*SUMMER INTERNSHIP REPORT ON*

# 1. ANALYSIS OF REC MECHANISM AND IDENTIFICATION OF AREAS FOR IMPROVEMENT

# 2. FINANCIAL MODELING OF SOLAR PV POWER PLANT

UNDER THE GUIDANCE OF

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And

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**Center for Advanced Management and Power Studies**

**NATIONAL POWER TRAINING INSTITUTE**

(Under Ministry of Power, Govt. of India)


Affiliated to

**MAHARSHI DAYANAND UNIVERSITY, ROTHAK**

**AUGUST 2012**

# TRAINING COMPLETION CERTIFICATE

# DECLARATION

I, Suyash, Roll no1120812288 / Semester 3rd / Class of 2011-13 of the **MBA (Power Management)** of the National Power Training Institute, Faridabad hereby declare that the Summer Training Report entitled

1. **Analysis of REC Mechanism and Identification of Areas for improvement.**

2. **Financial Modeling of Solar PV Power Plant**

is an original work and the same has not been submitted to any other Institute for the award of any other degree.

A Seminar presentation of the Training Report was made on …….. and the suggestions as approved by the faculty were duly incorporated.

Presentation In charge
(Faculty)

Signature of the Candidate

**Countersigned**

**Director/Principal of the Institute**

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I express my sincere thanks to **Mr. Subodh Singh** (Sr. Manager), MBPPLfor giving me a great opportunity to work in such an esteem organization. I am solemnly thankful to **Mr. Pushpender Singh Bais**(Asst. Manager), MBPPLfor his guidance and support.

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# EXECUTIVE SUMMARY

The report is divided into two parts and covers two projects

**Project 1: Analysis of REC Mechanism and Identification of Areas for improvement**

Government of India is endeavoring hard to increase share of renewable energy in electricity mix of country. As per target set under National Action Plan on Climate Change (NAPCC), government envisages renewable energy to constitute approx. 15% of total electricity consumption in the country by 2020. A number of regulatory provisions and fiscal policies like Renewable Purchase Obligation (RPO) and Accelerated Depreciation (AD) have been introduced for the same. Schemes like Feed in Tariff (FiT) has proved quite successful in providing initial thrust but it gives rise to problems such as price rigidity and rather slow cost reductions driven by mass production, and increases the financial burden on national governments.

REC mechanism, launched on November 18$^{th}$ 2010, is market based instrument to promote RES and in cost effective manner. In India where RE sources are not evenly spread across different parts of country the mechanism seems even more promising by helping the obligated entities to meet their binding targets (RPO). But the contemporary mechanism certainly has loose ends to work upon. Uncertainty about REC price after current control period (FY 2017), non-uniform approach in RE target setting, less frequent (once in a month) trading sessions, annual compliance of RPOs making REC market skewed towards year end, piling up of REC inventory etc. are making the mechanism less attractive for developers.

The project involves comprehensive study of current REC mechanism, REC pricing methodology, trading pattern and similar 'Certificate TradingSchemes' in operation in several other countries. Based on the study and discussion with several stakeholders areas of improvement in the contemporary mechanism have been identified and some recommendations have been given to make the mechanism more attractive and promising.

**Project 2: Financial Model of Solar PV Power Plant.**

Financial model helps the developer to explore in detail the financial benefits and costs associated with the investment. This facilitates the identification of key variables affecting the project value and enables financing decisions.

A generalized financial model for Solar PV power plant has been developed with flexibility to vary inputs like time taken for construction, capital cost, interest rates, capacity utilization factor (CUF), tax rates etc. Looking at the uncertainty regarding price of RECs post-2017 (i.e. current Control Period), model has been developed with a flexibility to vary REC price also. Eventually financial indicators like IRR and DSCR have been calculated to know the project feasibility at different level of inputs. The model developed in is based on hypothetical assumptions (inputs) but realistic figures are taken to have better understanding of scenario.

# LIST OF TABLES



# LIST OF FIGURES

# ABBREVIATIONS

| | |
|---|---|
| APPC | Average Power Purchase Cost |
| CA | Central Agency |
| CEA | Central Electricity Authority |
| CER | Carbon Emission Reduction |
| CERC | Central Electricity Regulatory Commission |
| DECC | Department for Energy and Climate Change |
| DISCOM | Distribution Company |
| DSCR | Debt Service Coverage Ratio |
| FiT | Feed in Tariff |
| GBI | Generation Based Incentive |
| IREDA | Indian Renewable Energy Development Agency |
| IRR | Internal Rate of Return |
| JNNSM | Jawaharlal Nehru National Solar Mission |
| LGC | Large-scale Generation Certificate |
| LRET | Large-scale Renewable Energy Target |
| MoP | Ministry of Power |
| MAT | Minimum Alternate Tax |
| MNRE | Ministry of New and Renewable Energy |
| NAPCC | National Action Plan on Climate Change |
| NIRO | Northern Ireland Renewable Obligation |
| NLDC | National Load Dispatch Center |
| NPV | Net Present Value |
| OFGEM | Office for Gas and Electricity Market |
| ORER | Office of Renewable Energy Regulator |
| O&M | Operation and Maintenance |

| | |
|---|---|
| PEx | Power Exchange |
| RE | Renewable Energy |
| REC | Renewable Energy Certificate |
| RET | Renewable Energy Target |
| ROC | Renewable Obligation Certificate |
| SNA | State Nodal Agency |
| SLDC | State Load Dispatch Center |
| SRES | Small-scale Renewable Energy Scheme |
| STC | Small scale Technology Certificate |
| UEP | Updated Emission Projections |
| UK | United Kingdom |
| WACC | Weighted Average Cost of Capital |

# WEIGHTS AND MEASURES

| | | |
|---|---|---|
| BU (billion unit) | – | Unit of energy, equal to 1 X $10^9$units |
| MWh (megawatt-hour) | – | Unit of energy, equal to 1 X $10^3$ units |
| MW (megawatt) | – | Unit of power, equal to 1 X $10^6$watts |
| GW (gigawatt) | – | Unit of power, equal to 1 billion ($10^9$) watts |

**Conversion:**

1 million = $1x10^6$

1 billion = $1x10^9$

1 lakh = $1x10^5$

1 crore = $1x10^7$

# TABLE OF CONTENTS

# CHAPTER 1: INTRODUCTION

## 1.1 RENEWABLE ENERGY IN INDIA

### 1.1.1 Evolution and Potential:

The role of new and renewable energy has been assuming increasing significance in recent times with the growing concern for the country's energy security. Energy self-sufficiency was identified as the major driver for new and renewable energy in the country in the wake of the two oil shocks of the 1970s. The sudden increase in the price of oil, uncertainties associated with its supply and the adverse impact on the balance of payments position led to the establishment of the Commission for Additional Sources of Energy in the Department of Science & Technology in March 1981. The Commission was charged with the responsibility of formulating policies and their implementation, programs for development of new and renewable energy apart from coordinating and intensifying R&D in the sector. In 1982, a new department, i.e., Department of Non-conventional Energy Sources (DNES), that incorporated CASE, was created in the then Ministry of Energy. In 1992, DNES became the Ministry of Non-conventional Energy Sources. In October 2006, the Ministry was re-christened as the Ministry of New and Renewable Energy (MNRE).The broad aim of the Ministry is to develop and deploy new and renewable energy for supplementing the energy requirements of the country.

There is a potential of around 90,000 MW for power generation from different RES in the country, including 48,561 MW of wind power, 14,294 MW of SHP and 26,367 MW of biomass. The potential for solar energy is estimated for most parts of the country at around 20 MW per square kilometer of open, shadow free area covered with solar collectors.[1]In April 2002, RE based power generation installed capacity was 3475 MW which was 2% of the total installed capacity. As on 31.12.2010, it has reached 18,655 MW, which was about 11% of the total installed capacity.[2]At present it stands over 25,000 MW.

[1] Source: “Indian Wind Energy Outlook 2009” by Global Wind Energy Council
[2] Source: “STRATEGIC PLAN FOR NEW AND RENEWABLE ENERGY SECTOR FOR THE PERIOD 2011-17” released in Feb 2011 by MNRE, Govt. of India

### 1.1.2 Current Scenario

As of May 2012, the installed capacity of India stands at 202.98 GW, the fifth largest in world. Captive power plants generate an additional 31.5 GW.Country's major portion of installed capacity, (more than 66%) is still based on fossil fuels. Hydro power accounts for little less than one-fifth whereas sources based on renewable energy accounts for nearly 12% of total installed capacity. *Annexure Part* **I**

***Table 13*****(**Annexure) gives a detail view of country's reliance on the different sources of fuel.

The electricity generation during the financial year 2011-12 was 876.43 BU with a growth rate of 8.05 % over same period last year.[3]The annual generation target of 855 BU for the financial year 2011-12 was achieved well in advance (on 23rd March, 2012). Thus, the achievement was 102.51 % of the yearly target.But nevertheless there was shortfall of approximately 8-9% with demand touching 937.19 BU.

As on 31.5.2012 total installed capacity based on renewable energy sourcescrossed25,000 MW mark, accounting a little above 12% of total installed capacity. Wind accounts for nearly 70%, SHP[4] for nearly 14%, of total installed capacity based on RE sources.Very recently Solar PV crossed mark of 1000 MW. Refer *Table 14*(Annexure) for details about percentage installed capacity (RE).

### 1.1.3 Need for Renewable Energy (India's Perspective)

India is seriously grappling with problem of fuel deficit. 2011 saw more than 50% of India's thermal power plants struggling to get adequate coal supplies. Again, fall in the gas output level from KG-basin has added to the concern. Shortage of coal and gas had caused a power generation loss to the tune of 9BU and 11 BU, respectively, during the FY 2011-12.[5] Due to logistics and transport issues, import of fuel (esp. coal) is constrained.

Environmental and climate change threats are getting more severe and project clearances more difficult to get. In spite of many policy and infrastructural initiatives, it appears unlikely that quantities required to achieve projected conventional power capacity will be available.

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[3] Source: CEA, Monthly Report No **CEA/OPM/PPI/6/1/2011**

[4]In India SHP (Small Hydro Power) are plants with installed capacity less than or equal to 25 MW and are classified as RE source.

[5]CEA Report No.CEA/OPM/PPI/6/1/2011 "Electricity Generation during the month of March'12 and during the period April'11- March'12." released on April 13, 2012.

Large hydro projects are also facing problems – largely related to environmental issues and some to project execution in difficult areas along with attendant issues of building long transmission lines. Natural gas difficulties and its competitive usages also do not create optimism. Nuclear power capacity building continues to face its own problems, especially due to increased skepticism from environment activists.

Although in recent years availability of power has both increased and improved, still demand has consistently outstripped supply. Again, some villages are in areas too remote to be connected by the grid supply. So off-grid seems the only option available for them.

Currently we import more than 80% of the country's crude requirement[6], and internal reserves unlikely to improve this percentage, serious problems of energy security may arise in near future. Moreover, these entail rising financial burdens of import[7] and internal financial burdens of subsidies, which are already controversial.

Again, rising level of greenhouse gas emission,[8] pressure from international community for checking the same and awareness towards environment and sustainability has pushed India to consider alternative sources of energy.

It is clear from the above that India's need for secure, affordable, and environmentally sustainable energy has become one of the principal economic and development challenges for the country. It is also clear that while energy conservation and energy-efficiency have an important role to play in the national energy strategy, renewable energy will become a key part of the solutions and is likely to play an increasingly important role for augmentation of grid power, providing energy access, reducing consumption of fossil fuels and helping India pursue its low carbon developmental pathway.

[6] Source: "Govt. considering allowing import of crude oil from Iran in Iranian vessels" – The Economic Times (June 22, 2012)

[7] India's trade deficit touched $185 Billion mark for FY 2011-12

[8] India has recently taken over Russia as the third-largest source of greenhouse gas emissions. The country contributes approx. 5% of total greenhouse gasses. Source http://agneyablog.wordpress.com/2011/01/25/india-on-rank-3-in-ghg-emissions/

### 1.1.4 Moves for RE Promotion

**1. Foreign Direct Investment ('FDI')**

The growth of clean energy sector in India is immense. India permits FDI up to 100 per cent in the sector under the automatic route in Renewable Energy Generation and Distribution projects subject to the provisions of the Electricity Act, 2003 i.e. no prior approval of regulatory authorities required.[9]

**2. Feed in tariff**

FIT is a preferential tariff set by different SERCs based on the guidelines of CERC in their respective states for encouraging the developers to participate in developing Renewable based generation power plants. Under the preferential tariff, the regional or national electric grid utilities are obliged to buy renewable electricity (electricity generated from renewable sources, such as solar, wind, biomass, hydropower, etc.), at the price determined by regulators using cost-plus approach. This approach enables development different RE sources and investors to obtain a reasonable return on their investments. It typically includes guaranteed grid access and long-term contract for the electricity produced. The purchase prices are methodologically based on Cost-plus approach. E.g. Gujarat Electricity Regulatory Commission (GERC) offers levelized tariff of INR 9.28 / kWh, for megawatt-scale solar PV power projects availing accelerated depreciation, and INR 10.37 / kWh for similar projects not availing accelerated depreciation.[10]

**3. Tax holiday under the domestic income tax law**

Undertakings engaged in generation or generation and distribution of power have been offered a 10-year tax holiday for renewable energy plants if it begins to generate power before 31 March 2013. However, they have to pay a minimum alternative tax at the rate of approximately 20 percent, which can be offset in future years. It is likely that a new direct taxes code will be made effective from 1 April 2013. The draft provisions of direct taxes code provides for alternative mechanism for providing tax incentives to power companies.[11]

[9] Source: Website - Overseas Indian Facilitation Centre http://www.oifc.in/Sectors/Infrastructure/Power
[10] Source: GERC Solar Tariff Order 2012
http://www.gercin.org/renewablepdf/Solar%20Tariff%20Order%201%20of%202012.pdf
[11] Source: "Taxes and Incentives for Renewable Energy" by KPMG International (2012, June)

**4. Renewable Purchase Obligation**

The RPOs are imposed on "Obligatory Entities" – distribution licensees, captive consumers and open-access consumers – to consume certain % of their total energy consumption through renewable energy sources. They can buy RECs from the market equivalent to the short fall in their RE purchase.

The legislative support for RPO comes from section 86 (1) (e) of the Electricity Act,-2003 which says: "to promote co–generation and generation of electricity through renewable sources of energy by providing suitable measures for connectivity with the grid and sale of electricity to any persons, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee." **Table 3** shows RPO level set by different states.

**5. Generation Based Incentive (GBI)**

MNRE introduced GBI schemes separately for wind and solar energy. Under the scheme for wind power, a GBI @ INR 0.50 per unit of electricity fed into the grid was provided for a period not less than 4 years and a maximum period of 10 years with a cap of INR 6.2 Mn per MW. The scheme was in parallel with accelerated depreciation but on a mutually exclusive manner. The total disbursement in a year was not to exceed one fourth of the maximum limit of the incentive i.e. INR 15.50 Mn per MW during the first four years. The Scheme included captive wind power projects, but excluded third party sale, (viz. merchant power plants). Recently government has phased out this scheme for wind projects.[12]

Under the Scheme for Solar Energy, GBI is provided to support small grid solar power projects connected to the distribution grid (below 33 KV) to the state utilities. IREDA has selected 78 projects with a total capacity of about 98 MW for which the Ministry will provide GBI of INR 12.41 per kWh to the State utilities when they directly purchase solar power from the project developers. Currently, the scheme is not open to accept new project proposals.[13]

[12] Source: Operational Guidelines for Implementation of "Generation Based Incentive" for Grid Connected Wind Power Projects by IREDA Ltd
www.ireda.gov.in/pdf/OPERATIONAL%20GUIDELINES%20for%20Wind%20GBI%20and%20AD%20as%20on%2026.05.2010.doc

[13] Source: Press Information Bureau – Print Release dated Dec 16, 2011
http://pib.nic.in/newsite/PrintRelease.aspx?relid=78829

**6. Accelerated Depreciation (AD)**

AD allows investors, mostly setting up capacity for captive use, to take advantage of up to 80% of the project cost if it's commissioned before September 30 of the financial year, or 40%, if the project is commissioned before March 31 of the financial year.

The income-tax department has issued a circular stating that wind farms commissioned in financial year 2012-13 would not get AD benefit that allowed them to write off investments sooner. The Central Board of Direct Taxes (CBDT) has recently amended the Income-Tax Rules, 1962, which means that beginning April 1, 2012 all new wind farms can only claim a standard depreciation rate of 15%.[14]It is surprising that accelerated depreciation has been rolled back for wind farms while it would be available for solar projects.

**7. Institutional Support**

MNRE is trying to open out more channels to broaden the move in reach and help market mode through other partners. MNRE has set up a Solar Energy Centre near Delhi with the state-of-art facilities for testing of solar thermal and solar photovoltaic materials, devices and systems. A Centre for Wind Energy Technology has been set up in Chennai for providing technical support to the Ministry in the implementation of its wind energy programmes. For market development and financing of renewable energy projects, a separate financing institution called the Indian Renewable Energy Development Agency (IREDA) has been set up as a public sector undertaking.

**8. CDM Benefits**

The Clean Development Mechanism (CDM) is an arrangement under the Kyoto Protocol allowing industrialized countries with a GHG reduction commitment to invest in projects that reduce emissions in developing countries as an alternative to more expensive emission reductions in their own countries. Under the CDM, a developed country can invest in a GHG mitigation project in a developing country. Developed country would get credit, while developing country would get capital and clean technology. With 795 registered projects, of the

[14] "Government rolls back tax incentive for wind farms" – The Economic Times (April 3, 2012) http://articles.economictimes.indiatimes.com/2012-04-03/news/31281284_1_wind-energy-wind-farms-wind-turbine

3,930 projects registered with UNFCCC, India ranks second in the number of certified emission reduction (CER) credits, after China. [15]

**9. Tax and Financial Incentive**

Tax cost forms a substantial part of the overall EPC Project cost which ranges from 10 percent to 20 percent of the total renewable energy project cost. Considering the special focus on renewable energy, the Central Government has given various incentives on setting up the renewable energy power project which includes exemption from customs and excise duties on specific goods required for setting up the renewable energy projects.

However, these exemptions are subject to fulfillment of prescribed conditions and compliances to be undertaken by the EPC contractor or IPP. Furthermore, some of the state governments have provided the incentives in the form of levy of VAT at reduced rate (i.e. 5 percent) whereas the other states levies VAT @ 12.5 percent.[16]

**10. REC Mechanism**

Renewable Energy Certificate (REC) mechanism is a market based instrument to promote renewable energy and facilitate compliance of renewable purchase obligations (RPO). It is aimed at addressing the mismatch between availability of RE resources in state and the requirement of the obligated entities to meet the renewable purchase obligation (RPO). Later part of report contains detail description of REC mechanism.

**11. Other Measures**

Apart from the above mentioned all state governments have come up with various policies to promote generation from RE sources in their respective states. Again, programs like Jawaharlal Nehru National Solar Mission (JNNSM) and Village Energy Security Program with objectives of achieving grid parity and meeting village energy requirement are also launched in country.

[15] "Carbon credits likely to fetch INR 4,775 Cr in '12" THE FINANCIAL EXPRESS (March 28, 2012) http://www.financialexpress.com/news/carbon-credits-likely-to-fetch-r4-775-cr-in-12/929349/

[16] Source: "Taxes and Incentives for Renewable Energy" by KPMG International (2012, June)

### 1.1.5 Renewable Energy Certificates

Renewable Energy Certificates (REC) is a market based policy instrument to catalyze the development of renewable energy. It helps the states meet their regulatory requirements (such as Renewable Purchase Obligations (RPOs)) by overcoming the geographical constraints on existing renewable potential in different states.

RECs unbundle the electricity component (commodity) from the green/environmental attributes of the power generated from renewable sources. Both the components can then be traded separately. Thus RECs help in incentivizing the production of renewable energy over and above the RPO state limit as tradable certificates are not constrained by the geographical limitations of commodity electricity.

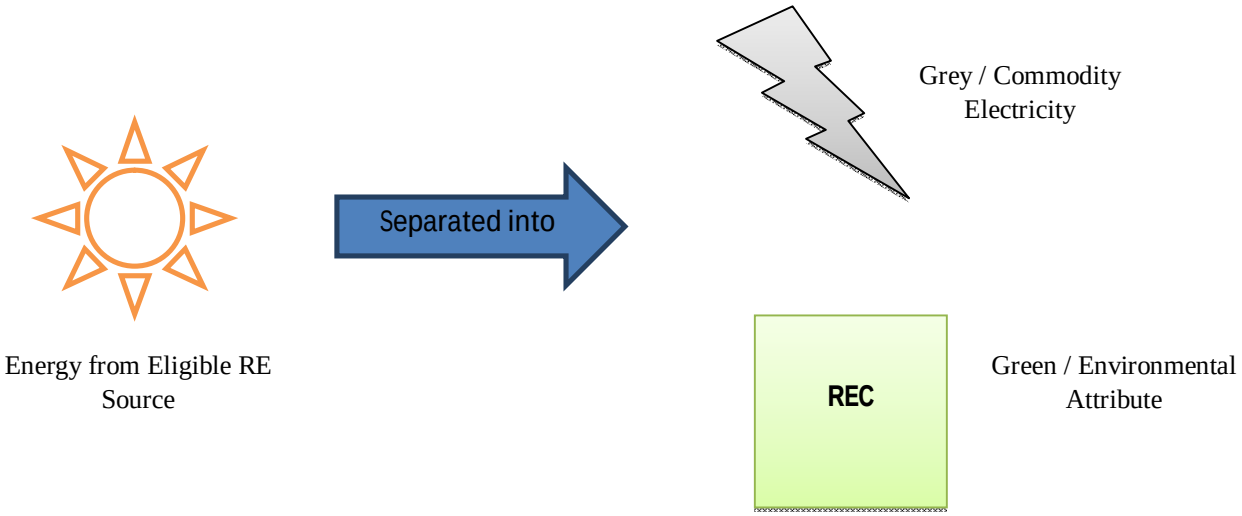



***Table 1: Salient Features of REC***

| | |
|---|---|
| REC Denomination | 1 MWh |
| Validity | 365 Days |
| Category | 1. Solar REC 2. Non Solar REC |
| Trading Platform | CERC approved power Exchanges only |
| Banking | Not Allowed |
| First Trading Session | March 30, 2011 |
| Price Discover Mechanism | Closed Double-Sided Auction |
| Price Guarantee | Through 'Forbearance' and 'Floor' Price |
| Trading Calendar | Last Wednesday of the Month |

## 1.2 SIGNIFICANCE OF PROJECT

REC mechanism was launched on November 18th 2010. In India where RE sources are unevenly spread across different parts of country the mechanism seems very promising by helping the obligated entities to meet their binding targets (RPO).The first trading at power exchange took place in March 2011 arousing new hopes for India's renewable energy sector.

But the contemporary mechanism certainly has loose ends to work upon. Uncertainty about REC price after current control period (FY 2017), non-uniform approach in RE target setting, less frequent (once in a month) trading sessions, annual compliance of RPOs making REC market skewed towards year end, piling up of REC inventory, unavailability of banking facility, lethargic participation by voluntary buyers etc. are making the mechanism less attractive for developers.

The project involves comprehensive study of current REC mechanism, REC pricing methodology, trading pattern and similar 'Certificate TradingSchemes' in operation in several other countries. Based on the study and discussion with several stakeholders areas of improvement in the contemporary mechanism have been identified and some recommendations have been given to make the mechanism more attractive and promising.

Lastly, a generalized financial model for Solar PV power plant has been developed with flexibility to vary inputs like time taken for construction, capital cost, interest rates, capacity utilization factor (CUF), tax rates etc. Looking at the uncertainty regarding price of RECs post-2017 (i.e. current Control Period), model has been developed with a flexibility to vary REC price also. Eventually effect of input parameters is studied on various financial indicators like IRR and DSCR to know the project feasibility at different level of inputs.

## 1.3 OBJECTIVES OF PROJECT

The objective of this study is to study and critically examine the regulations specified by Central Electricity Regulatory Commission for implementation of REC mechanism in India and thus identify areas for improvement. To solve a problem, it is ought to be understood precisely and incisively. An ill-defined problem leads to ambiguous and ineffective solutions. Thus this study is carried out to

- Develop a detailed understanding of the present REC mechanism.
- Do comprehensive analysis of REC pricing.
- Critically examine the regulations and identify loose-ends in it.
- Understand REC mechanism in other international markets.
- Identify issues and make recommendations for improving contemporary mechanism.
- To study and develop financial model for Solar PV power plant.
- To study effect of change in input parameters on various financial indicators and cash flows.

## 1.4 SCOPE OF WORK

The project involves comprehensive analysis of all the regulations given by CERC pertaining to REC mechanism in India. Similar 'Certificate Trading Scheme' in two international markets viz. (UK and Australia) has been studied to learn from their experience. Trading pattern of certificate on power exchanges has been analyzed. Issues are identified based on understanding of the mechanism and consultation with various stakeholders. Thereof recommendations are made to make the mechanism more attractive and promising.

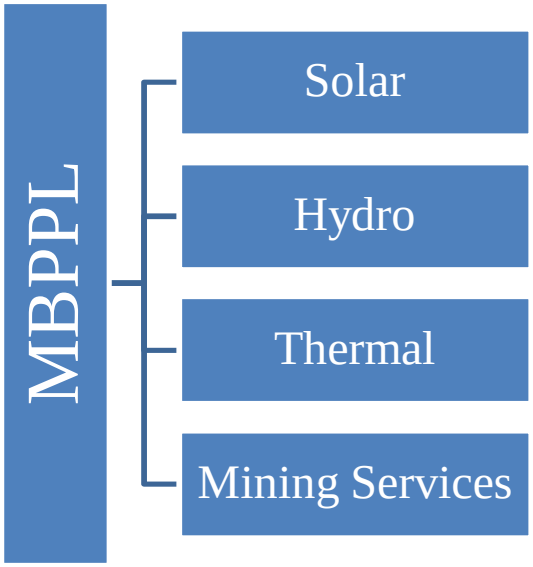
The financial model is developed to understand the effect of change in input parameters like CUF, REC price etc. on various financial indicators and cash flows. The assumptions are hypothetical but realistic figures are taken to have better understanding of scenario.

## 1.5 ABOUT THE ORGANIZATION

**Moser Baer India Limited**was founded in New Delhi in 1983 as a Time Recorder unit in technical collaboration with Maruzen Corporation, Japan and Moser Baer Sumiswald, Switzerland. Headquartered in New Delhi, Moser Baer successfully developed cutting edge technologies to become the world's second largest manufacturer of Optical Storage media like CDs and DVDs. Later, the company has diversified into manufacturing of Solar Photovoltaic cells and modules (in 2006), home entertainment (in 2006), power generation (in 2007), IT peripherals & consumer electronics (in 2007).

**Moser Baer Projects Private Limited:**In 2007, founders of Moser Baer ventured into power generation through Moser Baer Projects Private Limited (MBPPL). MBPPL is one of the fastest growingintegratedpowercompanies in India, operating across a synergetic span of verticals comprising Power Generation, Power Trading, EPC, Development and Renewables (Solar). MBPPL is committed to meet the energy requirements of country and is aimed at promoting industrial development and living standards of society. The company plans to commission 5000 MW of thermal, 500 MW of solar and 520 MW of hydro to emerge as a leading player in India's energy sector. Additionally the company has a pipeline of over 6100 MW of power projects.

**MBPPL Divisions:**



**Solar Power Division**

Moser Baer Clean Energy Limited (MBCEL), a 100% subsidiary of MBPPL, was incorporated in September 2008 with a strategy to undertake development of solar power projects worldwide. MBCEL is a project developer, owner and operator of solar power projects.MBCEL is a Moser Baer promoted company, established for setting up solar PV power projects in India and in international geographies. It is India's largest solar power development company with a presence in key international markets.

MBCEL has 250 MWp under development across multiple states in India and a project portfolio of over 200 MWp in Europe to be developed by 2012.

**Hydro Division**

Moser Baer Electric Power Limited (MBEPL) undertakes development of hydropower projects sustainably by respecting the environment, public safety and well-being by synergizing economy and development in a viable balance. MBEPL current have two hydro projects viz. (3 X 40 MW Miyar Hydro Electric Project and 4 X 100 MW Seli Hydro Electric Project) in its portfolio.

**Thermal Power Division**

Moser Baer Power & Infrastructures Ltd (MBPIL) was incorporated in 2008 with the strategy to foray into power and infrastructure. The company aims at having a thermal generation portfolio of 5000-6000 MW by 2015. The company is all set to enter into power distribution business through strategic tie-ups with various leading power sector companies. Currently MBPIL is developing three Thermal Power Generation Projects with a combined generation capacity of around 4000 MW in the states of Madhya Pradesh and Chhattisgarh.

**Mining Services Division**

Mining Division in MBPPL became functional in 2008 with the two pronged objective:

1. Building a portfolio of technically feasible and economically viable coal assets in India and other coal rich countries to:
    a. Provide fuel security to coal based thermal generation portfolio.
    b. Explore opportunities arising out of growing demand of commodity (coal) amongst bulk and marginal consumers, contribute a major share in organic growth of MBPPL and become a favored supplier of coal from domestic and international source.
2. To provide consultancy services to the mineral industry from planning to optimization of operation and value addition for organic growth of the customer.

Projects: Sondiha Coal Block, (Dist. Sarguja), Chhattisgar

Moser Baer Projects Private Limited, (MBPPL) one of its promoted company (Lumen engineering Private Limited) has formed a joint venture with Chhattisgarh Mineral Development Corporation Limited (CMDCL) as partner for development of a commercial coal block. The State Government holds 51% of the stake and 49% of economic interest of this coal block is held by MBPPL. This project is expected to add at least one million tonnes per annum of coal to the Indian economy.

# CHAPTER 2: POLICY AND LITERATURE SURVEY

Electricity is contained at Entry 38 of the List III in Constitution of India.Therefore it is joint responsibility of Union as well as State Government to legislate on the matters concerning electricity and allied matters of power industry. However by virtue of Part XI of the constitution in case of overlapping of laws enacted by the state and union legislature the union legislature shall prevail.

## 2.1 Legislative Developments

The Electricity Act, 1887 provided for protection of person and property from risk of injury consequent to supply of electricity. This act was replaced by the *Electricity Act, 1903* and again substituted by *The Electricity Act, 1910.*

*The Electricity Act, 1910*provided for development of basic legal framework for development of electricity industry in India. Certain basic changes such as grant of license for bulk supply and provision of purchase of electrical undertakings by the States was provided.

Subsequently *the Electricity (Supply) Act, 1948* dealt with the statutory powers and functions of Central Electricity Authority, the State Electricity Boards, and generating companies. The states were given a supervisory role by an amendment to the act in 1956.

In 1998 for the first time regulatory functions of the Government to a certain extent were transferred to Central Electricity Regularity Commission (CERC). The main motive of the *Electricity Regulatory Commission Act 1998* was rationalization of electricity tariff, consultative and transparent policy formulation, promotion of efficient and environmentally benign policies.

On Aug 30, 2000 the Electricity Bill was introduced in parliament. After deliberations of almost 3 years the *Electricity Act, 2003* was finally enforced on August 10, 2003 by the Union Government. EA, 2003 consolidates the laws relating to generation, transmission, distribution, trading and use of electricity and generally for taking measures conducive to development of electricity industry, promoting competition therein, protecting interest of consumers and supply of electricity to all areas, rationalization of electricity tariff, ensuring transparent policies regarding subsidies, promotion of efficient and environmentally benign policies, constitution of Central Electricity Authority, Regulatory Commissions and establishment of Appellate Tribunal and for matters connected therewith or incidental thereto.

## 2.2 Policy Support For RE

### Electricity Act 2003

- **Sections 3(1)**states that the Central Government shall, from time to time, prepare and publish the National Electricity Policy and Tariff Policy, in consultation with the state governments and authority for development of the power system based on optimal utilization of resources such as coal, natural gas, nuclear substances or material, hydro and renewable sources of energy.
- **Section 4**states that the Central Government shall, after consultation with the state governments, prepare and notify a national policy, permitting stand-alone systems (including those based on renewable sources of energy and other non-conventional sources of energy) for rural areas.
- **Section 61(h & i)** state that the appropriate commission shall, subject to the provision of this Act, specify the terms and conditions for the determination of tariff, and in doing so, shall be guided by the following, namely, the promotion of cogeneration and generation of electricity from renewable sources of energy; and the *National Electricity Policy and Tariff Policy*.
- **Section 86(1)(e)** Section 86(1) and 86(1)(e) state that the state commissions shall discharge the following functions, namely, promote cogeneration and generation of electricity from renewable sources of energy by providing, suitable measures for connectivity with the grid and sale of electricity to any person, and also specify, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution license.

### National Electricity Policy 2005

- The National Electricity Policy 2005 stipulates that progressively the share of electricity from non-conventional sources would need to be increased; such purchase by distribution companies shall be through competitive bidding process; considering the fact that it will take some time before non-conventional technologies compete, in terms of cost, with conventional sources, the commission may determine an appropriate deferential in prices to promote these technologies.

## National Tariff Policy 2006

The Tariff Policy announced in January 2006 has the following provisions:

- Pursuant to provisions of section 86 (1) (e) of the Act, the Appropriate Commission shall fix a minimum percentage for purchase of energy from such sources taking into account availability of such resources in the region and its impact on retail tariffs. Such percentages for purchase of energy should be made applicable for the tariffs to be determined by the SERCs latest by April 01, 2006.
- It will take some time before non-conventional technologies can compete with conventional sources in terms of cost of electricity. Therefore, procurement by distribution companies shall be done at preferential tariffs determined by the Appropriate Commission.
- Such procurement by Distribution Licensees for future requirements shall be done, as far as possible, through competitive bidding process under Section 63 of the Act within suppliers offering energy from same type of non-conventional sources. In the long-term, these technologies would need to compete with other sources in terms of full costs.
- The Central Commission should lay down guidelines within three months for pricing non-firm power, especially from non-conventional sources, to be followed in cases where such procurement is not through competitive bidding.

## National Rural Electrification Policy, 2006

- Section 3.1 states “For villages/habitations where grid connectivity would not be feasible or not cost effective, off-grid solutions based on stand-alone systems may be taken up for supply of electricity. Where these also are not feasible and if only alternative is to use isolated lighting technologies like solar photovoltaic, these may be adopted. However, such remote villages may not be designated as electrified.”

## 2.3 Literature Survey

N.H.van der Linden et al (2005). The main policy instruments currently used in the EU Member States to achieve the targets set for electricity produced from renewable energy sources are: 1) the quota obligation system; 2) the feed-in tariff system; and 3) the tendering system. The evaluation of international experiences with the obligation system gives rise to a mixed picture. Although an obligation in theory is effective and cost effective, it seems too early to conclude that the system delivers these promises in practice. On the one hand this is due to the limited period of implementation that makes it hard to distinguish between the direct effect of the system and some teething problems that will be solved in due time. On the other hand, the conclusion can be drawn that the obligation is a complex system, which will only function well if designed carefully. It does seem worthwhile, however, to continue monitoring the experiences with the obligation system abroad, because this will further reveal whether the system is indeed effective and cost effective in practice. In the longer term, e.g. beyond 2010, the introduction of an obligation system in the Netherlands could be considered. Finally, as the design of support schemes is being improved, it appears that the basic concepts of both the obligation system and the feed in system have been refined in such a way that the two systems are gradually converging. An important difference between the two systems however remains, namely that an obligation system relies more on market forces whereas the feed-in system is based on a greater involvement of the government.

AnoopSingh (2010) Renewable energy sources (RES) have been promoted through a number of policies including subsidies and fiscal incentives, as well as regulatory provisions. Attractive fiscal policies like higher depreciation and the Renewable Portfolio Obligation (RPO) with Feed-in-Tariff (FiT) have provided significant impetus to growth of renewable energy in the electricity sector in India.1 Economic efficiency of renewable energy promotional policies like RPO with FiT has been questioned as these do not provide incentive for cost reduction and exploitation of cost-effective resources with appropriate technology. Tradable Renewable Energy Certificates (RECs) are identified as market-based instruments that can help promote RES in a cost-effective manner. Renewable Energy Credits or RECs are used as a disclosure, marketing and compliance mechanisms in a number of countries. These are called Renewable Obligation Certificates (ROCs) in the UK and ‘green tags’ or Tradable Green Certificates (TGCs) across many countries

in the Europe, Guarantee of Origin (GO) or Renewable Energy Guarantee of Origin (REGO) is often used in the European Union (EU) as a disclosure mechanism. At least 21 REC schemes were under operation in a number of jurisdictions including the UK, Italy, the Netherlands, Sweden, Australia, and numerous states in the US (Mendonca et al. 2010; Bertoldi and Huld 2006).

In the Indian context, Singh (2006 and 2009) discusses the advantages of RECs and proposes its implementation to bring in economic efficiency in promotion of RES. The Central Electricity Regulatory Commission (CERC) has recently issued regulations2 for introducing a market for RECs in the country (CERC 2010a). This chapter critically examines the above regulations and identifies areas for improvement. We discuss the impact of market segmentation into solar and non-solar RECs, and propose a multiplier scheme. While presenting a mechanism for price discovery of RECs, it also highlights the importance of a buyout price. The chapter proposes a linkage between the FiT and REC mechanisms. It begins by highlighting the role of RECs in promoting RES in an economically efficient manner. We also present a framework for developing a market for RECs, and discuss institutional mechanisms and role of various stakeholders.

S.K.Soonee et al (2011) India has been richly endowed with renewable resources. Since the cost of electricity generated from such resources is expensive, large scale development of renewable resources did not take place. Concern about climate change and concerted action to reduce greenhouse gas emissions are powerful drivers for renewable energy. Lately, in view of growing awareness about green environment, development of renewable energy has been promoted by fiscal policies of Government of India. These include tax incentives and purchase of electricity generated through renewable energy sources. Enactment of the Electricity Act 2003 (the Act) has lent further support to renewable energy by stipulating purchase of a percentage of the power procurement by distribution utilities from renewable energy sources. The renewable purchase obligation as well as preferential tariff for procurement of such power has been specified by various State Electricity Regulatory Commissions (SERCs). Renewable energy sources are not spread evenly across the state boundaries and the very high cost of generation from RE sources discourages local distribution licensees from purchasing electricity generated from RE sources. Renewable Energy Certificate seeks to address the mismatch between availability of RE sources

and the requirement of the obligated entities to meet their renewable purchase obligation bypurchasing green attributes of renewable energy remotely located in the form of Renewable Energy Certificate (REC). This paper discusses regulatory developments including IndianElectricity Grid Code-2010 (IEGC) for promotion of renewable energy in India and in particularthe nationally tradable renewable energy credits in the form of Renewable Energy Certificates(REC) for achieving the targets set by respective SERCs for renewable purchase obligations.This would help to minimize cost of power procurement, and lead to efficient resource utilizationacross the country and provide incentive for investment in appropriate technologies. The paperhighlights salient features, advantages and implementation of REC mechanism in India. TheREC mechanism is a market based instrument, to promote renewable sources of energy anddevelopment of market in electricity, leading to the sustainable development of the country.Recognizing that, like other resources the renewable resources are also not evenly distributed across the country, it encourages setting up of larger generation capacities at resource rich locations and, through a process of Certification create a market based instrument which can betraded, on CERC approved power exchanges, to obligated entities or voluntary buyers to fulfill their Renewable Purchase Obligation/ Social Responsibility.

## 2.4 Research Methodology

Renewable Energy Certificate (REC) mechanism is a market-based instrument to promote renewable energy and facilitate renewable energy purchase obligations amongst various stakeholders. RECs have been successfully used in many countries such as Australia, Japan, US, Netherlands, Denmark and UK for promotion of renewable energy. However, these schemes vary in detail and need to be customized for local legislations and market situations. Further federal structure of governance as found in India and electricity being part of the concurrent list poses unique challenges for development of such a scheme in India.

Involvement of various stakeholders in the development and implementation of REC Mechanism is essential. As a result, a consultative approach, as well as, desktop study approach usually adopted for the project.

The following approach is adopted for executing the project

1. Study of all orders and regulations pertaining to current REC Mechanism.
2. Identification of key issues in current mechanism.
3. Analysis of International Experience of REC implementation.
4. Consultation and discussion with several stakeholders to gain further insight of issues.
5. Finally based on understanding of issues and learning from international scenario recommendations are made.
6. A financial model is also developed to study effect of change in REC pricepost current control period on various financial indicators. Effect of few other input parameters is also studied.

# CHAPTER 3: REC MECHANISM

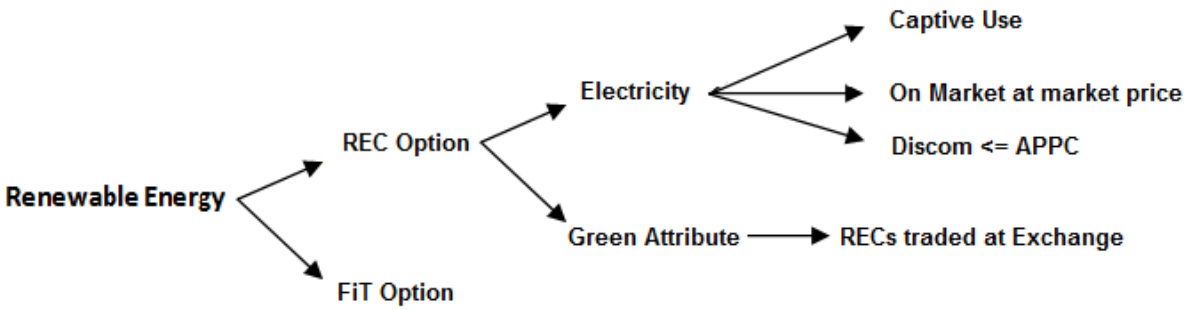
## 3.1 PRESENT REC MECHANISM (India)

Renewable Energy (RE) sources are not evenly spread across different parts of the country. On the one hand there are States (like Delhi) where the potential of RE sources is not that significant. This inhibits SERCs in these States from specifying higher Renewable Purchase Obligation (RPO). On the other hand there are States (like Rajasthan and Tamil Nadu) where there is very high potential of RE sources. In such States there are avenues for harnessing the RE potential beyond the RPO level fixed by the SERCs. However, the high cost of generation from RE sources discourages the local distribution licensees from purchasing RE generation beyond the RPO level mandated by the State Commission.

Renewable Energy Certificates (REC) seeks to address the mismatch between availability of RE sources and the requirement of the obligated entities to meet their RPO. It is also expected to encourage the RE capacity addition in the States where there is potential for RE generation as it creates a national level market for such generators to recover their cost.

CERC has notified Regulation on REC in fulfillment of its mandate to promote RE and development of market in electricity. The framework of REC is expected to give push to RE capacity addition in the country.

### 3.1.1 REC Concept



### 3.1.2 Salient Features of the REC Framework

- The RE generators will have two options - either to sell the renewable energy at preferential tariff fixed by the concerned Electricity Regulatory Commission or to sell the electricity generated and environmental attributes associated with RE generation separately.
- On choosing the second option, the environmental attributes can be exchanged in the form of REC. Price of electricity component would be equivalent to weighted average power purchase cost of the distribution company including short-term power purchase but excluding renewable power purchase cost.
- The Central Agency will issue the REC to RE generators.
- One REC will be issued to the RE generator for one MWh electrical energy fed into the grid. This energy will need to be produced from an approved Renewable Energy Source.
- The REC mechanism will enable Obligated Entities in any State to procure RECs generated in any of the States in India and surrender the same to satisfy its RPO target.
- The State Load Dispatch Centers (SLDC) and proposed new institutions such as National level REC Registry and State level Monitoring Committees are envisaged to play the pivotal role in day-to-day operation of REC mechanism.
- Can be sold once only. Sold on last Wednesday of each month.
- Every REC is sold by a unique code generated per generation unit.
- The REC will be exchanged only in the Power Exchanges approved by CERC within the band of a floor price and a forbearance (ceiling) price to be determined by CERC from time to time.
- The distribution companies, Open Access consumer, Captive Power Plants (CPPs) will have option of purchasing the REC to meet their Renewable Purchase Obligations (RPO).
- Compliance Auditors will ensure compliance of the requirement of the REC by the participants of the scheme.
- Validity period one year from date of issue.

### 3.1.3 Key Objectives of REC Mechanism

The REC mechanism meets a lot of objectives at the same time:

- **Effective implementation of RPO Regulations**

  REC mechanism enables obligated entities to procure renewable energy from RE generator outside the State. Thus for obligated entities, several avenues are available for purchase of REC. This enables obligated entities to fulfill their RPO obligation.

- **Increased Flexibility to Participants**

  REC mechanism offers increased flexibility to Obligated Entities and the RE generators to sell and purchase renewable energy. The Obligated Entities can procure RECs from RE generator outside the State and RE generator participating in the REC mechanism can sell its RECs and electricity separately to two different entities.

- **Overcome geographical constraints**

  The RE sources are dispersed unevenly across the States in India. Through implementation of REC mechanism, the available potential can be harnessed to promote RE sources based power generation and to some extent meet the unfulfilled demand for electricity.

- **Reduce transaction costs for RE transactions**

  REC mechanism enables RE generators to sell their electricity to any consumer of their choice and sale RECs generated from quantum of such electricity to any Obligated Entity. Hence, other than procurement of RECs, no other transaction (like OA charges and balancing market cost) is necessary for obligated entities to meet their RPO target. Thus, for Obligated Entities the cost of fulfilling RPO obligation is expected to go down substantially.

- **Enforcement or penalty mechanism**

  Earlier RPO Regulations/ Orders did not have strong enforcement provisions in case the obligated entities fail to meet their RPO. Through REC mechanism a penalty(Forbearance) price has been discovered.

- **Create competition between different RE technologies**

  RE technologies which are in nascent stage of their development (like Solar)are to be promoted over those which have already matured (like wind). The distinction between the two is important. The REC mechanism enables such distinction offering more prices to solar RECs, thus creating competition between different RE technologies.

- **Development of all-encompassing incentive mechanism**

  REC mechanism is primarily also used as an incentive mechanism for improving the financial viability of the renewable energy projects.[17]

- **Reduce risks for local distribution company**

  Earlier under the RPO regulation the Obligated Entity had to locate the RE generator and physically procure the power from to fulfill its RPO obligation. This increased the cost for local distribution company. Further, since most of RE generators arenotschedulable and/or dispatchable, procurement of power from such sources subject local distribution company to balancing market costs. The REC mechanism reduces the risks being borne by the local distribution company.

[17]This aspect of REC is shown in second half of this report covering Financial Modeling of Solar PV Power Plant.

***Table 2: Development on Implementation of REC***

| ORDERS | DATE OF ORDERS |
|---|---|
| Draft Model Regulations For SERC Under Section 86(1)(E) Of EA2003, FOR | Oct 2009 |
| CERC (Terms And Conditions For Recognition And Issuance Of Renewable Energy Certificate For Renewable Energy Generation) Regulations, 2010. | 14th January, 2010 |
| Designation Of Central Agency, CERC | 29th January 2010 |
| Model Procedure / Guidelines For Accreditation Of Renewable Energy Generation Project For REC Mechanism By State Agency | 17 March 2010 |
| CERC vide its Suo Motu Petition No.99/2010 issued an order for 'Determination Of Forbearance And Floor Price For The REC Framework' and invited comments from stakeholders. | 23rd March, 2010 |
| Approval Of The Rules, Bye-Laws And Business Rules Of Indian Energy Exchange, CERC. | 26 August 2010 |
| Finalized Determination Of Forbearance And Floor Price for the REC Framework - Petition No. 99/2010 (Suo Motu) | 01st June, 2010 |
| Determination Of Fees And Charges Payable For REC Under Regulation 11 Of CERC Regulations 2010, CERC Petition No. 230 /2010 (Suo Motu) | 21 September 2010 |
| CERCnotified1st Amendment to REC Regulations | 29th September,2010 |
| Commission after detailed analysis of the proposal approved the amendment to the detailed procedures | 9th November, 2010 |
| The REC Mechanism launched. | 18 November 2010 |
| NLDC requested CERCtoconsider Amendment regarding Mode Of Payment Of Fees And Charges | 18th March 2011 |
| CERC approved CA Request (2nd Amendment) | 18th April 2011 |
| Commission Vide Its Suo Motu Order (No.142 / 2011) Proposed Forbearance And Floor Price to be applicable from April 1, 2012 and invited comments and suggestions on the same | 13th June, 2011 |
| Determination Of Forbearance And Floor Price for The REC Framework to be applicable from 1st April 2012. Petition No. 142/2011 (Suo Motu) | 23rd August, 2011 |

### 3.1.4 Important Excerpts from REC Regulation

**Eligibility and Registration for Certificates:**

A generating company engaged in generation of electricity from renewable energy sources shall be eligible to apply for registration for issuance of and dealing in Certificates if it fulfills the following conditions:

- It has obtained accreditation from the State Agency;
- It does not have any power purchase agreement for the capacity related to such generation to sell electricity at a preferential tariff determined by the Appropriate Commission; and
- 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.

**Eligible REC Buyers:**

- Obligated Entities: Distribution Licensees, Captive Consumers and Open Access Consumers.
- Voluntary Entities: Corporate under CSR, Individuals.

**Categories of Certificates:**

There shall be two categories of certificates, viz.

- solar certificates issued to eligible entities for generation of electricity based on solar as renewableenergy source, and
- non-solar certificates issued to eligible entities for generation of electricity based on renewable energy sources other than solar:

### 3.1.5 REC Process


**Accreditation:**

An application for availing accreditation shall be made by the generating company to the host State Agency, as defined under in the CERC REC Regulations[18]. The applicant shall apply for Accreditation on the Web Based Application and shall also submit the same information in physical form with the State Agency.List of State Agency is given in*Table 16*(Annexure).

Key Features:

- Accreditation cannot be done before 6 months of proposed date of commissioning.
- SA shall assign a unique acknowledgement no. for future correspondence.
- Accreditation Certificate is valid for 5 years from date of accreditation.
- Separate applications for separate RE generation projects.

**Registration:**

Process for registration as 'Eligible Entity' is done with by Central Agency (CA).[19]

Key Features:

- Registration can be done only after receipt of the "Certificate ofAccreditation"
- Registration can't be done before 3 months of proposed date of commissioning.
- Registration is valid for 5 years from date of Registration

**Issuance**

This procedure shall be applicable to the CA while issuing the RECs to the Eligible Entities. An application for issuance of REC shall bemade by the Eligible Entity to the CA. Theapplication for issuance of certificate shall include

(i) Energy Injection Report duly certified by the concerned SLDC

(ii) Registration Certificate

[18] CERC REC Regulation refers to the document "PROCEDURE FOR ISSUANCE OF RENEWABLE ENERGY CERTIFICATE TO THE ELIGIBLE ENTITY BY CENTRAL AGENCY" issued by CERC.

[19] NLDC was designated as Central Agency by CERC via Petition No. 18/2010 (Suo Moto) dated Jan 29, 2010.

(iii) Fee & charges towards issuance of certificates as determined by CERC.

After receipt of physical application for issuance of renewable energycertificates from the Eligible Entity, the CA shall undertake apreliminary scrutiny and shall only issue RECs after confirming, the claims with the Energy Injection Report submitted by the SLDC.Upon issuance of RECs, the CA shall also intimate about such issuance to the concerned StateAgency.

Key Features:

- REC is issued based on energy fed into the grid and is valid only for 1 year.
- Application for REC can be done only on 1st day or 15th day of the month.

**REC Trading**

Once the RECs are issued to Eligible Entities, sale/purchase of RECs b/w Eligible Entities and Obligated Entities are done through Power Exchange only.

- Trading through Closed Double Sided Auction on last Wednesday of every month.
- Call of bids from 13:00 Hrs. to 15:00 Hrs. on auction day (T-day).
- PEx to intimate details of maximum sale bids placed by each Eligible RE generator to NLDC by 15:30 Hrs.
- NLDC to check availability of REC with eligible generators by 16:00 Hrs.
- Post confirmation from NLDC, PEx to determine MCV and MCP and send the details to NLDC for extinguishing of RECs sold by 17:00 Hrs.

**Surrender/Redeeming of RECs**

The obligated entities purchases RECs through PEx and surrender to SERC or other agency as specified by SERCs so as to meet their RPO. NLDC (REC registry) keeps record of REC inventory.

**Compliance Reporting**

Under Section 4.5 of CERC REC Regulationscompliance auditors have to monitor the compliance of duties and obligation as specified by CERC by undertaking detailed investigation/audit and submit the report on revocation of Registration of the Eligible Entity, if necessary, to the Central Agency/Central Commission.

### 3.1.6 Fees and Charges

In order to give flexibility to Power Exchanges, the fees and charges towards the transaction of the REC has not been specified. Since there are more than one exchanges approved by the Commission, the competition among them would result into reasonable fees for dealing in Power Exchanges. However, it is clarified that the fees and charges, to be levied by the exchanges, towards the transaction of the REC, shall be within the ceiling on service charges for the members of the power exchange as specified in the Power Market Regulations. Other charges are as follows.

***Table 3: Accreditation Charges***

| S. No. | Fee and Charges towards **Accreditation** | Amount in ₹ |
|---|---|---|
| 1. | Application Processing Fees (One Time) | 5,000 |
| 2 | Registration Charges (One Time) | 30,000 |
| 3 | Annual Charges | 10,000 |
| 4 | Revalidation Charge at the end of five (5) years | 15,000 |

***Table 4 : Registration Charges***

| S.No. | Fee and Charges towards Registration | Amount in ₹ |
|---|---|---|
| 1. | Application Processing Fees (One Time) | 1,000 |
| 2 | Registration Charges (One Time) | 5,000 |
| 3 | Annual Charges | 1,000 |
| 4 | Revalidation Charge at the end of five (5) years | 5,000 |

***Table 5: Issuance Charges***

| S.No. | Fee and Charges towards Issuance of REC | Amount in ₹ |
|---|---|---|
| 1. | Fees per Certificate | 10 |

*(Service tax @12.36% will be applicable on all charges)

### 3.1.7 REC Pricing

In exercise of the power under section 66 and 178 of the Electricity Act 2003, the Commission has notified the CERC (Terms and Conditions for recognition and issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010 (hereafter REC Regulations).

As per the first proviso to clause (1) of Regulation 9 of the REC Regulations, the Commission in consultation with the Central Agency and Forum of Regulators shall provide for the Forbearance and Floor Price separately for solar and Non-solar Renewable Energy Certificates.

As per section 2(f) & (g) of REC regulations the prices of REC are defined as:

**(f) 'Floor price'** means the minimum price as determined by the Commission in accordance with these regulations at and above which the certificate can be dealt in the power exchange;

**(g)'Forbearance price'** means the ceiling price as determined by the Commission in accordance with these regulations within which only the certificates can be dealt in the power exchange;

As per Section 9 of REC Regulation talks about pricing of REC

**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 CentralAgency 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 various State Commissions.

**Floor and Forbearance Price**

Based on the above principles, the following forbearance price and floor price are prescribed for dealing in Certificates under the REC Regulations: The following stated forbearance and floor prices were valid for the control period up to FY 2012.

***Table 6: REC Price valid up to March 2012***

| | **Non solar REC (INR/ MWh)** | **Solar REC (INR/ MWh)** |
|---|---|---|
| **Forbearance Price** | 3,900 | 17,090 |
| **Floor Price** | 1,500 | 12,000 |

Source[20]

On 13th June, 2011 the Commission vide its Suo Motu Order (No.142 / 2011) proposed the following forbearance and floor price (framework for control period from 1st April 2012 31st Match 2017) and invited comments and suggestions on the same.

| | **Non solar REC (INR/ MWh)** | **Solar REC (INR/ MWh)** |
|---|---|---|
| **Forbearance Price** | 3,400 | 13,690 |
| **Floor Price** | 1,400 | 9,880 |

The Commission considered the comments of the stakeholders, views of the participants in the public hearing on the proposed floor and forbearance prices and later finalized the following for dealing in Certificates under the REC Regulations

***Table 7: REC Price for Period 2012-17***

| | **Non solar REC (INR/ MWh)** | **Solar REC (INR/ MWh)** |
|---|---|---|
| **Forbearance Price** | 3,300 | 13,400 |
| **Floor Price** | 1,500 | 9,300 |

Source[21]

[20] CERC Petition No. 99/2010 (Suo Moto) Date of Order June 01, 2010.
[21] CERC Petition No. 142/2011(Suo Moto) Date of order August 23, 2011.

For Forbearance and Floor Price determination applicable from April 2012:

1. **RE Target:**The target for RE generation (year 2012-13) has been taken as average of renewable energy requirement as per the NAPCC and as per the MNRE Report on "Renewable Energy in India: progress, Vision and Strategy. Therefore, the Commission has, for computing floor price, settled on a figure which is around 70000 MUs.
2. **Additional RE capacity addition:** To develop scenarios for future state level RE technology specific supply, for each RE technology across select 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, current achievement, MNRE/GoI's 11th and 12th Plan Targets for Capacity Addition in RE and the untapped potential available in the State. Year 2011 has been taken as a base year for projection of capacity addition from RE. To estimate additional generation at the state level in the years 2011-12 and 2012-13, the capacity added under a specific RE technology has been multiplied by the Capacity Utilisation Factor of the RE technology, as per the CERC RE Tariff Regulations 2009, for the sake of uniformity.
3. **Cost of Generation/RE tariff:** Costs of Generation/ RE Tariff for different technologies for FY 2011-12 have been assumed as per the CERC RE Tariff Regulations 2009, for the sake of uniformity.
4. **Average Power Purchase Cost (APPC):** The APPC for a state represents the weighted average pooled power purchase by distribution licensees (without transmission charges) in the state during the financial year 2011-12.

**Forbearance Price:** The forbearance price has been derived based on the highest difference between cost of generation of RE technologies / RE tariff and the average power purchase cost of 2011-12 for the respective states.

**Floor Price:** 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.

In pursuance of the provisions specified in the Regulation 9 (2) of REC Regulations, the forbearance and floor prices for Solar and Non- Solar REC have been evolved based on following assumptions.

**Non-solar Forbearance price**:

The highest difference between the Costs of Generation (RE Tariff) and the APPChas been specified as the forbearance price for non–solar technologies. Thehighest difference has been rounded off to the next hundred's (or next ten's in caseof unit price), to arrive at the forbearance price of ` 3300/MWh

**Non – Solar Floor Price:**

The difference between the project viability requirement and APPC is arranged in ascending order (INR/kWh) for different RE technologies across states. The expected generation (MUs) from RE technology in a particular state is mapped with the respective difference between the project viability requirement and APPC.

In this case floor price has been taken as the price (difference between feasibility requirement and APPC) at which the target RE generation of 70000 MUs (average of renewable energy target as per NAPCC and MNRE vision Report 2010 for non-solar technology) will be realized. The difference at this point has been rounded off to the next hundred's (or next ten's in case of unit price), to arrive at the floor price of ` 1500/MWh

**Solar Forbearance price**

This has been derived based on the highest difference between the Solar PV/Thermal tariff for 2011-12 and the APPC of 2011-12 across states. The highest difference in unit price has been rounded off to the next hundred's (or next ten's in case of unit price), to arrive at the forbearance price of ` 13400/MWh

**Solar Floor price**

i. The floor price of solar RECs has been calculated based on the project viability approach. The project viability approach covers the cost required to meet viability parameters including O&M, interest, principal repayment etc.

ii. The highest difference between the minimum requirement for project viability of Solar PV/Thermal and respective state APPC of previous year (2011-12) has been considered as floor price. The highest difference has been rounded off to the nearest hundred's (or next ten's in case of unit price), to arrive at the floor price of ` 9300/MWh

## 3.2 INTERNATIONAL SCENARIO

The governments around the globe are thinking seriously about renewable sources of energy, and are undertaking a lot of policy measures for promoting the same. At least 109 countries had some type of renewable power policy by early 2012, up from the 96 countries in 2011[22]. Of all the renewable electricity policies employed by national and state/provincial governments, feed-in-tariffs (FIT) and renewable portfolio standards (RPS), also known as "renewable electricity standards," "renewable obligations," "mandated market shares," and "renewable purchase obligation", are the most common.

Feed-in-Tariff as used in Germany, Denmark, Spain, and other nations proved successful to a certain degree in its early stages. However, purchase at fixed prices is gradually shifting toward market-principle-oriented systems, typically the RPS System and Tradable Certificate Scheme (REC), as purchase at fixed prices gave rise to problems such as price rigidity and rather slow cost reductions driven by mass production, and increases the financial burden on national governments.

Germany reduced its solar PV tariffs several times in 2011 and early 2012, and introduced monthly tariff reduction.[23] Portugal indefinitely suspended the issuing of new licenses for projects benefiting from its FIT, and Spain halted all new FIT applications in early 2012 as it sought to reform its national energy system.[24] Outside Europe, China also announced significant reductions in solar FITs.[25] Similar trend is visible in many other countries.

In some countries Quota/RPS policies are linked with certificate schemes to add flexibility by enabling mandated entities (utilities) to meet their obligations through trading. RECs (also called Tradable Renewable Certificates, Green Tags, Renewable Electricity Certificates or Renewable Energy Credits) are functioning in 20 countries at national level, among which are: Australia, India, Japan, Russia, Norway and most of the EU member countries. In some countries Certificate schemes include all grid-interactive RE technologies, while some schemes also include off-grid RE technologies.

[22] Source: RENEWABLES *2012 GLOBAL STATUS REPORT* (page 14) by REN21
[23] Mathias Zuber "*Renaissance for Pumped Storage in Europe*" Hydroworld, July 2011
[24] Eskom "Ingula *Pumped Storage Scheme*" www.eskom.co.za/c/article/54/ingula-pumped-storage-scheme
[25] Dominique "China *Makes a Surprise Cut to Golden Sun Solar Subsidies*" (May 3, 2012) www.rechargenews.com

The table on the page shows different policy measures adopted by some countries to promote RE in their country's energy mix.

***Table 8: RE Support Policies - World***

| | **Feed-in tariff (incl. premium payment)** | **Electric utility quota obligation/ RPS** | **Net metering** | **Biofuels obligation/ mandate** | **Heat obligation/ mandate** | **Tradable REC** |
|---|---|---|---|---|---|---|
| HIGH INCOME COUNTRIES | | | | | | |
| **Australia** | • | | | • | | • |
| **France** | • | | | • | | • |
| **Germany** | • | | | • | • | |
| **Italy** | • | • | • | • | • | • |
| **Japan** | • | • | • | | | • |
| **United Kingdom** | • | • | | • | • | • |
| **United States3** | • | • | • | • | • | • |
| UPPER-MIDDLE INCOME COUNTRIES | | | | | | |
| **China** | • | • | | • | • | |
| **Russia** | | | | | | |
| **South Africa** | | | | | | |
| LOWER-MIDDLE INCOME COUNTRIES | | | | | | |
| **India** | • | • | | • | o | • |
| **Pakistan** | • | | • | | | |
| **Sri Lanka** | • | • | • | • | | |
| LOW INCOME COUNTRIES | | | | | | |
| **Bangladesh** | | | | | | |
| **Kenya** | • | | | | | |
| **Nepal** | | | | | | |
| • National Level Policy<br>o State / Provincial Policy | | | | | | |

Source: REN21 "RENEWABLES 2012 *GLOBAL STATUS REPORT*"

### 3.2.1 ROC Mechanism in UK

UK is a unitary state which consists of four countries England, Northern Ireland, Scotland and Wales. The UK has signed up to the EU Renewable Energy Directive which includes a target for the UK to supply 15% of total energy demand from renewables by 2020.[26] The Government published the Renewable Energy Strategy (RES) which explains how this legally-binding target will be met. The precise breakdown of the 2020 renewable energy target between technologies will depend on the response of investors to the separate government schemes and incentives. However, the Government has estimated that renewables, promoted under the Renewables Obligation, could provide more than 30% of electricity generation.

The first Renewables Obligation (RO) Order came into force in April 2002, as did the first Renewables Obligation (Scotland) (ROS) Order. The first Northern Ireland Renewables Obligation (NIRO) Order came into force in April 2005. These schemes were introduced by the Department of Trade and Industry (now the Department of Energy and Climate Change), the Scottish Executive and the Department of Enterprise, Trade and Investment respectively. The three schemes are administered by the Gas and Electricity Markets Authority (the Authority), whose day to day functions are performed by OFGEM.

The Orders place an obligation on licensed electricity suppliers in England and Wales, Scotland and Northern Ireland to source an increasing proportion of electricity from renewable sources. Suppliers can meet their obligations by presenting sufficient Renewables Obligation Certificates (ROCs) to cover their obligations. Where suppliers do not have sufficient ROCs to meet their obligation, they are required to pay an equivalent amount into a fund. This fund is then paid back on a pro-rata basis to those suppliers that have presented ROCs. From 1 April 2009, the Obligation changed from a percentage to an obligation to present a number of ROCs

[26] "The UK Renewable Energy Strategy" (July, 2009)
www.official-documents.gov.uk/document/cm76/7686/7686.pdf

*Table 9: Renewable Obligation- UK*

| **Obligation period (1st April - 31st March)** | **Buy-out price** | **Obligation for England & Wales and Scotland** (% of total supply ) | **Obligation for Northern Ireland** (% of total supply) |
|---|---|---|---|
| 2002-2003 | £30.00 | 3.0% | X |
| 2003-2004 | £30.51 | 4.3% | X |
| 2004-2005 | £31.39 | 4.9% | X |
| 2005-2006 | £32.33 | 5.5% | 2.5% |
| 2006-2007 | £33.24 | 6.7% | 2.6% |
| 2007-2008 | £34.30 | 7.9% | 2.8% |
| 2008-2009 | £35.76 | 9.1% | 3.0% |
| **Banding introduced in 2009 Orders. Obligation now in ROCs per MWh** | | | |
| 2009-2010 | £37.19 | 0.097 | 0.035 |
| 2010-2011 | £36.99 | 0.111 | 0.0427 |
| 2011-2012 | £38.69 | 0.124 | 0.055 |
| 2012-2013 | £40.71 | 0.158 | 0.081 |

Source[27]

From 1st April 2010 the obligation levels in England & Wales, Scotland and Northern Ireland are set by DECC. These are published on DECCs website around 1st October each 2 years.

Earlier setting the size of the Obligation required 3 calculations: The number of Renewable Obligation Certificates (ROCs) that would be needed for suppliers to meet a **fixed target; t**he amount of renewable electricity we expect to be generated based on this the number of ROCs that we expect will be issued, uplifted by 8% (**headroom**) and the number of ROCs that would be issued if suppliers were to source 0.2 ROCs per MWh from eligible renewable sources – the **cap**.

Later, through RO Amendment 2010, the obligation level was amended to **remove the obligation cap (**20 ROCs per 100MWh) and **increase the headroom** provision to 10% with effect from 1 April 2011. Since then setting the size of the Obligation requires 2 calculations: fixed target and the headroom.

[27]Source: Renewables Obligation: Guidance for licensed electricity suppliers 2012

As per The Renewables Obligation Order (ROO) 2009 the Secretary of State is required to announce the level of the Obligation six months preceding an Obligation period. For the 2012/13 period level of obligation was announced on 30 September 2011.

2 calculations were made to set the size of the Obligation.

A) The number of Renewable Obligation Certificates (ROCs) that would be needed for suppliers to meet a **fixed target** of 0.124 ROCs per MWh from eligible renewable sources in England, Scotland and Wales and 0.063 ROCs per MWh in Northern Ireland

B) The amount of renewable electricity we expect to be generated, and based on this the number of ROCs that we expect will be issued, uplifted by 10% (**headroom**)

The Obligation level is set as one of these calculations, determined as:

**Fixed targets**: If fixed targets (A) is greater than headroom (B).

**Headroom**: If headroom (B) is greater than the fixed target (A).

**Calculation A: Fixed Targets**

For 2012/13 DECC central UEP predictions are that 317.2TWh of electricity will be supplied by Licensed Supplier Electricity. At 0.124 ROCs per MWh for England and Wales and Scotland; and 0.063 ROCs per MWh for Northern Ireland, this gives a total of 38.83 million ROCs for Calculation A.

***Table 10: Fixed Target Renewable Obligations of UK***

| | 2009/10 | 2010/11 | 2011/12 | **2012/13** | 2013/14 | 2014/15 | 2015/16 |
|---|---|---|---|---|---|---|---|
| England and Wales | 9.7% | 10.4% | 11.4% | **12.4%** | 13.4% | 14.4% | 15.4% |
| Scotland | 9.7% | 10.4% | 11.4% | **12.4%** | 13.4% | 14.4% | 15.4% |
| Northern Ireland | 3.5% | 4.0% | 5.0% | **6.3%** | 6.3% | 6.3% | 6.3% |

Source[28]

[28]Source: OFGEM Obligation Orders 2009

**Calculation B**

Calculation B works by taking the potential amount of ROCs to be generated by stations accredited as of 27 July 2011– multiplying together the MW capacity, the number of hours in a year, the banding level of that technology and the load factors. This is then added to the potential new build (calculated as above) and assumptions for co-firing.

| | **ROCs (Millions)** |
|---|---|
| Potential ROCs from existing stations | 27.9 |
| Potential ROCs from new build | 17.2 |
| Co-firing assumed | 1.0 |
| Sub Total | 45.1 |
| **Total (with 10% headroom)** | **49.6** |

DECC calculations give a total of 45.1 million ROCs before headroom. With headroom this amounts to 49.6 million ROCs. **According to legislation, this means that Calculation B sets the obligation.**

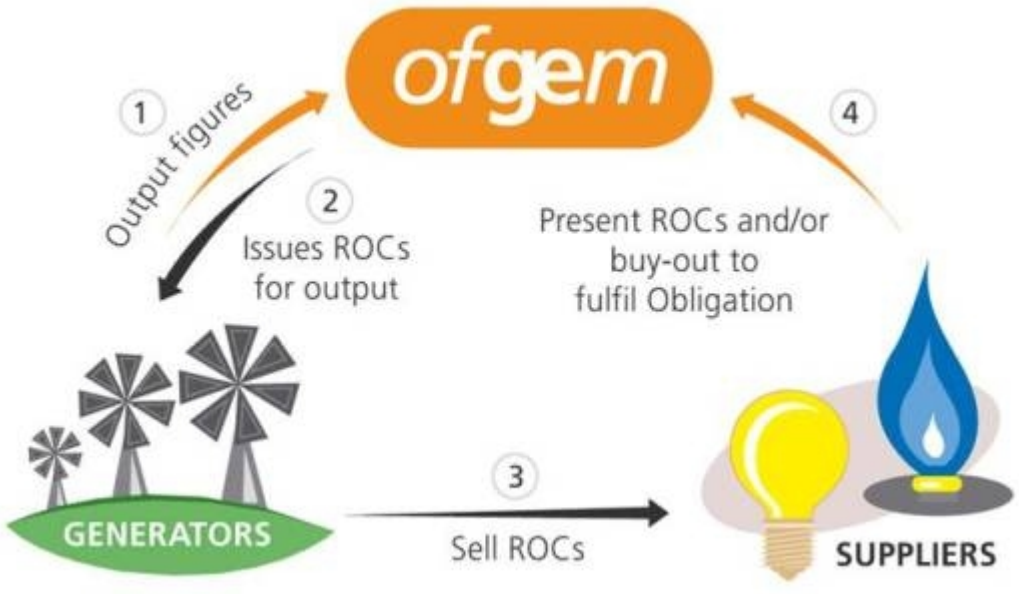



***Figure 1: ROC UK Process***

## The RO Cycle

- The obligation level is set by DECC six months in advance of each obligation period.
- The **buy-out** price (Suppliers meet their obligations by presenting sufficient ROCs to cover their obligations. Where suppliers do not have sufficient ROCs to meet their obligation, they must pay an equivalent amount into a fund known **as buy-out**, the proceeds of which are paid back on a pro-rated basis to those suppliers that have presented ROCs) is set by OFGEM in advance of the obligation period and is amended annually in line with RPI. OFGEM also sets mutualisation ceiling in advance of obligation period.
- The Authority is required to issue ROCs to operators of accredited generating stations that have generated electricity from eligible renewable sources. ROCs are issued to renewable generators on a monthly basis and cannot be issued before the end of the second month after the month of generation,
- The licensed electricity suppliers provide an estimate of the amount of electricity that they have supplied during the obligation period to DECC by **1 June** each year (and copy to Ofgem)
- The licensed electricity suppliers provide Ofgem with the actual amount of electricity that they have supplied during the obligation period by **1 July** each year.
- Suppliers can meet their obligation by presenting ROCs, making a buyout payment to cover any shortfall in the number of ROCs required, or by a combination of both. Each supplier is permitted to meet up to 12.5% of its total obligation under the Orders by presenting ROCs that have been issued for co-firing of fossil fuels and biomass.
- Suppliers have to present ROCs or pay the buy-out fund by the statutory deadline of **31 August**.
- Suppliers can make a late payment, where required, to meet any outstanding obligation by 31 October each year. During this time period they cannot present ROCs.
- By **single recycling mechanism** the funds are redistributed to suppliers in proportion to the total number of ROCs that each has presented across the three obligations. For example, a supplier that presented ROCs representing 3% of the total number of ROCs across all three obligations would get back 3% of the total sum of the three buy-out and any late payment funds. That would still be the case if that supplier had only presented these ROCs in respect of one of the obligations. Ofgem and NIAUR administration costs are deducted from the

buy-out funds prior to redistribution. Statutory deadline for Redistributing of buyout funds is **1 November.** Redistribution of the late payment funds is done on the same basis as the buy-out funds, legislative deadline of which is **1 January**.

### Mutualisation

In the event of a supplier being unable to meet its obligation under the RO and/or ROS, for example if the supplier has gone into administration during the obligation period, there may be a shortfall in the buy-out fund. Where the shortfall qualifies as a 'relevant shortfall'12, a mutualisation process applies.

If mutualisation is triggered by a relevant shortfall in the buy-out and/or late payment funds, all suppliers with an obligation under the RO and ROS are required to make additional payments to make up this shortfall. These payments are capped at the 'mutualisation ceiling' an amount published annually byOfgem.

Mutualisation payments are redistributed to suppliers on the same basis as the buy-out and late payment funds via the single recycling mechanism. Mutualisation does not apply in Northern Ireland; however, suppliers in Northern Ireland will receive a share of any mutualisation funds from the RO and ROS.Mutualisation has not been triggered to date under any of the Orders.

### Calculations for Buyout Price (FY 2012-13)

ROC Buyout Price for 2012-13 is calculated by multiplying the buyout price of preceding year (i.e. FY11-12) with the average percentage change of RPI value over 12 months of preceding year (i.e. FY2011-12). The latter is given in*Table 17*(Annexure)**.**

Buyout Price (2012-13) = Buyout Price (2011-12) * Change in RPI over 12 months of 2011

= £ 38.69 * 1.052083

= £ 40.705

### Legislative Changes

There have been several RO Orders and amendments to these since the introduction of the RO in 2002. In 2009 when banding, grandfathering and other changes were introduced. The RO and ROS 2010 amendments provided for the transition from RO support to support under the Feed-In-Tariff (FITs) scheme for certain generators. All three Orders were amended in 2011 to allow for enhanced sustainability reporting, phased support for offshore wind and other changes. In addition to this, amendments were made that allowed fuels such as biodiesel to be eligible for RO support.

### RO Amendment 2010

- Amendment orders for the RO, ROS and NIRO came into force on 1 April 2010.
- PV, hydro, wind and AD micro generation technologies (with capacity 50kW or less) were made ineligible for support under the RO and ROS. As of 1 April 2010 these technologies are now supported through the FIT scheme. The FIT scheme does not include generation in Northern Ireland.
- The amendment orders extended the RO and ROS to 2037, and the NIRO to 2033.
- 20 ROCs per 100MWh renewables obligation cap removed and the headroom provision increased to 10% with effect from 1 April 2011.
- An increased level of support for offshore wind projects was also introduced. Support increased from 1.5 ROCs per MWh to 2 ROCs per MWh, for stations that receive full RO accreditation between 1 April 2010 and 31 March 2014.

### RO Amendment 2011

- Amendment orders for the RO, ROS and NIRO came into force on 1 April 2011.
- A definition of ‘fossil derived bio-liquid’ was introduced to include bio-liquids produced directly or indirectly from coal, lignite, natural gas, crude liquid petroleum or petroleum products. As a result, generation using bio-liquids produced directly or indirectly from these products can now be considered as eligible for ROCs.
- Changes specific to the NIRO included increased levels of support for electricity generated from AD. Operators of onshore wind, hydro and PV generating stations (with capacity 50kW or less) accredited before 1 April 2010 receive higher ROC levels for any additional capacity added after this date, subject to the banding thresholds.

### RO amendment 2012 - 'Banding review'

The government and the devolved administrations closed their consultations on the first major banding review in January 2012. The new bands and associated rules are expected to come into effect on 1 April 2013. The following is a summary of the proposals as they currently stand.

- Based on the proposals, support will be reduced where possible without significantly affecting deployment. List of current n proposed bands is given in *Table 18* (Annexure).
- It is proposed that two new bands are to be created for enhanced co-firing and conversion stations (for former fossil fuel generating stations that convert to run on biomass).
- It is proposed that the definition of energy crops is to be amended to prevent the use of food crops in electricity generation.
- The consultation proposed that a cap is to be introduced to limit the number of bio-liquid ROCs that a supplier can use to meet their obligation and that the existing co-firing cap is removed.
- In light of the decrease in bands, 'grace periods' may be introduced so that generators can, in certain situations, realise pre-1 April 2013 ROC levels even if the stations were commissioned after this date.
- The NIRO is proposed to be extended to 2037, in line with the RO and ROS schemes.

### Future of the Renewables Obligation in UK

- In its White Paper of 12 July 2011 the government set out its proposals for the Electricity Market Reform (EMR). It committed to maintaining the RO (in its current banded format) until 31 March 2037 but will close the scheme to new entrants from 31 March 2017. Renewable generation already accredited under the RO will continue to receive support under a 'vintage' scheme.
- New renewable electricity generation will be supported through a new 'Contract for Difference' scheme, further details of this and the EMR will be released by DECC.

### 3.2.2 Australia

In 1997, the world came together to look for a solution for global warming and to reduce the emission of greenhouse gases when the Kyoto Protocol, an international agreement, was created under the United Nations Framework Convention on Climate Change (UNFCCC) in Kyoto, Japan. The aim was to reduce the collective greenhouse gas emissions of developed country Parties by at least five per cent below 1990 levels during 2008 to 2012—referred to as the first commitment period.

Australia didn't join the protocol originally but fortunately joined few years later. In reaction to Kyoto Protocol the Australian Government introduced the Renewable Energy *(Electricity)* Act 2000 which commenced its operation in April 2001. MRET (Mandatory Renewable Energy Target) established under the Act obliged Australian electricity retailers to source increasing amounts of their required electricity from approved renewable sources. This legislation required the large electricity purchasers, wholesalers and retailers, to source an additional 2% of their electricity purchases from renewable energy producers by 2010.That was to increase the use of renewable energy in Australia from 11% to 13% by 2010. This would be 9500 Giga Watt hour of renewable electricity per year by 2010.

In August 2009 a Bill was passed in the Australian parliament amending and expanding the existing MRET and replaced various existing and proposed state and territory schemes with one national scheme, the Renewable Energy Target (RET). The RET increased the MRET level of renewable energy from 9,500 Giga Watt hours (GWH) in 2010 to 45,000 GWH in 2020.[29] Targets under both the MRET and the RET refer to renewable energy in excess of the around 15,000 GWH that was in place in 1997. The total amount of electricity generated by renewable sources in 2020 will therefore be the base 15,000 GWH plus the target of 45,000 a total of 60,000 GWH. As the total electricity generated in 2020 is projected to be 300,000 GWH.

The Renewable Energy (Electricity) Act 2000 established a statutory agency the Office of Renewable Energy Regulator (ORER) to oversee the implementation of MRET. The Obligation percentage for Renewable Energy Target (RET) was set in "Renewable Energy (Electricity) Regulations 2001.

[29]Source: Website of Department of Climate Change and Energy Efficiency (Govt. of Australia) http://www.climatechange.gov.au/ret

Later with an amendment in Renewable Energy Bill 2000, the existing RET scheme has been operating in two parts since January 2011—the Small scale Renewable Energy Scheme (SRES) and the Large scale Renewable Energy Target (LRET). Combined, the new LRET and SRES are expected to deliver more renewable energy than the previous 45,000 GWh target in 2020. This was to provide more certainty for investments in large scale renewable projects and also for households. Liable entities will need to meet obligations under both the SRES and LRET by acquiring and surrendering renewable energy certificates created from both large and small-scale renewable energy technologies.

**Small-scale Renewable Energy Scheme (SRES)**

The SRES has been designed to deliver households; small business and community groups, up to $40 for each small-scale technology certificates (STCs) created by small-scale technologies like solar panels and solar water heaters. The Renewable Energy Regulator has established a voluntary 'clearing house' as a central point for the transfer of STCs at $40. There will be no cap on the number of STCs that can be created. In most cases, householders will continue to get the value of STCs immediately, as an agreed upfront discount on the cost of installing their solar water heater or solar PV system, as they do under the current arrangements.

In order to ensure the $40 clearing house price in the SRES remains relevant over time, the legislation establishes a process to review the price, if necessary. Before making any determination to reduce the $40 price, the Minister must obtain and take into consideration independent advice on a number of issues, including: changes in the costs of solar PV and solar water heaters; the extent to which owners of solar PV and solar water heaters contribute to the upfront costs of those systems; and the impact of the clearing house price and the levels of installation of solar PV and solar water heaters on the electricity market, including on electricity prices.

To facilitate the smooth operation of the small-scale market, the legislation also stages the flow of STCs. The regulations establish an estimate each year for the number of STCs needed to be acquired by liable entities. The target is set to align with expected rates of STC creation based on historic rates, analysis of government support, and expert judgment. Based on this target, liable entities are required to surrender STCs four times a year.

Eligibility: Small generation units (small-scale solar photovoltaic, small wind turbines and micro hydroelectric systems) and solar water heaters are eligible to create STCs under the SRES.

However, the legislation stipulates air source heat pumps with a volumetric capacity over 425 liters are excluded from creating STCs if installed on or after 29 June 2010 (subject to transitional arrangements prescribed by regulations).

**Solar Credits**

Solar Credits is a mechanism within the SRES scheme that provides additional support to households, businesses and community groups that install small-scale solar photovoltaic (PV or solar panels), wind and hydroelectricity systems by multiplying the number of small-scale technology certificates (STCs) able to be created for eligible installations.

Solar Credits apply to the first 1.5 kilowatts (kW) of capacity installed for systems connected to a main electricity grid and up to the first 20 kW of capacity for off-grid systems. Solar Credits work by multiplying the number of certificates that these systems would generally be eligible to create under the standard deeming arrangements. The level of support in terms of the number of certificates received via Solar Credits will be determined by the date the system is installed as noted below.

| Date installed | 9 June 2009 – 30 June 2011 | 1 July 2011 - 30 June 2012 | 1 July 2012 - 30 June 2013 | From 1 July 2013 onwards |
|---|---|---|---|---|
| Multiplier | 5 | 3 | 2 | 1 |

The Solar Credits multiplier reduces over time, reflecting reductions in technology costs. While system owners can create and sell the certificates themselves, in practice, providers of solar PV systems usually offer a discount on the price of a solar PV system, or a cash payment, in return for the right to create and sell the Solar Credits. Households considering installing solar PV systems are encouraged to shop around for the best deal on their solar PV system.

**Large-scale Renewable Energy Target (LRET)**

The LRET, covering large-scale renewable energy projects like wind farms, commercial solar and geothermal, will deliver the majority of the 2020 target. The LRET includes legislated annual targets and operates much the same as the previous RET design, but as a separate scheme to the SRES. From 2011 to 2030, the annual targets for the LRET are set at 4,000 GWh per year less than the previous RET targets, reaching 41,000 GWh by 2020. This is to take account of the separate mechanism to support small-scale renewable energy systems under the SRES. The LRET annual targets are listed in the table below.

***Table 11: LRET Annual Targets - Australia***

| Year | Revised targets (GWh) |
|---|---|
| 2011 | 10,400 |
| 2012 | 16,338 |
| 2013 | 18,238 |
| 2014 | 16,100 |
| 2015 | 18,000 |
| 2016 | 20,581 |
| 2017 | 25,181 |
| 2018 | 29,781 |
| 2019 | 34,381 |
| 2020-2030 | 41,000 |

Existing banked certificates will be available for use in the LRET but not for the new SRES. The annual LRET targets in 2012, 2013, 2016-2019 have been adjusted based on a provision in the legislation to take account of a higher than expected number of certificates created in 2010. The targets listed above reflect revisions announced by the Renewable Energy Regulator in January 2011.

Properly created LGCs are validated by the Clean Energy Regulator and are able to be transferred between eligible parties and liable parties for a negotiated price. Payment is arranged outside the REC Registry.

LGCs are surrendered:

- annually to demonstrate liability compliance against the requirements of the Large-scale Renewable Energy Target (LRET);
- voluntarily for any reason throughout the year; or
- For non-compliance (such as under the relevant enforceable undertaking sections of the Act) throughout the year.

Under The Renewable Energy (Electricity) Act 2000, the electricity acquisitions liable for REC are called “Relevant Acquisitions” (RA).

**Renewable Obligation:**

There are two different obligations set under LRET and SRES schemes. Renewable Power Percentage (RPP) under LRET and Small Scale Technology Percentage (STP) under SRES schemes places a legal liability on liable entities typically electricity retailers and wholesale purchasers of electricity to source certain amount of their purchase through renewable energy by purchase of LGC and STC every year. RPP and STP are set on the basis of:

- Required RE target of year.
- Estimated amount of electricity to be acquired by the liable entities for the year.
- Estimated amount of Partial Exemption Certificates (PEC) to be claimed for the year.
- Under/over surrender of LGCs and STCs in previous year.

The RPP and STP for the year 2011**is 9.15% (equivalent to 16.7 Mn LGCs)** and **23.96% (equivalent to 44.786 Mn STCs)** as a proportion of total estimated electricity consumption, both the percentage obligations are published before 31st of March every year on ORER‟s website. The entities which fail to comply with their obligations are supposed to pay a corresponding Renewable Energy Shortfall Charge (RESC). RESC was set by Renewable Energy (Electricity)(Charge) Act 2000 which has now been replaced by Large Scale Generation Shortfall Charge (LGSC) and Small Scale Technology Shortfall Charge (STSC) applicable under “The Renewable Energy (Electricity)(Large Scale Generation Shortfall Charge) Act 2000” and “The Renewable Energy (Electricity)(Small Scale Technology Shortfall Charge) Act 2010” respectively. The respective LGSC and STSC charge set are $65/LGC and $65/STC for compliance years from 2010 to 2030 and 2011 to 2030.

# CHAPTER 4: FINDINGS AND ANALYSIS

**1. Lack of Clarity Regarding Minimum Size of Projects to be Eligible for REC –**

CERC doesn't specify minimum installed capacity for projects to avail RECs, though in Draft document issued by CERC on March 17, 2010, it was mentioned as 250 KWp.[30] Only three state agencies, (viz. Jammu and Kashmir, Maharashtra and Orissa), have specifically notified the minimum size allowed for REC projects.

The table shows the details

| STATE | REC cap |
|---|---|
| Andhra Pradesh | No Cap |
| Assam | No Cap |
| Bihar | No Cap |
| Chattishgarh | No Cap |
| Delhi | No Cap |
| Gujarat | No Cap |
| Haryana | No Cap |
| Himachal Pradesh | No Cap |
| Jammu & Kashmir | 250 kW |
| Goa & UT | No Cap |
| Jharkhand | No Cap |
| Kerala | NA |
| Madhya Pradesh | No Cap |
| Maharashtra | 250 kW |
| Manipur and Mizoram | No Cap |
| Meghalaya | No Cap |
| Nagaland | NA |
| Orissa | 250 kW |
| Punjab | No Cap |
| Rajasthan | No Cap |
| Tamil Nadu | No Cap |
| Tripura | No Cap |
| Uttar Pradesh | No Cap |
| Uttrakhand | No Cap |

[30]Source: MODEL PROCEDURE / GUIDELINES FOR ACCREDITATION OF RENEWABLE ENERGY GENERATION PROJECT FOR REC MECHANISM BY STATE AGENCY (Draft dated March 17, 2010)

MERC specifies minimum installed capacity for availing REC benefit to be 250 kwp.[31]However, there are cases in Maharashtra where projects lower than the specified capacity (250 kWp) have been accredited.

| STATE | Energy Source | RE Generator | Project No. | Capacity (MW) | Date of Accrediation | Date of Registration |
|---|---|---|---|---|---|---|
| Maharastra | Wind | M-Tech Innovations Ltd | OO1 | 0.225 | 29-06-2012 | N/A |
| Maharastra | Wind | M/s KOTHARI AGRITECH PVT. LIMITED | OO1 | 0.225 | 6/6/2012 | N/A |
| Maharastra | Wind | M/s KOTHARI AGRITECH PVT. LIMITED | OO2 | 0.225 | 6/6/2012 | N/A |
| Maharastra | Wind | BotharaFoundary& Machine Works | OO1 | 0.225 | 29-03-2012 | 23-05-2012 |
| Maharastra | Wind | Deegee Orchards Pvt Ltd | OO1 | 0.23 | 17-02-2012 | 23-03-2012 |
| Maharastra | Wind | Sanjay D. Ghodawat HUF | OO1 | 0.23 | 17-02-2012 | N/A |
| Maharastra | Wind | NarendraSolvexPvt Ltd | OO1 | 0.23 | 17-02-2012 | 23-03-2012 |
| Maharastra | Wind | Narendra Vegetable Products Pvt Ltd | OO1 | 0.23 | 17-02-2012 | 23-03-2012 |

*Source: https://www.recregistryindia.in/index.php/general/publics/accredited_regens

There should be uniformity among states agencies while setting eligibility criteria for Accreditation. Again, the states which have specifically laid out criteria should follow them strictly. More clarity regarding minimum installed capacity for REC eligibility is desired.

[31]Source: MERC (RPO, ITS COMPLIANCE AND IMPLEMENTATION OF REC FRAMEWORK) REGULATIONS, 2010

**2. Non-Uniform Approach in target setting**

The target for RE generation (year 2012-13) has been taken as average of renewable energy requirement as per the NAPCC and as per the MNRE Report on "Renewable Energy in India: progress, Vision and Strategy. Therefore, the Commission has, for computing floor price, settled on a figure which is around 70000 MUs.

In the last order dated 1st June 2010 for calculating REC prices the respective RE (MU) for 6% of DMRPS it was considered on the basis of 17th Electric Power Survey (EPS) data.

A uniform approach should be adopted for setting the targetas it directly affectsthe floor price. Higher the target higher is the floor price.And subsequently it affects the cash flow for project developers.

**3. Non Availability of RPO levels and Periodic Accomplishment at Single Source**

Information about RPO levels of various states is not available at single source (website). Again, information about periodic accomplishment of RPO target by various obligated entities are also not available on public domain.

Once rational RPO targets have been set for various states, the information about it and its accomplishment should be available on website maintained by central agency (NLDC). The Central Agency (CA) from time to time, after each trading session (of RECs) or fortnightly, update the RPO achievement section and should intimate the utilities falling short of target. The regular updating of target achieved will give an idea of REC market to the RE generators and they can thus eventually anticipate the REC demand in months ahead.

**4. Piling Up of REC Inventory (Closing Balance)**

Since the first trading session in March 2011, in last 18 trading sessions, only three times number of RECs issued have exceeded number of RECs redeemed. This has led to huge surge of REC inventory (non-redeemed). Again, RECs are valid for only a year (from date of issuance) and eventually lapsed if not traded in one year.

This leaves the RE developers with skepticism about the popularity of certificate market as their cash inflows are at stake.

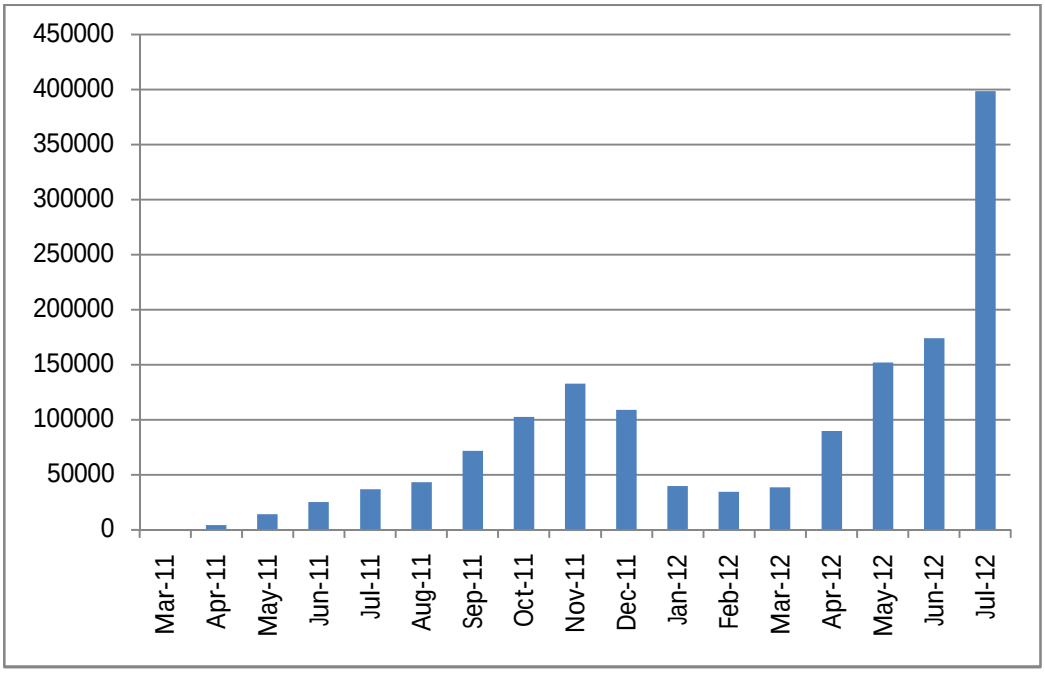



***Figure 2: REC Inventory (Closing Balance)***

Stricter compliance of RPO is recommended. Otherwise the balance between demand and supply is disturbed. Laxity in compliance leads to piling up of REC inventory. This again leads to skepticism in minds of RE project developers who are pondering about setting up plants under RE mechanism.

Another way of assuring the developers regarding this issue is increasing the validity period of REC (to 1.5 or 2 years) as is in other international markets.

## 5. REC Trade Volume Skewed at Year End

RPO compliance in India is on annual basis.The obligated entity buys RECs for meeting their RPO target at the end of financial year. This leads to the REC trade volume skew at year end.

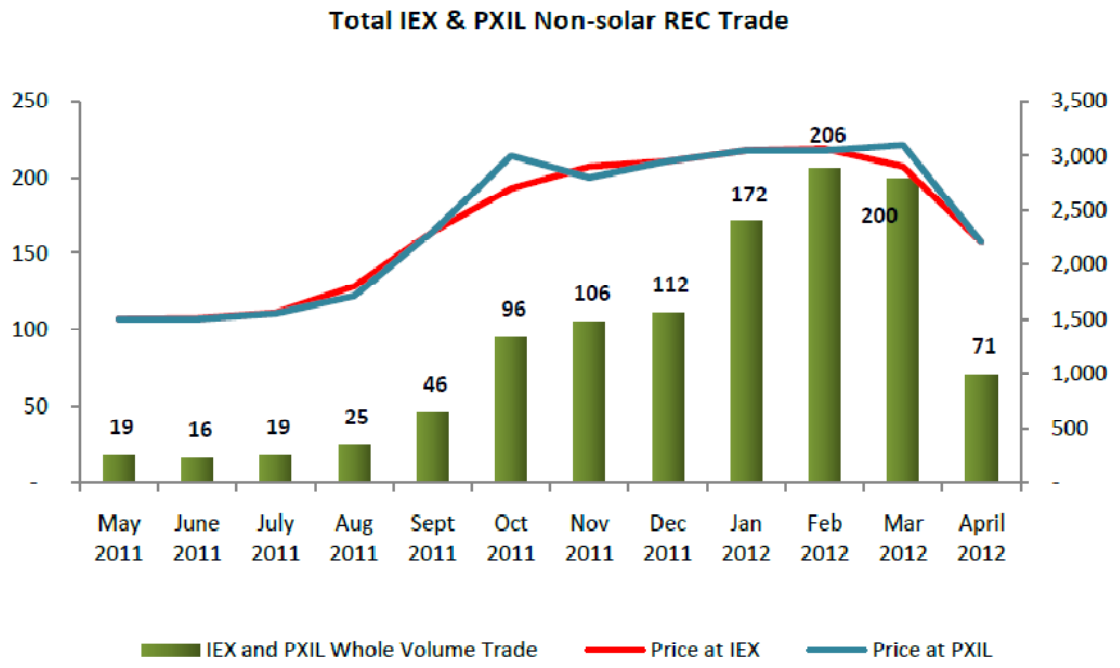



***Figure 3: REC Trade Volume***

More frequent RPO compliance should be there. This can be done quarterly or once in four months or even half yearly.

## 6. Uncertainty about Length of Control Period and REC price post 2017

A great deal of confusion and wide range of opinions persists when it comes to length of control period. A longer control period will give a sense of security and certainty to developers but at the same time this won't reflect the reduction in cost due to change in technology.

A longer control period should be set, with floor price kept constant over the control period. This will ensure minimum returns to the RE generators, giving certainty. But the forbearance price should be revised from time to time (yearly or once in two years) reflecting the reduction in cost due to improvement in technology. While anticipating his cash flows, the developer should take into account the floor price fixed. Anything above floor price he gets by selling RECs on PEx will be his premium for the risk he has taken.

### 7. Little Participation of Small Voluntary Buyers

While the primary goal of the RECs is to address the needs of the compliance market, it can also serve as a useful tool for meeting the 'green electricity' needs of the voluntary market. Such applications include participation by corporate as a part of their Corporate Social Responsibility (CSR) and by philanthropic organizations as well as individuals. In 2004, voluntary market in the USA was estimated to account for about 3 million MWh of green electricity with an estimated market value of $ 15–45 million. This is projected to go up to 20 million MWh of green electricity with an estimated market value of $ 100–300 million by 2010[32].

The increase in voluntary demand for RE by residentialand commercial consumers in the US is driven by green products offered by utilities and competitive electricitysuppliers, and RECs.Refer *Table 12*.

***Table 12: Voluntary Purchase of RE by Customer Type in USA***

| S. No. | *Year* | 2005 | 2006 | 2007 | 2008 |
|---|---|---|---|---|---|
| 1 | Residential (GWh) | 3,000 | 3,200 | 4,500 | 5,500 |
| 2 | Commercial (GWh) | 5,500 | 8,700 | 13,600 | 18,8000 |
| 3 | Total (GWh) | 8,500 | 11,900 | 18,100 | 24,300 |
| 4 | Share of Commercial (in %) | 65 | 73 | 75 | 77 |

Source[33]

In India REC has found little popularity among voluntary buyers. Only two corporates viz. (POSOCO and Manikaran Power Trading Ltd.) have voluntarily bought RECs from IEX so far.[34]

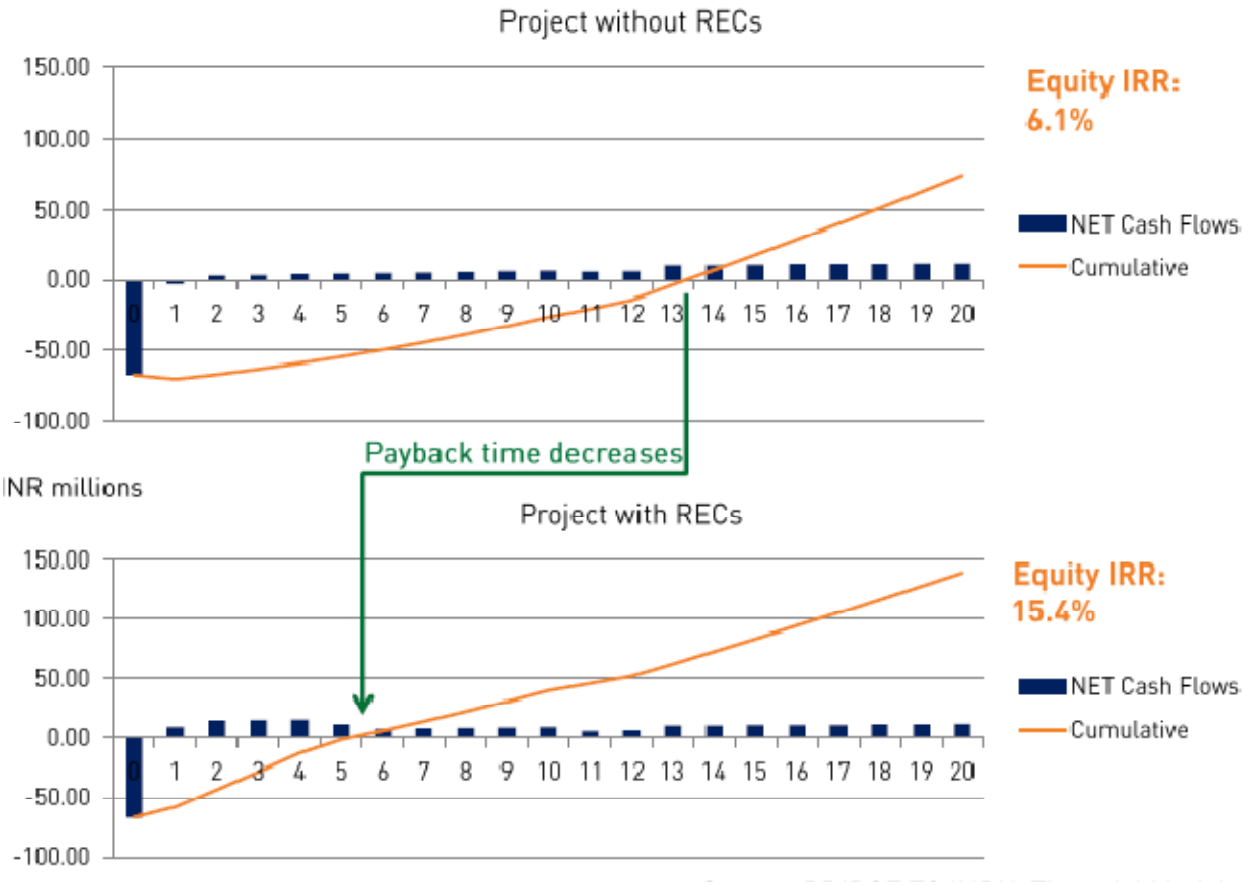
Recommendation: Steps should be taken to encourage participation of voluntary buyers. A smaller denomination of REC would enhance market participation and would improve liquidity in the market for RECs. Smaller denominationwill facilitate participation of small buyers as well as small projects across the country.While the compliance market may remain the primary driver for the RECs in India in the initial stage, the scope for voluntary market purchases would remain promising in future.

[32]Holt, Ed and Lori Bird (2005).*"Emerging Markets for Renewable Energy Certificates: Opportunities and Challenges"*, Technical Report, NREL/TP-620-37388, National Renewable Energy Laboratory, Colorado.
[33]Cook, O. and A. Karelas (2009). *Insights into the Renewable Energy Market: A Brief Overview of Procurement Trends, Drivers, and Impacts of Voluntary Commercial Purchasers*, Center for Resource Solutions. Francisco, California.
[34] Source: List of REC Voluntary Buyers from IEX http://www.iexindia.com/RECApp/RECVoluntaryBuyers.aspx

**8. Current REC Mechanism doesn't Incentivise Off-grid installations**

The present REC mechanism doesn't benefit off-grid application. As per current CERC REC Regulation the mechanism is only for grid connected plants. Thus the off-grid and small applications like rooftop solar PV cannot avail the benefit from REC mechanism.

By leveraging the REC mechanism, solar becomes cost competitive with conventional power production from commercial and industrial segments. REC represents critical source of cash flows for project owners. In several countries like Australia small RE installations are also included in beneficiary list of similar certificate trading schemes. The following figure shows how REC can substantially reduce payback period of small installations.




Source: BRIDGE TO INDIA Financial Model

# CHAPTER 5: FINANCIAL MODELING (SOLAR PV PLANT)

## 5.1 Introduction

Renewable power generation capacity in India has been set up largely through private sector investments. New investment is the most potent indicator of growth of the sector. As per an estimate, in 2009 the total financial investment in clean energy in India was at INR 135 billion. India ranked the fourth most attractive country for renewable energy investment in the world, only behind the United States, China, and Germany.[35] But highly aggressive bidding by developers in increasing fierce competitive environment and uncertainty regarding the various costs incurred; increases the risk associated with making an investment in setting up solar power plant.

A financial model helps the developer to explore in detail the financial benefits and costs associated with the investment. This facilitates the identification of key variables affecting the project value and enables financing decisions.The following section describe the key items and assumptions that are included in the financial modeling of a typical Indian solar PV project, and discusses the conclusions based on the calculation of various financial parameters.

## 5.2 Assumptions

**Capital Costs**

The normative capital cost for setting up Solar Photovoltaic Power Project shall be 1000 Lakh/MW for FY 2012-13 as per CERC (Terms and Conditions for Tariff determination from Renewable Energy Sources) Regulations, 2012. But the recent drop in module cost accompanied by increase in level of competition has dragged down the overall project cost quite substantially.

**Operations and Maintenance (O&M) Cost**

One of the major benefits of Solar PV power plants is less O&M costs as compared to other renewable energy technologies. In the financial model O&M has been taken as per prevailing in the industry.

[35] "All Renewables Index" for Feb 2012 – ERNST & YOUNG

**Annual Energy Yield**

There are a number of factors (e.g. Air pollution, shading, soiling, ambient temperature, module quality, DC cable resistance, invertor performance, AC losses, downtime etc.) which affect the annual energy yield of a solar PV project. The confidence level of the yield forecast is important, as the annual energy yield directly affects the annual revenue. The energy yield prediction provides the basis for calculating project revenue. The aim of an energy yield analysis is to predict the average annual energy output for the lifetime of the proposed power plant. Typically, a 25 to 30 year lifetime is assumed. Energy yield prediction reports should consider and (ideally) quantify each of these losses. In the financial model energy yield prediction for 25 years is made taking into account annual deration.

**Energy Price**

Besides the power generated, the solar PV project revenue is dependent upon the power price. This may be fixed or variable according to the time of day or year, and must be clearly stipulated in the power purchase agreement.Economic return has historically been the key limiting factor for development of large scale grid-connected solar PV projects. PV has a high initial capital cost. High energy prices are required for projects to be economic. Currently, grid-connected solar projects are highly dependent on policy support initiatives such as grants, feed-in tariffs, concessional project funding and mandatory purchase obligations.

The financial model has been made with flexibility to know various financial indicators with 3 power selling options:

1. Selling to State Discom at APPC.
2. Selling through open access to HT consumer.
3. Selling to power exchange at a market determined price.

**Certified Emission Reductions (CERs)**

As India is a non-Annex 1 party under the UN Clean Development Mechanism (CDM), qualifying Indian solar projects could generate Certified Emission Reductions (CERs). These CERs can then be sold to Annex 1 parties and help them comply with their emission reduction targets. This effectively causes transference of wealth from Annex 1 parties such as the UK and Germany to Indian developers.

Each CER is equivalent to the prevention of one tonne of carbon dioxide emissions. The income from CERs can be substantial. However, this revenue source cannot be predicted as it is uncertain whether the project will be accredited. Moreover, CER values fluctuate considerably.

The National CDM Authority under the Ministry of Environment and Forests (MoEF) is the designated authority in India for approving CDM projects. The model has the flexibility of taking into account approximate revenue from sale of CERs

**Financing Assumptions**

The project financing structure generally comprises of debt and equity.The general financial assumptions for a project in India are as follows:

• Financing structure – equity 30% and debt 70% as assumed in CERC tariff order.

• Debt repayment period – 10-12 years (approx.).

The following table shows assumptions taken for calculation in financial model.

| **Plant Details** | | |
|---|---|---|
| Installed Capacity | MW | 5 |
| CUF | % | 17.12% |
| Annual Deration | % | 0.75% |
| AUX | % | 0.25% |
| Useful Life | Years | 25 |

| **Capital Structure** | | |
|---|---|---|
| Debt | % | 70% |
| Equity | % | 30% |
| Total Debt Amount | Mn | 325.7062147 |
| Total Equity Amount | MN | 139.5883777 |

| **Project Cost** | INR Mn/MW | INR Mn |
|---|---|---|
| EPC | 80 | 400 |
| Land | 5 | 25 |
| Development Cost | 3.5 | 17.5 |
| IDC | | 22.79459241 |
| Total project Cost | | 465.2945924 |

| CDM Benefits | | |
|---|---|---|
| | | Yes |
| CERs per MU | | 950 |
| Rate per CER | Euro | 4 |
| 1 Euro | INR | 66.16 |
| Rate per CER | INR | 264.64 |
| Estimated Period of Availability | Years | 10 |
| 80 IA Benefit (1="Yes", 2="No") | | 1 |
| UNFCCC Adaptation Fee | | 2.00% |
| Revenue Retained (in 1st year) | | 100% |
| Incremental Share of Beneficiary (p.a.) | | 10% |
| Min. Retained Revenue | | 50% |

| Taxes | | | |
|---|---|---|---|
| Basic Tax | | | 30% |
| Add: Surcharge | | | 5.00% |
| Add: Cess | | | 3% |
| Net Corporate Tax | | | 32.45% |
| | | | 0.00% |
| Min. Alternate Tax | | | 18.50% |
| Add: Surcharge | | | 5.00% |
| Add: Cess | | | 3.00% |
| Net MAT | | | 20.01% |
| | Start Year | Year | |
| Tax Exemption u/s 80 IA | 8 | 10 | 100.00% |

| Debt Schedule | | |
|---|---|---|
| Loan Amount | Mn | 325.71 |
| Moratorium Period | No. Of Quarters | 0 |
| Repayment Period | Years | 7 |
| Repayment Period (Incl Moratorium) | Years | 7 |
| Repayment Style | | Quaterly |
| Interest on Term Loan | | 13% |
| Interest on WC | | 12% |

| Const. Time Table | | |
|---|---|---|
| Construction Start Date | | 1-Apr-12 |
| Time in Construction | Months | 12 |
| COD | | 1-Apr-13 |

| Misc. | | |
|---|---|---|
| Land appreciating @ | p.a. | 5% |
| Discount Rate | | 20.00% |

| Working Capital | | |
|---|---|---|
| O&M Charges | Months | 1 |
| Receivables for Debtors | Months | 1 |
| Maintenance Spare | (% O&M Exp.) | 15% |
| WC Loan | | 100% |

| Depreciation | | | |
|---|---|---|---|
| **Companies Act** | | | |
| Depreciation Rate for first 10 years | | per annum | 5% |
| Aggregate Dep. in first 10 years | | % | 50% |
| Total allowed Depreciable Value | | % | 100% |
| Depreciation Rate from 11 year onwards | | % p.a. | 3.33% |
| | | | |
| **Income Tax Act** | | | |
| Depreciation Rate | on WDV | | 80% |

| REC | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Control Period Ending on -->** | | 1-Apr-12 | 1-Apr-17 | 1-Apr-22 | 1-Apr-27 | 1-Apr-32 | 1-Apr-37 | 1-Apr-42 |
| **% Reduction in Price** | | | | 20% | 100% | 25% | 25% | 25% |
| Forbearance Price | (Rs/KWh) | 17 | 13.4 | 10.72 | 0 | 0 | 0 | 0 |
| Floor Price | (Rs/KWh) | 12 | 9.3 | 7.44 | 0 | 0 | 0 | 0 |

Note: The model is developed with flexibility to change the input field in cells with back ground color

## 5.3 Project Economics and Financial Indicators

Project financial model calculates a range of project value indicators in order to allow developers, lenders, investors and relevant government bodies to assess the project economics from several perspectives.

From an investor's point of view, a project is generally considered to be a reasonable investment only if the internal rate of return (IRR) is higher than the weighted average cost of capital (WACC). Investors will have access to capital at a range of costs; the return arising from investment of that capital must be sufficient to meet the costs of that capital. Moreover, the investment should generate a premium associated with the perceived risk levels of the project.

Solar projects are usually financed with equity and debt components. As a result, the IRR for the equity component can be calculated separately from the IRR for the project as a whole. The developer's decision to implement the project or not, will be based on the equity IRR.

As returns generated in the future are worth less than returns generated today, a discount can be applied to future cash flows to present them at their present value. The sum of discounted future cash flows is termed the net present value (NPV). Investors will seek a positive NPV, assessed using a discount rate that reflects the WACC and perceived risk levels of the project.

Lenders will be primarily concerned with the ability of the project to meet debt service requirements. This can be measured by means of the debt service coverage ratio (DSCR), which is the cash flow available to service debt divided by the debt service requirements. The Average DSCR represents the average debt serviceability of the project over the debt term. A higher DSCR results in a higher capacity of the project to service the debt. Minimum DSCR represents the minimum repayment ability of the project over the debt term. A Minimum DSCR value of less than one indicates the project is unable to service the debt in at least one year.

Based on assumptions taken and calculations[36] done in financial model following are values of various financial indicators.

| Project Economics | |
|---|---|
| Project IRR | 18.03% |
| Equity IRR | 21.56% |
| Min DSCR | 1.027023 |
| Avg. DSCR | 1.2971679 |

[36] Refer Annexure Part II for calculation sheets.

## 5.4 Sensitivity Analysis

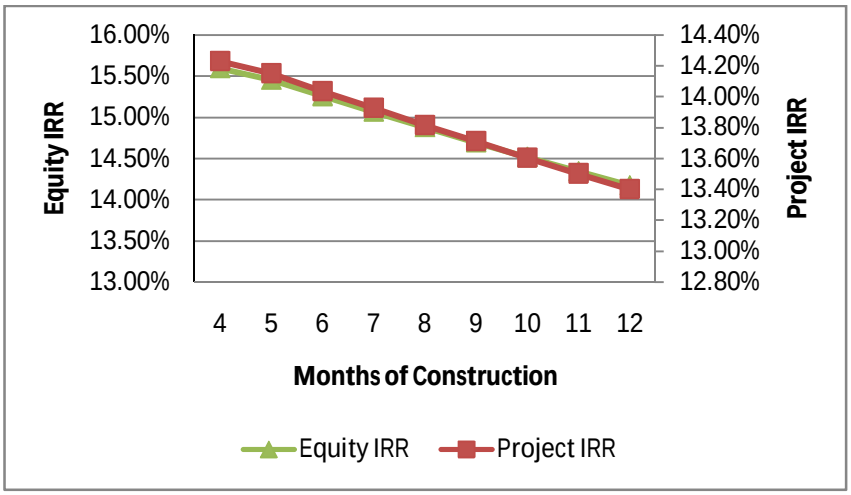
Sensitivity analysis involves changing the inputs in the financial model (such as power tariff, capital cost, interest rate etc.) to analyze how the value of the project changes (measured using Net Present Value, Internal Rate of Return, or the Debt Service Cover Ratio).

Sensitivity analysis gives lenders and investors a greater understanding of the effects of changes in inputs on the project's profitability and bankability. It helps them understand the key risks associated with the project. Lenders will conduct sensitivity analysis around the key variables in order to determine whether the project will be able to service the debt in a bad year, for example if energy yield is lower than expected, or operational expenditure is higher than expected.

Following sensitivity analysis was done

**1**. Effect of 'Time Taken in Construction' on financial parameters viz. Project IRR, Equity IRR, Minimum DSCR and Average DSCR. The effect can be seen in table below.

| Time in Const. (Months) | Project IRR | Equity IRR | Min. DSCR | Avg. DSCR |
|---|---|---|---|---|
| 4 | 18.20% | 21.87% | 1.0367 | 1.3039 |
| 5 | 18.13% | 21.74% | 1.0327 | 1.3011 |
| 6 | 18.03% | 21.56% | 1.0270 | 1.2972 |
| 7 | 17.94% | 21.39% | 1.0215 | 1.2933 |
| 8 | 17.84% | 21.22% | 1.0161 | 1.2896 |
| 9 | 17.75% | 21.05% | 1.0108 | 1.2859 |
| 10 | 17.66% | 20.89% | 1.0055 | 1.2823 |
| 11 | 17.57% | 20.73% | 1.0004 | 1.2787 |
| 12 | 17.49% | 20.57% | 0.9954 | 1.2752 |



**2. Effect of REC trade price on Financial Parameters**

CERC has given Forbearance Price and Floor Price for REC. RECs are traded in power exchanges between these two price ranges. But the current Floor and Forbearance price is applicable till March 2017. After that REC price is expected to go down.

Some developers are of the view that once grid parity is achieved the government may with draw the mechanism. Though, these are just speculations.

The following table shows the how financial indicators viz. Project IRR, Equity IRR and Average DSCR will vary with change in price at which REC would be traded post 2017. It is evident that if RECs are traded below a certain level then the project's viability will be jeopardized.

| Period From | COD | 1-Apr-17 | 1-Apr-22 | 1-Apr-27 | 1-Apr-32 | 1-Apr-37 | Project IRR | Equity IRR | Avg DSCR |
|---|---|---|---|---|---|---|---|---|---|
| Till | 1-Apr-17 | 1-Apr-22 | 1-Apr-27 | 1-Apr-32 | 1-Apr-37 | - | | | |
| REC Trade Price (Rs/KWh) | 9.3 | 7.44 | - | - | - | - | 18.03% | 21.56% | 1.29 |
| | 9.3 | 5.58 | - | - | - | - | 17.42% | 20.47% | 1.24 |
| | 9.3 | 4.65 | - | - | - | - | 17.05% | 19.80% | 1.19 |
| | 9.3 | 4.65 | 2.325 | - | - | - | 17.45% | 20.43% | 1.19 |
| | 9.3 | - | - | - | - | - | 15.16% | 16.59% | 0.98 |

## 5.5 Limitations of Financial Model

- The financial model (attached) is developed with the solely objective of learning the intricacies of financial modeling. Values in various input fields (like Tax Rate, EPC Cost etc.) may not be correct.
- The financial model developed is not perfectly flexible. It has some constraints while entering the input fields like
    - Moratorium Period can be either 0 or 1 or 2 years
    - Date of commissioning is hard fixed to be April 1, 2013
    - Debt service to bank is done quarterly. Etc.

# CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

## 6.1 Conclusion

At least 109 countries had some type of renewable power policy by early 2012, up from less than one hundredin 2011. More than half of these countries are developing countries or emerging economies. Of all the renewable electricity policies employed by national and state/provincial governments, feed-in-tariffs (FIT) and renewable portfolio standards (RPS) are the most common.

However, purchase at fixed prices is gradually shifting toward market-principle-oriented systems, typically the RPS System and Tradable Certificate Scheme (REC). Germany reduced its solar PV tariffs several times in 2011 and early 2012, and introduced monthly tariff reduction.Portugal indefinitely suspended the issuing of new licenses for projects benefiting from its FIT, and Spain halted all new FIT applications in early 2012 as it sought to reform its national energy system.Outside Europe, China also announced significant reductions in solar FITs.Similar trend is visible in many other countries as purchase at fixed prices gave rise to problems such as price rigidity and rather slow cost reductions driven by mass production, and increases the financial burden on national governments.

Certificate Trading Scheme (REC in Indian context), is a proven instrument world over to promote renewable energy. Such schemes have been adopted by more than 20 countries to increase share of renewable energy in electricity mix of their country. Apart from offering several other benefits like effective implementation of RPO regulations, increased flexibility to participants, overcoming geographical constraints, lesser transaction costs for RE transactions, enforcement or penalty mechanism, creating competition between different RE technologies, reducing risks for local distribution company, REC being a market driven mechanism, does not increase the financial burden on national governments like schemes offering preferential tariffs (FiT).

However, the current mechanism brings imperfections and leaves a lot of scope for improvement. The uncertain returns from REC make investors skeptic about the project viability. Financial institutions and commercial banks are also reluctant in extending loans for projects to be installed under REC mechanism as the cash flows are uncertain after the current control period.

Lack of Clarity Regarding Minimum Size of Projects to be Eligible for REC further makes the situation unambiguous. Absence of banking facility in current REC mechanism increases the risk profile of developer.

Again, validity of REC only one year also increases the risk of developers as they get limited number of chances to put their REC for trade on power exchange. In UK, Poland, Denmark and Netherlands the validity of certificate is unlimited.

Absence of sunset date in current REC mechanism leaves the stakeholder skeptic about the future of mechanism. Again, higher denomination and ramification of certificate type constraints the liquidity. A very little participation is seen from voluntary buyers in REC market in India. Only two buyers have voluntary bought RECs from IEX. The proportion of such voluntary buyers is quite high in USA.

Annual compliance reporting skew the demand supply equilibrium to the end of year and absence of stringent penalty mechanism further imbalances the whole demand-supply scenario. There have been cases where Solar RPO target is met with purchase of Non-Solar RECs. Again, any penalty for non-compliance of RPO targets has not come to fore. This leniency in RPO compliance distorts the whole REC market.

Again, non-uniformity in RE target setting for calculating the price for REC price makes this unclear. The target for RE generation (year 2012-13) has been taken as average of renewable energy requirement as per the NAPCC and as per the MNRE Report on “Renewable Energy in India: progress, Vision and Strategy. Therefore, the Commission has, for computing floor price, settled on a figure which is around 70000 MUs. In the last order dated 1st June 2010 for calculating REC prices the respective RE (MU) for 6% of DMRPS it was considered on the basis of 17th Electric Power Survey (EPS) data.

Again, the regulations are silent on a separate grid connection rules for REC projects. As for REC eligibility, the project is required to be grid connected thus grid connection become a necessity. The current grid connection rules according to Indian Electricity Grid Code (IEGC) – applicable to wind and solar projects in general – states that the injection points should always be at the higher voltage side of distribution or transmission network. The grid rules are made in context to large power plants where per unit cost of step-up transformer for connection to the grid is very low due to high energy generation. However these additional costs make small REC projects unviable.

Again, the open access charges for conventional energy are between INR 1 per kWh to INR 3.5 per kWh, which makes the sale of solar power through OA unviable even with the REC upside. Some states like Maharashtra give concession on OA charges but most states to do not have a separate regulation on open access charges. Further, the transmission and distribution losses are very high in India and a generator has to bear such charges if they are selling power through open access. It is possible to install a solar power plant on the consumer's roof itself, so that the generator and consumer are not using the infrastructure of the area's distribution company (DISCOM). In such cases DISCOMs should not charge any losses to the generator.

## 6.2 Recommendations

- There should be uniformity among states agencies while setting eligibility criteria for accreditation. The states which have specifically laid out criteria should follow them strictly. More clarity regarding minimum installed capacity for REC eligibility is desired.
- A uniform approach should be adopted for setting the RE target while calculating floor and forbearance price of RECs as it directly affectsthe floor price. Higher the target higher is the floor price.And subsequently it affects the cash flow for project developers.
- The information about RPOlevel and its accomplishment should be available on website maintained by central agency (NLDC). The Central Agency (CA) from time to time, after each trading session (of RECs) or fortnightly, update the RPO achievement section and should intimate the utilities falling short of target. The regular updating of target achieved will give an idea of REC market to the RE generators and they can thus eventually anticipate the REC demand in months ahead.
- In order to avoid piling of REC inventory and give a sense of security to developers, stricter compliance of RPO is recommended. Otherwise the balance between demand and supply is disturbed. Laxity in compliance leads to piling up of REC inventory. This again leads to skepticism in minds of RE project developers who are pondering about setting up plants under RE mechanism. Another way of assuring the developers regarding this issue is increasing the validity period of REC (to 1.5 or 2 years) as is in other international markets.
- Again, leniency in compliance should not be appreciated. There are cases when solar RPO targets are met by purchasing non-solar RECs. This distorts the whole demand supply equilibrium.
- CA should be made responsible to keep track of the utilities regarding their RPO compliance and penalty for not doing so. Because SERCs are too much influenced by the state level political equations and expecting them to behave in impartial manner would be futile. The power to impose penalty for non-compliance should be with CA.
- RPO should not, in any case, be allowed to carry forward (to next financial year) as this dissolves the purpose totally and disturb the whole demand-supply equilibrium. (Like Punjab SERC allowed the RPO of 2011-12 to be carried forward to next year.)

- Steps should be taken to encourage participation of voluntary buyers. A smaller denomination of REC would enhance market participation and would improve liquidity in the market for RECs. Smaller denomination will facilitate participation of small buyers as well as small projects across the country. While the compliance market may remain the primary driver for the RECs in India in the initial stage, the scope for voluntary market purchases would remain promising in future..
- A longer control period should be set, with floor price kept constant over the control period. This will ensure minimum returns to the RE generators, giving certainty. But the forbearance price should be revised from time to time (yearly or once in two years) reflecting the reduction in cost due to improvement in technology. While anticipating his cash flows, the developer should take into account the floor price fixed. Anything above floor price he gets by selling RECs on PEx will be his premium for the risk he has taken. Again, the control period should be equal to the time period in which loan is to be repaid.
- Multiplier mechanism can be introduced. Separate RECs for Solar and Non Solar unnecessarily ramify things. Again, if significant difference in the cost of generation is the reason behind it then by that logic there should be separate RECs for solar thermal and Solar PV. Again, high price of Solar REC decreases its trading volume on PEx. If the price of Solar REC is kept low this would increase its trading volume. The logic is same for which companies go for share split (based on face value of share) to increase its trading volume on stock exchange. Now if one type of REC is there, solar generators can be issued RECs proportionate to average of floor and forbearance price.
- Issuance of REC to entities other than RE generators.In states where OEs are buying expensive RE power over and above their RPO, they should be allowed to get RECs. Such a step will motivate RE investment in such potential states. OE should be allowed to redeem its REC on Power Exchange.
- More frequent ComplianceRPO compliance should be made quarterly, against annual. Otherwise, the market will tend to get skewed, with most of the activity happening at the year-end.
- Again, banking and vintage mechanism can also be considered to make the market more attractive and lucrative.

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   http://www.cercind.gov.in/
4. Central Electricity Authority
   http://www.cea.nic.in/
5. Renewable Energy Certificate Registry of India
   https://www.recregistryindia.in/
6. Power System Operation Corporation India Ltd.
   http://www.nldc.in/
7. Indian Renewable Agency Development Agency
   http://www.ireda.gov.in/
8. NTPC Vidyut Vyapar Nigam Ltd.
   http://nvvn.co.in/
9. Office of gas and Electricity Markets, U.K.
   www.ofgem.gov.uk/
10. Clean Energy Regulator, RET – Govt. Of Australia
    http://ret.cleanenergyregulator.gov.au

# ANNEXURE

## Annexure Part I

***Table 13: Installed Capacity, India (fuel wise breakup)***

| **Fuel** | **MW** | **%age** |
|---|---|---|
| Total Thermal | 134635.18 | 66.32 |
| Coal | 114,782.38 | 56.54 |
| Gas | 18,653.05 | 9.18 |
| Oil | 1,199.75 | 0.59 |
| Hydro | 39,060.40 | 19.24 |
| Nuclear | 4,780.00 | 2.35 |
| RES** | 24,503.45 | 12.07 |
| Total | 2,02,979.03 | 100.00 |

Renewable Energy Sources (RES) include SHP, BG, BP, U&I and Wind Energy

SHP= Small Hydro Project BG= Biomass Gasifier

BP= Biomass Power U & I=Urban & Industrial Waste Power

** The installed capacity in respect of RES is as on 31.03.2012

***Table 14: Renewable Installed Capacity (India)*** ***Source: MNRE***

| **New & Renewable Energy**<br>Cumulative deployment of various Renewable Energy Systems/ Devices in the country as on 31/05/2012 | | | | |
|---|---|---|---|---|
| Renewable Energy Programme/ Systems | Target for 2012-13 | Deployment during June, 2012 | Total Deployment in 2012-13 | Cumulative achievement up to 31.05.2012 |
| **POWER FROM RENEWABLES:** | | | | |
| **A. GRID-INTERACTIVE POWER (CAPACITIES IN MW)** | | | | |
| Wind Power | 2500 | 110.50 | 291.70 | 17644.35 |
| Small Hydro Power | 350 | 5.70 | 16.45 | 3411.76 |
| Biomass Power | 105 | 6.00 | 32.00 | 1182.10 |
| Bagasse Cogeneration | 350 | 34.50 | 61.50 | 2046.73 |
| Waste to Power- -Urban | 20 | 4 | 4 | 93.68 |
| -Industrial | | - | - | |
| Solar Power (SPV) | 800 | 51.66 | 89.38 | 1030.66 |
| **Total** | **4125.00** | **212.41** | **495.03** | **25409.28** |
| **B. OFF-GRID/ CAPTIVE POWER (CAPACITIES IN $MW_{EQ}$)** | | | | |
| Waste to Energy - - Urban | 20.00 | 1.39 | 3.59. | 105.34 |
| -Industrial | | | | |
| Biomass(non-bagasse) Cogeneration | 60.00 | 3.5 | 8.85 | 391.35 |
| Biomass Gasifiers -Rural- | 1.50 | .128 | 0.128 | 16.248 |
| - Industrial | 10.00 | 2.70 | 2.70 | 136.79 |
| Aero-Generators/Hybrid systems | 0.50 | 0.10 | 0.10 | 1.74 |
| SPV Systems (>1kW) | 30.00 | - | - | 85.21 |
| Water mills/micro Hydel | 2.00(500 Nos.) | 191 Nos. | 191 Nos. | 1877 Nos. |
| **Total** | **126.00** | **7.428** | **15.368** | **736.678** |

*Table 15: RPO Targets (State wise- India)*

| | | RPO / SPO (% total energy procured) | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 2010-11 | 2011-12 | 2012-13 | 2013-14 | 2014-15 | 2015-16 | 2016-17 |
| **Andra Pradesh** | RPO | | | | | 5 | 5 | 5 |
| | SPO | | | | | 0.25 | 0.25 | 0.25 |
| **Assam** | RPO | 1.4 | 2.8 | 4.2 | 5.6 | 7 | | |
| | SPO | 0.05 | 0.1 | 0.15 | 0.2 | 0.25 | | |
| **Bihar** | RPO | 1.5 | 2.5 | 4 | 4.5 | 5 | | |
| | SPO | 0.25 | 0.5 | 0.75 | 1 | 1.25 | | |
| **Chhattisgarh** | RPO | 5 | 5.25 | 5.75 | | | | |
| | SPO | 0.25 | 0.25 | 0.5 | | | | |
| **Delhi** | RPO | | 2 | 3.4 | 4.8 | 6.2 | 7.6 | 9 |
| | SPO | | 0.1 | 0.15 | 0.2 | 0.25 | 0.3 | 0.35 |
| **Goa*** | RPO | 1 | 2 | 3 | | | | |
| | SPO | 0.25 | 0.3 | 0.4 | | | | |
| **Gujarat** | RPO | 5 | 6 | 7 | | | | |
| | SPO | 0.25 | 0.5 | 1 | | | | |
| **Haryana** | RPO | 1 | 1 | 1 | | | | |
| | SPO | 0.25 | 0.5 | 0.75 | | | | |
| **Himachal Pradesh** | RPO | 10.1 | 11.1 | 12.1 | | | | |
| | SPO | 0 | 0.1 | 0.1 | | | | |
| **Jammu and Kashmir** | RPO | 1 | 3 | 5 | | | | |
| | SPO | 0.02 | 0.1 | 0.25 | | | | |
| **Jharkhand** | RPO | 2 | 3 | 4 | | | | |
| | SPO | 0.25 | 0.5 | 1 | | | | |
| **Karnataka** (BESCOM, MESCOM, CESC) | RPO | | 10 | | | | | |
| | SPO | | 0.25 | | | | | |
| **Karnataka** (HESCOM, GESCOM, Hukkeri Society) | RPO | | 7 | | | | | |
| | SPO | | 0.25 | | | | | |
| **Kerala** | RPO | 3 | 3.3 | 3.6 | 4.0 | 4.4 | 4.8 | 5.3 |
| | SPO | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 | 0.25 |
| **Madya Pradesh** | RPO | 0.8 | 2.5 | 4 | 5.5 | 7 | | |
| | SPO | | 0.4 | 0.6 | 0.8 | 1 | | |
| **Maharashtra** | RPO | 6 | 7 | 8 | 9 | 9 | 9 | |
| | SPO | 0.25 | 0.25 | 0.25 | 0.5 | 0.5 | 0.5 | |
| **Manipur** | RPO | 2 | 3 | 5 | | | | |
| | SPO | 0.25 | 0.25 | 0.25 | | | | |
| **Meghalaya** | RPO | 0.5 | 0.75 | 1 | | | | |
| | SPO | 0.2 | 0.3 | 0.4 | | | | |
| **Mizoram** | RPO | 5 | 6 | 7 | | | | |
| | SPO | 0.25 | 0.25 | 0.25 | | | | |
| **Nagaland (Draft)** | RPO | 15 | 16 | 17 | | | | |
| | SPO | 0.25 | 0.25 | 0.25 | | | | |
| **Orissa** | RPO | | 5 | 5.5 | 6 | 6.5 | 7 | |
| | SPO | | 0.5 | 0.75 | 1 | 1.25 | 1.5 | |
| **Punjab** | RPO | | 2.4 | 2.9 | 3.5 | 4 | | |
| | SPO | | 0.03 | 0.07 | 0.13 | 0.19 | | |
| **Rajasthan** | RPO | | 6 | 7.1 | 8.2 | | | |
| | SPO | | 0.5 | 0.75 | 1 | | | |
| **Tripura (Draft)** | RPO | 1 | 1 | 2 | | | | |
| | SPO | 0.1 | 0.1 | 0.1 | | | | |
| **Uttaranchal** | RPO | 4 | 4.5 | 5 | | | | |
| | SPO | 0 | 0.025 | 0.025 | | | | |
| **Uttar Pradesh** | RPO | 4 | 5 | 6 | | | | |
| | SPO | 0.25 | 0.5 | 1 | | | | |
| **West Bengal** | RPO* | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
| | SPO | | | | | | | |

*Including (Andaman n Nicobar, Chandigarh, Dadar, Daman Diu, Lakshadweep, Pondicherry)**including SPO

Source: Collected from RPO orders of various states

***Table 16: List of SNAs for REC Accreditation***

| State Name | Name |
|---|---|
| Andhra Pradesh | Andhra Pradesh State Load Dispatch Centre |
| Assam | Assam Energy Development Agency |
| Bihar | Bihar Renewable Energy Development Agency |
| Chhattisgarh | Chhattisgarh State Renewable Energy Development Agency |
| Delhi | Energy Efficiency & Renewable Energy Management Centre |
| Gujarat | Gujarat Energy Development Agency |
| Haryana | Haryana Renewable Energy Development Agency (HAREDA) |
| Himachal Pradesh | Directorate of Energy (DOE) |
| Jammu & Kashmir | Jammu & Kashmir State Power Development Corporation |
| Jharkhand | Jharkhand Renewable Energy Development Agency |
| Karnataka | SLDC, KPTCL |
| Kerala | ANERT |
| Madhya Pradesh | MP UrjaVikas Nigam Limited Bhopal |
| Maharashtra | Maharashtra Energy Development Agency (MEDA) |
| Mizoram | Zoram Energy Development Agency |
| Orissa | Orissa Renewable Energy Development Agency |
| Pondicherry | Renewable Energy Agency, Pondicherry |
| Punjab | Punjab Energy Development Agency |
| Rajasthan | Rajasthan Renewable Energy Corporation Limited |
| Tamil Nadu | TANTRANSCO |
| Tripura | Tripura Renewable Energy Development Agency |
| Uttar Pradesh | Uttar Pradesh New and Renewable Development Agency |
| Uttarakhand | Uttarakhand Renewable Energy Development Agency (UREDA) |

***Table 17: Retail Price Index for 2011, UK***

| **Months** | **RPI (Jan 13, 1987= 100)** | **%age Change over 12 months** |
|---|---|---|
| Jan | 229.0 | 5.1 |
| Feb | 231.3 | 5.5 |
| Mar | 232.5 | 5.3 |
| Apr | 234.4 | 5.2 |
| May | 235.2 | 5.2 |
| Jun | 235.2 | 5 |
| Jul | 234.7 | 5 |
| Aug | 236.1 | 5.2 |
| Sep | 237.9 | 5.6 |
| Oct | 238.0 | 5.4 |
| Nov | 238.5 | 5.2 |
| Dec | 239.4 | 4.8 |
| **Average** | 235.183 | **5.2083** |

*Source: Office of National Statistics (*http://www.ons.gov.uk/ons/dcp171778_250279.pdf*)

*Table 18: ROC Banding Regime UK*

| Band | Technologies | Current | Proposed Banding (2013-2017) * |
|---|---|---|---|
| Established 1 | Landfill gas | 0.25 | 0.00 |
| Established 2 | Sewage gas | 0.50 | 0.50 |
| | Co-firing of regular biomass | | |
| Reference | Onshore wind | 1.00 | 0.90 |
| | Hydro-electric | | 0.50 |
| | Co-firing of energy crops | | 1.00 |
| | EfW with CHP | | 0.50 |
| | Geopressure | | 1.00 |
| | Co-firing of Biomass with CHP | | 1.00 |
| | Standard Gasification and Pyrolysis | | 0.50 |
| Post-Demonstration | Offshore wind(2014/5) | 1.50 | 2 (2014/5) / 1.9 (2015/6) / 1.8 (2016/7) |
| | Dedicated regular biomass | | 1.50 (to 03/16) / 1.4 (thereafter) |
| | Co-firing of energy crops (with CHP) | | 1.50 |
| Engineering Technologies | Offshore wind (2013/4) | 2.00 | 2.00 |
| | Wave and tidal stream | | 5.00 (up to 30 MW) / 2.00 (above cap) |
| | Tidal barrage(<1GW) and lagoon (<1GW) | | 2.00 (2013-5) / 1.9 (2015/6) / 1.8 (2016/7) |
| | Advanced conversion technologies (anaerobic digestion, gasification and pyrolysis) | | 2.00 (2013-5) / 1.9 (2015/6) / 1.8 (2016/7) |
| | Dedicated energy crops | | 2.00 (2013-5) / 1.9 (2015/6) / 1.8 (2016/7) |
| | Dedicated biomass with CHP | | 2.00 (2013-5) / thereafter sat. consultation |
| | Solar photovoltaic | | 2.00 (2013-5) / 1.9 (2015/6) / 1.8 (2016/7) |
| | Geothermal | | 2.00 (2013-5) / 1.9 (2015/6) / 1.8 (2016/7) |

## Annexure Part II

Financial Model: Net Generation

| Year--> | Unit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Months in Operation | | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 | 12.00 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| CUF | 17.12% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Annual Deration Factor | 0.75% | | | | | | | | | | | | | | | | | | | | | | | | | |
| AUX | 0.25% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Useful Life (Years) | 25 | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Installed Capacity | MW | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 | 5 |
| Nominal Generation | | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 | 7.50 |
| Gross Generation post deration | | 7.50 | 7.44 | 7.39 | 7.33 | 7.27 | 7.22 | 7.16 | 7.10 | 7.05 | 6.99 | 6.94 | 6.88 | 6.82 | 6.77 | 6.71 | 6.65 | 6.60 | 6.54 | 6.49 | 6.43 | 6.37 | 6.32 | 6.26 | 6.21 | 6.15 |
| AUX | | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| **Net Generation** | **MU** | **7.48** | **7.42** | **7.37** | **7.31** | **7.26** | **7.20** | **7.14** | **7.09** | **7.03** | **6.97** | **6.92** | **6.86** | **6.81** | **6.75** | **6.69** | **6.64** | **6.58** | **6.53** | **6.47** | **6.41** | **6.36** | **6.30** | **6.25** | **6.19** | **6.13** |

# Financial Model: Calculation for Cost of Generation

| Year ---> | Unit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Net Generation | MU | 7.48 | 7.42 | 7.37 | 7.31 | 7.26 | 7.20 | 7.14 | 7.09 | 7.03 | 6.97 | 6.92 | 6.86 | 6.81 | 6.75 | 6.69 | 6.64 | 6.58 | 6.53 | 6.47 | 6.41 | 6.36 | 6.30 | 6.25 | 6.19 | 6.13 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Int on Loan | INR Mn | 38.39 | 32.56 | 26.73 | 20.90 | 15.06 | 9.23 | 3.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Int on WC | INR Mn | 0.36 | 0.39 | 0.42 | 0.46 | 0.50 | 0.54 | 0.59 | 0.64 | 0.69 | 0.75 | 0.82 | 0.89 | 0.96 | 1.05 | 1.14 | 1.23 | 1.34 | 1.46 | 1.58 | 1.72 | 1.87 | 2.03 | 2.21 | 2.40 | 2.61 |
| Depreciation (Comp Act.) | INR Mn | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 |
| O&M | INR Mn | 6.00 | 6.30 | 6.62 | 6.95 | 7.29 | 7.66 | 8.04 | 8.44 | 8.86 | 9.31 | 9.77 | 10.26 | 10.78 | 11.31 | 11.88 | 12.47 | 13.10 | 13.75 | 14.44 | 15.16 | 15.92 | 16.72 | 17.55 | 18.43 | 19.35 |
| **FIXED COST** | **INR Mn** | **67.18** | **61.68** | **56.20** | **50.73** | **45.29** | **39.86** | **34.46** | **31.51** | **31.99** | **32.49** | **25.54** | **26.10** | **26.69** | **27.31** | **27.97** | **28.66** | **29.39** | **30.16** | **30.98** | **31.84** | **32.74** | **33.70** | **34.71** | **35.78** | **36.91** |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **INTEREST ON WC** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Add: Recievables (1 month) | INR Mn | 2.49 | 2.72 | 2.97 | 3.24 | 3.54 | 3.86 | 4.22 | 4.60 | 5.02 | 5.48 | 5.98 | 6.53 | 7.12 | 7.77 | 8.47 | 9.24 | 10.08 | 11.00 | 11.99 | 13.08 | 14.26 | 15.54 | 16.95 | 18.47 | 20.14 |
| Add: O&M (1 Month) | INR Mn | 0.5 | 0.525 | 0.55 | 0.58 | 0.61 | 0.64 | 0.67 | 0.70 | 0.74 | 0.78 | 0.81 | 0.86 | 0.90 | 0.94 | 0.99 | 1.04 | 1.09 | 1.15 | 1.20 | 1.26 | 1.33 | 1.39 | 1.46 | 1.54 | 1.61 |
| Total WC | INR Mn | 2.99 | 3.25 | 3.52 | 3.82 | 4.15 | 4.50 | 4.89 | 5.31 | 5.76 | 6.26 | 6.80 | 7.38 | 8.02 | 8.71 | 9.46 | 10.28 | 11.17 | 12.14 | 13.19 | 14.34 | 15.58 | 16.94 | 18.41 | 20.01 | 21.75 |
| Loan on WC | INR Mn | 2.99 | 3.25 | 3.52 | 3.82 | 4.15 | 4.50 | 4.89 | 5.31 | 5.76 | 6.26 | 6.80 | 7.38 | 8.02 | 8.71 | 9.46 | 10.28 | 11.17 | 12.14 | 13.19 | 14.34 | 15.58 | 16.94 | 18.41 | 20.01 | 21.75 |
| **Int. on WC** | INR Mn | **0.36** | **0.39** | **0.42** | **0.46** | **0.50** | **0.54** | **0.59** | **0.64** | **0.69** | **0.75** | **0.82** | **0.89** | **0.96** | **1.05** | **1.14** | **1.23** | **1.34** | **1.46** | **1.58** | **1.72** | **1.87** | **2.03** | **2.21** | **2.40** | **2.61** |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Discount Factor | | 1.00 | 0.83 | 0.69 | 0.58 | 0.48 | 0.40 | 0.33 | 0.28 | 0.23 | 0.19 | 0.16 | 0.13 | 0.11 | 0.09 | 0.08 | 0.06 | 0.05 | 0.05 | 0.04 | 0.03 | 0.03 | 0.02 | 0.02 | 0.02 | 0.01 |
| | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Levelised Fixed Cost | | 47.91 | | | | | | | | | | | | | | | | | | | | | | | | |
| Levelised Generation | | 7.21 | | | | | | | | | | | | | | | | | | | | | | | | |

# Financial Model: Revenue from CER (CDM Benefit)

| Year--> | Unit | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CERs per MU | | 950 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rate per CER | Euro | 4 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 1 Euro | INR | 66.16 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rate per CER | INR | 264.64 | | | | | | | | | | | | | | | | | | | | | | | | | |
| Estimated Period of Availability | Years | 10 | | | | | | | | | | | | | | | | | | | | | | | | | |
| 80 IA Benefit (1="Yes", 2="No") | | 1 | | | | | | | | | | | | | | | | | | | | | | | | | |
| UNFCCC Adaptation Fee | | 2% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Revenue Retained (in 1st year) | | 100% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Incremental Share of Beneficiary (p.a.) | | 10% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Min. Retained Revenue | | 50% | | | | | | | | | | | | | | | | | | | | | | | | | |
| Net Generation | MU | | 7.48 | 7.42 | 7.37 | 7.31 | 7.26 | 7.20 | 7.14 | 7.09 | 7.03 | 6.97 | 6.92 | 6.86 | 6.81 | 6.75 | 6.69 | 6.64 | 6.58 | 6.53 | 6.47 | 6.41 | 6.36 | 6.30 | 6.25 | 6.19 | 6.13 |
| CERs Availed | | | 7106 | 7053 | 6999 | 6946 | 6893 | 6839 | 6786 | 6733 | 6679 | 6626 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| CER Benefit | INR Mn | | 1.88 | 1.87 | 1.85 | 1.84 | 1.82 | 1.81 | 1.80 | 1.78 | 1.77 | 1.75 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Less: UNFCC Adaptation Fees | INR Mn | | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Revenue from CERs | INR Mn | | 1.84 | 1.83 | 1.82 | 1.80 | 1.79 | 1.77 | 1.76 | 1.75 | 1.73 | 1.72 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Revenue Retained | % | | 100% | 90% | 80% | 70% | 60% | 50% | 50% | 50% | 50% | 50% | | | | | | | | | | | | | | | |
| **Net Revenue from CERs** | INR Mn | | **1.84** | **1.65** | **1.45** | **1.26** | **1.07** | **0.89** | **0.88** | **0.87** | **0.87** | **0.86** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** | **0.00** |

Financial Model: Calculation for IDC (Interest During Construction)

| | | 01-Oct-12 | 01-Nov-12 | 01-Dec-12 | 01-Jan-13 | 01-Feb-13 | 01-Mar-13 |
|---|---|---|---|---|---|---|---|
| Capital Available | % | 100% | 90.00% | 80.00% | 65.00% | 40.00% | 20.00% |
| Capial Required | % | 10% | 10% | 15% | 25% | 20% | 20% |
| Capital Required | INR Mn | 40.00 | 40.00 | 60.00 | 100.00 | 80.00 | 80.00 |
| Equity Exhausted | INR Mn | 40 | 40 | 54.575518 | 0 | 0 | 0 |
| Debt Component | INR Mn | 0 | 0 | 5.4244817 | 100 | 80 | 80 |
| Cumm. Debt | INR Mn | 0 | 0 | 5.4244817 | 105.42448 | 185.42448 | 265.42448 |
| Interest | INR Mn | 0 | 0 | 0.0587652 | 1.1420986 | 2.0087652 | 2.8754319 |
| | | | | | | | |
| **IDC** | INR Mn | 6.085061 | | | | | |

# Financial Model: Cash Flow and IRR Calculation

| Year--> | Unit | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Revenue (REC + Power) | INR Mn | 99.48 | 101.70 | 104.18 | 106.92 | 96.47 | 99.94 | 103.76 | 107.97 | 112.60 | 65.79 | 71.78 | 78.32 | 85.45 | 93.22 | 101.69 | 110.92 | 120.98 | 131.94 | 143.89 | 156.91 | 171.09 | 186.54 | 203.37 | 221.69 | 241.65 |
| Revenue (CER) | INR Mn | 1.84 | 1.65 | 1.45 | 1.26 | 1.07 | 0.89 | 0.88 | 0.87 | 0.87 | 0.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TOTAL REVENUE** | **INR Mn** | **101.32** | **103.35** | **105.63** | **108.18** | **97.54** | **100.83** | **104.64** | **108.84** | **113.46** | **66.65** | **71.78** | **78.32** | **85.45** | **93.22** | **101.69** | **110.92** | **120.98** | **131.94** | **143.89** | **156.91** | **171.09** | **186.54** | **203.37** | **221.69** | **241.65** |
| (Minus) OnM Expenses | INR Mn | 6.00 | 6.30 | 6.62 | 6.95 | 7.29 | 7.66 | 8.04 | 8.44 | 8.86 | 9.31 | 9.77 | 10.26 | 10.78 | 11.31 | 11.88 | 12.47 | 13.10 | 13.75 | 14.44 | 15.16 | 15.92 | 16.72 | 17.55 | 18.43 | 19.35 |
| **EBDITA** | **INR Mn** | **95.32** | **97.05** | **99.02** | **101.24** | **90.25** | **93.17** | **96.60** | **100.40** | **104.60** | **57.34** | **62.01** | **68.06** | **74.67** | **81.90** | **89.81** | **98.45** | **107.88** | **118.19** | **129.45** | **141.75** | **155.17** | **169.82** | **185.81** | **203.26** | **222.30** |
| (Minus) Depreciation | INR Mn | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 |
| (Minus) Interest | INR Mn | 38.39 | 32.56 | 26.73 | 20.90 | 15.06 | 9.23 | 3.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minus Int on WC | INR Mn | 0.36 | 0.39 | 0.42 | 0.46 | 0.50 | 0.54 | 0.59 | 0.64 | 0.69 | 0.75 | 0.82 | 0.89 | 0.96 | 1.05 | 1.14 | 1.23 | 1.34 | 1.46 | 1.58 | 1.72 | 1.87 | 2.03 | 2.21 | 2.40 | 2.61 |
| **PBT** | **INR Mn** | **34.14** | **41.67** | **49.44** | **57.45** | **52.26** | **60.97** | **70.19** | **77.34** | **81.48** | **34.16** | **46.24** | **52.22** | **58.76** | **65.91** | **73.72** | **82.26** | **91.59** | **101.78** | **112.92** | **125.07** | **138.35** | **152.84** | **168.65** | **185.91** | **204.74** |
| (Minus) Tax | INR Mn | 6.83 | 8.34 | 9.89 | 11.50 | 10.46 | 12.20 | 24.19 | 15.47 | 16.30 | 6.83 | 9.25 | 10.45 | 11.76 | 13.19 | 14.75 | 16.46 | 18.33 | 37.87 | 41.49 | 45.43 | 49.74 | 54.44 | 59.57 | 65.17 | 71.28 |
| **PAT** | **INR Mn** | **27.31** | **33.33** | **39.54** | **45.96** | **41.80** | **48.77** | **46.00** | **61.86** | **65.18** | **27.32** | **36.99** | **41.77** | **47.00** | **52.72** | **58.97** | **65.80** | **73.26** | **63.91** | **71.43** | **79.64** | **88.61** | **98.40** | **109.08** | **120.74** | **133.46** |
| **PROJECT CASH FLOW** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Add: PAT | | 27.31 | 33.33 | 39.54 | 45.96 | 41.80 | 48.77 | 46.00 | 61.86 | 65.18 | 27.32 | 36.99 | 41.77 | 47.00 | 52.72 | 58.97 | 65.80 | 73.26 | 63.91 | 71.43 | 79.64 | 88.61 | 98.40 | 109.08 | 120.74 | 133.46 |
| Add: Depreciation | | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 |
| Add: Int on Loan | | 38.39 | 32.56 | 26.73 | 20.90 | 15.06 | 9.23 | 3.40 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Add: Int on WC | | 0.36 | 0.39 | 0.42 | 0.46 | 0.50 | 0.54 | 0.59 | 0.64 | 0.69 | 0.75 | 0.82 | 0.89 | 0.96 | 1.05 | 1.14 | 1.23 | 1.34 | 1.46 | 1.58 | 1.72 | 1.87 | 2.03 | 2.21 | 2.40 | 2.61 |
| Less: Change in NWC | | -2.99 | -0.25 | -0.28 | -0.30 | -0.33 | -0.35 | -0.39 | -0.42 | -0.46 | -0.50 | -0.54 | -0.59 | -0.64 | -0.69 | -0.75 | -0.82 | -0.89 | -0.97 | -1.05 | -1.14 | -1.24 | -1.35 | -1.47 | -1.60 | -1.74 |
| Add: Terminal Value | | | | | | | | | | | | | | | | | | | | | | | | | | 84.66 |
| **Project Cash Flow** | **-448.58506** | **85.50** | **88.46** | **88.85** | **89.44** | **79.47** | **80.62** | **72.03** | **84.51** | **87.84** | **50.01** | **52.22** | **57.03** | **62.28** | **68.03** | **74.31** | **81.17** | **88.67** | **79.35** | **86.91** | **95.17** | **104.19** | **114.03** | **124.77** | **136.49** | **233.94** |
| **PROJECT IRR** | **18.03%** | | | | | | | | | | | | | | | | | | | | | | | | | |
| **EQUITY CASH FLOW** | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Add: PAT | | 27.31 | 33.33 | 39.54 | 45.96 | 41.80 | 48.77 | 46.00 | 61.86 | 65.18 | 27.32 | 36.99 | 41.77 | 47.00 | 52.72 | 58.97 | 65.80 | 73.26 | 63.91 | 71.43 | 79.64 | 88.61 | 98.40 | 109.08 | 120.74 | 133.46 |
| Add: Depreciation | | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 |
| Add: Terminal Value | | | | | | | | | | | | | | | | | | | | | | | | | | 84.66 |
| Less: Repayment | | -44.86 | -44.86 | -44.86 | -44.86 | -44.86 | -44.86 | -44.86 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Less: Change in NWC | | -2.99 | -0.25 | -0.28 | -0.30 | -0.33 | -0.35 | -0.39 | -0.42 | -0.46 | -0.50 | -0.54 | -0.59 | -0.64 | -0.69 | -0.75 | -0.82 | -0.89 | -0.97 | -1.05 | -1.14 | -1.24 | -1.35 | -1.47 | -1.60 | -1.74 |
| **Equity Cash Flow** | **-134.57552** | **1.89** | **10.65** | **16.84** | **23.23** | **19.05** | **25.99** | **23.19** | **83.87** | **87.15** | **49.26** | **51.40** | **56.14** | **61.32** | **66.98** | **73.17** | **79.94** | **87.33** | **77.89** | **85.33** | **93.45** | **102.32** | **112.00** | **122.56** | **134.09** | **231.33** |
| **EQUITY IRR** | **21.56%** | | | | | | | | | | | | | | | | | | | | | | | | | |

Financial Model: DSCR (Debt Service Coverage Ratio) Calculation

| YEAR--> | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Project Cash Flow | 85.50 | 88.46 | 88.85 | 89.44 | 79.47 | 80.62 | 72.03 | 84.51 | 87.84 | 50.01 | 52.22 | 57.03 | 62.28 | 68.03 | 74.31 | 81.17 | 88.67 | 79.35 | 86.91 | 95.17 | 104.2 | 114.0 | 124.8 | 136.5 | 233.9 |
| Annual Debt Service | 83.25 | 77.42 | 71.59 | 65.76 | 59.92 | 54.09 | 48.26 | | | | | | | | | | | | | | | | | | |
| DSCR | 1.027 | 1.143 | 1.241 | 1.36 | 1.326 | 1.49 | 1.493 | | | | | | | | | | | | | | | | | | |
| Avg DSCR | 1.297 | | | | | | | | | | | | | | | | | | | | | | | | |
| Min. DSCR | 1.027 | | | | | | | | | | | | | | | | | | | | | | | | |

# Financial Model: Debt Schedule

| Month | Opening Bal Principal | Principal Repayment | Closing Bal Principal | Interest | Cummulative Principal | Cummulative Interest | Annual Principal | Annual Interest | Annual Debt Service |
|---|---|---|---|---|---|---|---|---|---|
| Apr-13 | 314.01 | 0.00 | 314.01 | 3.40 | 0.00 | 3.40 | | | |
| May-13 | 314.01 | 0.00 | 314.01 | 3.40 | 0.00 | 6.80 | | | |
| Jun-13 | 314.01 | 11.21 | 302.79 | 3.34 | 11.21 | 10.14 | | | |
| Jul-13 | 302.79 | 0.00 | 302.79 | 3.28 | 11.21 | 13.42 | | | |
| Aug-13 | 302.79 | 0.00 | 302.79 | 3.28 | 11.21 | 16.71 | | | |
| Sep-13 | 302.79 | 11.21 | 291.58 | 3.22 | 22.43 | 19.92 | | | |
| Oct-13 | 291.58 | 0.00 | 291.58 | 3.16 | 22.43 | 23.08 | | | |
| Nov-13 | 291.58 | 0.00 | 291.58 | 3.16 | 22.43 | 26.24 | | | |
| Dec-13 | 291.58 | 11.21 | 280.37 | 3.10 | 33.64 | 29.34 | | | |
| Jan-14 | 280.37 | 0.00 | 280.37 | 3.04 | 33.64 | 32.38 | | | |
| Feb-14 | 280.37 | 0.00 | 280.37 | 3.04 | 33.64 | 35.41 | | | |
| Mar-14 | 280.37 | 11.21 | 269.15 | 2.98 | 44.86 | 38.39 | 44.86 | 38.39 | 83.25 |
| Apr-14 | 269.15 | 0.00 | 269.15 | 2.92 | 44.86 | 41.31 | | | |
| May-14 | 269.15 | 0.00 | 269.15 | 2.92 | 44.86 | 44.22 | | | |
| Jun-14 | 269.15 | 11.21 | 257.94 | 2.86 | 56.07 | 47.08 | | | |
| Jul-14 | 257.94 | 0.00 | 257.94 | 2.79 | 56.07 | 49.87 | | | |
| Aug-14 | 257.94 | 0.00 | 257.94 | 2.79 | 56.07 | 52.67 | | | |
| Sep-14 | 257.94 | 11.21 | 246.72 | 2.73 | 67.29 | 55.40 | | | |
| Oct-14 | 246.72 | 0.00 | 246.72 | 2.67 | 67.29 | 58.07 | | | |
| Nov-14 | 246.72 | 0.00 | 246.72 | 2.67 | 67.29 | 60.75 | | | |
| Dec-14 | 246.72 | 11.21 | 235.51 | 2.61 | 78.50 | 63.36 | | | |
| Jan-15 | 235.51 | 0.00 | 235.51 | 2.55 | 78.50 | 65.91 | | | |
| Feb-15 | 235.51 | 0.00 | 235.51 | 2.55 | 78.50 | 68.46 | | | |
| Mar-15 | 235.51 | 11.21 | 224.29 | 2.49 | 89.72 | 70.95 | 44.86 | 32.56 | 77.42 |
| Apr-15 | 224.29 | 0.00 | 224.29 | 2.43 | 89.72 | 73.38 | | | |
| May-15 | 224.29 | 0.00 | 224.29 | 2.43 | 89.72 | 75.81 | | | |
| Jun-15 | 224.29 | 11.21 | 213.08 | 2.37 | 100.93 | 78.18 | | | |
| Jul-15 | 213.08 | 0.00 | 213.08 | 2.31 | 100.93 | 80.49 | | | |
| Aug-15 | 213.08 | 0.00 | 213.08 | 2.31 | 100.93 | 82.80 | | | |
| Sep-15 | 213.08 | 11.21 | 201.86 | 2.25 | 112.15 | 85.04 | | | |
| Oct-15 | 201.86 | 0.00 | 201.86 | 2.19 | 112.15 | 87.23 | | | |
| Nov-15 | 201.86 | 0.00 | 201.86 | 2.19 | 112.15 | 89.42 | | | |
| Dec-15 | 201.86 | 11.21 | 190.65 | 2.13 | 123.36 | 91.54 | | | |
| Jan-16 | 190.65 | 0.00 | 190.65 | 2.07 | 123.36 | 93.61 | | | |
| Feb-16 | 190.65 | 0.00 | 190.65 | 2.07 | 123.36 | 95.67 | | | |
| Mar-16 | 190.65 | 11.21 | 179.43 | 2.00 | 134.58 | 97.68 | 44.86 | 26.73 | 71.59 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Apr-16 | 179.43 | 0.00 | 179.43 | 1.94 | 134.58 | 99.62 | | | |
| May-16 | 179.43 | 0.00 | 179.43 | 1.94 | 134.58 | 101.57 | | | |
| Jun-16 | 179.43 | 11.21 | 168.22 | 1.88 | 145.79 | 103.45 | | | |
| Jul-16 | 168.22 | 0.00 | 168.22 | 1.82 | 145.79 | 105.27 | | | |
| Aug-16 | 168.22 | 0.00 | 168.22 | 1.82 | 145.79 | 107.10 | | | |
| Sep-16 | 168.22 | 11.21 | 157.00 | 1.76 | 157.00 | 108.86 | | | |
| Oct-16 | 157.00 | 0.00 | 157.00 | 1.70 | 157.00 | 110.56 | | | |
| Nov-16 | 157.00 | 0.00 | 157.00 | 1.70 | 157.00 | 112.26 | | | |
| Dec-16 | 157.00 | 11.21 | 145.79 | 1.64 | 168.22 | 113.90 | | | |
| Jan-17 | 145.79 | 0.00 | 145.79 | 1.58 | 168.22 | 115.48 | | | |
| Feb-17 | 145.79 | 0.00 | 145.79 | 1.58 | 168.22 | 117.06 | | | |
| Mar-17 | 145.79 | 11.21 | 134.58 | 1.52 | 179.43 | 118.58 | 44.86 | 20.90 | 65.76 |
| Apr-17 | 134.58 | 0.00 | 134.58 | 1.46 | 179.43 | 120.03 | | | |
| May-17 | 134.58 | 0.00 | 134.58 | 1.46 | 179.43 | 121.49 | | | |
| Jun-17 | 134.58 | 11.21 | 123.36 | 1.40 | 190.65 | 122.89 | | | |
| Jul-17 | 123.36 | 0.00 | 123.36 | 1.34 | 190.65 | 124.23 | | | |
| Aug-17 | 123.36 | 0.00 | 123.36 | 1.34 | 190.65 | 125.56 | | | |
| Sep-17 | 123.36 | 11.21 | 112.15 | 1.28 | 201.86 | 126.84 | | | |
| Oct-17 | 112.15 | 0.00 | 112.15 | 1.21 | 201.86 | 128.05 | | | |
| Nov-17 | 112.15 | 0.00 | 112.15 | 1.21 | 201.86 | 129.27 | | | |
| Dec-17 | 112.15 | 11.21 | 100.93 | 1.15 | 213.08 | 130.42 | | | |
| Jan-18 | 100.93 | 0.00 | 100.93 | 1.09 | 213.08 | 131.51 | | | |
| Feb-18 | 100.93 | 0.00 | 100.93 | 1.09 | 213.08 | 132.61 | | | |
| Mar-18 | 100.93 | 11.21 | 89.72 | 1.03 | 224.29 | 133.64 | 44.86 | 15.06 | 59.92 |
| Apr-18 | 89.72 | 0.00 | 89.72 | 0.97 | 224.29 | 134.61 | | | |
| May-18 | 89.72 | 0.00 | 89.72 | 0.97 | 224.29 | 135.58 | | | |
| Jun-18 | 89.72 | 11.21 | 78.50 | 0.91 | 235.51 | 136.50 | | | |
| Jul-18 | 78.50 | 0.00 | 78.50 | 0.85 | 235.51 | 137.35 | | | |
| Aug-18 | 78.50 | 0.00 | 78.50 | 0.85 | 235.51 | 138.20 | | | |
| Sep-18 | 78.50 | 11.21 | 67.29 | 0.79 | 246.72 | 138.99 | | | |
| Oct-18 | 67.29 | 0.00 | 67.29 | 0.73 | 246.72 | 139.72 | | | |
| Nov-18 | 67.29 | 0.00 | 67.29 | 0.73 | 246.72 | 140.44 | | | |
| Dec-18 | 67.29 | 11.21 | 56.07 | 0.67 | 257.94 | 141.11 | | | |
| Jan-19 | 56.07 | 0.00 | 56.07 | 0.61 | 257.94 | 141.72 | | | |
| Feb-19 | 56.07 | 0.00 | 56.07 | 0.61 | 257.94 | 142.33 | | | |
| Mar-19 | 56.07 | 11.21 | 44.86 | 0.55 | 269.15 | 142.87 | 44.86 | 9.23 | 54.09 |
| Apr-19 | 44.86 | 0.00 | 44.86 | 0.49 | 269.15 | 143.36 | | | |
| May-19 | 44.86 | 0.00 | 44.86 | 0.49 | 269.15 | 143.85 | | | |
| Jun-19 | 44.86 | 11.21 | 33.64 | 0.43 | 280.37 | 144.27 | | | |
| Jul-19 | 33.64 | 0.00 | 33.64 | 0.36 | 280.37 | 144.64 | | | |
| Aug-19 | 33.64 | 0.00 | 33.64 | 0.36 | 280.37 | 145.00 | | | |
| Sep-19 | 33.64 | 11.21 | 22.43 | 0.30 | 291.58 | 145.30 | | | |
| Oct-19 | 22.43 | 0.00 | 22.43 | 0.24 | 291.58 | 145.55 | | | |
| Nov-19 | 22.43 | 0.00 | 22.43 | 0.24 | 291.58 | 145.79 | | | |
| Dec-19 | 22.43 | 11.21 | 11.21 | 0.18 | 302.79 | 145.97 | | | |
| Jan-20 | 11.21 | 0.00 | 11.21 | 0.12 | 302.79 | 146.09 | | | |
| Feb-20 | 11.21 | 0.00 | 11.21 | 0.12 | 302.79 | 146.22 | | | |
| Mar-20 | 11.21 | 11.21 | 0.00 | 0.06 | 314.01 | 146.28 | 44.86 | 3.40 | 48.26 |

# Financial Model: Tax Calculation

| YEAR | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PBT** | INR Mn | **34.14** | **41.67** | **49.44** | **57.45** | **52.26** | **60.97** | **70.19** | **77.34** | **81.48** | **34.16** | **46.24** | **52.22** | **58.76** | **65.91** | **73.72** | **82.26** | **91.59** | **101.78** | **112.92** | **125.07** | **138.35** | **152.84** | **168.65** | **185.91** | **204.74** |
| Add: Dep (Comp Act) | INR Mn | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 22.43 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 | 14.95 |
| Opening Value of Asset | | 448.59 | 89.72 | 17.94 | 3.59 | 0.72 | 0.14 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Minus: Dep (IT Act) | INR MN | 358.87 | 71.77 | 14.35 | 2.87 | 0.57 | 0.11 | 0.02 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Closing Value | | 89.72 | 17.94 | 3.59 | 0.72 | 0.14 | 0.03 | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| **TAXABLE INCOME** | INR Mn | **-302.29** | **-7.67** | **57.51** | **77.01** | **74.11** | **83.28** | **92.59** | **99.76** | **103.91** | **56.59** | **61.19** | **67.17** | **73.71** | **80.86** | **88.67** | **97.21** | **106.54** | **116.74** | **127.87** | **140.03** | **153.30** | **167.79** | **183.60** | **200.86** | **219.69** |
| PBT (Loss Adjusted) | INR Mn | -302.29 | -309.97 | -252.46 | -175.44 | -101.33 | -18.05 | 74.54 | 99.76 | 103.91 | 56.59 | 61.19 | 67.17 | 73.71 | 80.86 | 88.67 | 97.21 | 106.54 | 116.74 | 127.87 | 140.03 | 153.30 | 167.79 | 183.60 | 200.86 | 219.69 |
| TAX HOLIDAY | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Corporate Tax @ | 32.45% | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 24.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 37.87 | 41.49 | 45.43 | 49.74 | 54.44 | 59.57 | 65.17 | 71.28 |
| MAT @ | 20.01% | 6.83 | 8.34 | 9.89 | 11.50 | 10.46 | 12.20 | 14.04 | 15.47 | 16.30 | 6.83 | 9.25 | 10.45 | 11.76 | 13.19 | 14.75 | 16.46 | 18.33 | 20.36 | 22.59 | 25.02 | 27.68 | 30.58 | 33.74 | 37.20 | 40.96 |
| **TAX** (Max of CT/MAT) | | **6.83** | **8.34** | **9.89** | **11.50** | **10.46** | **12.20** | **24.19** | **15.47** | **16.30** | **6.83** | **9.25** | **10.45** | **11.76** | **13.19** | **14.75** | **16.46** | **18.33** | **37.87** | **41.49** | **45.43** | **49.74** | **54.44** | **59.57** | **65.17** | **71.28** |
| SET OFF (CT - MAT) | | -6.83 | -8.34 | -9.89 | -11.50 | -10.46 | -12.20 | 10.14 | -15.47 | -16.30 | -6.83 | -9.25 | -10.45 | -11.76 | -13.19 | -14.75 | -16.46 | -18.33 | 17.51 | 18.90 | 20.41 | 22.06 | 23.86 | 25.83 | 27.97 | 30.32 |
| **NET TAX PAID** | | **6.832** | **8.338** | **9.891** | **11.495** | **10.456** | **12.198** | **24.186** | **15.473** | **16.302** | **6.834** | **9.252** | **10.448** | **11.756** | **13.186** | **14.750** | **16.458** | **18.325** | **20.364** | **22.592** | **25.024** | **27.680** | **39.134** | **59.570** | **65.170** | **71.279** |
| **MAT Period** | **Years-->** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | | | | | | | | | | | | | | | |
| MAT during MAT Period | | 15.47 | 16.30 | 6.83 | 9.25 | 10.45 | 11.76 | 13.19 | 14.75 | 16.46 | 18.33 | | | | | | | | | | | | | | | |
| MAT Credit Opening Bal. | | 94.18 | 76.67 | 57.77 | 37.36 | 15.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | |
| MAT Credit Adjusted | | 17.51 | 18.90 | 20.41 | 22.06 | 15.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | |
| MAT Credit Closing Bal. | | 76.67 | 57.77 | 37.36 | 15.31 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | | | | | | | | | | | | |
| | **Years-->** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | | | | | | | | | | |
| SET OFF (CT - MAT) | | 17.51 | 18.90 | 20.41 | 22.06 | 23.86 | 25.83 | 27.97 | 30.32 | 30.32 | 30.32 | 30.32 | 30.32 | 30.32 | 30.32 | 30.32 | | | | | | | | | | |
| NET SET OFF | | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 17.51 | 18.90 | 20.41 | 22.06 | 15.31 | 0.00 | 0.00 | 0.00 |