CENTRAL ELECTRICITY REGULATORY COMMISSION

NEW DELHI

Petition No. 99/ 2010 (Suo Motu)

IN THE MATTER OF

Determination of Forbearance and Floor Price for the REC framework.

ORDER (Suo Motu)

A. BACKGROUND

1. In exercise of the power under section 66 and 178 of the Act, the Commission has notified the Central Electricity Regulatory Commission (Terms and Conditions for recognition and issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010 (hereafter REC Regulations).
2. As per the first proviso of the Regulation 9 (1) of the REC Regulations, the Commission in consultation with the Central Agency and Forum of Regulators shall provide the Forbearance and Floor Price separately for solar and Non-solar Renewable Energy Certificates. Further, Regulations 9 (2) of the REC Regulations provides guiding principles for determining the forbearance and floor price for solar and non- solar Certificates. The relevant provision is as under:

*"9. **Pricing of Certificate:***

(1) The price of Certificate shall be as discovered in the Power Exchange:

Provided that the Commission may, in consultation with the Central Agency and Forum of Regulators from time to time provide for the floor price and forbearance price separately for solar and non-solar Certificates.

(2) The Commission while determining the floor price and forbearance price shall be guided inter alia by the following principles:

(a) Variation in cost of generation of different renewable energy technologies falling under solar and non-solar category, across States in the country:

(b) Variation in the Pooled Cost of Purchase across States in the country;

(c) Expected electricity generation from renewable energy sources including:-

i. expected renewable energy capacity under preferential tariff

ii. expected renewable energy capacity under mechanism of certificates;

(d) Renewable Purchase obligation targets set by State Commissions"

3. The Commission awarded a study to a consultant firm for assisting it in assessment of the forbearance and floor price in line with the guidelines specified in the REC Regulations. The detailed methodology for determination of these prices has been explained in the study report which is appended to this order as **Appendix- I** .

4. The estimated forbearance price and floor price under REC mechanism has been based on the following approach:

(a) *RE target:* The overall national RE target for 2009-10 has been based on 11th Plan Targets for Capacity Addition in RE, the achievement till January 2010 and the gap that needs to be met to achieve that target. The target for 2010-11 has been taken as 6% of total projected generation (National Action plan on Climate Change Target).

(b) *Additional RE capacity addition* :To develop scenarios for future state level RE technology specific supply, for each RE technology across states, the growth in capacity has been projected based on the Cumulative Aggregate Growth Rate (CAGR) for that RE technology in the states based on the past 5 years performance.

(c) To estimate additional generation at the state level in year 2010-11, the capacity added under a specific RE technology has been multiplied by the Capacity Utilisation Factor of the RE technology, based on appropriate assumptions.

(d) *Cost of Generation/RE tariff:* Costs of Generation/ RE Tariff for different technologies for FY 2009-10 have been assumed as per the CERC RE Tariff Regulations 2009, for the sake of uniformity.

(e) The forbearance price has been derived based on the highest difference between cost of generation of RE technologies / RE tariff and the average pooled power purchase cost of 2009-10 for the respective states.

(f) The floor price has been determined keeping in view the basic minimum requirements for ensuring the viability of RE projects set up to meet the RE targets. This viability requirement shall cover loan repayment & interest charges, O&M expenses and fuel expenses in case of Biomass and Cogeneration.

5. The specific assumptions and basis for deriving the forbearance and floor price for solar and non-solar Certificates are as under:

A. **Non-solar forbearance price** :

(i) RE Tariffs (i.e. CERC determined RE tariff) across RE technologies and the Average Pooled Power Purchase Costs (APPC's) of 2009-10 across respective states have been mapped. The highest difference between RE tariff and Average Pooled Power Purchase Costs (APPC's) has been taken as the forbearance price.

(ii) Highest difference as forbearance price covers more than the target RE generation (as per NAPCC i.e. 6% total generation in FY 2011) and is considered necessary to take care of the risks involved for RE generators in opting for REC mechanism. This is also expected to give fillip to the promotion of RE generation.

B. **Non-solar floor Price** :

(i) Using the gap between the minimum requirement for project viability of Renewable Energy Technologies and respective state average power pool cost of previous year, an incremental supply curve is plotted with capacity (in MU) on one axis and gap price (Rs/kWh) in ascending order on the other axis.

(ii) The RPO targets for 2010-2011 have been marked on the supply curve. In the present case using NAPCC targets, a target of 6% for 2010-2011 has been taken.

(iii) The supply (RE supply) and demand (RE target) have been matched to determine the Market Equilibrium Price (MEP) that shall act as the floor price for RECs.

(iv) In this case floor price has been taken as the price (difference between feasibility requirement (Rs. /kWh) and APPC) at which the target RE generation (as per NAPCC) of 5437896 MUs (i.e. 6% total generation in FY 2010-11) will have been realized. This approach for floor price is considered adequate as the objective is to ensure that the basic minimum requirements (in terms of recovery of cost) of the target generation are met.

C. **Solar forbearance price**:

This has been derived based on the highest difference between the Solar PV tariff for 2009-10 (as per CERC regulation) and the APPC of 2009-10 across states.

D. **Solar floor price**:

This has been based on the project viability approach covering factors like loan repayment, interest charges and O&M expenses. The maximum difference between the minimum requirement for project viability of Solar PV and respective state average power pool cost of previous year will be considered as floor price.

6. The detailed computation of, and basic assumptions and clarifications related to the forbearance and floor prices are attached as **Appendix-II**. Based on the

above assumptions, forbearance price and floor price evolved for Certificates have been derived and are shown in following table:

	Non solar REC (Rs/ MWh)	**Solar REC (Rs/ MWh)**
Forbearance Price	3,780	17,230
Floor Price	1,450	12,280

7. The forbearance and floor prices evolved as above are proposed for transactions of solar and non solar Certificates under REC framework.

8. We direct that the proposed floor price and forbearance price may be placed in the public domain to invite comments and suggestions thereon. We further direct that Forum of Regulators and the Central Agency be consulted before finalising the forbearance and floor price.

Sd/- Sd/- Sd/- Sd/-

(M. Deena Dayalan) Member **(V.S. Verma) Member** **(S. Jayaraman) Member** **(Dr. Pramod Deo) Chairperson**

New Delhi, 23rd March, 2010

APPENDIX-1

STUDY ON DETERMINATION 0F FORBEARANCE AND FLOOR PRICE

March 2010

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A1: INTRODUCTION

1.1 Renewable energy (RE) provides a number of primary and secondary benefits which are economic, social, environmental or technical in nature. Some of the key benefits related with renewable energy generation are increased power/ energy availability, enhanced access to power in rural/ remote areas, increased employment generation, enhanced energy security and environmental benefits. Therefore a good mix of these energy sources in the overall energy mix would enhance sustainable development at the state, national and global level.

1.2 Though renewable energy sources are perennial in nature, the generation varies based on weather conditions, which makes scheduling and predicting their generation on a long term basis very difficult.

1.3 Even though renewable energy sources offer a number of economic, social and environmental benefits, their relatively high cost has meant that their share in the overall energy mix has remained limited. However, other aspects such as energy security and widely fluctuating fossil fuel prices have contributed to an increase their development and production.

1.4 Over the last two decades, the scaling up of installations and capacity of renewable energy sources has meant that the prices of several RE technologies have been on the decline. Technologies such as small hydro, wind and biomass are very near grid parity while the Jawaharlal Nehru Solar Mission aims at solar achieving grid parity by 2022. Therefore it can be confidently expected that in the near future most of these renewable energy based sources would compete on economic and financial terms with conventional thermal power generation.

1.5 Today, in the International Renewable Energy market, India is fast becoming one of the world's most attractive markets for Renewable Energy (RE) investments. India's rise has been due to the effective policy and regulatory support for investment in renewable energy technologies (RETs). The central government has just launched the Jawaharlal Nehru Solar Mission and the Electricity Regulatory Commissions (CERC and SERCs) are promoting renewable energy generation through preferential tariffs and renewable purchase obligations.

1.6 As a result the country's RE sector has registered a significant growth in the last decade, registering a 27% CAGR. However there is huge scope for further RE development, with the renewable energy potential of India lying in the range of around 138 GW of which only 10.8% (15 GW) had been harnessed till October 2009. A significant part of the total RE potential still remains to be utilized.

1.7 The following figures illustrate the current status of RE utilization at the national level as well as the potential available across technologies as of October 2009 and the development of the Indian RE sector including the main events that have shaped it.

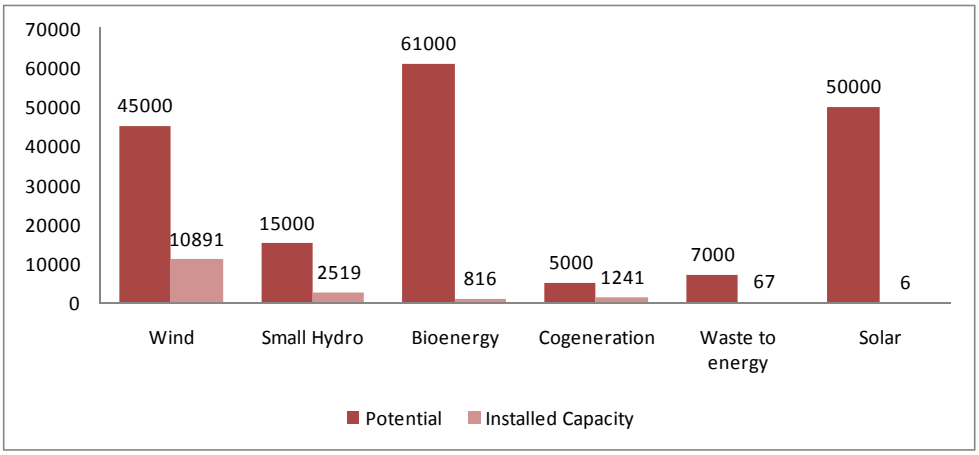


Figure 1: RE Potential and Installed Capacity, (Source: MNRE as on Oct 2009)

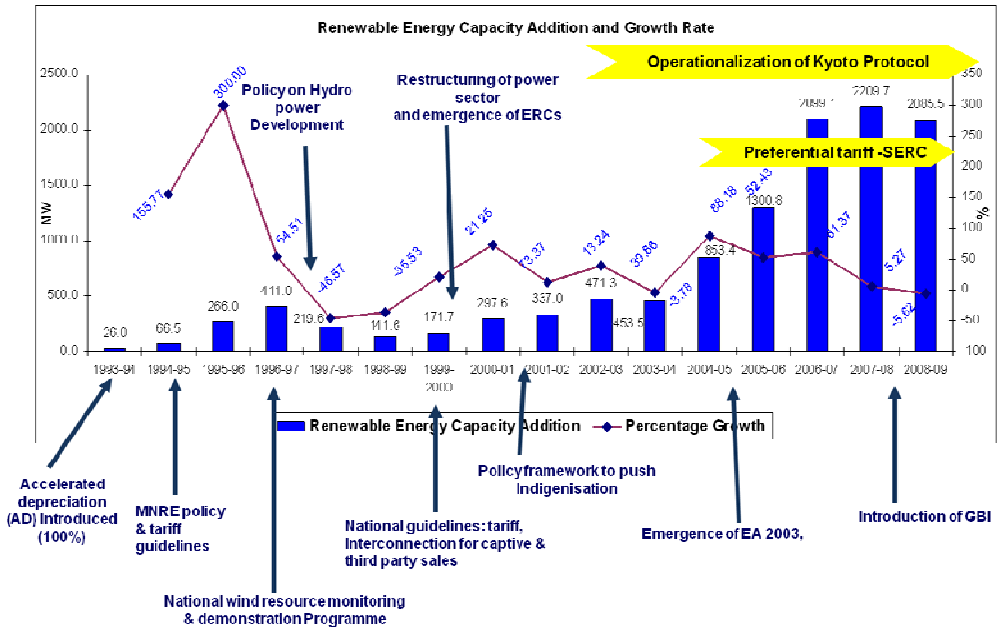


Figure 2 - Development of India's RE sector

1.8 One of the main drivers in the future for enhancing RE generation is likely to be the mandatory renewable energy purchase obligations for utilities as mandated by the Electricity Act 2003 and declared by the state commissions. Several states have issued the RPO obligations, but actual achievement against the RPO target is not encouraging. Some of the major factors responsible for states not achieving their RPO targets are - uneven distribution of RE resources in the country, absence of deterrent mechanism for enforcement of RPO and lack of state level conducive policy framework for RE.

1.9 The following table shows the status of RPO in key states.

Table 1: RPO status in 2007-08 (states true up orders)

2007-08		
State	**RPO Target**	**RPO Met**
Maharashtra	4%	3%
Gujarat	2%	2%
Karnataka	10%	11.5%
Tamil Nadu	10%	11%
Punjab	1%	0.74%
Haryana	4%	0%
Madhya Pradesh	10%	0.07%

1.10 The above table clearly shows that there are states like Karnataka, Tamil Nadu which have achieved their high level of RPO targets. However, a number of states like Madhya Pradesh have huge gap in the RPO target and the actual achievement by the obligated entities.

1.11 Although India has sufficient resource potential to achieve the renewable energy purchase obligations (RPO's) established by various State Electricity Regulatory Commissions and also proposed by the National Action Plan on Climate Change (NAPCC), the geographic distribution of these resources throughout the country and even within states, coupled with existing constraints in access and transmission infrastructure, has lead to a situation wherein achieving these RPO goals for some states becomes difficult.

1.12 On the other hand, a number of states have achieved their RPO target set by their respective SERC's (State Electricity Regulatory Commission) and are now unwilling to procure more RE based power. This scenario, compounded by the lack of inter-state sale of renewable based power, has adversely impacted investment and development of the RE sector.

1.13 To address these issues, the Forum of Regulators ('FOR') has developed a National level framework for implementation of Renewable Energy Certificate (REC) mechanism in India. The REC framework required Central Electricity Regulatory Commission (CERC) to frame a regulation to institutionalise REC mechanism at national level and State Electricity Regulatory Commissions (SERCs) to entrust REC mechanism to comply RPO at State level under Section 86 (1) (e) of the Act.

1.14 The CERC has issued the regulation called Central Electricity Regulatory Commission (CERC) (Terms and Conditions for recognition and issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010, on 14th January 2010 providing the institutional requirement of REC framework at National level. Model Regulation for SERCs under Section 86 (1) (e) of the Act has been forwarded to the SERCs for entrusting the REC as a valid instrument for compliance under Renewable Purchase Obligation (RPO).

1.15 Under the proposed REC framework, there will be two components of RE based generation viz. i) electricity that could be sold at the a discounted rate (at par with the state's average conventional power procurement price also known as Average Power Pooled Cost (APPC)) and ii) REC that could be exchanged and will have a monetary value attached to it.

1.16 As per the CERC regulation on REC, the electricity component will be represented as 'Pooled Cost of Purchase'. 'Pooled Cost of Purchase' means the weighted average pooled price at which the distribution licensee has purchased the electricity including cost of self generation, if any, in the previous year from all the energy suppliers long-term and short-term, but excluding those from renewable energy sources, as the case may be.

1.17 According to the CERC REC Regulations, released the price of REC's shall be as discovered in the Power Exchange. However the CERC, in consultation with the FOR may from time to time provide a floor and forbearance price for the solar and non-solar RE Certificates.

1.18 The regulation specifies that CERC, while determining the floor price and forbearance price, shall be guided by the following principles:

(a) Variation in cost of generation of different renewable energy technologies falling under solar and non-solar category, across States in the country

(b) Variation in the Pooled Cost of Purchase across States in the country;

(c) Expected electricity generation from renewable energy sources including:-

(i) expected renewable energy capacity under preferential tariff

(ii) expected renewable energy capacity under mechanism of certificates

(d) Renewable purchase obligation targets set by various State Commissions.

1.19 As a part of the process of further detailing for effective implementation of REC framework, the study was awarded for developing an approach for the fixing of the forbearance and floor price for RECs. The Scope of the work for study involved the analysis of relevant international experience and the REC liquidity in the near future.

1.20 Renewable Energy Certificates (RECs) can play vital role to address the issues related to the effective implementation of RPO and facilitate the scaling up of renewable energy in country.

1.21 A "Renewable Energy Certificate" is a commodity representing the environmental attributes of a unit of renewable energy. Renewable Energy Certificates (RECs) have been used by certain countries as market instrument for the development of RE technologies.

1.22 The REC mechanism offers a level playing field for RE generators and the utilities. It offers utilities easy access to electricity at a reasonable price and on the other hand allows REC generators to sell RECs to meet their cost of generation or even earn more.

1.23 Apart from this, the mechanism provides the states having a low RE potential, the means to meet their RPO through purchase of REC's. In this way the REC mechanism allows the development of the most efficient renewable energy resources regardless of their location. This becomes all the more important for India as there exist highly concentrated pockets of cost efficient RE resources (coastal belt for wind, the Thar desert for Solar and the Himalayan belt for small hydro).

A2: INTERNATIONAL EXPERIENCE

2.1 The REC market can be broadly classified into two markets: compliance market and voluntary market. However keeping in mind the nature of Indian RE market scenario, the RPO targets issued by different states and the recent CERC REC regulation, the focus of the REC framework is currently defined primarily for the compliance market.

2.2 REC mechanism has been used by a number of countries to promote RE sources in the country. A review of international experience indicates that RECs are market traded instruments and the price of the REC is generally market determined. Examples of this include countries like United Kingdom (UK), Australia and certain states of the United States of America (USA).

2.3 The structure of the market varies from country to country depending upon the volume, market participants, policy mandates and nature of transaction. However, a number of countries have penalty mechanism in place for non-compliance of the renewable energy procurement targets. The penalty acts as a forbearance price for trading of the REC in the market as the obligated entity would prefer to pay the penalty rather than buying the REC at higher price.

2.4 Some of the international experience related to penalty structure is detailed below :

(a) **Australia:** Liable parties who fail to submit the required number of certificates in each accounting period will be required to pay a penalty for the shortfall of $40/MWh. If a liable party is unable to discharge its liability for a particular year, but the shortfall is less than 10% of the party's total liability, the shortfall is carried forward into next year's liability. This penalty of $40/MWh in a way acts as a forbearance price for RECs.

(b) **United Kingdom**: The electricity suppliers are required to pay a buy-out amount into a buy-out fund for the shortfall in meeting the compliance (in MWh) by not presenting the Renewable obligation Certificates (ROCs). The buy-out price is £37.19 per megawatt hour for the period 2009-10. The buy-out price is adjusted with the Retail Prices Index. The buy-out price fixed every year acts as the ceiling price for ROCs in the market.

(c) **Texas, USA:** Texas has set a penalty of USD 50/MWh for non-compliance by the obligated entities. Essentially, penalties and alternate compliance mechanisms set a ceiling for RECs prices, because electricity providers would simply opt to pay the penalty if REC prices exceed the penalty price.

A3: FORBEARANCE AND FLOOR PRICE

Context

3.1 Fixing of forbearance and floor price will require an analysis of different factors impacting the price of solar and non-solar RECs. According to Basic Economic Theory *(Ivanova, 2007)*, renewable energy producers, operating in a competitive market, would be willing to sell their REC's at their *marginal costs.* However, in a regulated market with a limited number of players the market dynamics change. This change would be based on factors that define the boundaries of the market and the relative standing of various stakeholders.

3.2 Therefore the forbearance and floor prices would have to be designed keeping in view the impact of all these factors on the REC market. The forbearance and floor price shall also play different roles for different stakeholders. While the floor price shall ensure that basic project viability is maintained for developers, the forbearance price shall act as deterrent for the utilities against non-compliance of the RPO targets. However, it needs to be ensured that the deterrent need not be so harsh that it becomes a heavy burden on the ultimate consumers. Therefore, there is a need for developing forbearance and floor prices that provide a balanced environment which promotes utilities to buy REC's, developers to invest in RE projects and at the same time are not harsh enough to cause to heavy burden on the ultimate consumers of energy. Thus both these prices would need to be set in such a way that they sustain RE development yet at the same time prevent market speculation, gaming and undue punitive measures on the REC market participants.

Key factors/Issues

3.3 The price of REC's and consequently the forbearance & floor prices are influenced by a number of factors, some of which have been listed below:

(a) **Fluctuation in the price of conventional power procurement:** With an increase in electricity prices, the viability of RE projects increases which in turn prompts utilities to support RE generation.

(b) **RE Portfolio:** REC prices are also likely to be affected by factors such as the resources available for RE generation, RE tariffs, present level of RE percentage in the overall power mix, quantum of electricity required in the future RPO targets, RE specific technological developments, period for which REC's can be retained by RE generators, availability of other measures for meeting RPO compliance etc.

3.4 Although the proposed REC mechanism will result in a national level system, all the above stated factors would need to be analysed at the state and national level also to take into account the variation from state to state and their impact at the national level.

Broad Approach for setting Forbearance and Floor Price

3.5 The approach (from hereon called the project viability approach) identified for the determination of forbearance and floor price for REC's, balances the need for ensuring project viability while at the same time maintaining that a minimum quantum of renewable energy generation is available at the national level (in the medium to long term) to meet the national RPO/NAPCC targets.

3.6 For the determination of these prices, the following assumptions have been used:

(a) The overall national RE target for 2009-10 has been based on 11th Plan Targets for Capacity Addition in RE, the achievement till January 2010 and the gap that needs to be met to meet that target. The target for 2010-11 has been taken as 6% of total projected generation (NAPCC Target).

(b) *Cost of Generation:* RE tariff as per CERC regulation on RE tariff have been assumed as the cost of generation for different technologies.

(c) To develop scenarios for future state level technology specific supply, for each RE technology across states, the growth in capacity has been projected based on the number of scenarios:

(i) The Plan targets for the XIth Five Year Plan of the the Government of India for Capacity Addition in Renewable Energy, the achievement till January 2010 and the gap to be met to meet that target.

(ii) Cumulative Average Growth Rate of particular RE technologies across the states for the last 5 years. To estimate RE supply at the state level, the capacity added under a specific RE technology has been multiplied by that RE technologies Capacity Utilisation Factor (as provided by CERC RE tariff regulation). The current generation has also been calculated by using the installed capacity and normative CUF of each technology.

(iii) In specific cases, where high growth was seen over the past two or three years, a suitable trend based on the performance of these years.

(iv) MNRE data on the present status of Renewable Energy Project development across states and on projects under development.

(d) The forbearance price has been recommended based on the difference between cost of generation of RE technologies required to be exploited to meet the RE

target and the Average Power Pool Cost (APPC) of the previous year for the respective states.

(e) The floor price under this approach has been recommended keeping in view the basic minimum requirements for ensuring the sustainability and viability of RE projects set up to meet the RE targets. This viability requirement shall cover loan repayment & interest charges, O&M expenses and fuel expenses in case of Biomass and Cogeneration sources.

3.7 To estimate the RE technologies that would be utilised for meeting the RE targets, two supply curves have been drawn, one each for the determination of the forbearance and floor price. These incremental supply curves (merit order of the gap between preferential tariff of RETs and respective state average power pool cost/viability requirements) have been drawn for different RE technologies available across different states of the country.

3.8 *Forbearance price*: The supply curve for determining the forbearance price shall be drawn on the price (difference between RE tariff & average power pool cost of previous year) as well as the quantum of untapped potential available for exploitation. The CERC specified levelized tariffs have been used as a proxy for cost of generation across states and across technologies. Two options can be considered for selection of forbearance price:

(a) Option 1: The market equilibrium price (meeting point of supply and demand) of this supply curve shall give the forbearance price.

(b) Option 2: Highest difference between the RE tariff & average power pool cost of previous year on the supply curve can be considered as the forbearance price.

3.9 *Floor price*: On the other hand the second supply curve would be used for determining the floor price, and would be based on the difference between the minimum requirements for ensuring the viability of projects for each RET and the average power purchase cost of the respective states. The market equilibrium price of this supply curve shall give the floor price.

3.10 The basic data that has been used as an input (like target setting, RE supply quantification etc) for the determination of the forbearance and floor price have been highlighted as a part of Table 2 below.

Table 2 - Present RE Generation Status, Future RPO Targets and RE Generation Required to meet these Targets (*Source: EPS 17th and NAPCC*)

Year	RE Target	Energy Requirement (BU)	RE Generation Required (MU)
2010	5%	848.3	42419.5
2011	6%	906.31	54378.96
2012	7%	968.65	67806.13

2013	8%	1017.09	81367.35
2014	9%	1067.94	96115.18
2015	10%	1121.34	112134.38

3.11 The formula used for price determination may be as follows :

Forbearance Price = Maximum (Preferential Tariff – APPC)

Floor Price = Market Equilibrium Price (Minimum requirement for Project Viability of RE technologies – APPC)

The flow chart below shows the approach for determination of forbearance and Floor price and thereafter actual analysis results shall be covered in detail.

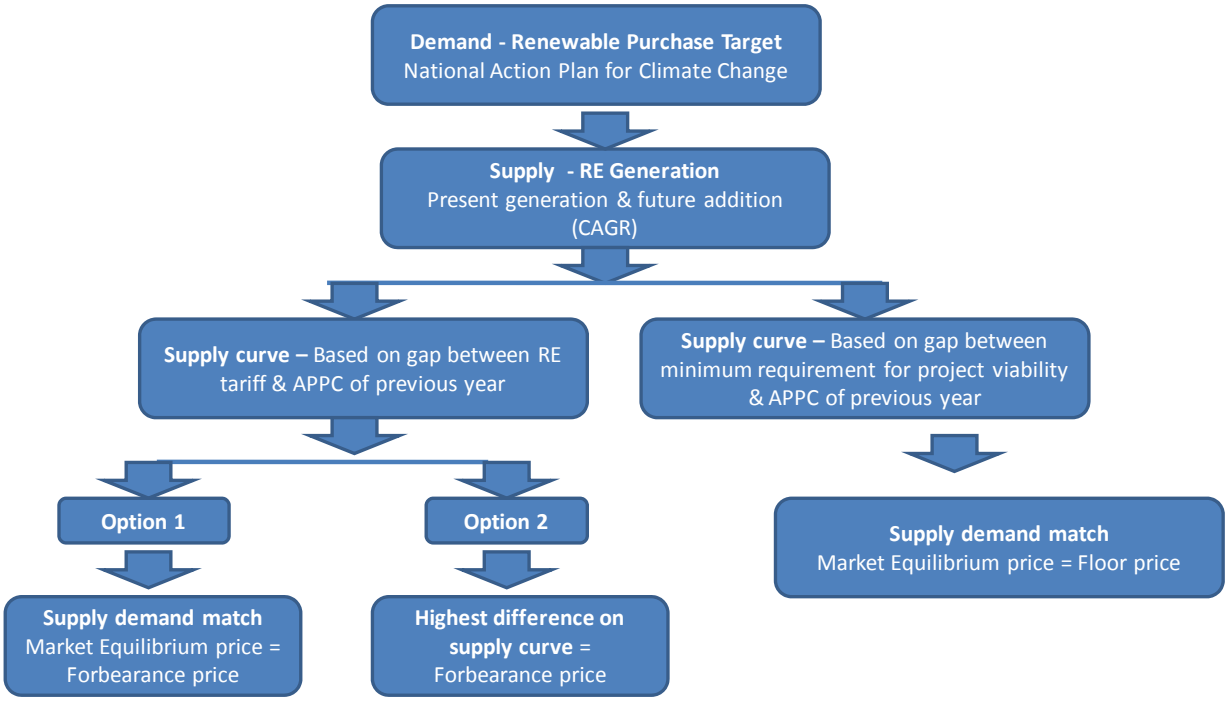


Figure 3: Approach Used for Determining Floor and Forbearance Price

3.12 The determination of the forbearance price of REC has been undertaken by following the below mentioned steps:

(a) Step 1: Map RE Tariffs (as per CERC RE tariff regulation) across RE technologies and the Average Power Pool Costs (APPC's) of previous year across respective states.

(b) Step 2: Using the gap between the RE tariff and average power pool cost of previous year in respective states, develop a supply curve for RE (merit order), with capacity (in MU) on one axis and gap price (Rs/kWh) (in ascending order) on the other axis. Mark the RPO target 2010-2011 on the supply curve.

In the present case using NAPCC targets, a target 6% for 2010-2011 is applicable.

(c) Step 3:

(i) Option 1: Match the supply (expected RE generation) to the demand (RE target) and interpolate the Market Equilibrium Price (MEP) where the demand and supply meets.

(ii) Option 2: Highest difference between the RE tariff & average power pool cost of previous year on the supply curve can be considered as the forbearance price.

3.13 The present approach has used the highest difference between the FIT and the APPC (Option 2) for the calculation of the forbearance price so as to allow the participation of the maximum number of players in the market.

3.14 The determination of the floor price of REC has been undertaken by following the below mentioned steps:

(a) Step 1: Map project viability requirement across RE technologies and the Average Power Pool Costs (APPC's) of previous year across respective states.

(b) Step 2: Using the difference between the minimum requirement for project viability of RET's and respective state's average power purchase cost an incremental supply curve is plotted. Mark the RPO targets for 2010-2011 on the supply curve. In the present case using NAPCC targets, a target of 6% for 2010-2011 is applicable.

(c) Step 3: Match the supply and demand to determine the Market Equilibrium Price (MEP) that shall act as the floor price for REC's.

3.15 Based on the approach detailed above, the RE supply curve for FY 2010-11 has been plotted and has been shown in Figure 4 and Figure 5 below. These supply curves have been used for the determination of the forbearance and floor price as pointed out above.

Figure 4 : REC Forbearance Price – Supply Curve

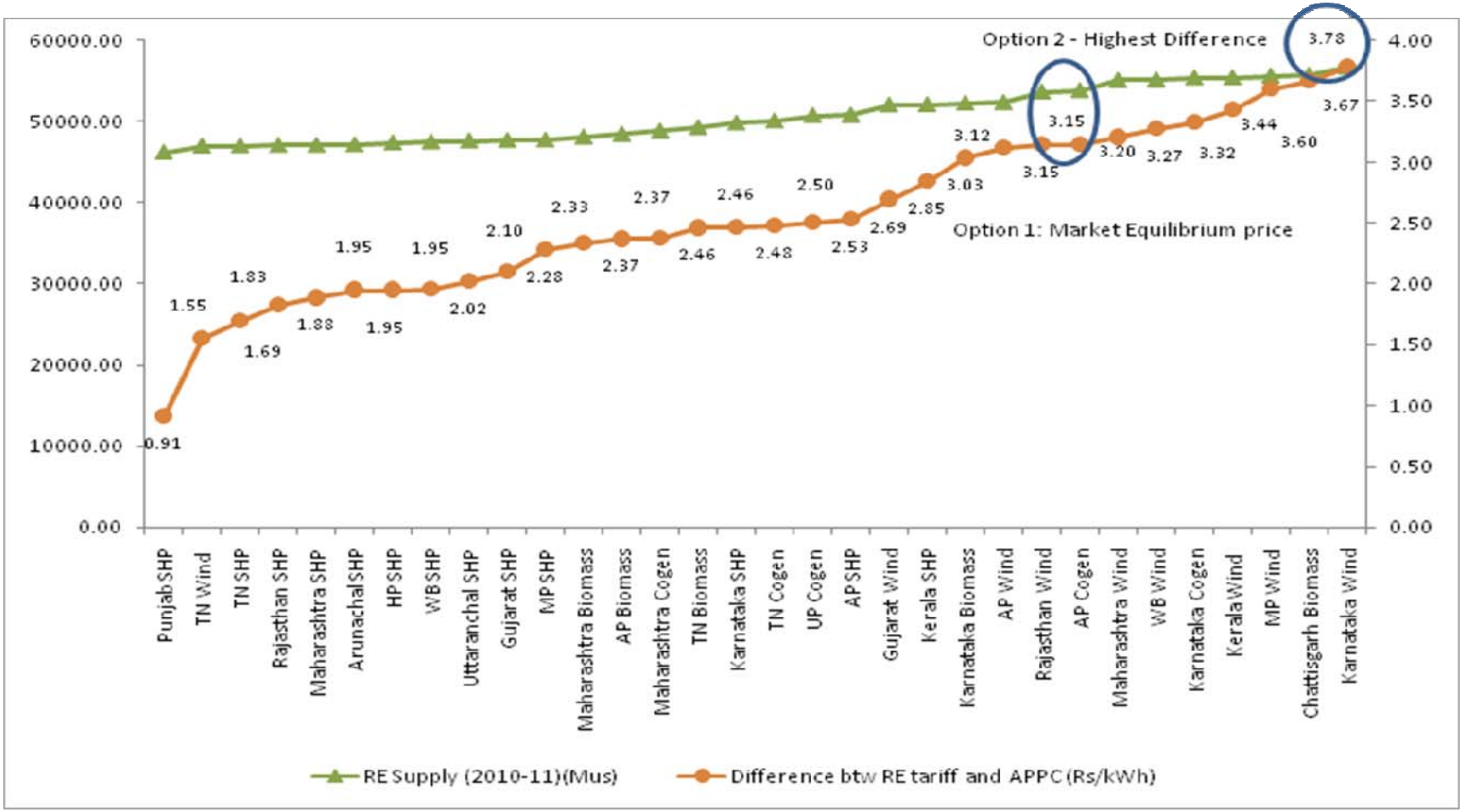
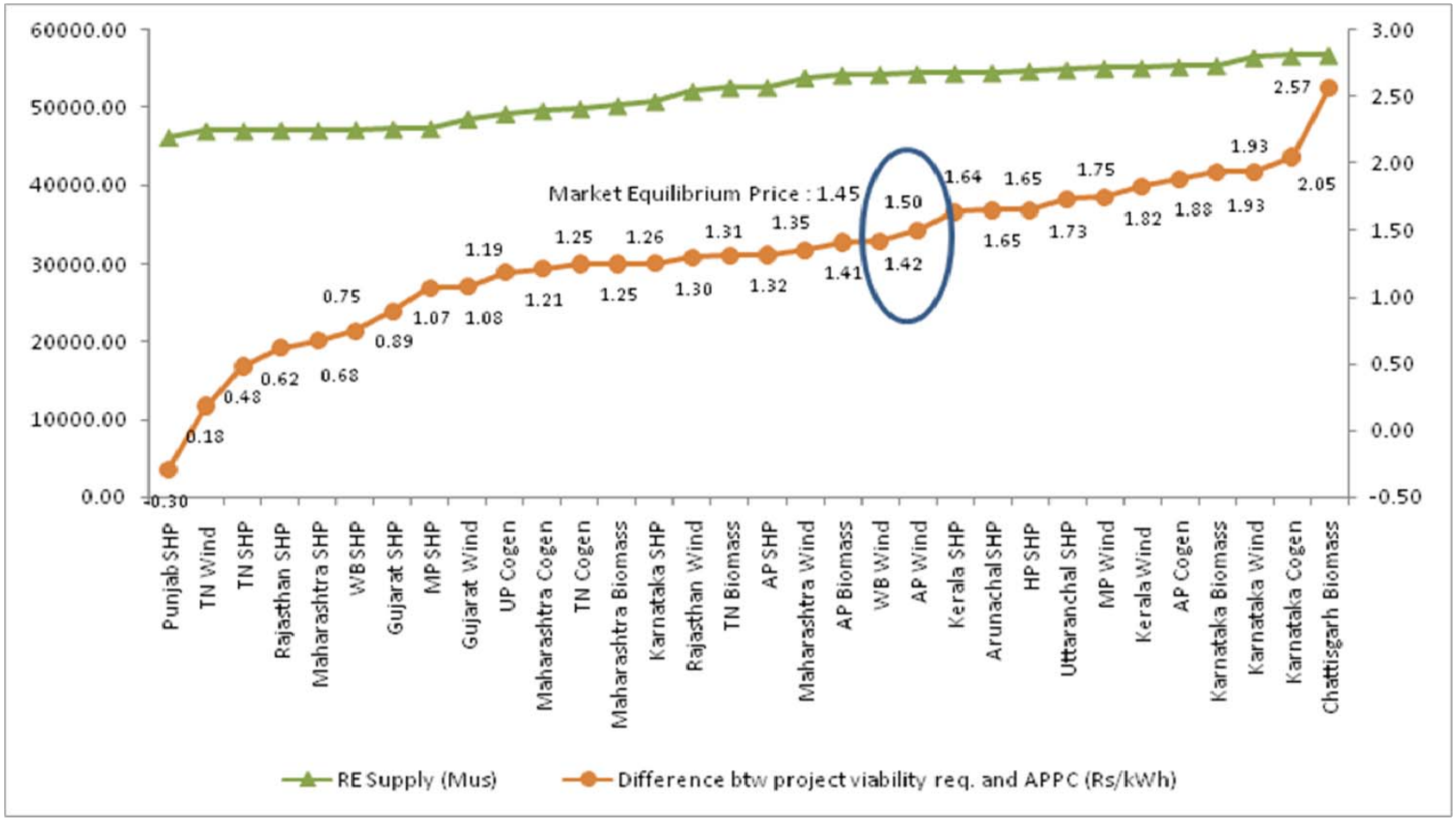


Figure 5 : REC Floor price – Supply Curve



3.16 The detailed tabulation for the supply curve is for forbearance & floor price is attached as Annexure 1 and Annexure 2.

Calculation of the Forbearance and Floor Price for REC's – Assumptions and Scenarios

3.17 The forbearance & floor price is very much dependent on the RE generation available to meet the targets. The performance in terms of generation of renewable energy projects is indicated by the CUF of the projects. The CUF is also dependent upon the technology & the resource available in a particular region.

3.18 The CUF assessment for wind projects done in Rajasthan for 2001-02, 2004-05, 2005-06 in respect of the following make and models has been done by C-WET and is shown in the table below:

Table 3 : Wind CUF variation

S.No.	Manufacturer	CUF in percentage		
		2001-02	2004-05	2005-06
1	M/s.Suzlon	18.45	20.93	16.43
2	M/s.Enercon	21.88	24.42	19.81
3	M/s.NEG MICON	19.76	22.24	17.88

Source: Rajasthan Wind tariff order 2007

3.19 The table above clearly shows that wind projects experience variation in generation levels over the years depending upon the wind variation & technology. In the similar way, it has been experienced that the actual generation levels (in terms of CUF) for RE projects at times may be lower than the normative CUF issued by the regulatory commissions. In order to capture the impact of electricity generation in comparison to the normative CUF, three scenarios have also been analyzed.

3.20 Nearly 70% of the total capacity and 60 % of the total renewable energy generation is from wind energy sources. Going forward and given the untapped potential, wind energy is likely to contribute significantly to future capacity addition and generation. However, it can be safely assumed and based on discussions with developers that the better sites for wind energy in different states have been utilized and in future, development is likely to take place in locations with lower expected CUF.

3.21 Given these, in a few instances, conservative estimates of generation from wind energy have been taken for arriving at the expected generation and working of floor and cap for REC. This is important to ensure that the right incentive prevails, particularly when investors are exposed to resource variability, market uncertainties in the absence of assured sale through PPA at preferential tariffs and uncertainty of compensation through REC price which will be determined through trading.

3.22 Further, it must be mentioned that in plotting of the supply curve, a few technologies across some states which have a very low installed capacity or low potential have been ignored.

3.23 Based on the above mentioned methodology, the assumptions used (attached as Annex – 5), the forbearance and base price have been determined as shown below:

Table 4: Forbearance and Floor Price under various scenarios

REC Price	Non solar REC (Rs/ MWh)	Solar REC (Rs/ MWh)
Forbearance Price	3,780	17,230
Floor Price	1,450	12,280

3.24 The analysis shows that in case the highest difference between RE tariff & APPC (i.e Rs 3.78/kWh) is considered, an RE supply of 56,789 MU (~ 6.3% of the India's Electricity requirement for 2010-11) can be supported under the REC mechanism. Keeping in mind the relatively low contribution of renewable energy in the current overall energy mix, it is proposed that the forbearance price of Rs 3.78/kWh (Rs 3780/MWh) can be considered for non-solar RECs. This will help in attracting new investment in the RE technologies under a new model and has the potential of providing considerable push in the development of the overall renewable energy sector.

Forbearance and Floor Pricing of Solar REC's

3.25 The Jawaharlal Nehru National Solar Mission (JNNSM) aims at adding 1000 MW of solar power under Phase I. This capacity is supposed to help meet a target RPO of 0.25% solar across states, as highlighted under the JNNSM.

3.26 At present, only 6 MW of grid interactive solar capacity exists in India. With guidelines being developed for the development and deployment of Solar Power projects, a limited number of solar projects are likely to come online in 2010. At the same time, the SERC's have also not ratified the 0.25% RPO for solar

3.27 Solar power is by far the most expensive power available and is being bundled with conventional power by NTPC's Vidyut Vyapar Nigam. The potential for a market based transaction of solar REC's in the near future looks bleak.

3.28 At the same time, the pricing of solar REC's, using the project viability approach would again be just a comparison of the APPC across states as the solar power cost (using the proxy of solar tariff) has no differences across the country. At the same time the installed capacity is meagre and to estimate any trends in its supply would be very difficult.

3.29 However, to get an indication of the future prospects and prices for Solar REC transactions, an analysis of the Solar PV REC market has been undertaken below. For this analysis, CERC tariffs for solar PV have been used for analysis purpose.

3.30 As pointed out earlier, the floor price of solar RECs shall have to cover the cost required to meet viability parameters including O&M, interest, principal repayment etc.

Table 5: Calculations for Solar RECs

State	APPC of 2009-10 (Rs/kWh)	CERC Tariff (PV) (Rs/kWh)	Gap between tariff and APPC (Rs/kWh)	Min Requirement (Rs/kWh)	Gap between Min Req and APPC (Rs/kWh)
Andhra Pradesh	1.78	18.44	16.66	13.49	11.71
Gujarat	2.21	18.44	16.23	13.49	11.28
Karnataka	1.85	18.44	16.59	13.49	11.64
Madhya Pradesh	2.04	18.44	16.40	13.49	11.45
Maharashtra	2.43	18.44	16.01	13.49	11.06
Rajasthan	2.48	18.44	15.96	13.49	11.01
Chhattisgarh	1.21	18.44	17.23	13.49	12.28
Haryana	2.64	18.44	15.80	13.49	10.85
Punjab	3.40	18.44	15.04	13.49	10.09
Himachal	1.68	18.44	16.76	13.49	11.81
TN	2.62	18.44	15.82	13.49	10.87
Bihar	1.99	18.44	16.45	13.49	11.50
Uttaranchal	1.60	18.44	16.84	13.49	11.89
West Bengal	2.36	18.44	16.08	13.49	11.13
Arunachal	1.68	18.44	16.76	13.49	11.81
Kerala	1.46	18.44	16.98	13.49	12.03
Uttar Pradesh	2.71	18.44	15.73	13.49	10.78
Maximum			17.23		12.28

3.31 The forbearance price has been arrived at by taking the difference between the APPC of previous year across different states and the tariff of Solar PV as per CERC's recent regulation. As shown in the table above, the maximum difference is Rs 17.23/kWh. Hence Rs 17,230/MWh can be considered as the forbearance price without any adoption factor for Solar RECs.

3.32 The maximum difference between the project viability requirements and APPC of previous year for different states comes to around Rs 12.28/kWh. Hence Rs 12,280/MWh can be considered as floor price for Solar RECs.

A4: REC LIQUIDITY

Context

4.1 The CERC has already issued the regulation regarding the implementation of REC mechanism in India. The REC framework suggests that the procurement of REC by obligated agencies will be treated as compliance against RPO. Hence the obligated entities can meet their RPO compliance either by purchase of RE power at preferential tariff or by purchasing RECs. Thus in the present context, the demand for REC will be driven by the obligated entities to meet their RPO compliance.

4.2 In certain countries like US the demand for RECs is also driven by the voluntary market apart from the compliance market. The voluntary market comprises of individuals and companies willing to purchase "green power". However in India the current REC mechanism is restricted only to the compliance market.

4.3 The key driving factors for demand and supply of RECs in India are detailed below :

(a) Demand for RECs: The demand for the RECs will be mainly driven by the states which are not able to meet their RPO targets by purchase of RE power . A review of RPO target and actual achievement shows that very few states have been able to meet their RPO targets. In long term, factors like RPO targets, total electricity consumption of the states and the gap between targets & achievement will vary, which will eventually change the demand for RECs.

(b) Supply for RECs: The supply of RECs will depend upon the new renewable energy capacity addition, RE projects getting eligible for issuance of RECs, players participating in the REC market etc.

4.4 The success of the REC mechanism will depend on the adequate liquidity of RECs in the market. Allowing participation of eligible entities from different states and regions in a central level REC market will definitely enhance the liquidity of RECs in the market.

Key Observations

4.5 REC liquidity analysis would assess the supply and demand situation of Renewable Energy Certificates in the Indian market. For understanding the demand and supply side of the RECs, a preliminary assessment has been done.

(a) Demand for RECs: The NAPCC targets for renewable energy forms the basis for the demand of RECs.

(b) Supply of RECs: The supply of RECs is related to the generation of electricity by the eligible RE projects in the country. It is expected that RECs will be issued mainly to generators in states which have met their RPO compliance and have adequate RE potential. A review of the capacity addition trend in the renewable energy projects has been done for the major renewable energy technologies across select states for the development of the supply curves and the assumptions for which have already been discussed earlier. .

4.6 For assessing the availability of RECs in the market, it has been assumed that states where obligated entities are able to meet their RPO compliance but still have adequate potential will be the markets supplying the RECs.

4.7 The table below shows the supply and demand side for select states indicating the expected RE generation[1], RPO requirement and the surplus/deficit scenario w.r.t. RPO target in the respective states:

Table 6: RE Liquidity

State	Generation from Installed (MU)	Cumulative additional generation over 2009 level (MU)			RPO Requirement (MU)			Liquidity (MU) Surplus (+ve) Deficit (-ve)		
	2009	2010	2011	2012	2010	2011	2012	2010	2011	2012
TN	12118.1	2778.5	4345.5	5115.6	6076.2	8682.0	9581.0	8820.4	7781.6	7652.7
Kerala	400.4	78.6	167.8	264.0	698.9	906.7	1144.2	-219.8	-338.4	-479.7
AP	2511.1	621.7	1237.8	2158.3	2996.1	3300.5	3638.3	136.8	448.4	1031.2
Maharashtra	5146.3	1595.1	3634.3	6135.6	4821.3	6074.7	7499.0	1920.0	2705.9	3782.9
Gujarat	3174.4	1298.3	2596.6	4265.7	4341.4	5360.0	6542.5	131.3	411.0	897.6
Rajasthan	1355.7	853.5	2219.9	4024.0	2183.4	2778.0	3460.1	25.8	797.7	1919.6
MP	558.0	214.2	494.0	839.6	2907.0	3239.2	3613.1	-2134.8	-2187.2	-2215.5
WB	258.0	165.4	332.0	502.6	1941.7	2569.8	3362.6	-1518.3	-1979.8	-2601.9
Karnataka	5121.1	1989.1	4057.5	6485.1	4108.2	4926.0	5881.3	3002.0	4252.6	5724.9
HP	901.1	236.2	501.5	766.9	633.1	690.3	761.7	504.2	712.3	906.3
Uttaranchal	499.1	113.7	239.8	365.8	424.5	530.1	653.9	188.4	208.8	211.0
Arunachal	239.3	42.3	88.1	133.9	8.0	7.8	14.4	273.6	319.6	358.9
Chhattisgarh	883.0	456.3	912.5	1368.8	1385.9	1539.1	1709.2	-46.6	256.4	542.6
UP	1269.6	865.7	1551.0	2272.4	3583.3	3981.5	4712.6	-1448.0	-1160.8	-1170.6

4.8 The above table clearly shows that states like Uttar Pradesh, Madhya Pradesh, West Bengal, Punjab and Kerala are not likely to meet their obligations through their own RE generation and thus shall have to buy the RECs to meet their RPO .

4.9 State like, Tamil Nadu, Karnataka, Himachal Pradesh and Uttarakhand have good RE potential. It is likely that these states will be able to meet their RPO and will be the markets supplying RECs to states not able to meet their RPO .

[1] Based on normative CUF as per CERC norms in RE tariff regulation

Availability of RECs

4.10 As per the CERC regulations on the REC mechanism, RE projects shall be eligible to apply for registration for issuance of and dealing in RECs if it fulfils the following conditions:

(a) it has obtained accreditation from the State Agency

(b) it does not have any power purchase agreement for the capacity related to such generation to sell electricity at a preferential tariff determined by SERC.

(c) it sells the electricity generated either (i) to the distribution licensee of the area in which the eligible entity is located, at a price not exceeding the pooled cost of power purchase of such distribution licensee, or (ii) to any other licensee or to an open access consumer at a mutually agreed price, or through power exchange at market determined price.

4.11 The above conditions clearly imply that the issuance of REC will depend on the commercial arrangement for sale of electricity by the RE project developers, apart from other conditions.

4.12 Some of the RE developers, especially those who perceive REC route as a risky proposition, may still prefer to sell power to distribution licensees at preferential tariff. In such scenario, the issuance of RECs will not be directly proportional to the total quantum of generation from new capacities.

4.13 For understanding the availability of RECs in the market, different scenarios have been analysed assuming that certain percentage of new RE projects that will be eligible for RECs. The following scenarios have been analysed :

(a) Scenario 1 : 100% of new projects eligible for RECs

(b) Scenario 2 : 75 % of new projects eligible for RECs

(c) Scenario 3 : 50% of new projects eligible for RECs

(d) Scenario 4 : 25% of new projects eligible for RECs

4.14 The new RE projects have been assumed over and above the year 2009 RE capacity levels. The future capacity addition is based on the projection based on the CAGR for capacity addition in the last 5 years for select states..

4.15 Based on the analysis, the figure below shows the indicative number of RECs available[2] in the market for the different scenarios detailed earlier :

[2] Analysis covers 14 states: Tamil Nadu, Kerala, A.P. Maharashtra, Gujarat, Rajasthan, MP, West Bengal, Karnataka, H.P., Uttaranchal, Arunachal Pradesh ,Chhattisgarh & U.P.

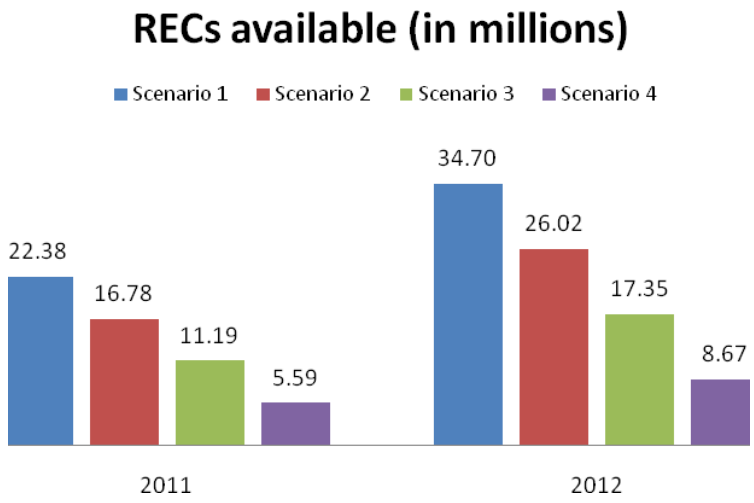


Figure 6: REC[3]s availability

4.16 The above analysis clearly shows that in the initial years the number of REC available in the market will be low, however with time it can be expected that more capacity may come under the REC framework which will eventually enhance the liquidity of RECs in market. The state wise expected availability of RECs is detailed in the Annexure 4.

A5: IMPACT OF FORBEARANCE PRICE

5.1 Cost of electricity generation from renewable energy is relatively higher than the conventional based power projects. Certain SERCs also analyse the impact of power purchase from renewable energy sources on the retail tariff while fixing RPO targets on obligated entities.

5.2 Forbearance price may act as deterrent on states not meeting their RPO requirements. The states not meeting their RPO targets may have to purchase RECs at forbearance price for achieving compliance. Thus there shall be some impact of this price on the average power purchase cost of such states.

5.3 The approach used for analysing the impact of renewable energy power purchase is detailed below :

(a) Data collection for total energy procurement (MU), renewable energy procurement (MU), total power purchase cost (Rs), renewable energy purchase cost (Rs), RPO target (%) for selective states for a particular financial year.

[3] 1 REC = 1 MWh

(b) Review of RPO target achieved on the basis of renewable energy purchased & the shortfall in the targets.

(c) Calculate the impact of the purchase of RECs at forbearance price to meet the shortfall in the RPO compliance. The impact is calculated on the average power purchase cost for select states.

Table 7: Impact of Indicative forbearance price

State	Total Power Purchase (MU)	RE Power Purchase Cost (Cr)	Conventional PPC (Cr)	Overall PPC (paise/Kwh)	RPO Target (%)	RPO Met (%)	Shortfall in Terms of MU	Indicative Forbearance Price (Rs/Kwh)	Additional PPC (Rs Crore)	APPC assuming RPO is met at Forbearance (paise/Kwh)	Additional Impact on power purchase (paise/kWh)
Andhra Pradesh	55967.0	759.0	8973.0	173.9	5.0	4.6	224.4	3.78	84.8	175.4	1.5
Madhya Pradesh	37110.0	14.6	7308.4	197.3	10.0	0.1	3666.1	3.78	1385.7	234.6	37
Maharashtra	109038.0	1216.3	24859.9	239.1	5.0	3.5	1583.8	3.78	598.6	244.6	5.4

5.4 The above table shows the maximum impact of purchase of RECs at an indicative forbearance price of Rs 3.78/kWh on the power purchase in the state. It must be noted that for the year 2007-08, the state of Madhya Pradesh had a target of 10% and could meet only 0.11% of this obligation. This has impact is of 37 paise/kWh on power purchase. This is with the assumption that the shortfall in the renewable purchase obligation is met by purchasing RECs at forbearance price, which will act like an enforcement charge.

A6: CONCLUSION

6.1 International experience has shown that the forbearance or the penalty price has amongst the biggest impact on the price at which REC's are traded in the market. For example in the case of Australia, the price of REC's was influenced directly by two things, the present and future forbearance price and the future RE target.

6.2 The REC market in India is likely to develop in the near future. Its behaviour and its success would to a large extent depend on a variety of factors such as the RPO targets and trajectory of these targets. In this context the CERC is in the process of undertaking a study setting guidelines for setting RPO's for states. The development of RPO targets together with the REC floor and cap prices will guide the development of the renewable energy market in India.

6.3 Investors are likely to perceive a market based on sale at average power purchase price as risky given uncertainty associated with realisation of revenues through sale of RECs. Lenders on the other hand would need to see that the realisation to generators is at least higher than the debt service requirement. As the Indian REC market will be a partially regulated one in the initial years, its future success will also depend upon the ability of the market to understand implications of RE based generation including the variations in RE Power generation and its impact on REC prices. It is important that there is sufficient incentive for investors and utilities to adopt this model which helps achieve compliance of minimum purchase obligation at the national level. The proposed framework and suggested levels of floor and forbearance price for REC can be refined in the following years based on the implementation experience.

Annexure 1: Forbearance Price Analysis

State/RET	Cumulative RE Supply at end 2009- 2010 (MU)	Additional Generation in 2010-11 (MUs)	Cumulative Supply 2010-11 - India (MUs)	Tariff as per RE Tariff Regulation (Rs/kWh)	APPC= for 2009-10 (Rs/kWh)	Difference between tariff & APPC (Rs/kWh)
India	46131.33					
Punjab SHP		78.05	46209.38	4.31	3.40	0.91
TN Wind		816.97	47026.35	4.17	2.62	1.55
TN SHP		40.06	47066.41	4.31	2.62	1.69
Rajasthan SHP		39.03	47105.44	4.31	2.48	1.83
Maharashtra SHP		7.45	47112.88	4.31	2.43	1.88
Arunachal SHP		45.83	47158.71	3.625	1.68	1.95
HP SHP		265.34	47424.05	3.625	1.68	1.95
WB SHP		105.33	47529.38	4.31	2.36	1.95
Uttaranchal SHP		126.03	47655.42	3.625	1.60	2.02
Gujarat SHP		39.03	47694.44	4.31	2.21	2.10
MP SHP		52.03	47746.48	4.31	2.03	2.28
Maharashtra Biomass		378.43	48124.91	4.76	2.43	2.33
AP Biomass		346.90	48471.80	4.15	1.78	2.37
Maharashtra Cogen		384.74	48856.54	4.8	2.43	2.37
TN Biomass		441.50	49298.05	5.08	2.62	2.46
Karnataka SHP		554.88	49852.93	4.31	1.85	2.46
TN Cogen		268.43	50121.36	5.1	2.62	2.48
UP Cogen		685.32	50806.67	5.21	2.71	2.50
AP SHP		27.60	50834.27	4.31	1.78	2.53
Gujarat Wind		1259.25	52093.52	4.9	2.21	2.69
Kerala SHP		66.97	52160.49	4.31	1.46	2.85
Karnataka Biomass		157.68	52318.17	4.88	1.85	3.03
AP Wind		79.26	52397.43	4.9	1.78	3.12
Rajasthan Wind		1327.36	53724.79	5.63	2.48	3.15
AP Cogen		162.31	53887.10	4.93	1.78	3.15
Maharashtra Wind		1268.65	55155.76	5.63	2.43	3.20
WB Wind		61.32	55217.08	5.63	2.36	3.27
Karnataka Cogen		243.13	55460.20	5.17	1.85	3.32
Kerala Wind		22.24	55482.44	4.9	1.46	3.44
MP Wind		227.76	55710.20	5.63	2.03	3.60
Chhattisgarh Biomass		63.07	55773.27	4.88	1.21	3.67
Karnataka Wind		1016.16	56789.4299	5.63	1.85	3.78

Annexure 2: Floor Price

State/RET	Cumulative RE Supply at end 2009- 2010 (MU)	Additional[4] Generation in 2010-11 (MUs)	Cumulative Supply 2010-11 - India (MUs)	APPC[5] for 2009-10 (Rs/kWh)	Minimum Req. for project viability (Rs/kWh)	Difference between req. and APPC (Rs/kWh)
India	46131.33					
Punjab SHP		78.05	46209.38	3.40	3.10	-0.30
TN Wind		816.97	47026.35	2.62	2.80	0.18
TN SHP		40.06	47066.41	2.62	3.10	0.48
Rajasthan SHP		39.03	47105.44	2.48	3.10	0.62
Maharashtra SHP		7.45	47112.88	2.43	3.10	0.68
WB SHP		105.33	47218.21	2.36	3.10	0.75
Gujarat SHP		39.03	47257.24	2.21	3.10	0.89
MP SHP		52.03	47309.27	2.03	3.10	1.07
Gujarat Wind		1259.25	48568.52	2.21	3.29	1.08
UP Cogen		685.32	49253.84	2.71	3.89	1.19
Maharashtra Cogen		384.74	49638.58	2.43	3.64	1.21
TN Cogen		268.43	49907.01	2.62	3.87	1.25
Maharashtra Biomass		378.43	50285.44	2.43	3.67	1.25
Karnataka SHP		554.88	50840.32	1.85	3.10	1.26
Rajasthan Wind		1327.36	52167.68	2.48	3.78	1.30
TN Biomass		441.50	52609.19	2.62	3.93	1.31
AP SHP		27.60	52636.79	1.78	3.10	1.32
Maharashtra Wind		1268.65	53905.44	2.43	3.78	1.35
AP Biomass		346.90	54252.33	1.78	3.19	1.41
WB Wind		61.32	54313.65	2.36	3.78	1.42
AP Wind		79.26	54392.92	1.78	3.29	1.50
Kerala SHP		66.97	54459.88	1.46	3.10	1.64
Arunachal SHP		45.83	54505.71	1.68	3.33	1.65
HP SHP		265.34	54771.05	1.68	3.33	1.65
Uttaranchal SHP		126.03	54897.08	1.60	3.33	1.73
MP Wind		227.76	55124.84	2.03	3.78	1.75
Kerala Wind		22.24	55147.08	1.46	3.29	1.82
AP Cogen		162.31	55309.39	1.78	3.66	1.88
Karnataka Biomass		157.68	55467.07	1.85	3.77	1.93
Karnataka Wind		1016.16	56483.23	1.85	3.78	1.93
Karnataka Cogen		243.13	56726.36	1.85	3.90	2.05
Chhattisgarh Biomass		63.07	56789.43	1.21	3.77	2.57

[4] Additional generation based on the CAGR for last 4-5 years capacity addition, MNRE/State targets, under implementation projects etc
[5] APPC of true up and tariff orders of 2007-08/2008-09 is escalated at annual rate of 3%

Annexure 3: RE Generation

	MW Installed 2009	Additional RE[6] Capacity in 2009-10 over 2008-09 levels (MW)	Additional RE Capacity in 2010-11 over 2008-09 levels(MW)	Generation from Installed in 2009	Additional RE generation in 2009-10(MU) over 2008-09 levels	Additional RE generation in 2010-11(MU) over 2008-09 levels
Wind						
TN	4304.50	880.09	345.41	10181.00	2081.59	2898.55
Kerala	27.00	8.41	11.04	54.40	16.95	39.19
AP	122.50	31.33	39.34	246.81	63.12	142.38
Maharashtra	1938.90	561.50	724.12	3396.95	983.76	2252.41
Gujarat	1566.50	625.00	625.00	3156.18	1259.25	2518.50
Rajasthan	738.40	464.91	757.63	1293.68	814.52	2141.88
MP	212.80	100.00	130.00	372.83	175.20	402.96
WB	1.75	35.00	35.00	3.07	61.32	122.64
Karnataka	1327.40	580.71	580.00	2325.60	1017.41	2033.57
SHP						
TN	90.00	15.00	15.40	234.15	39.03	79.09
Kerala	133.00	23.71	25.74	346.03	61.69	128.66
AP	181.00	10.32	10.61	470.91	26.84	54.44
Maharashtra	211.00	2.84	2.86	548.96	7.40	14.84
Gujarat	7.00	15.00	15.00	18.21	39.03	78.05
Rajasthan	23.85	15.00	15.00	62.05	39.03	78.05
MP	71.16	15.00	20.00	185.14	39.03	91.06
WB	98.00	40.00	40.48	254.97	104.07	209.40
HP	230.90	60.52	67.99	901.11	236.18	501.52
Uttaranchal	127.90	29.14	32.29	499.14	113.74	239.77
Karnataka	563.40	213.28	250.41	1465.81	554.88	1206.38
Arunachal	61.32	10.83	11.74	239.31	42.25	88.08
Punjab	123.90	25.00	30.00	322.35	65.04	143.09
Biomass						
TN	148.00	70.00	70.00	933.47	441.50	883.01
AP	210.00	50.00	55.00	1324.51	315.36	662.26
Maharashtra	95.00	50.00	60.00	599.18	315.36	693.79
Karnataka	81.50	35.00	25.00	514.04	220.75	378.43
Chhattisgarh	140.00	72.34	72.34	883.01	456.27	912.53
Cogeneration						

[6] Additional generation based on the CAGR, MNRE/State projections, allocated capacity etc

TN	160.00	45.00	55.81	769.48	216.42	484.84
AP	130.00	60.00	45.00	468.90	216.42	378.73
Maharashtra	125.00	60.00	80.00	601.16	288.55	673.29
Karnataka	192.00	46.14	57.23	815.65	196.02	439.15
UP	352.00	240.00	190.00	1269.64	865.66	1550.98

Annexure 4: State-wise REC[7] availability

		Additional RE generation (MU) over 2009 levels			Scenario 1 : 100% of New RE projects eligible for RECs			Scenario 2 : 75% of New RE projects eligible for RECs			Scenario 3 : 50% of New RE projects eligible for RECs			Scenario 4 : 50% of New RE projects eligible for RECs		
					Number of RECs available			Number of RECs available			Number of RECs available			Number of RECs available		
		2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
1	Tamil Nadu	2779	4345	5116	2778532	4345488	5115607	2083899	3259116	3836705	1389266	2172744	2557804	694633	1086372	1278902
2	Kerala	79	168	264	78644	167846	263976	58983	125884	197982	39322	83923	131988	19661	41961	65994
3	A.P.	622	1238	2158	621741	1237811	2158322	466306	928358	1618742	310870	618905	1079161	155435	309453	539581
4	Maharashtra	1595	3634	6136	1595067	3634336	6135613	1196300	2725752	4601710	797534	1817168	3067807	398767	908584	1533903
5	Gujarat	1298	2597	4266	1298276	2596552	4265716	973707	1947414	3199287	649138	1298276	2132858	324569	649138	1066429
6	Rajasthan	854	2220	4024	853549	2219936	4023970	640161	1664952	3017977	426774	1109968	2011985	213387	554984	1005992
7	MP	214	494	840	214226	494020	839595	160669	370515	629696	107113	247010	419797	53556	123505	209899
8	WB	165	332	503	165389	332038	502622	124042	249029	376966	82694	166019	251311	41347	83010	125655
9	Karnataka	1989	4058	6485	1989066	4057533	6485092	1491800	3043150	4863819	994533	2028767	3242546	497267	1014383	1621273
10	HP	236	502	767	236185	501523	766861	177139	376142	575146	118092	250761	383430	59046	125381	191715
11	Uttaranchal	114	240	366	113739	239773	365807	85304	179830	274355	56870	119887	182903	28435	59943	91452

[7] 1 REC = 1 MWh

12	Arunachal	42	88	134	42251	88081	133910	31688	66061	100433	21126	44040	66955	10563	22020	33478
13	Chhattisgarh	456	913	1369	456267	912533	1368800	342200	684400	1026600	228133	456267	684400	114067	228133	342200
14	UP	866	1551	2272	865663	1550980	2272366	649247	1163235	1704274	432832	775490	1136183	216416	387745	568091

Annexure 5: Basic Assumptions

- **3% annual escalation in the Average Power Purchase Price across states:**

  Rationale for the Projection: The Average Power Purchase Price for different states is based on data available for most recent year. Where recent data is not available, we have used the True Up Orders for the states for the year 2007-08 and applied an escalation factor to arrive at Average Power Purchase cost for FY 10. The True Up Orders for FY 08 are available for the states of Haryana, Chhattisgarh and Punjab and these represent the approved power purchase costs of the utilities. For others, the power purchase costs have been based on Tariff orders for FY 09 or FY 10 as is available. Where such data was not available, we have used the power purchase costs as stated in PFC's report on Performance of Power Utilities. To arrive at the Average Power Purchase Cost for FY 10 for all states, an escalation rate of 3% has been used where the data pertains to FY 08 or FY 09 in a uniform manner, as the case may be. The workings consider an average escalation in the Power Purchase costs across selected states (15 states) as per PFC's report which was 3.7%. However this data includes the cost of purchase from RE sources. On a conservative basis, an increase of 3% has been considered for projections of average power purchase costs.

- **Projections for capacity addition in Renewable Energy Capacity for Years 2009-10 and 2010-11:**

  Rationale for the Projection: Although the renewable energy capacity for the country as a whole is available for the period ended Dec 2009, data on state wise capacity is available till March 2009 only (Source MNRE). For working out the floor and cap prices for REC, a projection of capacity addition in the Renewable Energy sector has been considered based on the following factors and considerations:

  - MNRE/ GoI's 11th Plan Targets for Capacity Addition in RE, the achievement till January 2010 and the gap that needs to be met to meet that target
  - Cumulative Average Growth Rate of particular RE technologies across the states for the last 5 years.
  - In case of high growth in the past 2 or 3 years, the performance of these years has been considered for arriving at the likely capacity that can be added.
  - MNRE projections on the status of RE development across states and information on projects under development. The table below highlights the status of projects under implementation across states in areas such as Biomass and Co-generation.

S.No.	State	Under Implementation			
		Biomass		Bagasse	
		No. of Projects	Capacity (in MW)	No. of Projects	Capacity (in MW)
1	Andhra Pradesh	3	16.00	10	107.71
2	Assam	1	10.00	--	--
3	Chattisgarh	17	160.80	--	--
4	Karnataka	6	41.50	16	198.78
5	Maharashtra	14	138.50	15	147.80
6	Punjab	4	46.00	4	71.00
7	Rajasthan	5	44.50	--	--
8	Tamil Nadu	9	72.00	6	75.00
9	Uttar Pradesh	1	15.00	63	859.80
10	Uttranchal	--	--	2	30.00
11	West Bengal	2	16.00	--	--
	Total	**62**	**560.30**	**116**	**1490.09**

Figure 7 - MNRE Data Highlighting Present and Future Capacity Addition across states in Biomass and Co-generation

- In case of states where little or no capacity addition was made over the last 3 or 4 years and a new policy or tariff order has been released, considering the attractiveness of the states RE resource and its position in the RE supply curve a suitable increase has been projected.

- **Wind Zones :**

Rationale for the Projection:

Nearly 70% of the total capacity and 60 % of the total renewable energy generation is from wind energy sources. Going forward and given the untapped potential, wind energy is likely to contribute significantly to future capacity addition and generation.

Discussions with developers reveal that the better sites for wind energy in different states have been utilized and in future, development is likely to take place in locations with lower expected CUF. Given these, in a few instances we have been conservative in estimates of generation from wind energy, in arriving at the expected generation and working of floor and cap for REC. This is important to ensure that the right incentive prevails, particularly when investors are exposed to resource variability, market uncertainties in the absence of assured sale through PPA at preferential tariffs and uncertainty of compensation through REC price which will be determined through trading.

Appendix -II

Computation of Forbearance and Floor price for non-solar and solar Certificates

State/RET	Cumulative RE Supply at end 2009- 2010 (MU)	Additional Generation in 2010-11 (MUs)	Cumulative Supply 2010-11 - India (MUs)	Tariff as per RE Tariff Regulation (Rs/kWh)	APPC for 2009-10 (Rs/kWh)	Difference between tariff & APPC (Rs/kWh)
India	46131.33					
Punjab SHP		78.05	46209.38	4.31	3.40	0.91
TN Wind		816.97	47026.35	4.17	2.62	1.55
TN SHP		40.06	47066.41	4.31	2.62	1.69
Rajasthan SHP		39.03	47105.44	4.31	2.48	1.83
Maharashtra SHP		7.45	47112.88	4.31	2.43	1.88
Arunachal SHP		45.83	47158.71	3.625	1.68	1.95
HP SHP		265.34	47424.05	3.625	1.68	1.95
WB SHP		105.33	47529.38	4.31	2.36	1.95
Uttaranchal SHP		126.03	47655.42	3.625	1.60	2.02
Gujarat SHP		39.03	47694.44	4.31	2.21	2.10
MP SHP		52.03	47746.48	4.31	2.03	2.28
Maharashtra Biomass		378.43	48124.91	4.76	2.43	2.33
AP Biomass		346.90	48471.80	4.15	1.78	2.37
Maharashtra Cogen		384.74	48856.54	4.8	2.43	2.37
TN Biomass		441.50	49298.05	5.08	2.62	2.46
Karnataka SHP		554.88	49852.93	4.31	1.85	2.46
TN Cogen		268.43	50121.36	5.1	2.62	2.48
UP Cogen		685.32	50806.67	5.21	2.71	2.50
AP SHP		27.60	50834.27	4.31	1.78	2.53
Gujarat Wind		1259.25	52093.52	4.9	2.21	2.69
Kerala SHP		66.97	52160.49	4.31	1.46	2.85
Karnataka Biomass		157.68	52318.17	4.88	1.85	3.03
AP Wind		79.26	52397.43	4.9	1.78	3.12
Rajasthan Wind		1327.36	53724.79	5.63	2.48	3.15
AP Cogen		162.31	53887.10	4.93	1.78	3.15
Maharashtra Wind		1268.65	55155.76	5.63	2.43	3.20
WB Wind		61.32	55217.08	5.63	2.36	3.27
Karnataka Cogen		243.13	55460.20	5.17	1.85	3.32
Kerala Wind		22.24	55482.44	4.9	1.46	3.44
MP Wind		227.76	55710.20	5.63	2.03	3.60
Chhattisgarh Biomass		63.07	55773.27	4.88	1.21	3.67
Karnataka Wind		1016.16	56789.4299	5.63	1.85	3.78

1. Computation of Floor Price for non-solar Certificates:

State/RET	Cumulative RE Supply at end 2009- 2010 (MU)	Additional[1] Generation in 2010-11 (MUs)	Cumulative Supply 2010-11 - India (MUs)	APPC[2] for 2009-10 (Rs/kWh)	Minimum Req. for project viability (Rs/kWh)	Difference between req. and APPC (Rs/kWh)
India	46131.33					
Punjab SHP		78.05	46209.38	3.40	3.10	-0.30
TN Wind		816.97	47026.35	2.62	2.80	0.18
TN SHP		40.06	47066.41	2.62	3.10	0.48
Rajasthan SHP		39.03	47105.44	2.48	3.10	0.62
Maharashtra SHP		7.45	47112.88	2.43	3.10	0.68
WB SHP		105.33	47218.21	2.36	3.10	0.75
Gujarat SHP		39.03	47257.24	2.21	3.10	0.89
MP SHP		52.03	47309.27	2.03	3.10	1.07
Gujarat Wind		1259.25	48568.52	2.21	3.29	1.08
UP Cogen		685.32	49253.84	2.71	3.89	1.19
Maharashtra Cogen		384.74	49638.58	2.43	3.64	1.21
TN Cogen		268.43	49907.01	2.62	3.87	1.25
Maharashtra Biomass		378.43	50285.44	2.43	3.67	1.25
Karnataka SHP		554.88	50840.32	1.85	3.10	1.26
Rajasthan Wind		1327.36	52167.68	2.48	3.78	1.30
TN Biomass		441.50	52609.19	2.62	3.93	1.31
AP SHP		27.60	52636.79	1.78	3.10	1.32
Maharashtra Wind		1268.65	53905.44	2.43	3.78	1.35
AP Biomass		346.90	54252.33	1.78	3.19	1.41
WB Wind		61.32	54313.65	2.36	3.78	1.42
AP Wind		79.26	54392.92	1.78	3.29	1.50
Kerala SHP		66.97	54459.88	1.46	3.10	1.64
Arunachal SHP		45.83	54505.71	1.68	3.33	1.65
HP SHP		265.34	54771.05	1.68	3.33	1.65
Uttaranchal SHP		126.03	54897.08	1.60	3.33	1.73
MP Wind		227.76	55124.84	2.03	3.78	1.75
Kerala Wind		22.24	55147.08	1.46	3.29	1.82
AP Cogen		162.31	55309.39	1.78	3.66	1.88
Karnataka Biomass		157.68	55467.07	1.85	3.77	1.93
Karnataka Wind		1016.16	56483.23	1.85	3.78	1.93
Karnataka Cogen		243.13	56726.36	1.85	3.90	2.05
Chhattisgarh Biomass		63.07	56789.43	1.21	3.77	2.57

[1] Additional generation based on the CAGR for last 4-5 years capacity addition, MNRE/State targets, under implementation projects etc
[2] APPC of true up and tariff orders of 2007-08/2008-09 is escalated at annual rate of 3%

2. Computation of Forbearance and floor Price for Solar Certificates:

State	APPC of 2009-10 (Rs/kWh)	CERC Tariff (PV) (Rs/kWh)	Gap between tariff and APPC (Rs/kWh)	Min Requirement (Rs/kWh)	Gap between Min Req and APPC (Rs/kWh)
Andhra Pradesh	1.78	18.44	16.66	13.49	11.71
Gujarat	2.21	18.44	16.23	13.49	11.28
Karnataka	1.85	18.44	16.59	13.49	11.64
Madhya Pradesh	2.04	18.44	16.40	13.49	11.45
Maharashtra	2.43	18.44	16.01	13.49	11.06
Rajasthan	2.48	18.44	15.96	13.49	11.01
Chhattisgarh	1.21	18.44	17.23	13.49	12.28
Haryana	2.64	18.44	15.80	13.49	10.85
Punjab	3.40	18.44	15.04	13.49	10.09
Himachal	1.68	18.44	16.76	13.49	11.81
TN	2.62	18.44	15.82	13.49	10.87
Bihar	1.99	18.44	16.45	13.49	11.50
Uttaranchal	1.60	18.44	16.84	13.49	11.89
West Bengal	2.36	18.44	16.08	13.49	11.13
Arunachal	1.68	18.44	16.76	13.49	11.81
Kerala	1.46	18.44	16.98	13.49	12.03
Uttar Pradesh	2.71	18.44	15.73	13.49	10.78
Maximum			17.23		12.28

Solar : REC **Floor Price** (Rs/kWh):12.28 and REC **Forbearance Price** (Rs/kWh): 17.23

Basic Assumptions and Clarifications related to the Design of Forbearance and Floor Price

- **Average Power Purchase Price across states :**

  The Average Power Purchase Price for different states is based on data available for most recent year. Where recent data is not available, the True Up Orders for the states for the year 2007-08 have been used and an escalation factor has been applied to arrive at Average Power Purchase cost for FY 10. The True Up Orders for FY 08 are available for the states of Haryana, Chattisgarh and Punjab and these represent the approved power purchase costs of the utilities. For others, the power purchase costs are based on Tariff orders for FY 09 or FY 10 as is available. Where such data is not available (eg. TN), the power purchase costs as stated in PFC's report titled "PFC Report on Performance of Power Utilities". To arrive at the Average Power Purchase Cost for FY 10 for all states, an escalation rate of 3% has been used where the data pertains to FY 08 or FY 09 in a uniform manner, as the case may be. The workings consider an average escalation in the Power Purchase costs across selected states (15 states) as per PFC's report which was 3.7%. However this data includes the cost of purchase from RE sources. On a conservative basis, an increase of 3% has been considered for projections of average power purchase costs.

- **Projections for capacity addition in Renewable Energy Capacity for Years 2009-10 and 2010-11:**

  Although the renewable energy capacity for the country as a whole is available for the period ended Dec 2009, data on statewise capacity is available till March 2009 only (Source MNRE). For working out the floor and cap prices for REC, a projection of capacity addition in the Renewable Energy sector has been considered based on the following factors and considerations:

  - MNRE/ GoI's 11^{th} Plan Targets for Capacity Addition in RE, the achievement till January 2010 and the gap that needs to be met to meet that target
  - Cumulative Average Growth Rate of particular RE technologies across the states for the last 5 years.
  - In case of high growth in the past 2 or 3 years, the performance of these years has been considered for arriving at the likely capacity that can be added.
  - MNRE projections on the status of RE development across states and information on projects under development.

- In case of states where little or no capacity addition was made over the last 3 or 4 years and a new policy or tariff order has been released, considering the attractiveness of the states RE resource and its position in the RE supply curve a suitable increase has been projected.

- **Wind Zones :**

Rationale for the Projection :

Nearly 70% of the total capacity and 60 % of the total renewable energy generation is from wind energy sources. Going forward and given the untapped potential, wind energy is likely to contribute significantly to future capacity addition and generation.

The Study Report brings out that the better sites for wind energy in different states have been utilized and in future, development is likely to take place in locations with lower expected CUF. The Report, therefore, recommends a conservative approach in estimates of generation from wind energy, in arriving at the expected generation and working of floor and cap for REC. This is important to ensure that the right incentive prevails, particularly when investors are exposed to resource variability, market uncertainties in the absence of assured sale through PPA at preferential tariffs and uncertainty of compensation through REC price which will be determined through trading.

- **Floor and Forbearance Price:** The Forbearance Price and Floor Price were arrived at were as follows:
  - Forbearance Price: Rs 3.78/ kWh
  - Floor Price: Rs 1.45/ kWh

The RE generation target of the year for FY 11 can be achieved at an equilibrium point between West Bengal Wind (Rs 1.42/ kWh) and Andhra Pradesh Wind (Rs 1.50/ kWh). The floor represents the difference between minimum project viability requirements and APPC. Based on interpolation, this value has been interpolated to Rs 1.45/kWh.