. The floor and forbearance prices are valid up to 2017. This

creates uncertainty in terms of revenue stream (cash flow) estimation for a project which is expected to have life of 25-35 years. As a result, financing of the project becomes difficult. There is, therefore, an urgent need for longer visibility of REC pricing. In UK the buyout price is set as the difference between the electricity cost and anticipated value of marginal cost. Once set in 2002, this price is escalated year on year with reference to the WPI. It is suggested that REC prices in India should be determined based on the difference between projected incremental conventional power purchase cost and current cost of conventional power. REC price so determined should be indexed to inflation (WPI and CPI).

Another important lesson from UK experience is the concept of banding or multiplier. In India, we have a segmented market for solar and non-solar REC. Such segmentation restricts market for the respective technologies. REC market should be unified and technologies like solar which need support in the present phase of its development should be given higher REC credit (more than one REC for one megawatt hour of electricity generated). Technology and vintage based multiplier should be introduced in India.

It is equally important to allow traders and other intermediaries to participate in REC trade. This is not allowed presently. Introduction of traders and other intermediaries will bring depth in the market while at the same time taking care of risks that go with the present scheme of REC. There is at the same time a strong need for development of voluntary market. This can supplement market making which today is dependent only on mandatory market through obligated entities.

The last set of recommendations relate to external factors. Creation of transmission infrastructure and handling the need for balancing power may not be directly related to REC design and framework. But these issues need to be addressed to mainstream the RE sources in general and REC framework in particular.

REC system has a lot of potential in terms of promotion of renewable energy. In fact, this mechanism was introduced to address inter alia the problems arising out of their infirm nature and constraints in terms of inter-state transfer of power from RE sources. It did start off well but is today saddled with challenges. It is felt that the above suggested policy and regulatory prescriptions are the minimum level of interventions required to revitalize the RE segment and in particular the wind and solar sources of energy.

# THEORETICAL CONTRIBUTION

The present research contributes by way of presenting a systems thinking approach to address the problems of policy process and performance in the context of REC framework in India. The systems approach or system thinking is a perspective which views an event or a system in a holistic manner by placing explicit emphasis on the relationships and interactions between the system's elements and constituents (Senge 1990). Much of systems thinking power lies in its ability as a problem solver to identify the system's underlying structure that explains (similar) patterns of behaviour in a variety of different situations. Systems thinking also requires that we shift our mind from event orientation (linear causality) to focusing on internal system structure (circular causality), as the underlying system structure is often the root cause of the problems (YEO KAR LING CATRINA, 2012).

In the context of present research on REC framework in India, various literatures highlighted the policy performance and associated issues. From the literature it was found out that there are various factors which are affecting the policy processes and some of the factors have been studied in isolation. For instance, the pre-dominant view emerging from the literature survey is that lack of RPO compliance is the reason for poor implementation of REC framework in India. Again there are literatures that present data and statistics to establish that the buyers are not coming forward in the REC market. Based on the factors identified each such literature gives its recommendation in terms of desirable corrective measure.

However, most of these diagnoses and recommendations stand alone and do not necessarily examine the factors in totality. This study has brought out a comprehensive research in which all possible factors responsible for the present state of REC scheme in India have been covered.

The research started with understanding of factors based on literature and went on to validate them by engaging with stakeholders through questionnaire. The study then analysed the behavior of important stakeholders like buyers, sellers, investors, financial institutions to reinforce the understanding of the factors. This brought a 360-degree view of the problem at hand.

The unique theoretical contribution of this work lies in its novel perspective to identify various parameters from different papers, reports and documents and from international experience of REC scheme. In this study, broad parameters like structural/design parameters, institutional parameters, Operation and Commercial Parameters have been identified in the context of REC. Within these broad contours, parameters like Institutions involved, sunset clause of ROC/REC scheme and long term visibility, RPO target, RPO monitoring and compliance, eligibility, denomination, banding/multiplier of ROC/REC, categorization of ROC, shelf life of ROC/REC, ROC/REC trading, ROC/REC pricing, visibility of pricing etc. have been conceptualized. The parameter identification is the important contribution of this study.

This study also seeks to contribute to the discipline of Policy Design by articulating the need for factoring in the behavioral aspects right at the stage of conceptualization and design of any policy. Behavior and possible response of REC

system on the users and service providers have been analysed before recommending policy prescriptions in the context.

Finally, by considering the parameters identified, benchmarking with ROC of UK, opinion survey, and behavioral aspects, way forward has been recommended for effective policy implementation of REC system in India for mainstreaming RE generation.

The way forward suggested in the present research would be a real aid to policy making on renewable energy. This research would provide a theoretical construct of how effectiveness of alternatives available should be explored and understood, before policy decision. The research also at the same time seeks to contribute to management practices. It is expected to enhance knowledge in emerging field of green energy and sustainable development.

However, the researcher feels that while all possible factors have been identified to understand the 'whole' problem around REC scheme in India, the degree and extent of inter-relationship among factors has not been covered due to limitations of scope of the present study. It would be an interesting future research as has been suggested in the limitations/future scope section.

# LIMITATIONS OF STUDY

In the study, the researcher has limited his study to the various factors affecting the REC mechanism in India, and based on analysis of the available data and comparison with international experiences (especially, UK experience of ROC) has suggested way forward for India. REC framework in India being a new concept (REC scheme was launched only in 2010), data availability was a real constraint. REC trade takes place on monthly basis. As such, details in terms of trade volumes and traded price of REC were also limited in number. Equally challenging was lack of awareness of stakeholders about this new market based instrument for promotion for green energy. This posed a challenge to the process of collection of responses from stakeholders on the questionnaire framed for seeking opinion. Another limitation was in terms of influence of external factors on the REC design in India.

**Future Scope of Study**

As has been highlighted in the Theoretical Contribution section, the degree and extent of inter-relationship among factors responsible for present state of REC scheme in India has not been covered due to limitations of scope of the present study. It would be an interesting future scope of research.

In course of the research, the researcher realised the external factors, especially those relating to grid integration of renewable unless addressed adequately can pose a challenge to the efforts on promoting renewable sources in India in general and REC scheme in particular.

However, this was beyond the scope of the present proposition of the research. The research reveals that this aspect of grid integration of renewable and its impact on REC framework could make a good case for future research.

Another area that demands detailed research relates to exploring the feasibility of crediting REC to every unit of RE generation irrespective of whether the said generation has been sold through FiT or otherwise. In the present study, this has been recommended as one of the desirable policy interventions. However, this is a topic fit for separate research. Several issues need to be examined and evaluated before this can be implemented.

In course of the research, discussions on fungibility/exchangeability of REC with energy efficiency certificate were also noticed. Both energy efficiency and renewable energy help reduce carbon footprints. This aspect has not been studied in depth. Fungibility of REC and energy efficiency certificate could also make a good case for future study.

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# APPENDICES

## APPENDIX I
## QUESTIONNAIRE

These questionnaires are meant for academic/research purpose and aimed at eliciting views of stakeholders on the factors affecting, and the way forward for the existing framework of REC scheme in India.

Questions may be answered by signing (X) in the boxes against each such question.

**Factors affecting renewable energy certificate (REC) framework in India**

Existing Indian REC framework is affected by various factors. According to the experience so far, how do you value the following factors adversely impacting the REC framework in India in terms of achieving its objectives and how do you view the requirement of change in the framework going forward?

| | **Issues/Factors** | **Strongly disagree** | | **Disagree** | | **Neither Agree or Disagree** | | **Agree** | | **Strongly Agree** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | There should be clarity and certainty about continuation of REC framework on longer time horizon (need for sunset clause) | | | | | | | | | | |
| | | | | | | | | | | | |
| 2 | All RE generation (whether sold at preferential tariff or otherwise) should be given the REC credit. | | | | | | | | | | |
| | | | | | | | | | | | |

| | Issues/Factors | Strongly disagree | | Disagree | | Neither Agree or Disagree | | Agree | | Strongly Agree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 3 | In the event of sale of RE generation to the obligated entity at preferential tariff, REC credit should also be transferred to the obligated entity. | | | | | | | | | | |
| | | | | | | | | | | | |
| 4 | Obligated entity should be entitled to sell the RECs left surplus after meeting its RPO compliance | | | | | | | | | | |
| | | | | | | | | | | | |
| 5 | REC should be the only instrument for RPO compliance as against the existing framework of multiple options (of preferential tariff and REC) for RPO compliance | | | | | | | | | | |
| | | | | | | | | | | | |
| 6 | Off-grid RE generations should also be made eligible for REC | | | | | | | | | | |
| | | | | | | | | | | | |
| 7 | Eligibility criteria for REC should be defined at central level by CERC and it should not vary from State to State | | | | | | | | | | |
| | | | | | | | | | | | |
| 8 | REC should be designed to encourage only new RE projects | | | | | | | | | | |
| | | | | | | | | | | | |
| 9 | Denomination of REC should be lowered from the current denomination of 1 REC=1 MWh, to take care of smaller size of RE generating plants | | | | | | | | | | |

| | **Issues/Factors** | **Strongly disagree** | | **Disagree** | | **Neither Agree or Disagree** | | **Agree** | | **Strongly Agree** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | Nascent technology could be given credit of higher number of RECs based on the same level of generation | | | | | | | | | | |
| | | | | | | | | | | | |
| 11 | Older projects could be given more RECs, to insulate such projects from adverse impact of reduction in floor price in future | | | | | | | | | | |
| | | | | | | | | | | | |
| 12 | Shelf life/validity of REC should be higher than current validity period of 365 days | | | | | | | | | | |
| | | | | | | | | | | | |
| 13 | There is a need for a guarantee fund to buy out unsold RECs at discounted price, for certainty of revenue to investors | | | | | | | | | | |
| | | | | | | | | | | | |
| 14 | RECs purchased beyond RPO should allowed to banked for fulfillment of target in next year | | | | | | | | | | |
| | | | | | | | | | | | |
| 15 | There should be more trading sessions, instead of the current framework of once–in-a-month only trading session | | | | | | | | | | |
| | | | | | | | | | | | |
| 16 | REC trade should be allowed through traders, direct bilateral trade between discoms, financial institutions | | | | | | | | | | |
| | | | | | | | | | | | |

| | **Issues/Factors** | **Strongly disagree** | | **Disagree** | | **Neither Agree or Disagree** | | **Agree** | | **Strongly Agree** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 17 | Final trade and extinction of REC happen only through Power Exchange | | | | | | | | | | |
| | | | | | | | | | | | |
| 18 | Present process of purchase of REC is cumbersome for voluntary buyers | | | | | | | | | | |
| | | | | | | | | | | | |
| 19 | There is a need for Floor price for REC till RE generation achieves grid parity | | | | | | | | | | |
| | | | | | | | | | | | |
| 20 | Current method of fixing floor and forbearance price based on APPC and RE tariff should be reviewed | | | | | | | | | | |
| | | | | | | | | | | | |
| 21 | There should be a longer visibility for REC price band | | | | | | | | | | |
| | | | | | | | | | | | |
| 22 | Average Pool Power Purchase Price (APPC) determination methodology needs to be standardized at the national level | | | | | | | | | | |
| | | | | | | | | | | | |
| 23 | National level RPO should be evolved and adopted by all States | | | | | | | | | | |
| | | | | | | | | | | | |
| 24 | There should be longer term RPO trajectory | | | | | | | | | | |
| | | | | | | | | | | | |
| 25 | Large consumers (say 1 MW and above) should be obligated to meet RPO separately? | | | | | | | | | | |
| | | | | | | | | | | | |

| | Issues/Factors | Strongly disagree | | Disagree | | Neither Agree or Disagree | | Agree | | Strongly Agree | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 26 | RPO of Discoms should exclude consumption of such large consumers? | | | | | | | | | | |
| | | | | | | | | | | | |
| 27 | There be a legislative mandate (provision in the Act itself) for longer and stable RPO trajectory | | | | | | | | | | |
| | | | | | | | | | | | |
| 28 | Non-compliance of RPO should attract penalty which the regulator should enforce effectively | | | | | | | | | | |
| | | | | | | | | | | | |
| 29 | There should be a graded penalty for non-compliance of RPO linked to efforts made to fulfill the RPO | | | | | | | | | | |
| | | | | | | | | | | | |
| 30 | Quarterly compliance requirement (instead of current annual compliance requirement) will help develop REC market | | | | | | | | | | |
| | | | | | | | | | | | |
| 31 | Distribution companies (discoms), especially in power deficit states do not opt for REC because REC purchase (which needs to be supplemented by power purchase) is more expensive than preferential tariff based PPA, for them | | | | | | | | | | |
| | | | | | | | | | | | |
| 32 | REC is a viable option for a discom in power surplus state | | | | | | | | | | |
| | | | | | | | | | | | |

| | **Issues/Factors** | **Strongly disagree** | | **Disagree** | | **Neither Agree or Disagree** | | **Agree** | | **Strongly Agree** | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 33 | REC route is fraught with uncertainty of revenue for a generator | | | | | | | | | | |
| | | | | | | | | | | | |
| 34 | Transmission infrastructure for evacuation of RE generation is crucial for success of REC | | | | | | | | | | |
| | | | | | | | | | | | |
| 35 | Success of REC also depends on how variation of RE generation is handled | | | | | | | | | | |
| | | | | | | | | | | | |
| 36 | Success REC also depends on how balancing power requirements of host states are addressed | | | | | | | | | | |
| | | | | | | | | | | | |
| 37 | There should be an incentive mechanism to encourage States to set higher RPO | | | | | | | | | | |
| | | | | | | | | | | | |
| 38 | Host states should be compensated for the evacuation infrastructure and balancing power needed to integrate RE | | | | | | | | | | |
| | | | | | | | | | | | |

## APPENDIX II

## OPINION SURVEY: FACTORS AFFECTING RENEWABLE ENERGY CERTIFICATE (REC) FRAMEWORK IN INDIA

Dear Sir,

As you aware that the Renewable Energy Certificate (REC) mechanism has been put in place in India to overcome the geographical constraints in terms of inter-state transfer of Renewable Energy (RE) power and to enable the obligated entities in the resource deficit states to meet their Renewable Purchase Obligation (RPO). With this mechanism in place, the Regulators would not be constrained by non-availability of RE source within the State for purpose of fixation of RPO. This mechanism will also eventually bring about the desired competition in the RE sector and will in turn mainstream the RE sources along with other conventional sources.

It is about more than two years since REC framework has been formally launched in the country. Nineteen trading sessions have already been undertaken successfully. However literature survey reveals certain operational constraints in the process of implementation of framework.

It is in this context that a set of questionnaire has been prepared (as shown). These questionnaires are meant for academic/research (under aegis of University of Petroleum & Energy Studies (UPES), Dehradun) purpose and aimed at eliciting views of stakeholders on the factors affecting, and the way forward for the existing framework of REC scheme in India.

We would appreciate if you could spare some time out of your schedule to answer the questionnaire and send them back to this email ID at an early date.

Regards,

**1. Questionnaire**

These questionnaires are meant for academic/research purpose and aimed at eliciting views of stakeholders on the factors affecting, and the way forward for the existing framework of REC scheme in India.

**2. Factors Affecting Renewable Energy Certificate (REC) Framework in India**

Existing Indian REC framework has its own strengths. But comparison with international experience especially UK model of Renewable Obligation Certificate (ROC) – as also India's own experience of implementation of REC scheme so far – brings forth gaps in the REC framework in India. Being an expert and keen observer of developments of renewable energy segment of power market, how do you value various factors affecting the REC framework in India in terms of achieving its objectives and how do you view the requirement of change in the framework going forward?

**Opinion Survey: Questions**

1. What according to you are the strengths of Indian REC framework?
2. What do you think are the critical factors affecting the REC framework in India?
3. To what extent, do you think, RPO compliance, monitoring and enforcement can help sustain REC market? What according to you, needs to be done on these fronts?

4. International experience on Renewable Portfolio Standards (RPS) reveals that all RE generation is eligible for REC and REC is the only instrument for meeting renewable obligation. Do you think India should also adopt such a policy framework? (We will appreciate justification)
5. In about two years since REC framework has been introduced in India, more than 3500 MW of RE capacity has been added through REC route. Under the existing REC framework do you see this trend continuing in future?
6. REC trade data reveals that very few distribution companies are opting for REC route. What according to you are the reasons for this?
7. Do you think large consumers Large consumers (say 1 MW and above) should be obligated to meet RPO separately and RPO of Discom should exclude RE purchase requirement corresponding to consumption of such large consumers?
8. Should we allow secondary or over the counter (OTC) market in REC trade? Or should we continue with the existing system of REC trades only in Power Exchanges?
9. What according to you are the specific steps required to be taken to address the financing constraints for an RE project opting REC route?
10. What according to you are the specific challenges for solar REC?
11. What external factors are required to be addressed to make REC a success?
12. What according to you are the changes required – in terms of policy and regulatory interventions - in the existing REC framework to achieve its objectives?

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