UPES Centre for Continuing Education

ASSESSMENT OF SOLAR ENERGY PROJECTS IN INDIA

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Declaration by the Guide

This is to certify that the Mr. Shubham Sharma a student of MBA PM, SAP ID 500057350 of UPES has successfully completed this dissertation report on "ASSESSMENT OF SOLAR ENERGY PROJECTS IN INDIA" under my supervision.

Further, I certify that the work is based on the investigation made, data collected and analyzed by him and it has not been submitted in any other University or Institution for award of any degree. In my opinion it is fully adequate, in scope and utility, as a dissertation towards partial fulfillment for the award of degree of MBA.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

SEB – state electricity board
CEB – central electricity board
SLDC – state load dispatch centre
RLDC – regional load dispatch centre
CAGR – compound annual growth rate
TEC – Techno-economic clearance
CEA – central electricity authority
SERC – state electricity regulatory commission
CERC – central electricity regulatory commission
RPO – renewable purchase obligation
RPS – renewable purchase specification
REC – renewable energy certificate
FOR – Forum of regulator
RFP – request for proposal
PPA – power purchase agreement
PV – photovoltaic
PLF – plant load factor
CUF – capacity utilization factor
O&M – operation & maintenance
CDM – clean development mechanism
CSP – concentrated solar power
JNNSM – Jawaharlal Nehru national solar mission
NSM – national solar mission
MNRE – ministry of new and renewable energy
NVVN – NTPC Vidyut Vyapar Nigam
DCR – domestic content requirement
SECI – Solar Energy Corporation of India
VGF – viability gap funding
MoP – ministry of power
FIT – feed in tariff
GERC – Gujarat electricity regulatory commission
GEDA – Gujarat energy development agency
GETCO – Gujarat energy transmission corporation ltd
ABT – availability based tariff
KERC – Karnataka electricity regulatory commission
KREDL – Karnataka renewable energy development agency
GOI – government of India
RERC – Rajasthan electricity regulatory commission
RPSSGP - Rooftop PV & Small Solar Generation Programme
RREC – Rajasthan renewable energy corporation ltd
MPERC – Madhya Pradesh electricity regulatory commission

GoMP – government of MP
NRSE – new and renewable energy sources
VAT – value added tax
APERC – Andhra Pradesh electricity regulatory commission
TOD – time of day
OA – open access
SPO – solar purchase obligation
GBI – generation based incentive
TEDA – Tamil Nadu energy development agency
UPERC – Uttar Pradesh electricity regulatory commission
UPPCL – Uttar Pradesh power corporation limited

EXECUTIVE SUMMARY

In this report, I have done analysis of REC market and included a case studies in which Financial modelling of solar projects are shown. In order to fully understand and complete the financial modelling, I started with studying the regulatory aspects like what was the scenario before and after Electricity Act, 2003. This report contains provisions given in EA, 2003, National Electricity Policy, National Tariff Policy, NAPCC etc to promote deployment of renewable energy especially solar energy.

I have summarized the regulations given by CERC so as to quickly pick up all the values to be considered while setting up a solar project and competitive bidding guidelines so to know how to bid for the project. This report contains various state solar policies and a comparison is done to know which state provides maximum benefit, what the target set by them was and how much capacity has been installed up till now.

CHAPTER – 2: LITERATURE REVIEW

1. *Review of the electricity act, 2003* by 'Anay Vete'
   With the changing times many of the acts had become passé and thus had to be reviewed. The Electricity Act 2003, enacted by the Parliament of India, received the President's assent on 26th May 2003 and came in to force on June 10, 2003. The main aim of the Act was to consolidate 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. However even after many deliberations there are some major issues that were overlooked. They need to be addressed promptly so that the power sector can be truly the engine of growth for the Indian Economy. This paper briefly tries to point out the troublesome issues and will try to suggest remedial measures.

2. *REC market and regulation* by 'Ajit Pandit'
   This literature covers following topics:
   - Legal, Policy and Regulatory Framework to support RE Deployment
   - Evolution of Market Model
   - RPO Framework : Driver for RE Development
   - REC Mechanism Need and Concept
   - Experience: REC Trading
   - Challenges and Way Forward

3. *Report on development of REC framework in India, pricing of renewable energy and REC* by 'Anand Parmar'
   This paper goes into the development of the REC framework in the country and the pricing of the electricity as well as the RECs. It delves into the considerations that were taken into account before finalizing the REC mechanism in India. CERC has released the detailed procedures under the REC mechanism, the roles of the various players involved in this mechanism, the responsibilities, along with the fee for all the transactions. The pricing of REC has been linked to the notional price of the electricity and presently the minimum quotable price in the Power Exchange India Ltd of each REC is 1 paisa. The types of RECs have already been differentiated in the form of solar and non-solar certificates, due to the presumably vast difference in the price of solar electricity and other competing RE technologies. Going forward, a close monitoring of the development of the market has to be ensured for better regulatory structure and mechanisms to sustain the same.

4. *Solar PV industry 2010: contemporary scenario and emerging* trends by 'ISA'
   This report looks at the contemporary scenario of the solar PV industry, both globally and within India. The analysis is based on a comprehensive review of secondary literature and extensive fieldwork. The report would help the various stakeholders in taking informed decisions and contribute to India's emergence as one of the major solar hubs in the world.

5. *Setting up Grid Connected Solar Power Plants (100 MW) in the campus of Dahanu Thermal Power Plant, Maharashtra, India* by 'Reliance energy'
   This is a DPR which addresses following dimensions of the project:
   Project justification, site assessment, solar radiation resource assessment, solar PV technology assessment, energy yield estimation, plant layout, project technical details and design, project registration and clearances, clean development mechanism, bill of quantity, risk assessment and financial analysis

CHAPTER - 3: REGULATORY REGIME

3.1. PRE-EA, 2003 - LEGISLATIVE FRAMEWORK

3.1.1. INDIAN ELECTRICITY ACT, 1910

SUPPLY

LICENSES

1. **Grant of licenses**
   The State Government can give license to any person to supply energy in any specified area and license shall not be granted until all objections are considered.
2. **Revocation of license**
   The State Govt may cancel a license if the licensee breaks any of the terms or conditions of license or is unable to discharge his duties and unless licensee has been heard, no revocation would be done
3. **Provision where license is cancelled**
   Where license is revoked, state govt may enquire from SEB whether it is willing to purchase undertaking and if so licensee shall sell the undertaking to SEB at purchase price determined accordingly. If SEB refuses then state govt can elect to purchase. Further if both SEB and state govt refuses then it can be sold to local authority or third person;
   When no purchase takes place, the licensee can dispose all lands, buildings, works, materials and plants belonging to the undertaking
4. **Determination of purchase price**
   The purchase price of the undertaking shall be the market value of the undertaking at the time of purchase or delivery
5. **Power of govt**
   State govt can vary the terms and conditions of license
6. **Annual accounts of license**
   Every licensee shall prepare an annual accounts of his undertaking and shall keep copies of such statement

WORKS

1. **Provision as to the opening and breaking up of streets, railways and tramways**
   Any licensee may open and break up streets, railways and tramways to lay down electric lines for supply of energy subject to terms and conditions of license
2. **Notice of new works**
   Licensee should serve a notice to the repairing authority describing about the new works at least 1 month before the commissioning. If repairing authority disapproves then licensee can appeal to the state govt whose decision shall be final
3. **Alterations of pipes or wires**
   Any licensee can alter the position of pipes or wire of which he is authorized to after serving a notice to the owner describing the alteration 1 month before the commissioning.

4. **Laying of electric supply lines**
   Any licensee can dig or sink any trench for laying down electric lines after serving a notice to the owner 48hrs before commencing.
5. **Streets, drains, tunnels etc broken up to be restored**
   Any person authorized to break up streets, railways, tramways, tunnels or drain shall guard it with fence and provide sufficient sunlight for the warning to the passengers before sunset
6. **Notice to telegraph authority**
   Any licensee before laying down telegraph lines or electric lines should give a notice to the telegraph authority at least 10 days before commissioning
7. **Overhead lines**
   No licensee is authorized to place any overhead line unless state govt gives approval in writing.
8. **Compensation for damage**
   A licensee should cause as little damage as possible and should make full compensation for any damage

SUPPLY

1. **Power for licensee to enter premises**
   A licensee or any authorized person can enter a premise to which energy is supplied by him on informing the occupier for the purpose of:
   a. Inspecting, testing, repairing, altering or removing the electric supply line
   b. Ascertaining the amount of energy supplied
   If a consumer refuses then the licensee can cut off the supply after 24hrs of serving a notice to the customer
2. **Restriction on licensees**
   A licensee is not entitled to prescribe any special form of appliance for utilizing energy supplied by him or in any way to control or interfere with the use of such energy
3. **Obligation on licensee**
   Licensee is obligated to supply energy to every person within his area of supply on application
4. **Power of state govt to give direction to licensee**
   State govt can direct any licensee to supply energy to any establishment in preference to any other customer if necessary in the interest of public. Any dispute in this regard shall be determined by arbitration
5. **Power to control distribution and consumption of energy**
   State govt can regulate the supply, distribution and consumption of energy if it is necessary for fair distribution of energy
6. **Charges for energy to be made without undue preference**
   A licensee shall not give undue preference to any person;
   A licensee may charge a customer by:
   a. Actual amount of energy supplied
   b. Electrical quantity
   c. Other methods approved by the state govt.(this method consider load factor, power factor, total consumption and hours during which energy is required)
7. **Discontinuance of supply**
   When a person fails to pay charges due for the energy supplied, the licensee can cut off the supply after giving 7 days' notice and can discontinue the supply until the recovery of total amount including the expense in cutting off and reconnecting the supply

8. **Meters**
The amount of energy supplied to customer can be ascertained with the help of a correct meter. Meter can be installed either by the licensee after procuring the security money or by the consumer himself;
Licensee can inspect and test the meter at any time on informing the customer and if meter found is damaged or tempered then it can be recovered from the customer. Any dispute in this regard shall be referred to electrical inspector;
A consumer can connect or disconnect meter with any electric supply line through which energy is provided by licensee by giving 48 hours' notice to the licensee
9. **Supply of energy outside area of supply**
State govt can order any licensee to supply energy to any person outside the area of supply and to lay down electric supply lines for that purpose and no such authority is granted to the licensee in the area of supply of another licensee:
   a. without another licensee's consent
   b. unless the customer has entered into a specific agreement with the licensee

SUPPLY, TRANSMISSION AND USE OF ENERGY BY NON-LICENSEES

Non-licensee shall not engage in the business of supplying energy except with the sanction of state govt which is only after consulting SEB and local authority

The local authority can impose any or all of the power and liabilities mentioned in the section "WORK" on any person who has obtained the sanction of govt.

Only licensee or a person who is granted a sanction can transmit or use energy exceeding 250watts and 100volts in any place

GENERAL

PROTECTIVE CLAUSES

1. **Protection of railways, canals etc**
No person shall damage any railway, aerodrome, tramway, canal or water-way or any dock, wharf or pier in the generation, transmission, or use of energy and take precautions in constructing and laying down electric supply lines
2. **Notice of accidents and enquiries**
If any accident occurs then electrical inspector should be notified so that further enquiry can be done
3. **Prohibition of connection with earth**
No person can connect his electric supply lines with earth unless sanctioned by the govt

ADMINISTRATION AND RULES

1. **Advisory Board**
Central govt can constitute advisory board which should consist of at least 3members;
Central govt or state govt can determine the number of members, their duties, tenure and pay
2. **Appointment of electrical inspector**
The appropriate govt can appoint a duly qualified person to be an electrical inspector and perform functions under this act

3. **Power of Central Electricity Board**
   CEB should be constituted and consist of a chairman and 5 other members;
   CEB can make rules such as:
   a. The form of application and the payment
   b. Regulate the publication of notices
   c. Manner in which objection is to be made
   d. Preparation and submission of accounts by licensees
   e. Protection of people and property from injury
   f. Qualification of electrical inspector etc

CRIMINAL OFFENCES AND PROCEDURE

1. **Theft of energy**
   Any person who dishonestly abstract or consume energy would be punished with imprisonment for a term that may extend to 3 years or with fine or both.
2. **Penalty for maliciously wasting energy or injuring works**
   Any person who intends to waste energy or cut off supply or injuring work would be punished with imprisonment for a term that may extend to 2 years or with a fine of Rs1000 or with both
3. **Penalty for unauthorized supply of energy**
   Any non-licensee engaged in the business of supplying energy shall be punished with a fine that may extend to Rs3000
4. **Penalty for illegal transmission or use of energy**
   Any person who uses or transmit energy without giving notice shall be punished with a fine that may extend to Rs500
5. **Penalty for interference with meters or licensee's works**
   Whoever interferes with meter or connect or disconnect meter with any electric supply lines shall be punished with imprisonment for a term that may extend to 3 years or with a fine of Rs5000 or with both

SUPPLEMENTARY

1. **State Government to have powers and obligations of a licensee**
   Where the State Government engages in the business of supplying energy to the public, it shall have all the powers and obligations of a licensee under this Act
2. **Amendments of land acquisition act**
   Any person (not a company) can acquire a land under Land Acquisition Act, 1894

COMPULSORY WORKS AND SUPPLY

1. **Execution of work after commencement of license.**
   After getting license, licensee shall execute all such works as specified in license within 3yrs
2. **Requisition for supply to owners or occupiers in vicinity**
   A licensee shall supply energy within 1month to a person who has made a demand for it unless delayed by natural calamities
3. **Supply for public lamps**
   If the state govt or a local authority demands supply for public lamps for a period of 7yrs or more then the licensee of that area shall supply energy

SUPPLY BY BULK-LICENSEES

1. **Special provisions applying to supply by bulk-licensee**
   a. Any distributing licensees within the bulk-licensee's area of supply can make a demand to give a supply of energy specifying the point, the maximum rate per unit of time and the date upon which the supply is to commence
   b. Such distributing licensee shall enter into an agreement to receive and pay for supply of energy for a period not less than 7yrs
   c. Any dispute shall be determined by arbitration

TESTING AND INSPECTION

1. **Licensee to establish testing stations**
   The licensee shall establish testing stations and keep it in proper condition at his own cost
2. **Facilities for testing**
   The licensee shall afford an Electrical Inspector for inspection and testing of his works and instruments

3.1.2. ELECTRICITY SUPPLY ACT, 1947

THE CENTRAL ELECTRICITY AUTHORITY

1. **Constitution of the Central Electricity Authority**
   The Central Government shall constitute a body called the Central Electricity Authority to perform functions such as:
   a. Develop a national power policy
   b. Act as arbitrators in matters between the state govt or board and licensee
   c. Publication of reports
   d. Promote and assist timely operation of schemes
   e. Advise central govt. etc
   It shall consist of not more than 14 members out of which 8 shall be full-time members
2. **Power to require accounts, statistics and returns**
   A licensee or any person supplying energy shall furnish accounts, statistics etc to the authority
3. **Directions by Central Government to The Authority**
   The authority shall be guided by directions given by central govt to perform its function
4. **Power of Central Government to make rules**
   The central govt can make following rules by notifying in the Official Gazette:
   a. Functions and duties of authority
   b. Terms and conditions of service
5. **Power of Authority to regulations**
   The authority can make regulations such as holding the meetings of the authority or any other matter relating to its function

STATE ELECTRICITY BOARDS, GENERATING COMPANIES, STATE ELECTRICITY CONSULTATIVE COUNCILS AND LOCAL ADVISORY COMMITTEES

1. **Constitution and composition of State Electricity Boards**
   State govt shall constitute a state electricity board and it shall consist of 3-7 members
2. **Members not to hold interest in certain concerns**
   Members cannot hold interest in anything which will benefit him or associate himself with business of supplying electricity, fuels etc
3. **Removal or suspension of members**
   State govt can suspend or remove a member of the board who is found to be lunatic or refuse to act or fails to comply with the provision
4. **Temporary absence of members**
   If any member of the board is temporarily absent then state govt can appoint another person to carry out the function
5. **Incorporation of Board**
   The Board shall be a body corporate with power to acquire and hold property both moveable and immovable, and shall by the said name sue and be sued.
6. **Board may have capital structure**
   State govt can direct the board to have capital not exceeding 10crores if it considers necessary by notifying the official gazette and can increase the limit from time to time
7. **Appointment of staff**
   The Board may appoint a Secretary and such other officers to enable the Board to carry out its functions
8. **Objects of generating companies**
   The objects of a generating station is establishment, operation and maintenance of generating stations and tie-lines, sub-stations, and main transmission lines
9. **State Electricity Consultative Council**
   The State Government shall constitute a State Electricity Consultative Council for the State and it shall consist of members of the board, representatives of generating stations and such other persons. Its function is to advise the board on policy, to review the progress of work of generating stations and to consider such other matters
10. **Local Advisory Committee**
    State govt can constitute local advisory committee for such area as it thinks fits and consult the committee on any business coming before the govt

POWERS AND DUTIES OF STATE ELECTRICITY BOARDS AND GENERATING COMPANIES

1. **General duties of the Board**
   a. To arrange for the most efficient and economical transmission, distribution and supply of electricity within the state as soon as practicable
   b. To collect data for the use of electricity
   c. To prepare and carry out schemes for transmission, distribution and promoting the use of electricity

d. To operate the generating station under its control

2. **Duties of Generating Company**
   To establish, operate and maintain such generating stations and the lines, sub-stations and main transmission lines in the most efficient and economical manner
3. **Powers of the Board to supply electricity**
   The Board may supply electricity to any licensee or person requiring such supply in any area
4. **Leasing out of generating stations**
   State govt can make arrangements with the board or generating company for the operation and maintenance of generating station owned by it
5. **Powers of Board in relation to water power and to conduct investigation**
   With the approval of the state govt, the board or the generating company can take measures to advance the water-power in state and conduct investigations, experiments and trials for the improvement in any means of generating electricity.
6. **Loans by Board to licensees**
   The board may grant loans to licensees for the purpose of his undertaking and its expansion
7. **Power to Board to contribute to certain associations**
   Board can contribute funds to association object of which is to develop and use electricity and promote knowledge and research in electrical appliances

THE WORKS AND TRADING PROCEDURE OF THE BOARD AND THE GENERATING COMPANY

1. **Preparation and sanctioning of schemes**
   The board or generating company which has prepared a scheme either generally or for any specified area can be sanctioned
2. **Submission of schemes for concurrence of Authority, etc.**
   Steps involved are:
   a. Every scheme exceeding a capital sum fixed by the central govt shall be submitted to the authority for agreement
   b. The board or generating company shall publish such scheme in official gazette and in local newspaper with a notice of 2months so that interested licensees and other persons can make representation
   c. The scheme can then be modified after considering the representations received and submitted to the authority
   d. Copy of the scheme is forwarded to state govt or central govt
   e. The authority can give directions in the content and procedure to be followed in preparation, submission and approval of such scheme
3. **Matters to be considered by the Authority**
   a. Any river-work proposed will have prospects for best development of river for power generation in consistent with irrigation, navigation and flood-control
   b. The proposed scheme is the proper combination of hydroelectric and thermoelectric power
   c. The proposed transmission lines will be suitable
   d. The scheme provides reasonable allowances for expenditure on capital and revenue account

e. The generating station is best suited to the region in case of thermal power plant taking into account factors such as optimum utilization of fuel resources, the distance of load centre, water availability etc
f. The scheme correspond to technical, economic or other criteria

4. **Concurrence of Authority to scheme submitted to it by Board or Generating Company**
The Authority can either agree with the modified scheme or demands to modify the scheme so as to conform to the national power policy. The revised scheme can be submitted to the authority which can concur if satisfied
5. **Power to alter or extend schemes**
The board or generating company can extend or alter the scheme by a supplementary scheme from time to time
6. **Power to Board to close down generating stations**
The board at any time can declare a licensee owning a generating station situated in an area for which scheme is in force to permanently close down
7. **Operation of Board's generating stations**
The Board shall operate the generating station with the sanction of the govt which it has established or acquired. Board can also appoint any licensee or a person for its operation
8. **Use of transmission lines**
Central govt/central commission and state govt/state commission shall determine the charges for the use of transmission system by the board/generating company/licensee in case of inter-state and intra-state transmission system respectively
9. **Power to Board to enter into arrangements for purchase or sale of electricity**
Board can enter into an agreement with any person for purchase or sale of surplus electricity with the consent of state govt
10. **Terms, conditions and tariff for sale of electricity by Generating Company**
Generating company can enter into a contract with the board for sale of electricity;
The tariff can be determined according to the operation, plant load factor, rate of depreciation, return and such other factors
11. **Restriction on establishment of new generating stations or major additions or replacement of plant in generating stations**
Setting up new generating station or additions or replacement of plant can only be done by the consent of the board and the board shall consult the authority before giving consent in case the capacity exceeds 25MW
12. **Power to Board to enter upon and shut down generating stations in certain circumstances**
If licensee fails to comply the orders of the board to close down generating station or add, establish or remove plant illegally then board can enter upon the premise and shut down generating station
13. **The Grid Tariff**
Grid tariff for different areas shall be fixed from time to time according to the regulations and it is applied to the sale of electricity by the board to licensees. It has 2 components a fixed kilowatt charges component and a running charges component
14. **Provision for the sale of electricity by the Board to persons other than licensees**
The Board can supply electricity to any person other than a licensee and frame uniform tariffs for which factors considered are the nature of supply, purpose, standardization of methods, rates of charges of supply, cheapened supply in developed areas etc
15. **Lower limit of power factor in supply by Board**
Lower limit of power factor in supply of electricity to the licensee is 0.85 during maximum demand unless there is an agreement

16. **Provision of accommodation and right of way**
    If board requires accommodation for any work or apparatus to be provided by the board then the licensee shall provide it free of cost if available otherwise they can come to an agreement;
    The Board and any licensee shall each have a right of access at all times to his own property on, in, over and under the property of the other
17. **Power to Board to connect meters, etc., to apparatus of licensees**
    The board has power to connect meters, switchgears etc., to apparatus of licensees at his own cost unless there is an agreement
18. **Compliance of directions of the Regional Electricity Board etc. by licensees or Generating Companies**
    a. Central transmission utility will operate RLDC and State transmission utility will operate SLDC
    b. RLDC and SLDC can give such directions to ensure integrated grid operation and maximum economy and efficiency in the region and in the state respectively
    c. Every licensee, board, generating company or person connected with the operation shall comply the directions of Load Dispatch Centre
    d. All directions given by RLDC is issued through SLDC and SLDC should ensure it is duly complied
    e. RLDC or SLDC should enforce the decision of regional electricity board
    f. Central govt/central commission and state govt/state commission may specify the fees and charges to be paid to the RLDC and SLDC for load dispatch functions
19. **Leases of generating stations**
    No licensee can enter into an agreement to let any generating station on lease without the approval of the board and it will be void
20. **Rating Committees**
    The Board can constitute a rating committee if any licensee fails to comply or if a licensee request to and such committee shall be constituted within 3months of the notice

THE BOARD'S FINANCE, ACCOUNTS AND AUDIT

1. **General principles for Board's finance**
2. **Board to assume obligations of State Government in respect of matters to which this Act applies**
    All debts, expenditure and obligation incurred or scheme sanctioned by the state govt for the purpose of this act is considered to have been done by the board
3. **Annual financial statement**
    Every year in February the board shall submit estimated capital, revenue and expenditure to the state govt and the govt shall submit it to the house of parliament for discussion
4. **Restriction on unbudgeted expenditure**
    In urgency, Board will spend not exceeding Rs75000 in recurring expense or 3lacs in case of non-recurring expense in any year according to the regulations and a report is made
5. **Subventions to the Board**
    State govt can grant money to the board from time to time to time for this act with the approval of the state legislature
6. **Loans to the Board**
    State govt can give loan to the board on terms and conditions consistent with this act

7. **Power of Board to borrow**
   - Board can borrow any sum required for this act with the sanction from the state govt and maximum limit fixed is Rs10crores
8. **Conversion of amount of loans into capital**
   Any loan obtained by the board from the state govt can be asked to be converted into capital considering various factors if state govt thinks it necessary in public interest
9. **Priority of liabilities of the Board**
   The board shall distribute surplus in following order:
   a. Repayment of principal of any loan raised including debentures or bonds
   b. Repayment of principal of any loan advanced to the Board by the State Government
   Interest on loans advanced by State Government to be paid only after other expenses
10. **Accounts and audit**
    The board shall prepare an annual statement of accounts and keep it properly;
    It shall be audited by the Comptroller and Auditor-General of India or any authorized person in this behalf and expenditure incurred is paid by the Board;
    CAG has right to demand books, accounts, other documents and papers, and to inspect any of the offices of the Board;
    The accounts and audit report is forwarded to the authority and board has to comply with the directions of authority. State govt shall forward the same to the state legislature and publish it

MISCELLANEOUS

1. **Effect of other laws**
   Any rules or provisions under Indian electricity act, 1910 is ineffective as long as it is inconsistent with this act
2. **Water-power concessions to be granted only to the Board or a Generating company**
   State govt will grant concession only to the board or a generating company to the development and use of water-power
3. **Co-ordination between the Board's schemes and multipurpose schemes**
   Where there is multipurpose scheme, the board and the generating company shall coordinate their activities
4. **Annual reports, statistics and returns**
   The Board shall submit a report giving an account of its activities during the previous financial year to the state govt and any account of activity to be taken by the board in next financial year
5. **Arbitration**
   Matters in which arbitration is required, 2arbitrators can be appointed, 1 from each party or where authority is referred, he will act as arbitrator;
   Any fee or charges due to the authority is to be paid in 1month from the date of notice
6. **Penalties**
   Any licensee or any person fails to comply with the directions of RLDC/SLDC or fails to produce accounts etc shall be punishable with a fine that may extend to Rs500
7. **Offences by companies**
   If offence is committed by a company then every person in charge and responsible at that time and the company itself shall be considered guilty and punished accordingly
8. **Cognizance of offences**
   Court shall not take notice of any offence unless a complaint is made by an authority, board or state govt

9. **Directions by the State Government**
   The board shall be guided by the state govt on question of policy and any dispute in this regard is referred to the authority
10. **Power to make regulations**
    Board can make regulations consistent with this act and can be about any of the following matters:
    a. Administration of funds of the board
    b. Meetings of the board
    c. The duties and operations of the board
    d. Giving loans to the licensees
    e. Procedure of tenders
    f. Principle governing the fixing of grid tariff and supply of electricity by the board to any person other than licensee etc
11. **Provision relating to income tax and super-tax**
    According to the Indian Income-tax Act, 1922 the Board is considered a company and is liable to income-tax and super-tax on its income, profits and gains;
    State govt is not entitled to refund any such taxes
12. **Members, officers and other employees of the Board to be public servants**
    All members, officers and other employees of the Board shall be considered to be public servants when carrying out the provisions of this act
13. **Protection to persons acting under this Act**
    No suit, prosecution or other legal proceeding shall lie against any member or officer or other employee of Board for anything which is in done in good faith under this Act.

3.2. SALIENT FEATURES OF THE ELECTRICITY ACT, 2003

- **Role of Government**
  - ✓ *Section 3*
    Central government to prepare National Electricity Policy and Tariff Policy
  - ✓ *Section 4*
    Central government to notify National policy for rural areas permitting stand alone systems based on renewable and non-conventional source in consultation with state
  - ✓ *Section 5*
    Central government to formulate National Policy in consultation with the concerned State Governments for bulk purchase of power and management of local distribution through user's association, cooperatives, franchisees and panchayat institution etc.

- **Rural Electrification**
  - ✓ *Section 6*
    Appropriate govt. to endeavor to extend supply of electricity to all villages/hamlets
  - ✓ *Section 14*
    No requirement of license if a person intends to generate and distribute power in rural area

- **Licensing**
  - ✓ *Section 12*
    License for transmission, distribution and trading is mandatory
  - ✓ *Section 14*
    Appropriate commission to grant license;
    Appropriate commission may grant distribution license to two or more persons within the same area;
    No license required for generation and distribution of electricity in rural area as notified by state government

- **Generation**
  - ✓ *Section 7*
    Generation free from licensing;
    Requirement of TEC for non-hydro generation done away with
  - ✓ *Section 8*
    Clearance of CEA for hydro projects required. Necessary due to concern of dam safety and inter-state issues
  - ✓ *Section 9*
    Captive generation is free from controls. Open access to captive generation subject to availability of transmission facility
  - ✓ *Section 86(1)(e)*
    Generation from non-conventional sources/Co-generation is to be promoted;
    Minimum percentage of purchase of power from renewable may be prescribed by regulatory commissions.

- **Transmission**
  - ✓ *Section 15(5)(b)*
    Transmission companies to be licensed by the Appropriate Commission after giving due consideration to the views of the transmission utility
  - ✓ *Sections 26, 27, 31, 38, 39*
    Load dispatch to be in the hands of a govt company/organization;
    Flexibility regarding keeping transmission utility and load dispatch centre together or separating them;
    Load dispatch function critical for grid stability and neutrality vis a vis generators and distributors. Instructions are to be bounding on both.
  - ✓ *Sections 27, 31, 38, 39, 41*
    The load dispatch centre/Transmission utility/Transmission licensee not to trade in power facilitating genuine competition between generators
  - ✓ *Sections 38-40*
    Open access to transmission lines to be provided to distribution licensees and generating companies;

There would be transmission utility at the centre and in the states to undertake planning and development of transmission system

- **Distribution**
  - ✓ *Section 12*
    Distribution licensee free to take up generation & generating company
  - ✓ *Sections 19, 24*
    Provision for suspension/revocation of license by regulatory commission as it is an essential service which cannot be allowed to collapse
  - ✓ *Section 42*
    Open access in distribution to be allowed by SERC in phases;
    State commission shall, not later than 5years, provide open access to all consumers where the maximum power consumed exceeds 1MW;
    In addition to wheeling charges provision for surcharge to cover current level of cross subsidy
  - ✓ *Section 55*
    Metering made mandatory
  - ✓ *Section 62*
    Retail tariff to be determined by regulatory commission

- **Trading**
  - ✓ *Section 12*
    Trading recognized as a distinct activity
  - ✓ *Section 66*
    Regulatory commission to promote development of market including trading
  - ✓ *Sections 79(1)(j), 86(1)(j)*
    Regulatory commission may fix ceiling on trading margin

- **Regulatory commission**
  - ✓ *Section 38(2)(d), 39(2)(d)*
    Specify open access at distribution;
    Specify the surcharge for meeting the current level of cross subsidy that is to be reduced gradually
  - ✓ *Section 82*
    SERC mandatory;
    Constitution of SERC within 6months from the appointed date;
    SERC to have not more than 3 members
  - ✓ *Section 86*
    Key function of SERC includes:
    a. Tariff determination for generation, supply, transmission, and wheeling of electricity

b. Regulate electricity purchase and procurement process of distribution licensees
c. Facilitate intra-state transmission and wheeling of electricity
d. Issue license to transmission, distribution and trading co.
e. Promote generation and cogeneration of electricity from renewable sources of energy
f. Specify state grid code consistent with the grid code
g. Specify or enforce standards with respect to quality, continuity and reliability of service by licensees

- **Tariff principle**
  - ✓ *Section 61*

    Consumer tariff to progressively reduce cross subsidy and move towards the actual cost of supply;

    Regulatory commissions to undertake regulation including determination of multi-year tariff principles
  - ✓ *Section 62*

    Regulatory commission to determine tariff for supply of electricity by generating company on long/medium term contracts;

    No tariff fixation if tariff determined through competitive bidding or where consumers, on being allowed open access enter into agreement with generators/traders;

    Regulatory commission to consider cost of generation, transmission and distribution separately
  - ✓ *Section 65*

    State government to provide subsidy in advance through the budget for specified target groups, if tariff is required to be lower than that determined by regulatory commission

- **Dispute resolution**
  - ✓ *Section 11*

    Appellate tribunal to hear appeal against the orders of CERC/SERC
  - ✓ *Section 121*

    Appellate tribunal may issue orders to any appropriate commission for performance of its statutory functions
  - ✓ *Section 125*

    Appeals against the order of the Appellate tribunal to be placed before the Supreme Court
  - ✓ *Section 143*

    Appropriate commission may appoint any of it member to be an adjudicating officer for holding an enquiry;

Adjudicating officer has the power to summon and enforce the attendance of any person

- ✓ *Section 158*
  In case of any dispute directed under the EA, 2003 to be determined by arbitration, it would be determined by such persons nominated by the appropriate commission

- **Role of CEA**
  - ✓ *Section 70*
    To continue as the main technical advisor of government of India/state govt with the responsibility of overall planning
  - ✓ *Section 72*
    To specify safety standards
  - ✓ *Section 73*
    Technical advisor to CERC as well as SERCs;
    Specify technical standards for electrical plants and electrical lines

- **Restructuring of SEBs**
  - ✓ *Section 131*
    Provision for transfer scheme to create one or more companies from SEB
  - ✓ *Section 167*
    State government may continue with SEB as state transmission utility and Generation Company and Distribution Company

- **Consumer protection**
  - ✓ *Section 42*
    Redressal forum for redressal of grievances of consumers to be appointed by every distribution licensee within 6 months
  - ✓ *Section 43*
    Consumer to be given connection within stipulated time;
    Penalty in the event of failure to give connection
  - ✓ *Section 57*
    Licensees require meeting standards of performance specified by regulatory commission. Failure to meet standards makes them liable to pay compensation to affected person within ninety days

- **Anti-theft provisions**
  - ✓ *Section 26*
    Focus on revenue realization rather than criminal proceedings;
    Assessment of electricity charges for unauthorized use of electricity by the assessing officer designated by the state government

- ✓ *Section 135*
  Theft of electricity/electricity lines and materials punishable with imprisonment for a term that may extend to 3 years or with fine or both
- ✓ *Section 150*
  Punishment provision for abetment of theft
- ✓ *Section 152*
  Provisions for compounding of thefts
- ✓ *Sections 153-158*
  Special courts

3.3. POST-ELECTRICITY ACT, 2003 SCENARIO

- **NATIONAL ELECTRICITY POLICY, 2005**
  - ✓ Access to Electricity - Available for all households in next five years
  - ✓ Availability of Power - Demand to be fully met by 2012. Energy and peaking shortages to be overcome and adequate spinning reserve to be available
  - ✓ Supply of Reliable and Quality Power of specified standards in an efficient manner and at reasonable rates.
  - ✓ Per capita availability of electricity to be increased to over 1000 units by 2012
  - ✓ Minimum lifeline consumption of 1 unit/household/day as a merit good by year 2012.
  - ✓ Financial Turnaround and Commercial Viability of Electricity Sector
  - ✓ Protection of consumers' interests.

- **NATIONAL TARIFF POLICY, 2006**
  - ✓ Ensure availability of electricity to consumers at reasonable and competitive rates;
  - ✓ Ensure financial viability of the sector and attract investments;
  - ✓ Promote transparency, consistency and predictability in regulatory approaches across jurisdictions and minimize perceptions of regulatory risks;
  - ✓ Promote competition, efficiency in operations and improvement in quality of supply.
  - ✓ General approach to tariff structuring
    a. Two part tariffs for all long term contracts
    b. CERC to periodically determine rate of return
    c. Option to the CERC to consider Return on Equity (RoE) or Return on Capital Employed (RoCE)
    d. Debt swaps to be incentivized keeping in view consumer interest
    e. After 5 years of policy formulation all power to be procured by distribution licensees through competitive bid process

- **RURAL ELECTRIFICATION POLICY, 2006**
  - ✓ Grid connectivity is the normal way of electrification of villages. For villages/habitation, 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 so that every household gets access to electricity.
  - ✓ The State Governments should, within 6 months prepare and notify a Rural Electrification Plan to achieve the goal of providing access to all households includes the electrification of delivery mechanisms (grid or stand alone)
  - ✓ Rural Electrification Corporation Ltd. (REC), a government of India enterprise under the Ministry of Power, is the nodal agency at Central Government level to implement the rural electrification program
  - ✓ Local community to be involved in rural electrification program particularly the women
  - ✓ Programs for encouraging energy efficient equipment specially irrigation pump sets have to be taken up
  - ✓ The tariff for sale of electricity generated from standalone systems has to be decided by market forces, however the benefit of financial assistance/ capital subsidy received from the government should be fully passed on to the consumers
  - ✓ The policy enables the franchisee arrangement for local management of rural distribution of electricity. As far as possible, the franchisee to be selected on competitive bidding
  - ✓ There is a provision for special and automatic approval for standalone systems for up to 1 MW which is based on cost effective proven technology and use locally available resources such as biomass.

3.4. REGULATORY FRAMEWORK FOR RE DEPLOYMENT

3.4.1. ELECTRICITY ACT, 2003

Electricity Act, 2003 has several enabling provision to accelerate the development of renewable energy based generation such as:-

- ✓ **Section 3:** National Electricity Policy and Plan for development of power system based on optimal utilization of resources including renewable sources of energy.
- ✓ **Section 4:** The Central Government shall prepare a national policy, permitting stand alone systems (including those based on renewable sources of energy) for rural areas.
- ✓ **Section 61(h):** Tariff Regulations by Regulatory Commissions to be guided by promotion of generation of electricity from renewable energy sources in their area of jurisdiction.

✓ **Section 86(1) (e):** Regulatory Commissions to specify percentage of renewable energy to be procured as renewable purchase obligation for licensees and other persons.

- Under Section **61(h)**, promotion of cogeneration and generation of electricity from renewable sources of energy has been made the explicit responsibility of state electricity regulatory commissions (SERCs), who are taking these considerations into account while drafting their terms and conditions for tariff regulations. Nearly all SERCs have issued their tariff regulations/orders incorporating suitable clauses which will enable the SERCs to provide a preferential treatment to renewable energy during the tariff determination process.
- Under Section **86 (1)(e),** SERC is also made responsible for the following:
  i. Ensuring suitable measures for connectivity of renewable power to the grid;
  ii. Sale of renewable energy electricity to any person;
  iii. Mandating purchase of a certain percentage of total energy consumption from renewable.
- As mandated under section 86 1(e) of EA, 2003, almost 24 SERCs have fixed certain quota (in terms of percentage of electricity being handled by the power utility) to procure renewable energy. The mandate termed as Renewable Purchase Obligation (RPO) or Renewable Purchase Specification (RPS) varies from 0.5% to 14% in various states. Few states have come out with technology-specific RPO or RPS. Besides, the state regulators determine the tariff for all RE projects in the states and ensure connectivity to the grid through extension of power evacuation from the RE project sites which are generally at remote locations and away from major load centers.

3.4.2. NATIONAL ELECTRICITY POLICY

Clause **5.12** of the National Electricity Policy stipulates several conditions for promotion and harnessing of renewable energy sources. The salient features of the said provisions of NEP are reproduced below.

- **5.12.1**: Non-conventional sources of energy being the most environment-friendly, there is an urgent need to promote generation of electricity based on such sources of energy. For this purpose, efforts need to be made to reduce the capital cost of projects based on non-conventional and renewable sources of energy. Cost of energy can also be reduced by promoting competition within such projects. At the same time, adequate promotional measures would also have to be taken for development of technologies and a sustained growth of these sources.

- **5.12.2**: The Electricity Act, 2003, provides that co-generation and generation of electricity from non-conventional sources would be promoted by the SERCs by providing suitable measures for connectivity with the grid and sale of electricity to any person and also by specifying, for purchase of electricity from such sources, a percentage of the total consumption of electricity in the area of a distribution licensee.

3.4.3. NATIONAL TARIFF POLICY

This policy further elaborates the role of regulatory commissions, the mechanism for promoting renewable energy, the time frame for implementation, etc. Clause 6.4 of the policy addresses various aspects associated with promoting and harnessing renewable energy sources. Salient features of the provisions made by the NTP are as follows.

- Under Section 86(1) (e), Appropriate Commission shall fix RPO and SERCs shall fix its tariff latest by April 1, 2006
- Initially Appropriate Commission to fix preferential tariffs for distribution utility to procure RE since it will take some time before RE technologies can compete with conventional sources in terms of cost of electricity
- In future, distribution utility to procure RE through competitive bidding within suppliers offering same type of RE under Section 63
- In long-term, RE technologies need to compete with all other sources in terms of full costs
- CERC to provide guidelines for pricing non-firm power if RE procurement is not through competitive bidding

Amendments to Tariff Policy (20th January, 2011)

- SERCs to reserve a minimum percentage for purchase of solar energy which shall go up to 0.25% by the end of 2012-12 and further up to 3% by 2022
- Purchase of energy from non-conventional sources of energy takes place more or less in same proportion in different states
- An appropriate mechanism such as renewable energy certificate (REC) would need to be evolved
- REC mechanism should also have a solar specific REC

3.4.4. NATIONAL ACTION PLAN FOR CLIMATE CHANGE (NAPCC)

- At National level for FY 2010, target for RE Purchase may be set at 5% of total grid purchase, to be increased by 1% each year for 10 years
- SERCs may set higher target than this minimum at any point in time
- Central & State Govts may set up a verification mechanism to ensure that renewable power is actually procured
- Appropriate authorities may issue certificates that procure renewable power in excess of the national standard. Such certificates may be tradable, to enable utilities falling short to meet their RPO

- Penalties as may be allowed under EA 2003 may be levied, if utilities are still falling short in RPO

3.4.5. ELEVENTH PLAN 2007-2012

Establishes a target that 10% of power generating capacity shall be from renewable sources by 2012 (a goal that has already been reached); supports phasing out of investment-related subsidies in favor of performance-measured incentives.
As of April 2010, 18 states had established RPOs or had draft regulations under consideration with RPO requirements ranging from 1% to 15% of total electricity generation. In January 2010, CERC announced the terms of a tradable Renewable Energy Certificate (REC) program. Under this program, generators choose between selling the renewable electricity generated at a preferential tariff and selling the electricity generated separately from the environmental benefits. The environmental attributes can be exchanged in the form of RECs, which will be issued by a central agency set up for administration of this program. RPOs are not yet enforced.

3.4.6. FORUM OF REGULATOR (FOR)

FOR report on 'Policies on Renewable' recommends

- Ascertaining Need for Inter-State exchange of RE power
  a. Inter-State exchange of RE power is desirable from National perspective and the same should be promoted
  b. Mechanism for appropriate treatment for inter-State RE exchange through Regional Energy Account needs to be developed

- Ascertaining feasibility of REC mechanism
  a. Concept of RE Certificate as a tool for promotion of RE sources has been used in some countries
  b. REC mechanism can be introduced within existing framework of EA 2003
  c. Co-operation amongst States is essential and SERCs should recognize procurement of RE generated in other States for purpose of compliance as RPO by regulated entity in their respective jurisdiction

3.4.7. GUIDELINES FOR COMPETITIVE BIDDING

I. Competitive bidding is done through the following mechanism:
   a. CASE 1- RE: Where the location or technology of Renewable Power project is not specified by the Procurer
   b. CASE 2- RE: Location specific Renewable, which the Procurer intends to set up under tariff based bidding process

II. Bidding process:
   a. For long-term or medium term procurement, a single stage process i.e. Request for Proposal (RFP) shall be adopted for the bidding process. Procurer or authorized representative shall prepare bid documents (RFP)
   b. The Procurer shall publish a RFP notice in at least two national Newspapers and company website which contains minimum conditions to be met by the Bidder
   c. All parties shall rely solely on the written communication
   d. RFP shall include:
      i. Procurer's requirements(Quantum of electricity proposed to be bought in MW, Term of contract, Normative availability requirement, Expected date of commencement of supply, Point where electricity is to be delivered, Financial requirements to be met by the Bidder, Structure of tariff)
      ii. Payment security made by procurer
      iii. Bid evaluation methodology to be adopted by the Procurer including the discount rates for evaluating the bids(tariff is decided either on discount offered on tariff or fixed tariff quoted by the bidder)
      iv. Other technical, operational and safety criteria to be met by Bidder
   e. Model PPA proposed to be entered with the selected Bidder which shall include:
      i. Risk allocation between parties
      ii. Technical requirements
      iii. Industry standards
      iv. Default conditions, cure and penalties
      v. Payment security to be offered by procurer
   f. The clarification/revised-bidding document shall be uploaded on the website of the Procurer informing about the deviations and clarifications.

III. Bid submission and evaluation
   a. The minimum number of qualified Bidders should be at least two other than the Procurer
   b. The Procurer shall constitute committee for evaluation of the bids (Evaluation Committee) with at least one external member
   c. Bidders shall be required to submit separate technical and price bids. Bidders shall also be required to furnish necessary bid-guarantee along with the bids to eliminate non-serious bid
   d. The technical bid is evaluated first to ensure that the bids submitted meet eligibility criteria set out in RFP. Only the bids that meet the technical criteria shall be considered for further evaluation on the price bids
   e. The price bid shall be rejected, if it contains any deviation from the tender conditions for submission of price bids
   f. In the case of procurement under 'Case 1- RE', the Bidder shall quote the price of electricity at the interconnection point
   g. Charges up to the injection point shall be borne by the Bidder and transmission charges from the injection point to the delivery point shall be borne by the Procurers
   h. The Bidder, who has quoted lowest levellised tariff as per evaluation procedure, shall be considered for the award
   i. In case there is any deviation from these guidelines, it can only be with the prior approval of the Appropriate Commission

IV. Contract award and conclusion

a. The PPA shall be signed with the selected Bidder consequent to the selection process in accordance with the terms and conditions of RFP bid documents
b. After the conclusion of bidding process, the Evaluation Committee shall provide appropriate certification on conformity of the bidding process evaluation.
c. The Procurer shall make the bids public by indicating all the components of tariff quoted by all the Bidders and only the name of the successful Bidder shall be made public
d. Full details shall be posted on the website of the Procurer for at least thirty days
e. The signed PPA along with the certification certificates shall be forwarded to the Appropriate Commission for adoption of tariffs

3.4.8. RENEWABLE ENERGY TARIFF REGULATIONS BY CERC(2012)

I. **General principles:**

a. Useful life

Wind energy project	25 years
Biomass with rankine cycle	20 years
Non-fossil fuel cogeneration project	20 years
Small hydro plant	35 years
Solar PV/Solar thermal	25 years
Biomass gasifier	20 years
Biogas based power project	20 years

b. *Control period* – The period during which the norms for determination of tariff specified in these Regulations shall remain valid is 5 years

c. *Tariff period* – It is the period for which tariff is to be determined by the Commission.

Small hydro projects below 5 MW	35 years
Solar PV and Solar thermal	25 years
Biomass gasifier and Biogas	20 years
Others	13years

d. *Tariff structure* – The tariff for renewable energy technologies shall be single part tariff and tariff for renewable energy technologies having fuel cost component like biomass power projects and non-fossil fuel based cogeneration, single part tariff with two components (fixed cost component and fuel cost component) shall be determined.

e. *Tariff design* – The generic tariff shall be determined on levellised basis for the Tariff Period. For this purpose, the discount factor equivalent to Post Tax weighted average cost of capital shall be considered.

f. *Dispatch principles* – All renewable energy power plants shall be treated as 'MUST RUN' power plants and shall not be subjected to 'merit order dispatch' principles except for following:
   i. Biomass power plants of 10 MW and above and non-fossil fuel based cogeneration plants,
   ii. Wind power plant of 10 MW and above at 33 kV connection point
   iii. Solar plant of 5 MW and above at 33 kV connection point

II. **Financial principles:**

a. *Capital cost* – Capital cost consist of all capital work including plant and machinery, civil work, erection and commissioning, financing and interest during construction, and evacuation infrastructure up to inter-connection point

b. *Debt equity ratio* – For generic tariff debt equity ratio shall be 70:30

c. *Loan and finance charges* –
   i. Loan tenure: 12 years
   ii. Interest rate

d. *Depreciation*:
   - The Salvage value of the asset shall be considered as 10% and depreciation shall be allowed up to maximum of 90% of the Capital Cost of the asset.
   - The depreciation rate for the first 12 years of the Tariff Period (loan tenure) shall be 5.83% per annum and the remaining depreciation shall be spread over the remaining useful life from 13th year onwards

e. *Return on equity* – The normative return on equity shall be:
   i. 20% per annum for the first 10 years
   ii. 24% per annum 11th years onwards.

f. *Interest on working capital* – Interest on Working Capital shall be at interest rate equivalent to the average State Bank of India Base Rate prevalent during the first six months of the previous year plus 350 basis points

- Working capital is calculated in following way:

	Wind energy/small hydro power/solar PV /solar thermal	Biomass/biogas power/non-fossil fuel cogeneration
Fuel cost	-	For 4 months
Operation & maintenance expense	For 1 month	For 1 month
Receivables equivalent to	2 months of energy charges on normative CUF	2 months of fixed and variable charges on the target PLF
Maintenance spare @	15% of O&M	15% of O&M

g. *Operation and maintenance expenses* – It shall comprise of repair and maintenance, establishment including employee expenses and administrative & general expenses Normative O&M expenses allowed during first year of the Control Period (i.e. FY 2012-13) under these Regulations shall be escalated at the rate of 5.72% per annum over the Tariff Period.

h. *Sharing of CDM benefits* – CDM benefits is shared between generating company and concerned beneficiary in following manner:
   i. 100% to be retained by the project developer in first year
   ii. In the second year, the share of the beneficiaries shall be 10% which shall be progressively increased by 10% every year till it reaches 50%, where after the proceeds shall be shared in equal proportion.

i. *Subsidy or incentive by state/central govt* – The Commission shall consider any incentive or subsidy offered by the Central/State Government, including accelerated depreciation benefit while determining the tariff under these Regulations

j. *Taxes and duties* – Tariff determined under these regulations shall be exclusive of taxes and duties as may be levied by the appropriate Government

3.5. REGULATORY FRAMEWORK FOR SOLAR ENERGY DEPLOYMENT

3.5.1. CERC TARIFF REGULATIONS (2012):

I. Technology specific parameters for Solar PV & Solar Thermal:

	Solar PV	Solar Thermal
Technology aspects	Norms shall be applicable for grid connected PV systems that directly convert solar energy into electricity and are based on the technologies such as crystalline silicon or thin film etc. as may be approved by MNRE	Norms CSP technologies viz. line focusing or point focusing and uses direct sunlight, concentrating it several times to reach higher energy densities and temperatures whereby is used to operate a conventional power cycle to generate electricity
Capital cost	Rs1000lakh/MW for FY 2012-13	Rs1000lakh/MW for FY 2012-13
Capacity utilization factor	19%	23%
Operation and maintenance expenses	Rs11lakh/MW for 1st year and escalated at the rate of 5.72% per annum	Rs15lakh/MW for 1st year and escalated at the rate of 5.72% per annum

TABLE – 1: Technology specific parameters for Solar PV & Solar Thermal

3.5.2. JAWAHARLAL NEHRU NATIONAL SOLAR MISSION

- The Jawaharlal Nehru National Solar Mission (NSM) was launched in January 2010, and since then has been one of the key drivers of the solar industry in India. The NSM, regulated by the Ministry of New and Renewable Energy (MNRE), is targeting an installed capacity of 20GW for grid connected solar power by 2022, spaced out over three phases.

Segment	Phase-I April, 2010-March, 2013	Phase-II April, 2013-March, 2017	Phase-III April,2017-March, 2022
Utility Grid Power (Including Rooftop)	1000-2000 MW	4000-10,000 MW	10,000-20,000 MW

- Phase-I

  As a part of phase one of the NSM, the MNRE announced that it would allocate 500MW of PV and Concentrated Solar Power (CSP) projects each, in its attempt to equally encourage both technologies. Allocations of projects in phase one of the NSM was carried out in two batches. The NTPC Vidyut Vyapar Nigam (NVVN) has been the nodal agency for NSM during this phase.

  - Batch-1

    As a part of phase one batch one, the MNRE received bids from 333 project developers, amounting to bids worth 1,815MW for just 150MW of solar PV projects. In order to impartially allocate these projects, the MNRE initiated a process of reverse bidding to allocate the projects. As per this process, the developers with the lowest bid amount (the highest discount upon the initial tariff of Rs17.91/kWh) would be allocated projects under phase one of the NSM. The average tariff for 150MW of solar PV projects allocated under phase one batch one was Rs12/kWh. Of the allocated capacity, 130MW have already been commissioned, while 10MW of projects have been cancelled and 10MW have been delayed.

- Batch-2
  - ✓ Allocations of projects during batch two of phase one was carried out in December 2011, for which 350MW were allocated, while PPAs were signed for only 340MW. The average tariff under this batch was Rs8.2/kWh. The deadline for the completion of these projects is March 2013.
  - ✓ The guidelines for batch two of phase one of the NSM included a Domestic Content Requirement (DCR) which specifies that allocated projects could only use domestically manufactured Crystalline Silicon (c-Si) cells and modules8. The developers could however, use international thin film technology in their solar power plants. The DCR was formulated with the intention of boosting the domestic manufacturing base. However, most developers under the NSM, over 70% in phase one batch two, chose to opt for cheaper international thin film technology rather than expensive domestic c-Si modules. This resulted in the domestic manufacturers operating their plants at a minimal fraction of their capacity or having to shut down.

- Phase-II
  - ➢ The draft guidelines for phase two of the NSM were released in December 2012. The nodal agency for this phase is the Solar Energy Corporation of India (SECI).According to the draft guidelines for phase two of the NSM, MNRE had planned to allocate 800 MW through a bundling of power mechanism (as in phase one of the NSM), and 750 MW through a Viability Gap Funding (VGF) mechanism.
  - ➢ For a large part of the first quarter of 2013 (January to March), MNRE has tried to arrange for unbundled power from the Ministry of Power (MoP) to carry out the tariff based bidding component of allocations. However, as there is only a limited amount of unbundled power available and all the states in India demand access to it, the MoP has been unwilling to provide this. Consequently, MNRE has now decided to go ahead only with the allocations for 750 MW based on VGF.
  - ➢ The VGF is generally a financial investment made by the government, by meeting a part of the initial costs of a project, whose high economic costs and low returns would otherwise make it unviable for a private project developer. The VGF has so far been used to build roads, railways, airports, and other large infrastructural projects. The allocations under VGF have so far been carried out through competitive bidding processes.
  - ➢ The minimum project capacity for a single bid is to be 10 MW and the maximum capacity is to be 50 MW. Projects are to be allocated in multiples of 10 MW. The allocation process, signing of PPAs and disbursement of VGF will all be coordinated by the SECI. According to the draft, a fixed tariff ` 5.45 (€ 0.08/$ 0.11)/kWh will be awarded to projects not availing accelerated depreciation and a fixed tariff of ` 4.95 (€ 0.07/$ 0.10)/kWh will be awarded to projects availing accelerated depreciation. Over and above this, VGF will be provided with an upper limit of 30% of the project cost or Rs 25m/MW. The exact quantum of VGF will be determined by a reverse bidding mechanism

-			2013-2014	2014-2015	Total
Rooftop and small Solar		PV	100 MW	100 MW	200 MW
Utility scale	Bundling (FIT)	PV	800 MW	0	800 MW
	VGF	PV	750 MW	770 MW	1500 MW
		CSP	0	1080 MW	1080 MW
Total		PV	1650 MW	870 MW	2520 MW
		CSP	0	1080 MW	1080

TABLE – 2: Targeted capacity addition under phase two of the NSM

3.6. POLICIES CANVAS FOR VARIOUS STATE SOLAR

3.6.1. GUJARAT SOLAR POLICY 2009

The state of Gujarat introduced a solar power policy in the state in 2009, even before the introduction of the NSM. The current policy is in operation till 31st March, 2014. Gujarat is the only policy in the country which has a fixed tariff, and does not follow the reverse bidding mechanism. In its tariff order released in January 2012 it fixed different tariffs for the next three years. The tariffs decrease every year as compared to the previous year.

Salient Features:

a. *Capacity:*

- Only new plants and machinery will be eligible under this Policy. No fossil fuel shall be allowed for Solar Thermal Project.
- The minimum capacity of for Solar PV and Solar Thermal projects will be 5 MW each. It had an initial target of 500 MW. But ultimately, 958.5 MW of solar power projects were allocated in the state. Only 14% of the allocated capacity was commissioned by the completion deadline of December 31st 2011. However, as of May 2013, a capacity of 824.09 MW has been commissioned under the Gujarat policy. The state is already fulfilling its RPO and is currently a power surplus state.

b. *Cross-subsidy charge:*

- Cross subsidy surcharges shall not be applicable for Open Access obtained for third party sale within the state

c. *Wheeling charges:*

- As determined by GERC from time to time

d. *Electricity duty:*

- Exempted from payment of electricity duty for sale through all modes(self consumption/sale to third party/sale to licensee)
- Exemption from demand cut to the extent of 50% of installed capacity

e. *PPA:*

- PPA duration will be 25 years

f. *Bank guarantee:*

- Developer to furnish a BG @Rs 50Lakhs/MW at the time of PPA signing with Distribution Licensee.BG to be refunded if the developer commissions the project in time as per PPA

g. *Metering of electricity:*

- Electricity generated would be metered jointly on a monthly basis by GEDA/GETCO. Metering to done at sending sub-station of 66 kV or above, located at the site

h. *Reactive power charges:*

- As per GERC order.

i. *Transmission infrastructure:*

- Transmission line from SPG switch yard to GETCO sub-station shall be laid by GETCO.SPG to inject power at 66kV.

j. *Sharing of CDM benefit:*

- SPG will pass 50% of CDM benefit to DISCOM with whom PPA is signed.

k. *Forecasting & Scheduling:*

- SPG based generation shall not be covered under scheduling procedure for Intra-state ABT.

l. *Nodal Agencies for facilitation and implementation of Solar Power Policy- 2009:*

- Gujarat Energy Development Agency (GEDA)
- Gujarat Power Corporation Limited (GPCL)

3.6.2. KARNATAKA SOLAR POLICY 2011-2016

Under the Karnataka Renewable Energy Policy, it is envisaged that the State will have a target for achieving 126 MW of solar power up to 2013-14. The Govt. of Karnataka had released the Solar Policy for FY11-FY16 on 1st July 2011 envisaging to set up a capacity of 200 MW of solar power in the state for the RPO fulfillment of the ESCOMs. The policy came into force from 1st July 2011 and shall remain in force up to 31st March 2016.

Salient features:

a. *Proposed Capacity:*

- It is proposed to install 200 MW up to 2015-16, for the purpose of procurement by the ESCOMS. This will be in addition to the allotment received under JNNSM. The annual capacity approved will be as follows:

Years	Capacity (MW)
2011-2012	40
2012-2013	40
2013-2014	40
2014-2015	40
2015-2016	40

- This does not include CPP and those put up for sale of power to third party.
- The minimum capacity shall be 3 MW and max. capacity will be 10 MW for Solar PV projects and min. capacity shall be 5 MW for Solar Thermal projects
- Power evacuation shall be through 11 KV and above voltage will only be permissible.
- Project allocation will be done through competitive bidding process with a maximum tariff being in accordance with the KERC order.

b. *Wheeling & OA charges:*

- In addition to envisaged 200MW capacity, captive power plants and plants for sale to third party will also be set up. In case of captive power plants and projects for sale of power to third party other than ESCOMs, wheeling and open access charges have to be paid as determined by KERC/CERC

c. *REC Scheme:*

- Under the REC mechanism the project developers can sell their power at the pooled cost of power purchase only to the ESCOMS. A capacity of 100 MW can be installed under this scheme.

d. *CDM Proceeds:*

- Sharing of CDM proceeds will be as per bidding documents.

e. *Metering:*

- Metering arrangement shall be made as per Central Electricity Authority (Installation & Operation of Meters) Regulations, 2006, the grid code, the metering code and other relevant regulations issued by KERC/CERC in this regard

f. *Nodal Agency:*

- KREDL will be the nodal agency for facilitating and implementing this policy.

3.6.3. RAJASTHAN SOLAR POLICY 2011

The policy aims at developing Rajasthan as a global hub of solar power of 10,000-12,000 MW capacity in next 10-12 years to meet energy requirements of Rajasthan and India

Salient features:

a. Capacity target:

- The State Government has sanctioned two Solar Power Projects of 5 MW capacity under the GOI guidelines for Generation Based Incentive scheme for Grid Interactive Solar Power Generation Projects issued by MNRE.
- The Rajasthan State has sanctioned 66 MW solar power projects in compliance of the RERC's orders. These sanctioned projects were migrated to National Solar Mission by the State Government.
- The Rajasthan State will develop 50 MW SPV and 50 MW Solar Thermal Power Plants through selection of developer(s) by the tariff based competitive bidding process on concept of bundling of Solar Power with equivalent amount of MW capacity of conventional power.
- The state government will support setting up of 100 MW solar photovoltaic power plants and 100 MW solar thermal power plants under phase I of the Rajasthan Solar Energy Policy 2011 for direct sale of power to Discoms in the state. Under phase II (2012-2017), the state government plans to add another 400MW of solar power through tariff based competitive bidding process.

	Phase-I (up to 2013)	Phase-II (2013-2017)
Maximum capacity to be developed	200 MW	400 (additional)

- The Rajasthan State will promote deployment of Roof-top and Other Small Solar Power Plants connected to LT/11kV Grid as per guidelines of MNRE under Rooftop PV & Small Solar Generation Programme (RPSSGP) of NSM
- The State will promote setting up of small solar power plants connected at 11 kV grid of 1 MW capacity each for direct sale to State Discoms of Rajasthan. The total capacity under this category will be 50 MW. The selection of the projects will be through tariff based competitive bidding process.
- The Rajasthan State will promote Solar Power Producers to set up Solar Power Plants along with Solar PV manufacturing plants in Rajasthan. The target under this category will be 200 MW up to 2013
- The Rajasthan State will develop Solar Parks (with RREC as nodal Agency) of more than 1000 MW capacity in identified areas of Jodhpur, Jaisalmer, Bikaner and Barmer districts in various stages
- Rajasthan also intends to set up Pilot Demonstration Projects under National Solar Mission's R&D initiatives in Phase – 1 of Solar Mission. This will include :

i. 50-100 MW Solar thermal plant with 4-6 hours storage (which can meet both morning and evening peak load and increased plant load factor up to 40%)
ii. A 100 MW Parabolic trough technologies based solar thermal plant
iii. A 100-150 MW Solar hybrid plant with coal, gas or bio-mass to address variability and space-constraints.
iv. 20-50 MW Solar plant with or without storage, based on central receiver technology with molten salt/steam as working fluid and other emerging technologies.
v. Grid connected rooftops PV systems on selected Government buildings and installations, with net metering
Solar based space cooling and refrigeration systems

b. *Development charges:*

For Solar power projects established for sale of solar power to parties other than Discoms of Rajasthan, the Solar Power Producer shall deposit non-refundable development charge of Rs. 10 Lacs per MW to Rajasthan Renewable Energy Corporation Ltd. within one month from the date of issue of in-principle clearance for availing benefits, facilities and concessions under the provisions of this policy. For solar power projects established for sale of solar power to Discoms of Rajasthan State, no development charges will be leviable from the Solar Power Producers.

c. *Electricity Duty:*

- The energy consumed by the Power producers for own use will be exempted from payment of the electricity duty.

d. *Open Access charges and losses:*

- As approved by RERC from time to time.

e. *Metering of Electricity:*

- Metering arrangement shall be made as per Central Electricity Authority (Installation & Operation of Meters) Regulations, 2006, the grid code, the metering code and other relevant regulations issued by RERC/CERC in this regard

f. *Reactive power charges:*

- As per RERC order

g. *Sharing of CDM benefit:*

- Solar Power Producer will pass CDM benefit to DISCOM with whom PPA is signed as per appropriate commission's order

h. Forecasting and scheduling:

- The Solar energy generated for sale will not be covered under scheduling procedure for Intra-State ABT

i. Nodal Agency:

- RREC to act as Nodal Agency for Single Window Clearance of Projects

3.6.4. MADHYA PRADESH SOLAR POLICY 2012

CATEGORY OF SOLAR PROJECTS UNDER THE POLICY

Category I	Projects selected as per the competitive bidding process for selling power to MP Discoms / MP Power Management Company
Category II	Projects set up for captive use or sale of power to 3rd party within or outside the state or for sale of power to other states through open access.
Category III	Projects set up under Renewable Energy Certificate (REC) mode
Category IV	Projects under Jawaharlal Nehru National Solar Mission.

Salient features:

a. Tariff:

1. Category I projects: Setting up of Solar Power projects for direct sale to MP Discoms/MP Power Management Company Ltd. Selection of these Solar Power projects shall be through tariff based competitive bidding process. For the projects allotted under tariff based competitive bidding route, the Power Purchase Agreement will be executed between MP Discoms / MP Power Management Co. Ltd and successful bidders as per the provisions of bid/qualification document on the tariff arrived by the process of tariff-based bidding.
2. Category II projects: The Power Purchase Agreement will be executed between the Power Producer and the Procurer on mutually agreed rates. A separate Agreement will be executed for banking of power with MP Discoms/ MP Power Management Co Ltd. for such banking. The wheeling agreement with Transmission Company will be executed separately.
3. Category III Projects: The Power Purchase Agreement as required, will be executed between solar power producers and the Procurer as per the Regulations/Orders of CERC and/or MPERC
4. Category IV Projects: The Power Purchase Agreement will be executed between the solar power producer and the Procurer (NVVN and/or MP Discoms/ MP Power Management Co Ltd.) as per Guidelines under JNNSM.

b. Land:

1. Category I projects: Only project capacities to be installed in the state of Madhya Pradesh shall be eligible for incentives under this Policy, subject to registration as per the provisions of this policy

2. Category II projects:
   i. Projects on Private Land: Any Developer willing to establish power generation projects based on Solar Energy (Solar PV/Solar thermal) on private land under this category in the state shall be eligible for incentives under the new Policy, subject to registration with the GoMP.
   ii. Projects on Government Land: There shall be a set of qualification criteria fixed by the GoMP for the prospective Developers proposing to develop projects on government land. Upon eligibility, the available land shall be offered on the basis of maximum free energy per Mega Watt offered by the qualified bidders. Only such selected projects shall be eligible for incentives under this Policy.
3. Category III Projects: Solar projects under the REC mechanism shall be eligible for Policy benefits (subject to registration with GoMP) as allowed under CERC REC mechanism
   i. Projects on Private Land: Any enterprise fulfilling the requirements/criterion can apply for registration any time.
   ii. Projects on Government Land: There shall be a set of qualification criteria fixed by the GoMP for the prospective Developers proposing to develop projects on government land. Upon eligibility, the available land shall be offered on the basis of maximum free energy per Mega Watt offered by the qualified bidders. Only such selected projects shall be eligible for incentives under this Policy.
4. Category II Projects and Category III projects availing policy benefits: In case the project is set up on private land then developer is exempted from submitting any performance guarantee.

c. *Stamp duty exemption on purchase of private land:*
In case the Developer purchases private land for the project, then they will be eligible for an exemption of 50% on stamp duty. In case of non-installation of the project on this land, the exemption (given) will be withdrawn and recovery shall be made as per rules.

d. *Migration of Solar projects registered under NRSE Policy, 2006:*
A onetime offer will be extended to all solar project Developers currently registered under NRSE Policy, 2006 and which have not attained commissioning to develop projects under the following project categories:
   i. Category I projects: No separate registration will be required for availing benefits under the present Policy
   ii. Category II projects:
   iii. Category III projects: In case the Developers wish to set up projects under REC mechanism without availing Policy benefits, GoMP shall release the full processing fee initially paid (without interest) to such Developers within thirty (30) days of the receipt of written request from the Developer.

e. *Electricity duty & cess exemption:*
All Solar power projects (including captive units) will be eligible for exemption from payment of electricity duty and cess for a period of 10 years from the date of commissioning of the project.

f. *Wheeling charges:*
On wheeling charges, GoMP will provide a grant of four percent (4%) in terms of energy injected and the balance, if any, shall be borne by the project developer.

g. *Industry status:*
The Solar projects implemented under this Solar Policy will have the status of industry and will be eligible for all benefits under Industrial Promotion Policy

h. *Entry tax / VAT Exemption:*
The equipments purchased for installation of solar power plants under the policy shall be exempted from VAT and entry tax

i. *CDM benefits:*
CDM benefits to the solar power project Developers/Investors shall be as per the provisions specified by MPERC

3.6.5. ANDHRA PRADESH POLICY 2012 & FIRST AMENDMENT

The policy shall come into operation with effect from the date of issuance (26/9/2012) and shall remain applicable till 2017.

Salient features:

a. *Installed capacity:*
It intends to promote utility grid power projects for Captive Use/ Direct Sale to third party/within the state and Utility Grid Power Projects for sale through RE (Solar) Certificate Mechanism. Also, it intends to promote the Off-Grid Solar applications to meet the power needs on Stand-alone basis

b. *Wheeling and Transmission Charges:*
There will be no wheeling and transmission charges for wheeling of power generated from the Solar Power Projects, to the desired location/s for captive use/third party sale within the state through 33 KV system subject to industries maintaining their demand within its contracted demand. However, wheeling and transmission charges for wheeling of power generated from the Solar Power Projects for sale outside the state will be as per APERC regulations

c. *Banking:*

Banking of 100% of energy shall be permitted for one year from the date of banking. The settlement of banked energy will be done on monthly basis. However, banked units cannot be consumed/redeemed from February to June and also during TOD hours as amended from time to time. Developer will be required to pay 2% of the banked energy towards banking charges.

d. *OA charges:*

Intra-state Open Access clearance for the whole tenure of the project or 25 years whichever is earlier will be granted within 15 working days of application to both the generator and consumer irrespective of voltage level

e. *Cross Subsidy charges:*

Cross subsidy surcharge shall not be applicable for Open Access obtained for third party sale within the state and for captive use subject to the industries maintaining their demand within its contracted demand with the DISCOMs.

f. *Electricity Duty exemption:*

All Solar Power projects will be exempted from paying Electricity Duty for captive consumption and third party sale within the state.

g. *VAT refund:*

VAT for all the inputs required for solar power projects will be refunded by the Commercial Tax Department.

h. *Refund of Stamp Duty and Registration charges:*

Industries Department will provide incentive in terms of refund of Stamp Duty and Registration charges for land purchased for setting up solar power project.

i. *REC:*

All projects developed with the above incentives will also be eligible for REC benefits. Deemed injection into the grid for in-house captive solar generation plant (in the same premises) will be considered for issue of REC.

3.6.6. TAMIL NADU SOLAR POLICY 2012

Tamil Nadu solar policy aims to achieve 3GW installed capacity by 2015 and thereby achieve grid parity.

Salient features:

a. *RPO mechanism:*

- 3% solar RPO requirement till December 2013 & 6% solar RPO requirement from 2014

- RPO to be applicable to:
  - Special Economic Zones (SEZs)
  - Industries guaranteed with 24/7 power supply
  - IT Parks, Telecom Towers
  - All Colleges & Residential Schools
  - Buildings with a built up area of 20,000 sq.m. or more
  - This mechanism will require generation of 1000 MW by 2015.
- The following categories are exempted from SPO
  - Domestic consumers
  - Huts
  - Cottage & Tiny Industries
  - Power looms
  - LT Industrial consumers
  - Agricultural consumers

b. *Programme Break – up:*

The 3,000 MW of Solar Power will be achieved through Utility Scale Projects, Rooftops and under REC mechanism as follows:

Year	Utility scale (MW)	Solar roof tops (MW)	REC (MW)	Total (MW)
2013	750	100	150	1000
2014	550	125	325	1000
2015	200	125	675	1000
Total	1500	350	1150	3000

c. *Promotion of solar roof-top systems:*

i. Domestic rooftop GBI:

All domestic consumers will be encouraged to put up roof-top solar installations. A generation based incentive (GBI) of Rs 2/unit for first two years, Re 1/ unit for next two years and Re 0.5/unit for subsequent 2 years will be provided for all solar or solar-wind hybrid rooftops being installed before 31March,2014. A capacity addition of 50 MW is targeted under this scheme.

ii. Promoting rooftops in Government:

- Existing government buildings will be provided with solar rooftops in phased manner.
- All new government/local body buildings will necessarily be installed with solar roof-tops.
- All street lights and water supply installations in local bodies will be energized through solar power in a phased manner.

iii. Promoting Solar Water Heating:
Government of Tamil Nadu, through various orders, has made the use of solar water heating systems mandatory for all new houses/buildings/marriage halls/hotels/ industries having hot water boiler (steam boiler) using fossil fuel etc.

d. Development of solar parks:
Utility scale solar parks may comprise 250 MW in sizes of 1 to 5 MW, 600 MW in sizes of 5 to 10 MW and 650 MW of sizes above 10 MW. Solar Power projects will be developed through competitive/reverse bidding. Solar Parks with a capacity of about 50 MW each will be targeted in 24 districts.

e. Competitive bidding:
State will select developers through competitive bidding. Investments through Joint Ventures by State Public Sector Undertakings will also be encouraged at competitive tariffs.

f. Guaranteed single window clearance in 30 days :
Various statutory clearances that are essential for the development and commissioning of Solar Energy Projects will be handled by TEDA in co-ordination with the concerned departments/agencies. Guaranteed single window clearance will be provided through TEDA in 30 days so that the plants can be commissioned in less than 12 months.

g. Solar Manufacturing facilities:
The government aims to promote indigenous manufacturing of solar panels and other related equipment. Land will be identified for development of solar manufacturing parks.

h. Net metering:

- Net metering will be allowed (at multiple voltage levels) to promote rooftop penetration.
- Net metering facility will be extended to Solar power systems installed in commercial establishments and individual homes connected to the electrical grid to feed excess power back to the grid with "power credits" accruing to the Photovoltaic energy producer

i. Wheeling and banking charges:
The wheeling and banking charges for wheeling of power generated from the Solar Power Projects, to the desired locations for captive use/third party sale within the State will be as per the orders of the Tamil Nadu Electricity Regulatory Commission.

j. Electricity Tax:
Exemption from electricity tax to the extent of 100% of electricity generated from solar power used for self consumption/sale to utility will be allowed for 5 years.

3.6.7. DRAFT UTTAR PRADESH SOLAR POLICY 2012

The state of Uttar Pradesh (U.P.) in September 2012 has published a draft solar policy 'The Uttar Pradesh Solar Power Policy 2012'. The target it to reach 500 MW of installed capacity of SPP in the state by March 2017.

This policy will come into effect from the date of issuance and shall remain in operation up to 31stMarch 2017. However, no benefit of this policy will be available to projects set up under any incentive scheme of MNRE

Salient features:

- Grid connected solar power projects will be implemented on suitable land banks identified and procured by the developer. In case of Projects to be set up on government land or space, selection of the developer will be done by the department or nodal agency through a transparent process.
- Minimum 5 MW capacity solar power projects will be covered under this policy.
- The energy generated from solar power projects that are commissioned during this policy period can be sold to distribution utility UPPCL or to third party or for captive use.

a. *Sale of energy to local DISCOM:*
   - Projects developers willing to sell their electricity to the distribution company of the state will compulsorily have to participate in the competitive bidding process for tariff determination, subject to approval from UPERC.
   - In case the bids are received for an aggregate capacity more than 200 MW, selection of bidders shall be done on the basis of lowest quoted tariff in ascending order.
   - UPPCL will sign PPA with successful bidders for a period of ten years.
   - For PPAs signed as a result of competitive bidding, difference in the case I bidding tariff arrived at by UPPCL for purchase of conventional power and the price of solar power discovered through this bidding shall be payable to the distribution utility for power purchased from solar power projects for first 200 MW of solar power commissioned under this policy for a period of ten years. Budgetary support provided by the State Government to the Nodal Agency under the budgetary head "Incentive scheme for Solar Power Generation" will be utilized for these purposes.

b. *Sale of energy to third party:*
   Project developers can sale their power to a third party but no PPA would allowed even in future date with distribution utility. Projects under this route will have to register with the nodal agency, sign an agreement and furnish a performance bank guarantee till the commissioning of the project to avail the incentives.

c. *Captive sale of solar power:*
   Solar power plants of above 5 MW capacity to be built for captive use will also be eligible for the incentives under this policy either within the premises of the user plant or outside with wheeling arrangement.

d. *Timeframe:*

Time frame for commissioning of Solar PV projects will be 13 months and solar thermal projects would be 28 months.

e. *Grid connectivity & evacuation infrastructure:*

- The responsibility of getting connectivity with the transmission system owned by the Discom/STU will lie with the Project Developer.
- The cost of the transmission line up to the "feed in substation" viz the point of interconnection where the metering is done shall be borne by the Solar Project Developer.
- The entire cost of transmission including cost of construction of line, wheeling charges, losses etc. will be borne by the Project Developer and will not be met by the STU/Discom.

f. *Others:*

Facilitation in all clearances approvals, permissions, training and consents required from the State Government/its agencies will be the main task of the Nodal Agency as single window.

	Policy	Financial incentives	DCR	Target	PPA/MOU signed	Commissioned
Gujarat	State policy Rooftop scheme	Fixed tariff	None	no target announced for phase3	968.5MW	708.8MW
Karnataka	State policy(july.2011) Allocations(april,2012)	No wheeling charges	None	350MW by 2016 50MW(PV) 30MW(CSP)	60MW(PV) 20MW(CSP)	0 14MW
Rajasthan	State policy(april,2011) Base FIT announced Projects delayed	Bidding process for 150MW	250MW	12GW by 2022	NSM Batch1:105MW Batch2:295MW RPSSGP:12MW GBI:10MW RPO:100MW	 100MW 0 10MW 10MW 40MW
MP	Not guided by policy State policy announced(no clarity on: total target, timeframe, eligible entities, incentives, methods)	Reverse bidding		800MW (four solar park of 200MW each)	State:125MW Direct:100MW RPSSGP:5.25MW REC:2MW	0 0 5.25MW 2MW
Andhra Pradesh	Direct agreements New solar policy (REC mechanism)(sept.,2012)	Exemption from all charges(wheeling, cross-subsidy, electricity duty, VAT, stamp duty, registration for land), RECs can be availed	None	Not driven by target	NSM Batch1:15MW Batch2:20MW RPSSGP:10.5MW GBI:2MW RPO:2MW MoU:100MW	 15MW 0 10.5MW 2MW 0 0
Tamil Nadu	New solar policy (oct,2012)	50MW-GBI for rooftop through net-metering 500MW-GBI based on reverse bidding 1500MW-REC mechanism	None	3GW by 2015	NSM Batch1:5MW RPSSGP:7MW GBI:5MW	 5MW 5MW 5MW
Kerala	Rooftop solar policy	1kW non-grid connection: FI-39,000+(30,000 subsidy or 81,000(MNRE), whichever is lower)		10MW capacity addition by solar rooftop	No development so far	
UP	New solar policy	No wheeling charges for sale to third party Developers with experience of commissioning are eligible to bid	None	1GW by 2017	NSM Batch1:5MW RPSSGP:8MW MoU:50MW	 5MW 7MW 0
Punjab	Renewable energy policy with target for solar power	Competitive bidding, developers can enter into a private PPA directly with the state		65MW by 2015 200MW by 2020(Punjab energy development agency)	RPSSGP:8.5MW Migration projects:7MW	6MW 2MW

TABLE – 3: Overview of various state solar policies

CHAPTER - 4: RPO/REC ANALYSIS

4.1. RENEWABLE ENERGY MARKET MODELS

There are three types of RE market model:
Alternate A – Preferential tariff based market model
Alternate B – REC market model
Alternate C – Open access and wheeling model

- **ALTERNATE A – PREFERENTIAL TARIFF BASED MARKET MODEL**

a) Preferential tariffs determination by various SERCs
b) Generic tariff approach based on Norms for projects to be commissioned over pre-specified control period
c) Substantial addition of capacity occurred under this market model

➢ Issues in determination of preferential tariff
  i. Different Approaches for Tariff determination across States:
    a. RERC notifies norms through Tariff Regulations
    b. MERC specifies tariff parameters through separate Orders
  ii. Ambiguity over the definition of preferential tariff, control period etc.
  iii. Wide variation in financial parameters like O&M expense, interest rate, which is not State specific
  iv. Constant tariff over the Control Period, not reflecting changes in market conditions and underlying parameters

- **ALTERNATE B – REC MARKET MODEL**

a) Renewable Energy Certificate Mechanism to enable Inter-State exchange of RE power
b) REC mechanism seeks to address the mismatch between availability of RE sources and the requirement of the obligated entities to meet their renewable purchase obligation across States.
c) REC mechanism shall facilitate emergence of large number of cross-border RE transactions based on non-firm RE sources and firm RE sources

➢ Aspects considered for REC Design in Indian Context
  i. Electricity Market is Regulated to large extent
  ii. More than 90 % of electricity volumes continue to be transacted at regulated price
  iii. Preferential RE Tariff Regime to continue (Feed-in-Tariff & REC shall co-exist)

- **ALTERNATE C – OPEN ACCESS AND WHEELING MODEL**

a) RE Power Plant setup mainly to meet captive/third party requirements
b) Wheeling of power limited to two or three locations
c) Governed by State Government policy provisions or concessional wheeling arrangements

➢ Market models based on Wheeling and Open Access have the following difficulties
  i. Compatibility with Open Access Regulations
  ii. Pricing Reforms and un-bundling of State Utilities have resulted into High Transmission/Wheeling Charges
  iii. Complex scheduling and Energy Accounting requirements pose limitation on Inter-State wheeling transactions

4.2. RPO MECHANISM

4.2.1. BACKGROUND AND OVERVIEW

Although India is abundantly gifted with variety of RE sources, not all States are endowed with same level of RES. While some States have very high renewable energy potential, some States have very little renewable energy potential. Under EA 2003, the SERCs are required to fix targets for distribution companies to purchase certain percentage of their total power requirement from RES, termed as Renewable Purchase Obligation. Generation from grid connected RE projects based on RES, as approved by the Ministry of New and Renewable Energy (MNRE) Govt. of India or State Government, shall be considered for the purpose of compliance of 'RPO percentage target'. In this regard, the Commission has specified combined targets for all RE technologies except for solar. Keeping in view that solar energy can become a major energy source in future, specifying some percentage of RPO to be met through solar energy will help in developing the market for large scale solar projects and reduction in capital cost and cost of generation thereof. Further it, either on its own motion or on recommendation of the State Agency, by order, may revise or carry forward the RPO targets in case of genuine difficulty in complying with RPO.

- RPO fulfilled is under two categories:
  - ✓ Non-Solar
  - ✓ Solar (0.25% in most states)
- These Regulations shall apply to "Obligated Entities" enumerated below:
  I. Distribution companies or DISCOMs
  II. Open access consumers above 1MW
    - ✓ Procuring power from power exchanges (IEX/PXIL), traders, bilateral agreements etc.

III. Captive consumers above 5MW
   - ✓ Generating and consuming power from captive coal/ natural gas power plants
   - ✓ Primarily industrial users - cement, steel, chemical etc.

Every Obligated Entity would be required to submit necessary details regarding total consumption of electricity and purchase of energy from renewable sources for fulfillment of RPO on yearly basis to the State Agency. The incremental trajectory for RPO percentages has been specified considering the renewable energy growth on annual basis. The RPO percentage specified would be minimum percentage and would not be construed as ceiling percentage

- Penalty & RPO Regulatory Fund:

In case of shortfall in RE procurement in any year, the Commission may direct the obligated entity to deposit into a separate fund, such amount as the Commission may determine on the basis of the shortfall in units of RPO and the forbearance price decided by the Central Commission. The Commission may outline conditions for utilization of such funds for purchase of RECs and/or addressing concerns/constraints related to renewable energy development within the State. The penalty enforced by the Commission on the obligated entity, in case of non-compliance, would not be a pass through in the Aggregate Revenue Requirement.

- Options for Compliance:
  Obligated Entities can meet their obligations in three ways:
  a) Generating RE power for self consumption
  b) Buying power from RE generator
  c) Buying Renewable Energy Certificates (RECs)

4.2.2. RPO TARGET OF VARIOUS STATES

Under Section 86(1) (e) of the EA2003, the SERCs are empowered to specify the percentage of electricity to be procured by the obligated entities from the renewable sources of energy. Most SERCs have put significant emphasis on this provision and have issued Orders/Regulations specifying such percentages. This percentage is referred to as 'Renewable Portfolio Standard' (RPS) or Renewable Purchase Specification (RPS) or 'Renewable Purchase Obligation' (RPO). The Working Group on Renewable Energy of Forum of Regulators has recommended usage of 'Renewable Purchase Obligation' (RPO) for this percentage under Section 86(1) (e).

Accordingly many SERCs have specified the percentage or RPO for area under their jurisdiction by issuing RPO Orders or Regulations. The table below presents the percentage obligations levied by various SERCs in their respective jurisdictions. It can be easily noted from the table that obligation under Section 86(1) (e) varies significantly from the State to State.

STATE	RE TECHNOLOGY	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16	2016-17	2017-18	2018-19	2019-20	2020-21	2021-22
MAHARASHTRA	NON-SOLAR	5.75%	6.75%	7.75%	8.50%	8.50%	8.50%						
	SOLAR	0.25%	0.25%	0.25%	0.50%	0.50%	0.50%						
	TOTAL	6%	7%	8%	9%	9%	9%						
KERALA	NON-SOLAR		3.35%	3.65%	3.95%	4.25%	4.55%	4.85%	5.15%	5.45%	5.75%	6.05%	6.35%
	SOLAR		0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%	0.25%
	TOTAL		3.60%	3.90%	4.20%	4.50%	4.80%	5.10%	5.40%	5.70%	6.00%	6.30%	6.60%
GUJARAT	NON-SOLAR	4.75%	5.50%	6.00%									
	SOLAR	0.25%	0.50%	1.00%									
	TOTAL	5%	6%	7%									
MADHYA PRADESH	NON-SOLAR	0.80%	2.10%	3.40%	4.70%	6%							
	SOLAR	0.00%	0.40%	0.60%	0.80%	1%							
	TOTAL	0.80%	2.50%	4.00%	5.50%	7.00%							
ANDHRA PRADESH	NON-SOLAR		4.75%	4.75%	4.75%	4.75%	4.75%	4.75%					
	SOLAR		0.25%	0.25%	0.25%	0.25%	0.25%	0.25%					
	TOTAL		5.00%	5.00%	5.00%	5.00%	5.00%	5.00%					
RAJASTHAN	NON-SOLAR		5.50%	6.35%	7.00%								
	SOLAR		0.50%	0.75%	1.00%								
	TOTAL		6.00%	7.10%	8.20%								
PUNJAB	NON-SOLAR		2.37%	2.83%	3.37%	3.81%							
	SOLAR		0.03%	0.07%	0.13%	0.19%							
	TOTAL		2.40%	2.90%	3.50%	4.00%							
TAMIL NADU	NON-SOLAR		8.95%										
	SOLAR		0.05%										
	TOTAL		9.00%										
DELHI	NON-SOLAR		1.70%	2.60%									
	SOLAR		0.10%	0.15%	0.20%	0.25%	0.30%	0.35%					
	TOTAL		2.00%	3.40%	4.80%	6.20%	7.60%	9.00%					
HARYANA	NON-SOLAR		10.00%	10.00%	10.00%	10.00%	11.00%	12.00%	13.00%	14.00%	15.00%	15.50%	16.00%
	SOLAR		0.01%	0.25%	0.25%	0.25%	0.25%	0.25%	0.50%	75.00%	1.00%	2.00%	3.00%
	TOTAL		10.01%	10.25%	10.25%	10.25%	11.25%	12.25%	13.50%	14.75%	16.00%	17.50%	19.00%

TABLE – 4: RPO set by various states

4.2.3. STATUS OF RPO COMPLIANCE

As shown in the table, almost all states failed to achieve the target set by respective SERCs. Gujarat is the only state who achieved well and above the set target. Tamil Nadu is one other state who did not default but target set by them is very low as compared to Gujarat.

	Solar RPO Achievement		
State	Target	Achievement	% Achievement
Gujarat	475	709	149
Rajasthan	222	196	88
Andhra Pradesh	210	24	11
Maharashtra	338	19	6
Tamil Nadu	9	15	167
Uttar Pradesh	463	12	3
Karnataka	92	11	12
Punjab	11	8	73
Madhya Pradesh	220	7	3
Chattisgarh	76	4	5
Delhi	30	2	7
West Bengal	130	2	2
Total	2276	1009	

TABLE – 5: Status of solar RPO compliance

4.3. REC MECHANISM

Renewable energy certificates (RECs) represent the green attribute of electricity generated from renewable energy sources. These attributes are unbundled from the physical electricity and the 2 products formed – the green attribute embodied in the certificate and the commodity electricity – may be sold or traded separately. In other words, one REC represents that 1MWh of energy is generated from renewable sources. RECs have now become the currency of renewable energy markets because of their flexibility and the fact that they are not subject to the geographic and physical limitations of commodity electricity.

- There are 2 categories of certificates:
  a. Solar certificates
     Solar RECs include both PV and CSP technologies.
  b. Non-Solar certificates
     Non-solar RECs include a basket of renewable energy technologies such as wind, biomass, biofuel cogeneration and small-hydro

- There are 3 categories of project that are eligible for REC:
  a. Projects for captive consumption
  b. Projects for third party sale (RESCO)
  c. Projects with a PPA with a DISCOM

- Solar REC eligible entities:
  a. Captive user with no concession on transmission/wheeling, no banking facility benefit and no electricity duty waiver

  b. Sale of electricity to open access consumer or other licensee at a mutually agreed price
  c. PPA with distribution licensee at APPC

- Thus RE generators have 2 options:
  a. To sell the renewable energy at preferential tariff
  b. To sell electricity generation and environmental attributes associated with RE generations separately.

4.3.1. OBJECTIVES AND CONCEPT

- Key Objectives for Introduction of REC Mechanism
  a. Effective implementation of RPS
  b. Increased flexibility for participants
  c. Overcome geographical constraints
  d. Reduce transaction costs for RE transactions
  e. Enforcement of penalty mechanism
  f. Create competition among different RE technologies
  g. Development of all encompassing incentive mechanism
  h. Reduce risks for local distributor by limiting its liability to energy purchase

4.3.2. DESIGN AND FEATURES

RECs are traded on the Indian Energy Exchange (IEX) and the Power Exchange of India Ltd. (PXIL). The IEX currently has a leading market share of 91%. Every MWh of solar energy produced generates one REC. Solar RECs are traded once, on the last Wednesday of every month. The trade price is discovered based on their demand and supply. In addition, and in order to provide a minimum of certainty on REC prices, the Central Electricity Regulatory Commission (CERC) has fixed a floor and forbearance price for the period 2012 to 2017 between which the RECs can be traded.

Shelf life of REC	1 year
REC issuing authority	NLDC shall issue REC to generator based on the energy injection report prepared by SLDC
Trading platform	Power exchange under the guidance of CERC
Transfer type	Single transfer only, repeated trade of the same certificate is not possible
Banking and borrowing	Not allowed
Trading calendar	Last Wednesday of the month
Trading period	1pm – 3pm on the day of auction
Trading methodology	Close bid double sided auction for each type of certificate separately
Penalty for non-compliance	Forbearance Price (may vary depending on SERC)
Minimum bid volume	1 certificate (equivalent to 1MWh of energy injected)

TABLE – 6: Salient features of REC

- **Institutional framework of REC mechanism:**

  For successful implementation of the proposed REC mechanism, regulatory oversight through Forum of Regulators (FOR), various State Electricity Regulatory Commissions (SERCs) and Central Electricity Regulatory Commission (CERC) will play the pivotal role. It is envisaged that Forum of Regulators shall perform an important task of development of harmonized regulations for implementation of REC mechanism at the State level.

  The schematic diagram at Figure below presents the institutional framework for implementation of the proposed REC mechanism

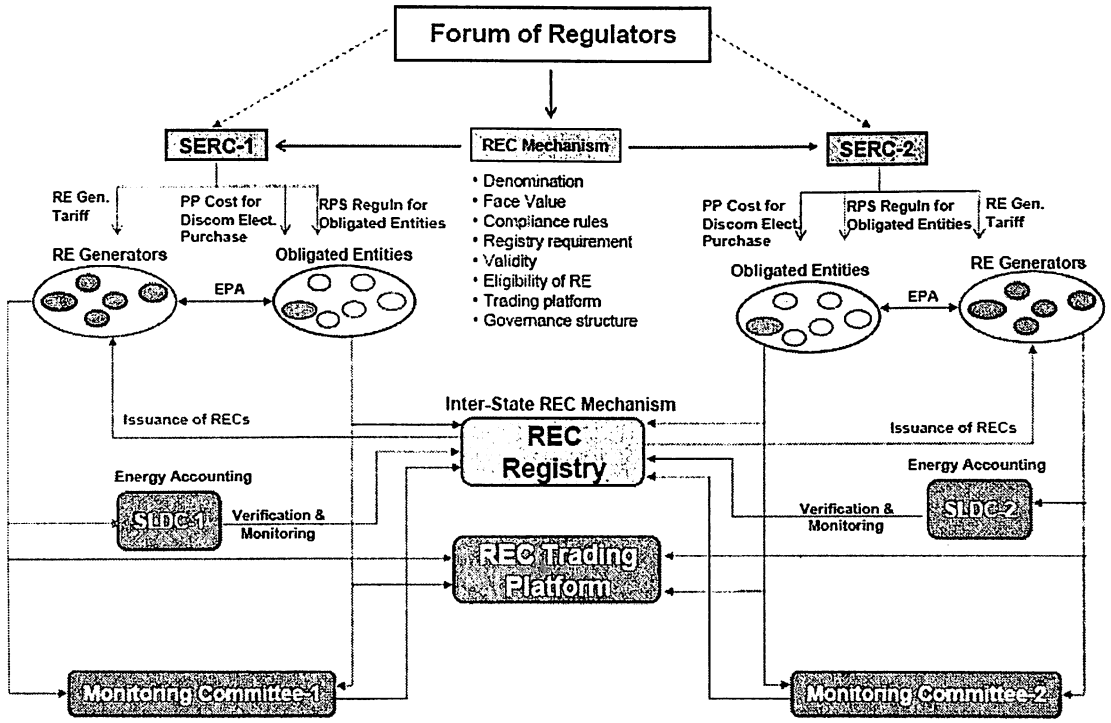

FIGURE – 1: REC Mechanism: Institutional Framework at National Level

- **Roles and Responsibilities of Institutions**

1. *Ministry of New and Renewable Energy (MNRE)*
   MNRE, being the nodal agency for promotion of renewable energy in the country is primarily expected to facilitate the development of REC mechanism in India. Some of the activities which MNRE is expected to perform are listed below:
   - To facilitate development of REC mechanism
   - To provide support as desired by Forum of Regulators
   - To approve technologies eligible for participation in REC Mechanism
   - To assist SERCs in implementation of generation accreditation process
   - To ensure that any future incentive mechanism for promotion of RE is compatible with the REC Mechanism

2. *Forum of Regulators (FOR)*
   FOR is expected to evolve consensus on following issues:
   - Standard Regulations under Section 86(1)(e) incorporating REC covering:
     - ✓ Institutional structure for REC Mechanism
     - ✓ Operating Framework for REC Mechanism
     - ✓ Methodology for pricing of electricity component
     - ✓ Methodology for pricing of REC component

- ✓ Enforcement Principles for non-compliance of RPO
- ✓ Generation accreditation process
- ✓ Structure & Rules of the Monitoring Committee

- Development of standard methodology for energy accounting process
- Assessment of market for REC
- Review and comment on the Regulations developed by the CERC for REC Registry and REC Exchange Platform
- Periodic review of the development and implementation of REC mechanism
- Seek inputs from time to time from the MNRE and other stakeholders
- Resolve any issue which may crop up during implementation in any State

3. *Central Electricity Regulatory Commission (CERC)*

CERC is expected to develop and implement:

- Institutional and Regulatory Mechanism for REC Registry
- Regulation for REC Exchange Platform
- Principles for determination of tariff for RE Technologies which may be used by SERCs for determination of pricing of RE in the State
- Develop criteria for eligibility of RE technologies for inclusion in REC mechanism in consultation with MNRE and FOR
- Approve RE technologies for inclusion in REC mechanism, in consultation with MNRE

4. *State Electricity Regulatory Commissions (SERCs)*

SERCs will carry out following activities:

- Adopt Standard Regulation developed by FOR after taking into account state specific issues
- Determination of RE Technology specific tariffs
- Determine the Tariff Rate for procurement of electricity component of RE
- Specify the RPS percentage and eligibility for RE procurement
- Specify enforcement mechanism for different Stakeholders for non-compliance
- Amend State Grid code to enable SLDC to take up energy accounting
- Amend Regulations under Section 86(1)(b) to account for acquisition of RECs
- Adopt with suitable modifications, regulations for monitoring committees
- Design Contractual framework between SLDC/ Distribution Company, RE Generator and Monitoring Committee for energy accounting
- Design Contractual framework between SLDC/ Distribution Company, Obligated entities and Monitoring Committee for energy accounting

5. *State Load Dispatch Centre (SLDC)*

Energy Accounting would be the backbone of the proposed REC mechanism and the mandate for this important task under the Act is with SLDC. SLDCs to undertake following functions:

- Accounting of renewable energy fed into the grid (electricity generated)
- Accounting of renewable energy procurement by the Obligated Entities
- Issuance of power generation certificate to REC registry
- Accounting of total energy procurement by all obligated entities

6. *Monitoring Committee*

The Monitoring Committee is expected to undertake following activities:

- The Primary Responsibility of the Monitoring Committee would be to monitor the compliance of the RPO by all obligated entities.
- Accreditation of eligible RE generators in the State
- Act as a repository of all information pertaining to renewable energy in the State
- Maintain database of Obligated Entities in the State
- Monitoring the compliance of Market rules by all stakeholders
- Reporting of non-compliance, breach of rules to the concerned SERC
- Enter into tripartite agreement with SLDC/ Distribution Company & RE Generator for energy accounting
- Enter into tripartite agreement with SLDC/ Distribution Company, Obligated entities for energy accounting

7. *REC Registry*

The REC Registry will also have to perform following tasks:

- Registration of eligible RE generators
- Registration of REC buyers which could be any person, obligated entity, trader or individual buyer who wishes to buy RECs to be carbon neutral
- Issuance of RECs to RE generators
- Redemption of RECs on receipt of redemption request
- Track transactions involving sell and purchase of RECs
- Provide requisite information to Monitoring Committee of each State on redemption of RECs by buyers
- Automatically redeem RECs if the life of the RECs is over

8. *REC Exchange Platform*

REC Exchange Platform is expected to provide REC buyers and sellers a fair and transparent platform for sell and purchase of REC. REC Exchange Platform is expected to undertake the following tasks:

- Development of hardware and software in accordance with CERC Regulations

- Facilitate exchange of RECs amongst interested parties in accordance with CERC Regulations
- Periodic reporting to the CERC regarding REC trades
- Recovery of costs from participants on the Platform

- **Operational framework of REC mechanism**

Over a period of time, the electricity sector has developed a well established institutional and operational structure at central level as well as state level for generation, transmission and distribution of electricity. However, REC mechanism is totally a new concept in electricity sector therefore the institutional as well as operational structure would need to be defined. Further, the structure should be such that it is compatible and could be operational zed in harmony with the existing framework. After due consideration of all these aspects, the schematic of operational framework for the proposed REC mechanism is shown in figure

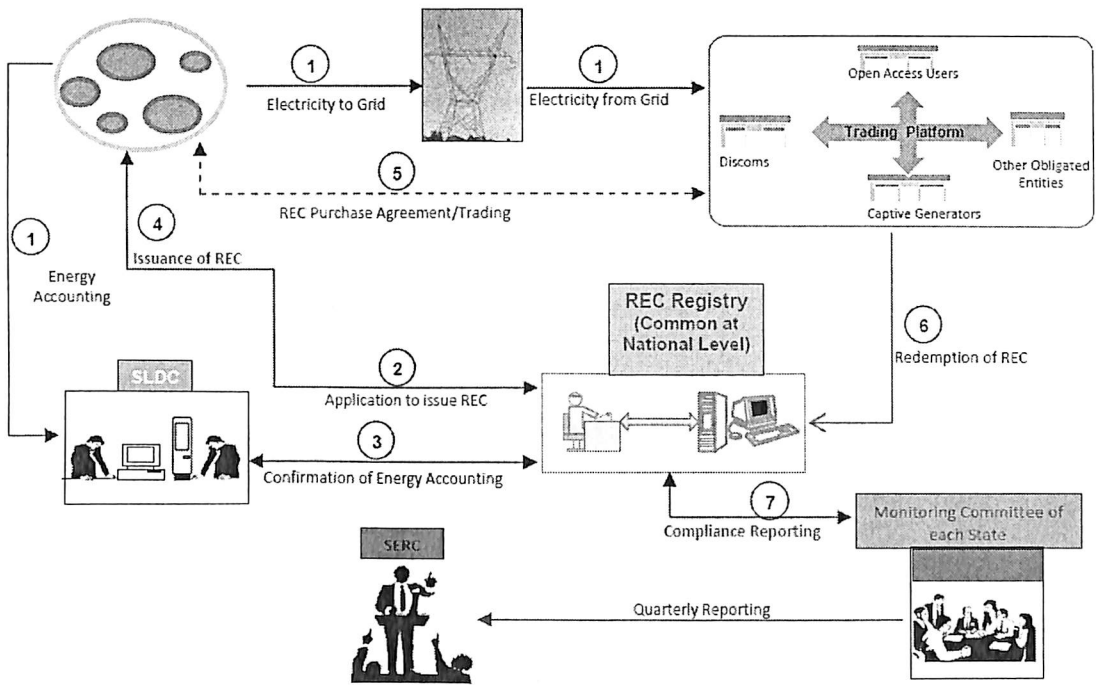

FIGURE – 2: Operational framework of REC mechanism

Step 1: Electricity Generation and Feeding to the Grid

The electricity generated in RE project is injected into the grid. This electricity is consumed in real time by load prevalent in the system, which in turn is accounted against the consumption by the entities which had contract with that particular RE project. The

metering of quantum of electricity injected into the grid and energy accounting will be done by the State Load Dispatch Centre (SLDC).

Step 2: Request for issuance of REC

The RE Generator will send a request to the REC Issuance Registry to issue the RE certificates equivalent to the amount of electricity injected into the grid and as certified by the SLDC.

Step 3: Confirmation of Electricity Generation

The REC Registry and SLDC shall establish procedure for exchange of information about actual electricity generated by registered RE projects on monthly basis. The SLDC shall submit the report for the energy accounts of RE projects to the REC Registry, as per established procedures on regular basis.

Step 4: Creation and Issuance of RECs

Referring to the generation report submitted by SLDC, the REC Registry will create and issue appropriate number of RECs to the concerned RE Generator. Further, in case, obligated entities have entered into long term contract with a RE generating station for purchase of both the electricity as well as REC, REC may be directly issued to the obligated entities on the basis of energy generation certificate and contract for such REC procurement submitted by the obligated entities.

Step 5: REC Sale by RE Generator

Once the RECs are issued to the RE Generator, it can be sold to any buyer either by way of a bilateral agreement or through an aggregator. Further, sale/purchase of RECs amongst various RE Generators / Obligated entities / Voluntary Buyers can be undertaken through REC Exchange Platform to be established in accordance with the Regulations to be formulated by CERC for this purpose.

Step 6: Surrender/Redeeming of RECs

The obligated entities can procure the RECs directly from the RE generator or from the market and need to surrender the RECs to the REC Registry to meet their RPS obligation. This will facilitate convenient and effective mechanism for ensuring the RPO compliance by the obligated entities. REC Registry shall maintain record of RECs issued and RECs received for redemption on regular basis.

Step 7: Compliance Reporting

REC registry will prepare a state specific and Obligated Entity Specific REC Procurement report on the basis of the RECs redeemed by each of the obligated entities and send it to the State level Monitoring Committee. In addition, the report will also provide the details of RECs issued to each of the RE generators in that State. Further, state level Monitoring Committee will verify the information provided in the REC

Procurement report and provide the summary of status of RPS compliance of individual obligated entities in its State to the SERC on quarterly basis.

- **Procedure for issuance of REC:**
  - Registration
  - Request submission
  - Verification
  - Data recording
  - Issuance of RE certificate

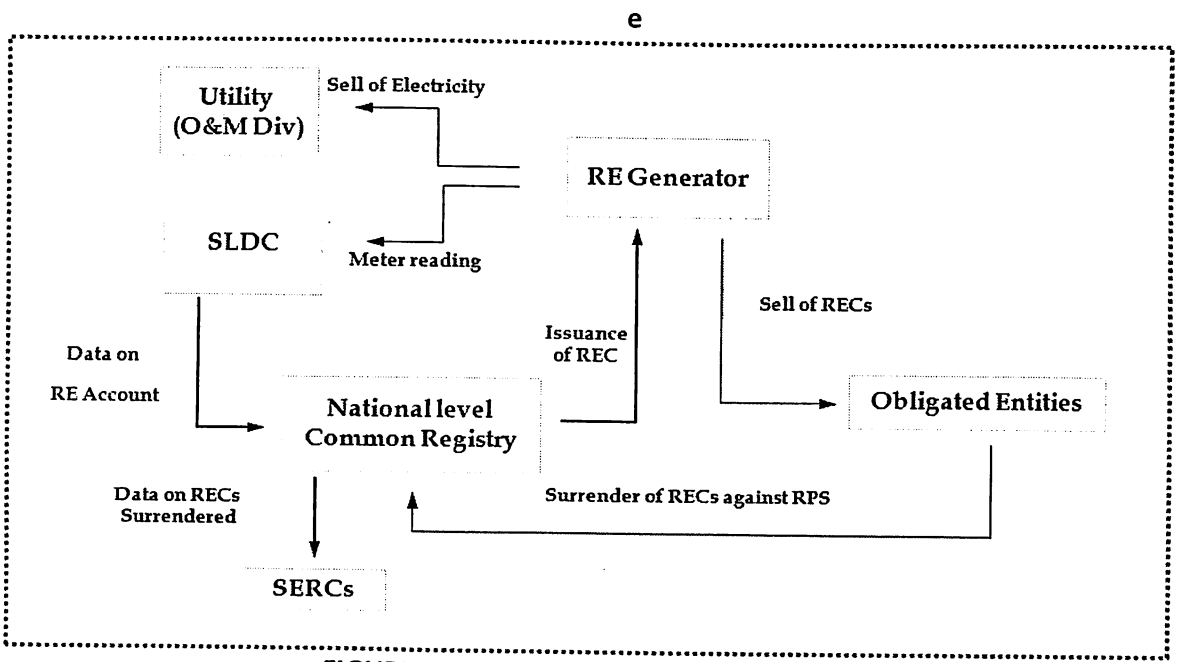

FIGURE – 3: Procedure for issuance of REC

Stage 1- Registration:

For participating in REC mechanism, the RE generator must be registered with REC registry with separate registration for each RE project. Such registration would enable creation of a permanent account for purpose of keeping record of REC transaction by a particular RE generator separately for each of its RE project. The RE generator may need to provide the following details such as contact address, location, metering details, fuel sources, technology, installed capacity, start-up date. In turn the registry will issue a unique registration number to the individual generator. To control the volume of registered accounts, REC Registry may specify the validity period for such registered account. Further, the RE generator may register the different RE generation projects, for each RE generator of which energy accounting is separately done by SLDC, in a single account

Stage 2- Request submission:

The registered RE generator would submit the request for issuance of REC on the basis of energy generation certificate issued by the state load dispatch centre.

Stage 3- Verification:

The REC registry will verify the request on the aspects of eligibility of RE technology, and period of issuance of generation certificate. REC Registry may decline such request if any of the criteria is not met.

Stage 4- Data recording:

REC registry shall maintain a database keeping record of all relevant information related to the RE generator identity, its project location, type of RE source, technology used, and date of electricity generation etc.

Stage 5- Issuance of RE certificate:

A unique number will be generated for a particular RE Certificate. RE certificate in electronic form shall be given to the RE generator. The same shall be updated in the account of RE generator.

4.3.3. REC PRICING FRAMEWORK

1. Guiding principle
   a. CERC shall provide floor price and forbearance price for solar and non-solar REC separately in consultation with CEA and FOR and price of REC shall be discovered in the power exchange
   b. While determining the price, CERC shall be guided by following:
      - Variation in cost of generation and APPC across different states
      - RPO set by the states
      - Expected electricity generation from RE including:
        - Under preferential tariff
        - Under REC

2. APPC

   In the absence of latest tariff order for the FY 2011-12, in order to arrive at the APPC for FY 2011-12, the commission has considered an escalation factor which is the lowest among average CAGR, State specific CAGR (of the power purchase cost data of previous years as per PFC report), year on year escalation factor derived from APPC data of FY 2009-10 and 2010-11.

STATE	APPC (2011-12)	STATE	APPC (2011-12)
Himachal Pradesh	2.23	Tamil Nadu	3.38
Madhya Pradesh	2.09	Gujarat	2.98
Chhattisgarh	2.05	Haryana	2.77
Kerala	1.99	Punjab	2.71
Andhra Pradesh	2.50	Karnataka	2.66
West Bengal	2.43	Uttar Pradesh	2.62
Uttaranchal	2.34	Maharashtra	2.62
Rajasthan	2.60		

TABLE – 7: APPC for FY 2011-12

3. Control Period
   Control period shall be 5 years starting from 1st April, 2012 for REC price band. Commission is of the view that it will reduce regulatory uncertainty and provide comfort to investors and lenders

4. 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

5. 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

6. 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.

7. Non-Solar floor price
   a. Difference between the project viability requirement and APPC for different RE technologies across states is taken out in Rs/kWh
   b. These are arranged in ascending order
   c. The expected RE generation in a particular state is mapped with the respective difference calculated

d. The price at which the target RE generation (of 70000 MUs) is realized is taken as the floor price
e. This price which we got from the difference is then rounded off to arrive at the floor price

8. Non-Solar forbearance price
The highest difference between the Costs of Generation (RE Tariff) and the APPC has been specified as the forbearance price for non–solar technologies. The highest difference has been rounded off to the next hundred's to arrive at the forbearance price

9. Solar Floor price
The difference between the minimum requirement for project viability of Solar PV/Thermal and respective state APPC of previous year (2011-12) is taken out and the highest value among these is considered as floor price. The project viability approach covers the cost required to meet viability parameters including O&M, interest, principal repayment etc.

10. 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 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

11. History

a. 1st June, 2010 – 31st March, 2012

	Non-Solar REC (Rs/MWh)	Solar REC (Rs/MWh)
Forbearance Price	3900	17000
Floor Price	1500	12000

b. 13th June, 2011 draft

	Non-Solar REC (Rs/MWh)	Solar REC (Rs/MWh)
Forbearance Price	3480	13690
Floor Price	1400	9880

c. 1st April, 2012 – 31st March, 2017

	Non-Solar REC (Rs/MWh)	Solar REC (Rs/MWh)
Forbearance Price	3300	13400
Floor Price	1500	9300

4.3.4. ANALYSIS OF REC MARKET

While Non-Solar REC market has been active since May 2011, Solar REC market has taken off in May 2012. There was a total of 1637 buy bids at IEX and a total of 149 sell bids. However, only 5 RECs were traded finally at Rs. 13,000 per REC. This can be attributed to unwillingness of buyers to pay high prices for Solar RECs so early in the year 2012.

Between May 2012 to June 2013, there were total 12,914 Solar RECs have been traded on IEX. In June 2013, 797 RECs were traded at price of Rs 9300 per REC.

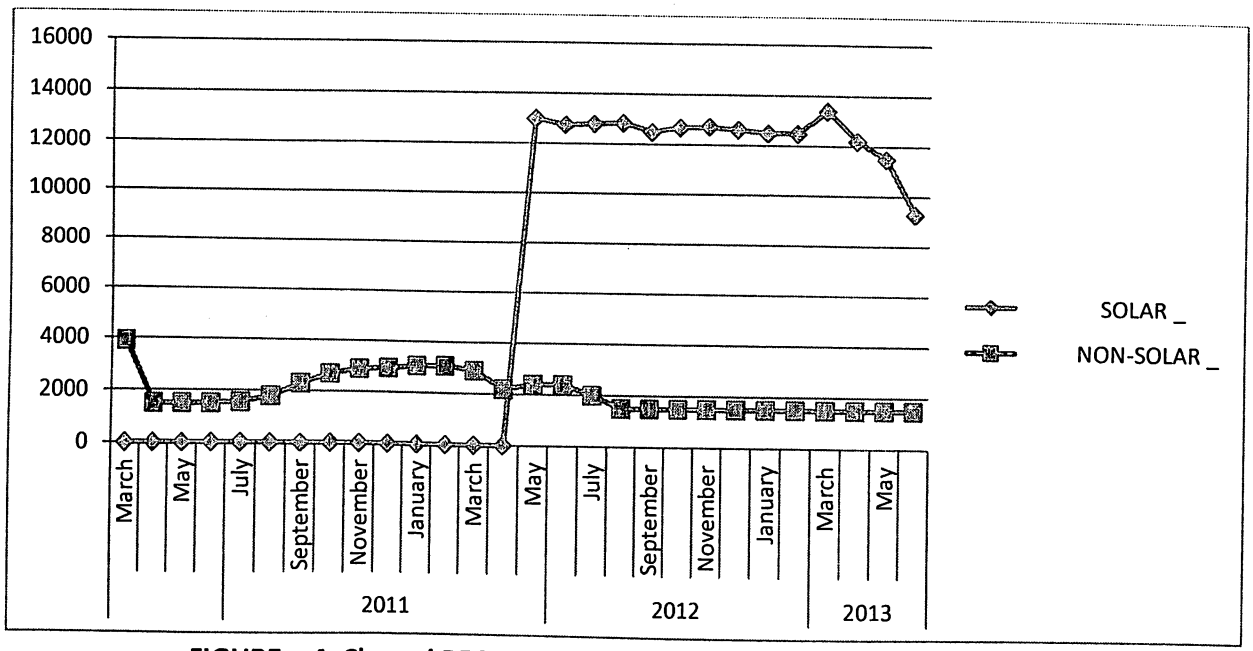

FIGURE – 4: Cleared REC price of Solar and Non-Solar RE sources

Solar REC market nose dived directly to floor price for the first time since the trade began in May 2012. Like Non-Solar RECs, even at floor price there was not enough demand to meet Solar REC supply available at floor price

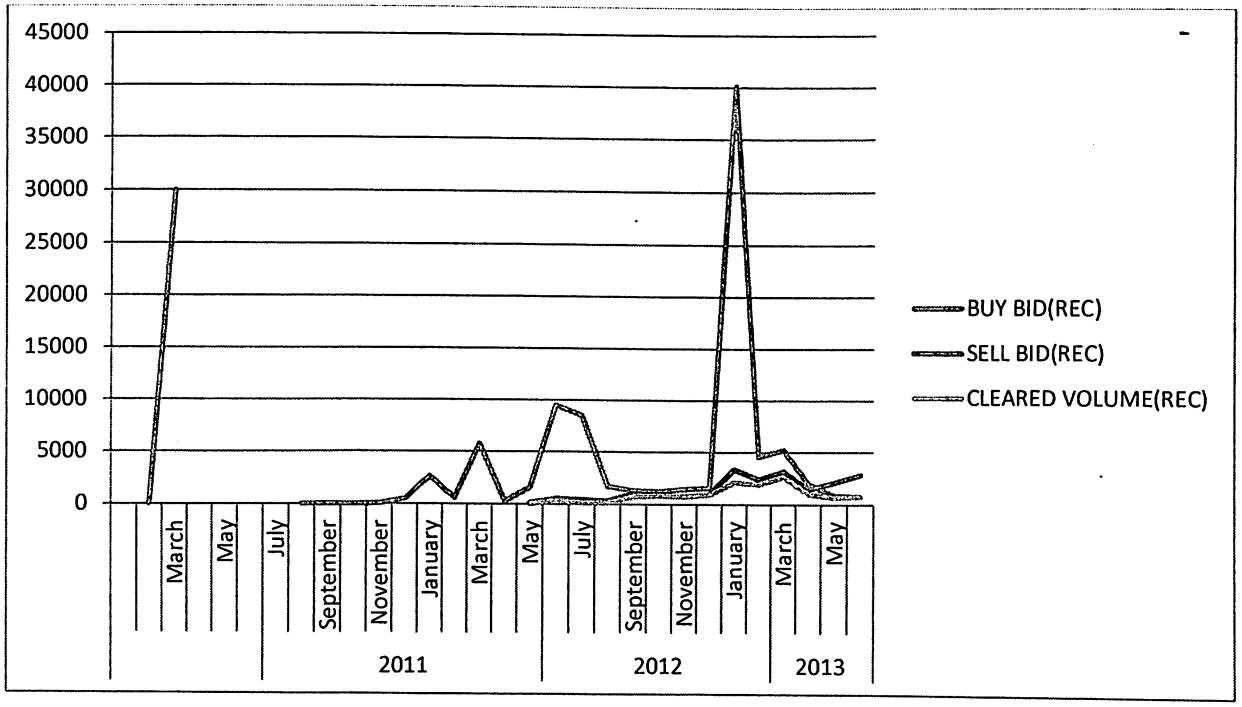

FIGURE – 5: Solar REC bid volume

The maximum demand for non-solar RECs occurred towards the end of the financial year between the months of January and March 2012. This suggests that there would be a rush to fulfill the RPOs at the year-end to prevent being penalized.

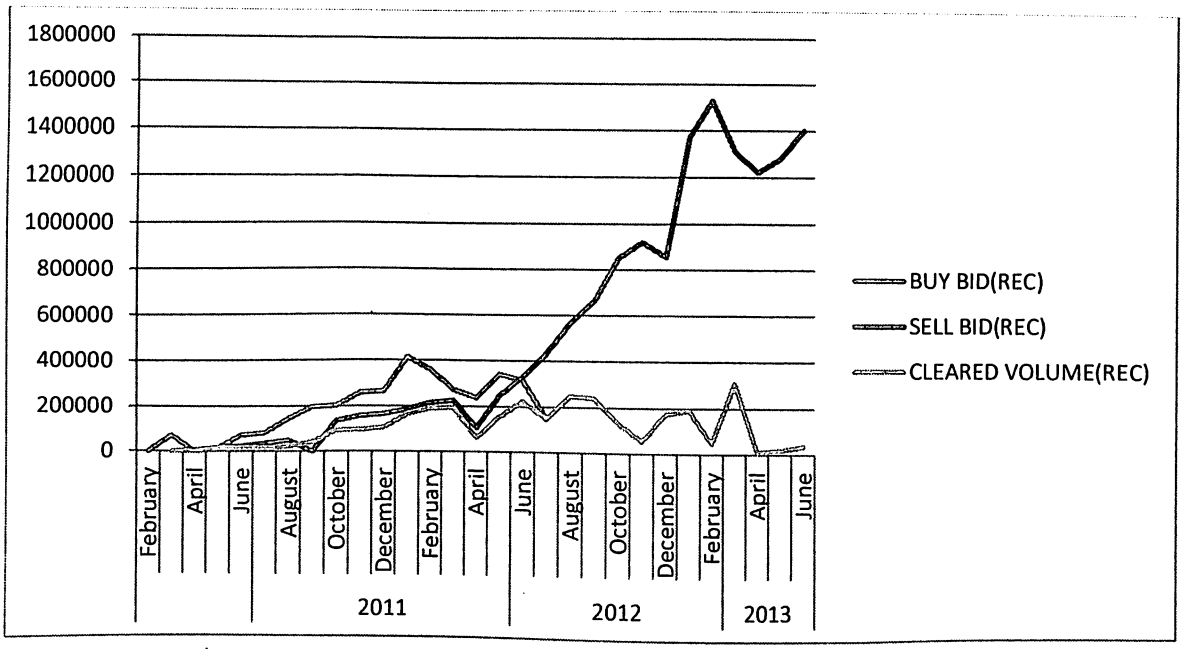

FIGURE – 6: Non-Solar REC bid volume

- **Issues**

1. *Piling up of REC*
   The quantum of REC redeemed as compared to REC issued is worrisome.

   a. NON-SOLAR
      In case of Non-Solar, out of 28 trading sessions, only three times number of RECs redeemed has exceeded number of RECs issued.

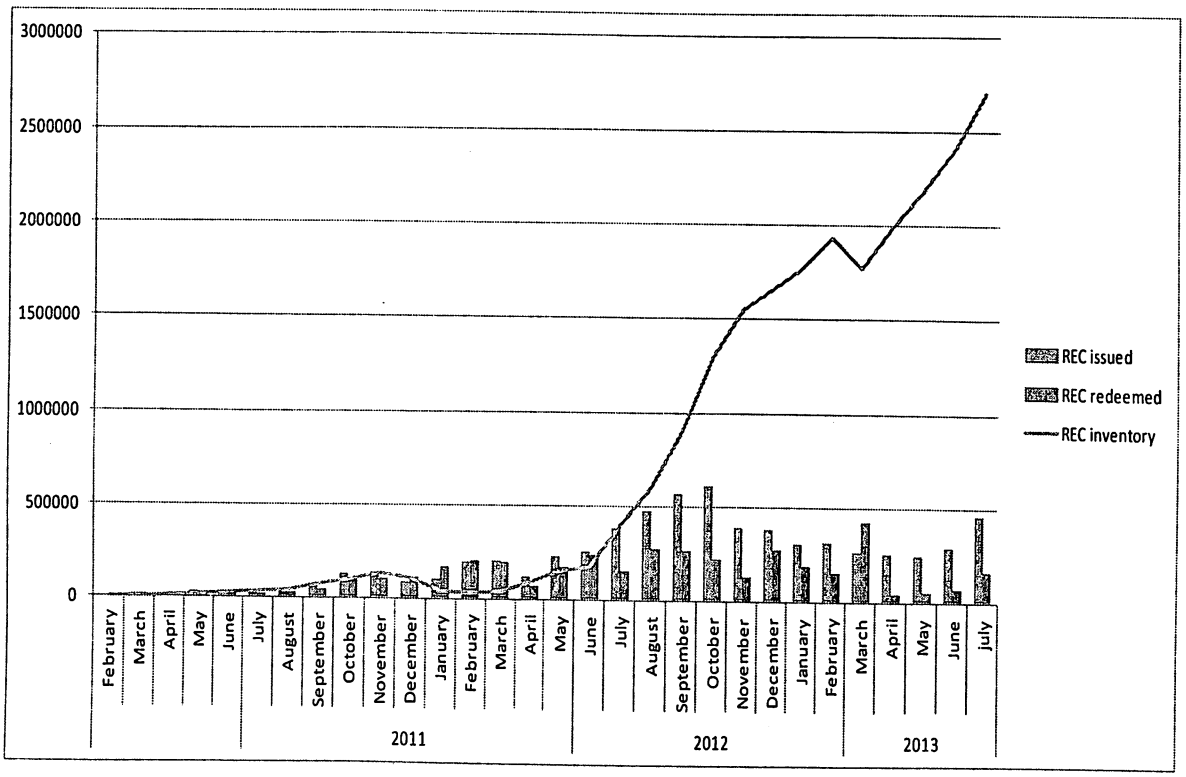

FIGURE – 7: Non-Solar REC inventory

   b. SOLAR
      Since the first trading session in May 2012, only six times number of RECs redeemed has exceeded number of RECs issued.

      This has led to huge surge of REC inventory (non-redeemed). This leaves the RE developers with skepticism about the popularity of certificate market as their cash inflows are at stake. RECs are valid for only a year (from date of issuance) and eventually get lapsed. This further adds to woes of developer.

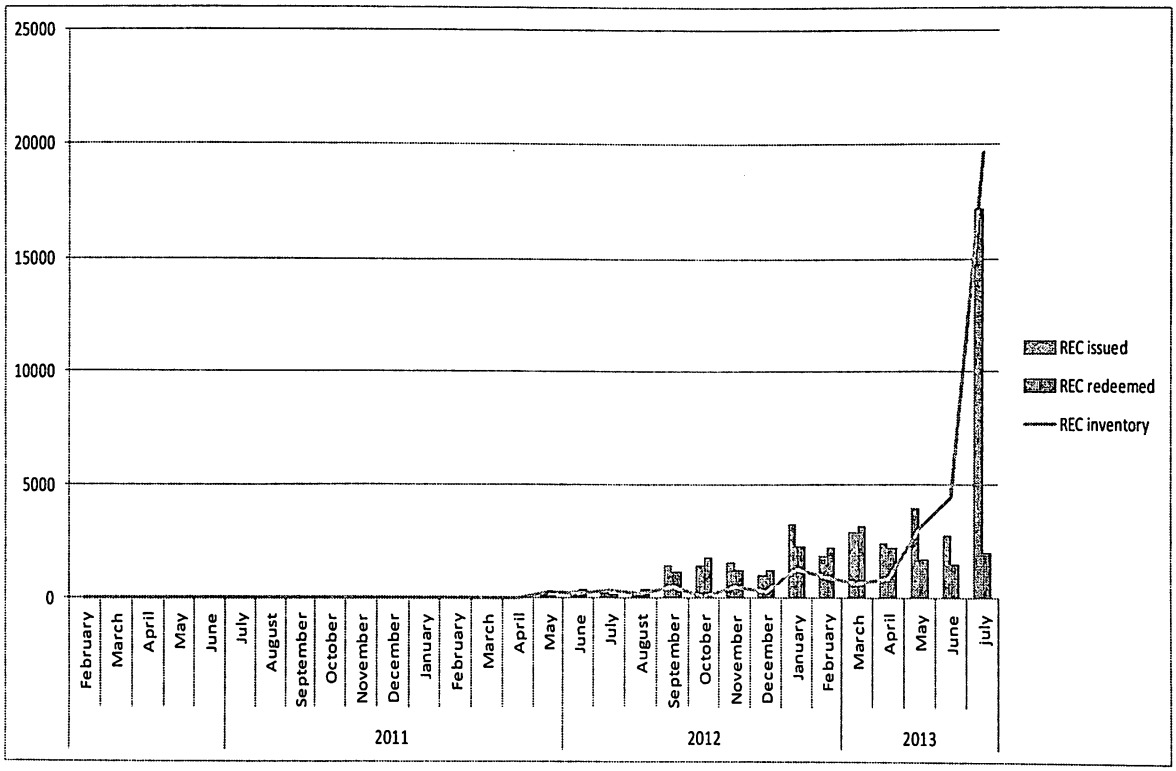

FIGURE – 8: Solar REC inventory

2. *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. Hence, the RPO, its monitoring and subsequent penalties should be done on either monthly or quarterly basis so that the uniform trading pattern for RECs can be ensured on the exchanges

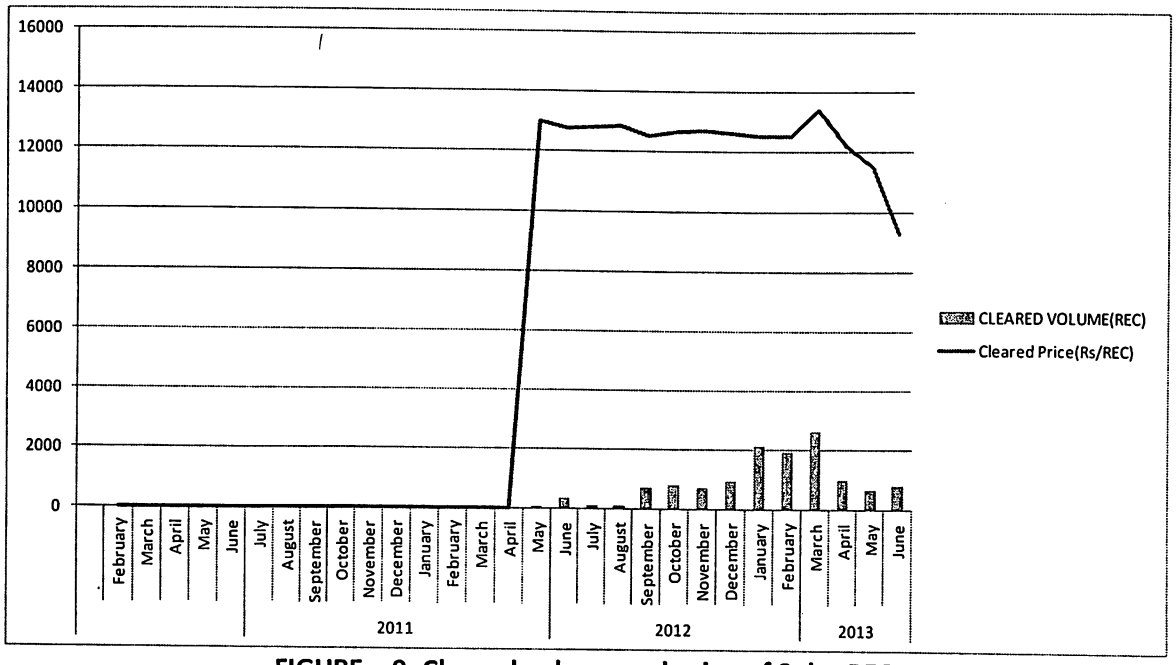

FIGURE – 9: Cleared volume and price of Solar REC

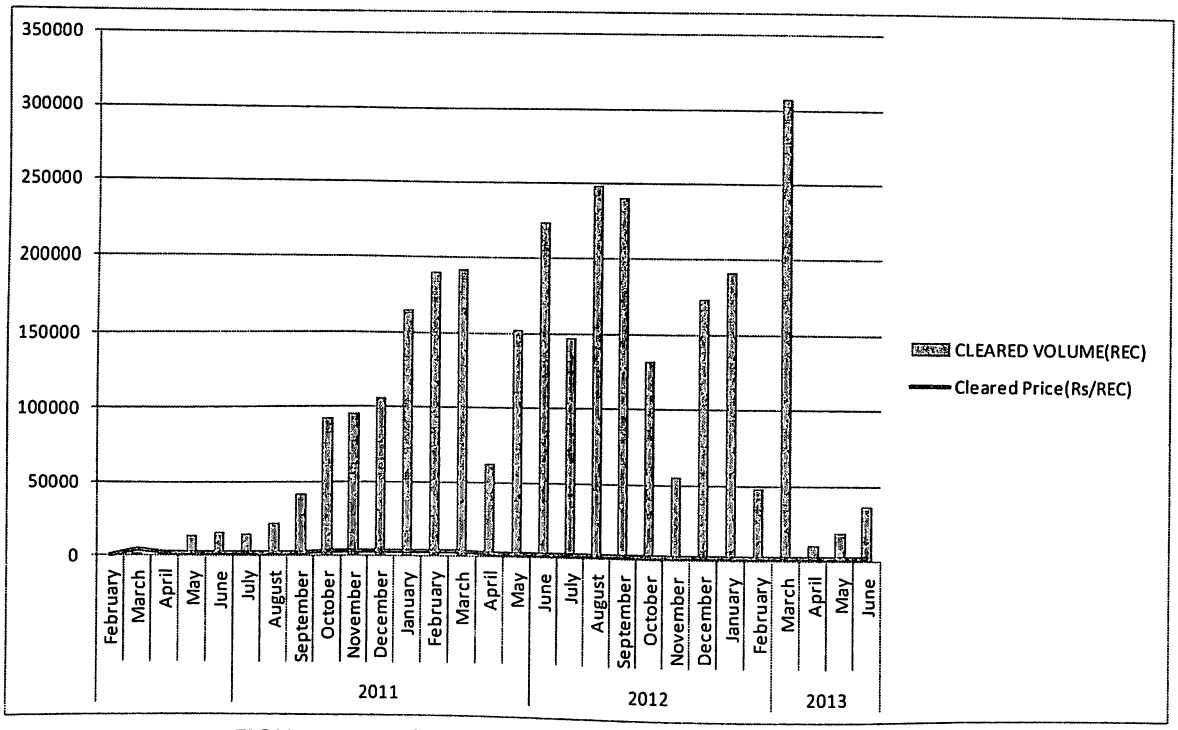

FIGURE – 10: Cleared volume and price of Non-Solar REC

3. *Strong enforcement mechanism*

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.)

4. *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.

5. *Monitoring & Control of Trading by Other Obligated Entities (except Distribution Utilities)*

Currently, compliances done by only Distribution Utilities are being monitored and controlled by the Regulatory Commissions. However, the obligations of other Obligated Entities such as Captive Consumers and Open Access consumers are not being done on usual basis hence the smaller players are encouraged to skip complying RPO Obligations. A mechanism should be devised and implement to check and control the obligations and compliances of each and every Obligated Entities.

6. *Multiplier Mechanism*

The REC Regulations define two categories of RECs Solar Certificates and Non solar Certificates. There are pros and cons of separate categorization of the RECs depending on the source of energy or the geographical jurisdiction. Given the significant cost difference across the two categories, such a categorization may help in defining and seeking compliance of source specific RPO, 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. However, this would reduce liquidity and trade in the two separate markets as compared to a common market for RECs.

7. *Lack of clarity regarding minimum size of project*

CERC doesn't specify minimum installed capacity for projects to avail RECs, though draft document issued by CERC on March 17, 2010, it was mentioned 250 kWp. Only specifically notified the minimum size of project allowed for REC project.

8. *Less 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) as well as individuals.

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 Power System Operation Corporation Ltd. (POSOCO) which is a wholly owned subsidiary of PGCIL, is the first PSE as well as company in India to participate in voluntary purchase of RECs for offsetting carbon emissions. Manikaran Power trading has been the first private firm which voluntarily purchased RECs. Various corporate have expressed their interest in buying RECs on voluntary basis to portray 'Green Image' but, as expressed by Mr. Pramod Deo – Chairman of CERC, cumbersome registration process for RECs has been observed a barrier to their participation. Along with making the process easy there has also been a proposition for attaching financial benefits such as tax rebate on Voluntary REC (VREC) purchase to boost the Voluntary Market.

9. *Scope for Off-grid RE Projects*

In India, REC for off-grid projects are excluded from the REC mechanism, extending the REC scheme to off-grid projects or to the small scale grid connected projects at this stage is not feasible due to various challenges in energy accounting of the generated electricity, lack of visibility to the SLDC, etc. The current regulation state that REC projects must be grid connected. Also according to the Indian electricity Grid Code, the electricity injection point should always be at higher voltage side of the distribution or the transmission network. Stepping up the voltage to higher levels and then stepping it down to cater to the point of consumption is not only inefficient but also unnecessary

10. *Central level monitoring*

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.

CHAPTER - 5: TECHNICAL ASPECTS

5.1. BRIEF ON SOLAR ENERGY GENERATION

To generate solar power, photovoltaic cells, or solar cells, need to be exposed to sunlight. Photons contain various amounts of energy corresponding to the different wavelengths of the solar spectrum. When photons strike a photovoltaic cell, they may be reflected, pass right through, or be absorbed. When enough sunlight (energy) is absorbed by the material (a semiconductor), electrons are dislodged from the material's atoms and are allowed to flow creating an electrical current. Special treatment of the material surface during manufacturing makes the front surface of the cell more receptive to free electrons, so the electrons naturally migrate to the surface. These cells are thin semiconductors, such as silicon. In order to produce useful amounts of electricity, many solar cells are linked. Cells are mounted on a panel to make up a module, which are in turn organized into arrays. After the electricity is created by the solar cells, it passes through an electrical inverter, which changes the electricity from direct current to alternating current. Once solar energy is converted into a usable form, it needs to be distributed or stored. Major solar plants transfer their electricity through cables directly into the national grid, which distributes it to residences and businesses.

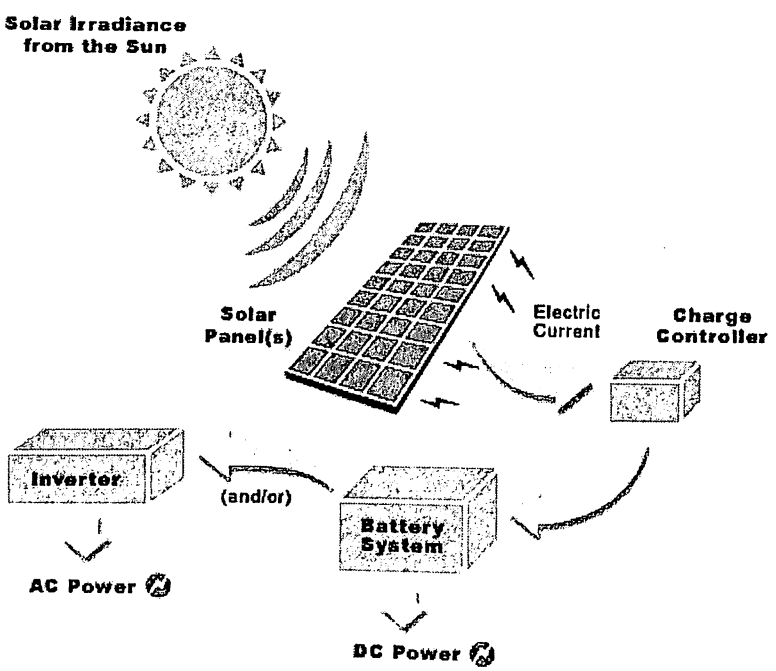

FIGURE – 11: Process of Solar energy generation process

5.2. MAJOR COMPONENTS OF SOLAR PROJECTS

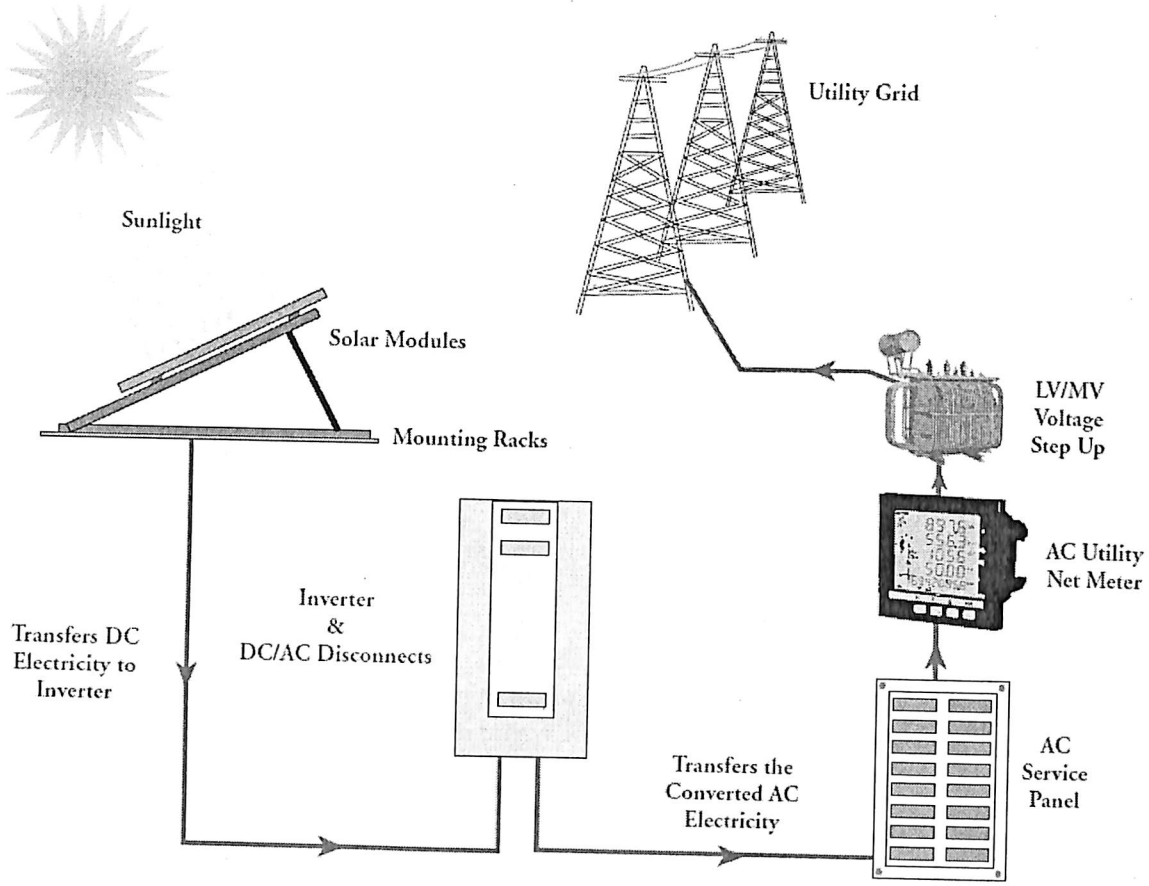

FIGURE – 12: Components of Solar project

- **SOLAR PV MODULES**

  A Solar PV module is the smallest PV unit that can be used to generate electricity. Although individual PV cells produce only small amounts of electricity, PV modules are manufactured with varying electrical outputs ranging from a few watts to more than 100 watts of direct current (DC) electricity. The modules can be connected into PV arrays for powering a wide variety of electrical equipment.

- **SOLAR CELLS**

  Solar cells represent the fundamental power conversion unit of a photovoltaic system. For practical operation, solar cells are usually assembled into modules. Its operation is based on the ability of semiconductors to convert sunlight directly into electricity by exploiting the photovoltaic effect.

- **SOLAR PV TRACKING SYSTEM**
  Solar tracking systems are used to minimize the angle of incidence between the incoming solar irradiance and collecting surface like photovoltaic panel; which effectively increases the amount of energy produced from a fixed amount of installed power generating capacity. In concentrating solar systems (i.e. CSP or CPV) the trackers are essential to keep solar collectors aligned with solar radiation over the day.

- **INVERTERS**
  Inverters are solid state electronic devices that convert DC electricity generated by the PV modules into AC electricity, suitable for supply to the grid. In addition, inverters can also perform a range of functions to maximize the output of a PV plant. In general, there are two main classes of inverters: central inverters and string inverters. Central inverters are connected to a number of parallel strings of modules. String inverters are connected to one or more series strings.

- **STEP-UP TRANSFORMERS**
  The output from the inverters generally requires a further step-up in voltage to reach the AC grid voltage level. The step-up transformer takes the output from the inverters to the required grid voltage (for example 25 kV, 33 kV, 38 kV, 110 kV depending on the grid connection point and requirements).

- **THE GRID CONNECTION INTERFACE**
  This is where the electricity is exported into the grid network. The substation will also have the required grid interface switchgear such as circuit breakers and disconnects for protection and isolation of the PV power plant as well as generation and supply metering equipment.

5.3. AVAILABLE TECHNOLOGIES

Solar Photovoltaic (SPV) technology is primarily a solid-state semiconductor- based technology, which converts a fraction of the incident solar radiation (photons) in to direct electricity. PV system can deliver electric energy to a specific appliance and/or to the electric grid. Photovoltaic systems are flexible and modular; hence the technology can be implemented on virtually any scale size, connected to the electricity network or used as stand-alone or off grid systems, easily complementing other energy sources.

Basically, two different approaches are being distinguished in the manufacturing of photovoltaic modules: the crystalline technologies and the thin-film technologies. The crystalline silicon solar cells are the most widely used solar cells for numerous applications ranging from space applications to village electrification. At present, bulk

- silicon in mono crystalline and multi crystalline form is the principal cell technology; and this dominance is likely to continue for some years.

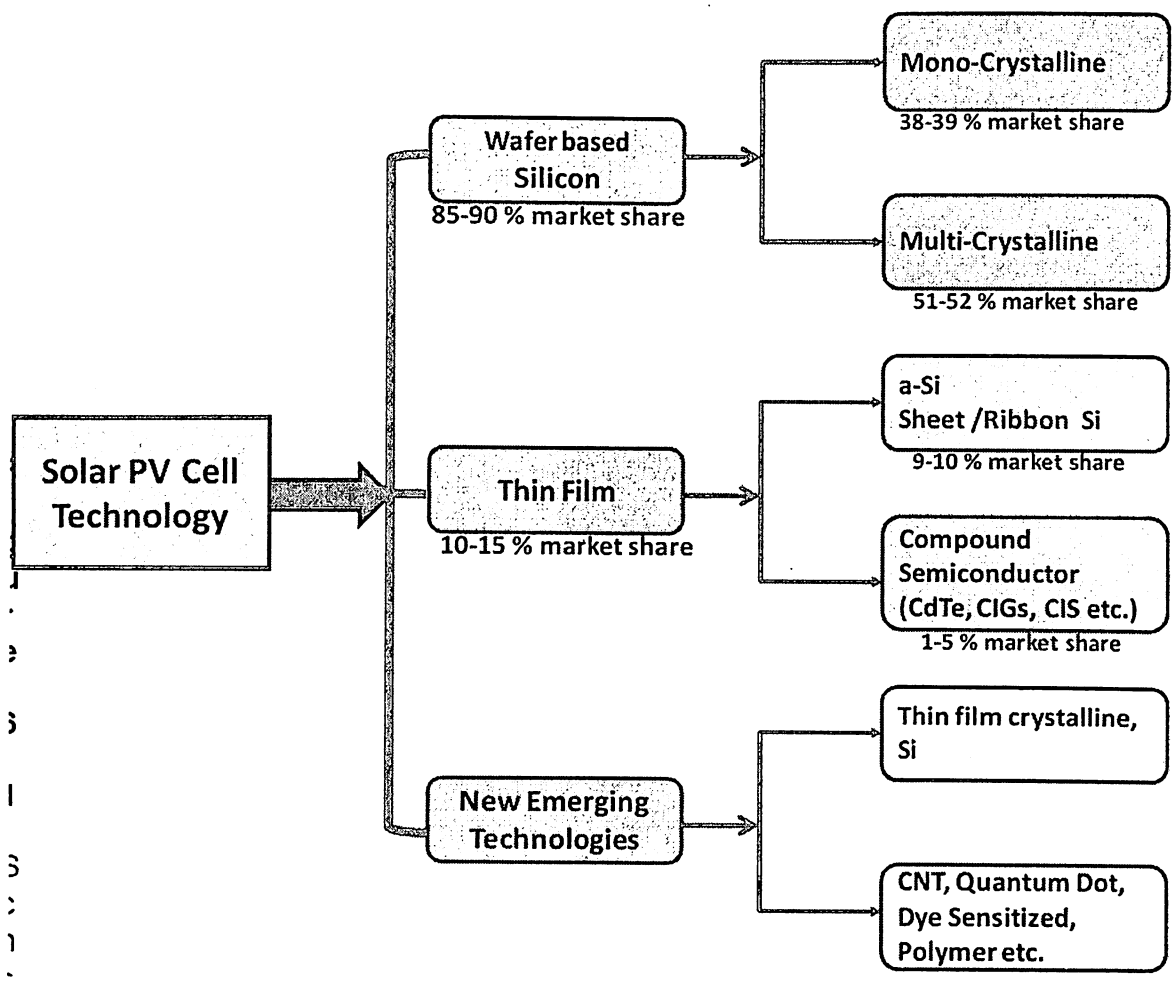

FIGURE – 13: Solar PV technologies

Depending upon the type of absorbing material used, manufacturing technique / process adopted, and type of junction formed etc., the solar cell technologies can be broadly classified as following:

- Wafer based crystalline silicon solar cells
- Thin-film solar cells, which includes, Copper Indium Gallium Diselenide (CIGS), Cadmium Telluride, Amorphous silicon (a-Si) etc.
- Concentrating Photovoltaic (CPV) and
- Emerging technologies such as thin-film silicon, dye sensitized solar cells; polymer organic solar cells etc.

5.3.1. WAFER-BASED CRYSTALLINE SILICON SOLAR CELL TECHNOLOGY

The technology used to make most of the solar cells, fabricated so far, borrows heavily from the microelectronics industry; which is further classified into two categories as;

- Single-/ Mono-crystalline silicon solar cell and
- Polycrystalline silicon solar cell

a. *Single/mono-crystalline silicon solar cell*

This is the most established and efficient solar cell technologies till date, having a module efficiency of 15-18%. The cell and module fabrication technology is well developed and reliable. These cells are manufactured from single silicon crystal. During the manufacturing, c-Si crystals are cut from cylindrical ingots; they do not completely cover a square solar cell module.

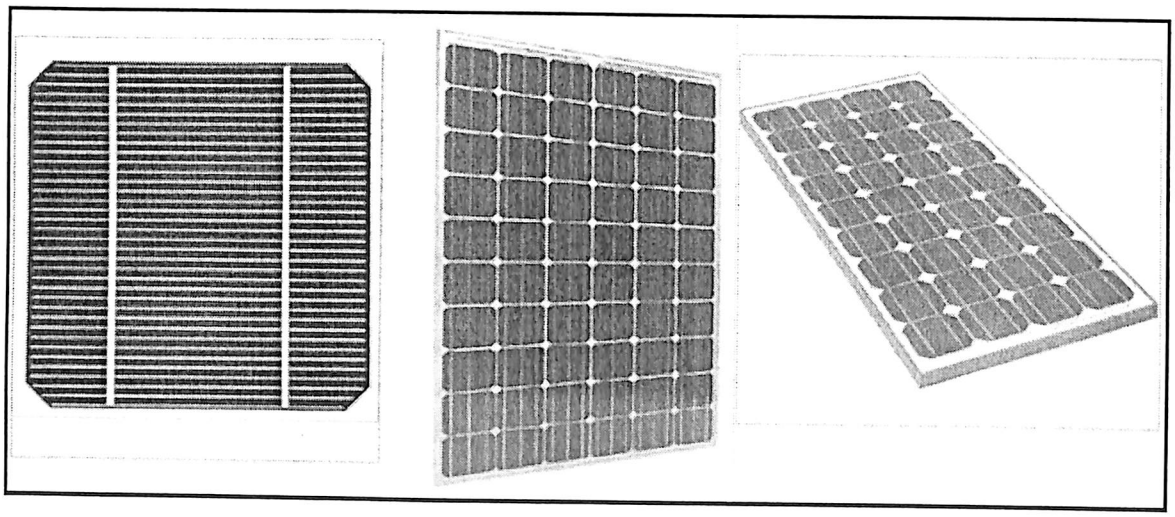

FIGURE – 14: Single/mono-crystalline silicon solar cell

a. *Polycrystalline silicon solar cell (poly-Si or mc-Si)*

The production of polycrystalline cells is more cost-efficient which are manufactured by cooling a graphite mold filled with molten silicon. In this process, liquid silicon is poured into blocks that are subsequently sawed into plates. During solidification of the material, crystal structures of varying sizes are formed, at whose borders defects emerge. These cells have module efficiency of around 12-14%.

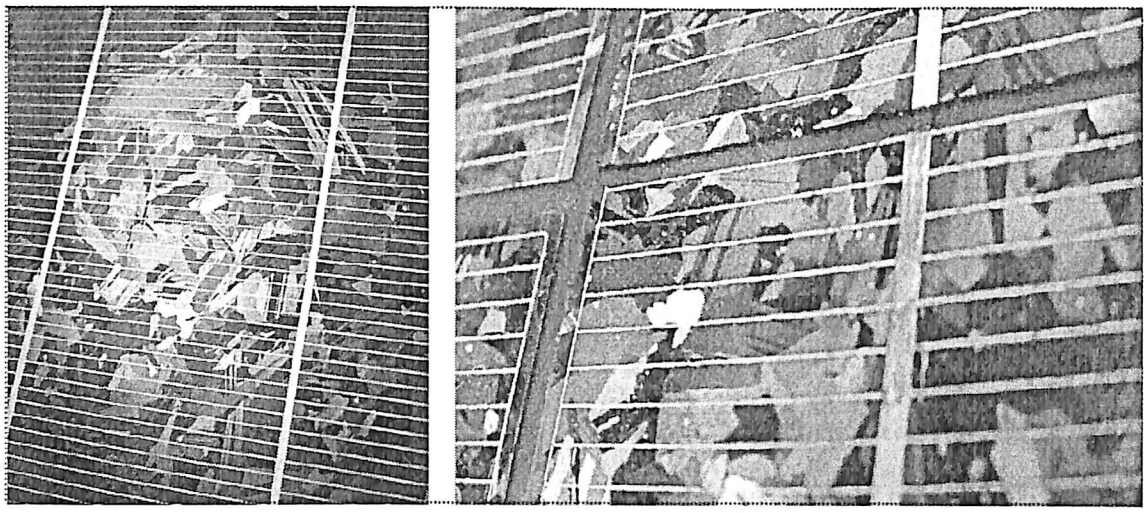

FIGURE – 15: Polycrystalline silicon solar cell

5.3.2. THIN FILM SOLAR CELL TECHNOLOGY

In this approach thin layers of semiconductor material are deposited onto a supporting substrate, such as a large sheet of glass.

Thin-film photovoltaic modules are fundamentally different in their composition and their production from crystalline photovoltaic modules. Though nearly all thin-film technologies target a lower cost structure than traditional c-Si PV systems, the ability to scale beyond the pilot stage to full commercial module production in MW scale based on these Thin Film Technologies has proven difficult. In general, thin-film modules are made by coating and patterning entire sheets of substrate, generally glass or stainless steel, with micron-thin layers of conducting and semiconductor materials, followed by encapsulation. This leads to a process that can be highly efficient in material utilization, relatively low labour requirements and uses comparatively little energy in the total manufacturing process.

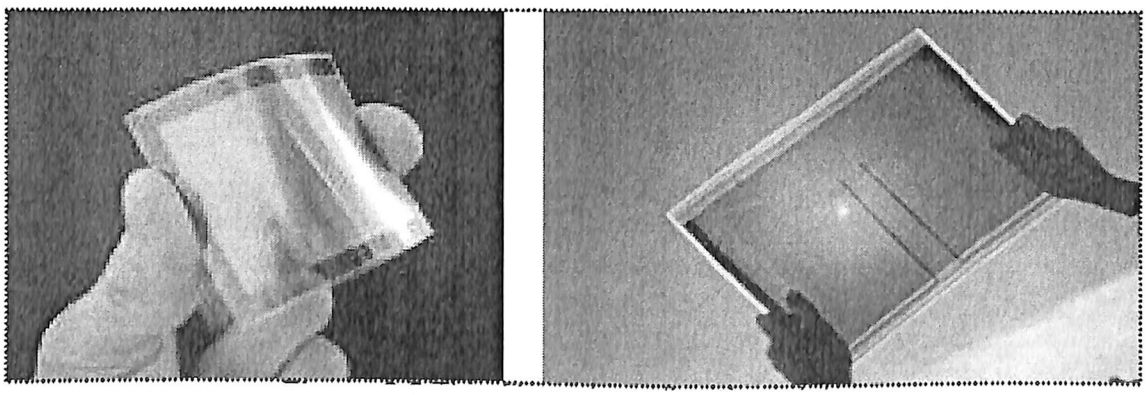

FIGURE – 16: Thin film solar cell

Typically, less than a micron thickness of semiconductor material is required, 100-1000 times less than the thickness of Silicon wafer. Some of the thin film solar cells in use are as follows;

- a – Si (Amorphous-Silicon)
- CdTe (Cadmium Telluride)
- CIS, CIGS (copper indium gallium di-selenide)
- Thin film crystalline silicon

5.3.3. CONCENTRATING SOLAR PHOTOVOLTAIC (CPV)

Concentrating the sunlight by optical devices like lenses or mirrors reduces the area of expensive solar cells or modules, and, moreover, increases their efficiency. CPV systems use optical concentrators to focus direct solar radiation onto solar cells for conversion into electricity. By using optical concentrators to focus the solar radiation onto solar cells, the cell area, and consequently cell cost, can be reduced by a factor of up to 1000. One disadvantage of CPV is the necessity to track the sun's orbit by moving the system accordingly, is partly compensated by a longer exposition time of the cells during the day.

CPV systems employ solar radiation concentrated onto photovoltaic surfaces for electricity production. Solar concentrators of all varieties may be used, and these are often mounted on a solar tracker in order to keep the focal point upon the cell as the Sun moves across the sky. Additionally, increasing the concentration ratio improves the performance of general photovoltaic materials. CPV systems are categorized according to the amount of their solar concentration. There are four types of CPV technologies:

a. Dish CPV
b. Lens CPV
c. Low concentration PV (LCPV)
d. Non-Tacking CPV

a. Dish CPV

The parabolic dishes are now being coupled with photovoltaic in dish CPV systems. Dish CPV systems are available in a range of sizes and configurations from large systems that resemble Dish-Engines with the engines replaced with a CPV receiver to several small dishes combined together in a tracking panel. Dish concentrators coupled with PV to form Dish CPV systems are taking shape in three main forms namely:

- Large Dish CPV: These are essentially Dish-Engine systems with the engine replaced with a PV receiver. These are systems are stand-alone systems consisting of a 2-axis tracking dish and a CPV receiver
- Medium Dish CPV: These systems are typically made up of sets of dish-PV assemblies that track in unison. Medium sized dishes have lower wind exposure than large dishes, reducing the wind loading and strain on the tracking systems.

- Small Dish CPV: These systems consist of several small dishes with small PV receiver placed together in a panel that tracks as a panel. Small Dishes are also being used to focus sunlight onto very small areas of PV material. Small Dish CPV systems consisting of a very small dish, a secondary reflector, and a PV receiver are assembled together in a panel that tracks the sun.

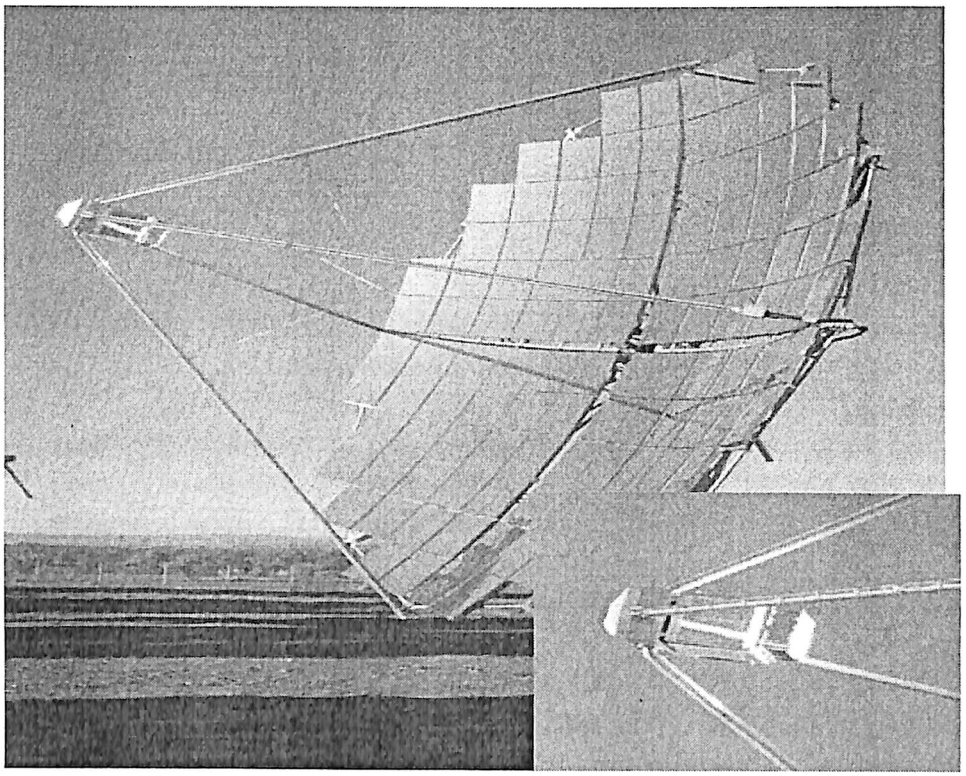

FIGURE – 17: Small Dish CPV

b. Lens CPV

Lens CPV technology is most popular CPV technology among the entrepreneurial community, with several start-ups springing up with various solutions for products that promise lower costs than standard PV. The technology comprises full tracking panels of lens-CPV assemblies, and arrays of individually tracking facets.

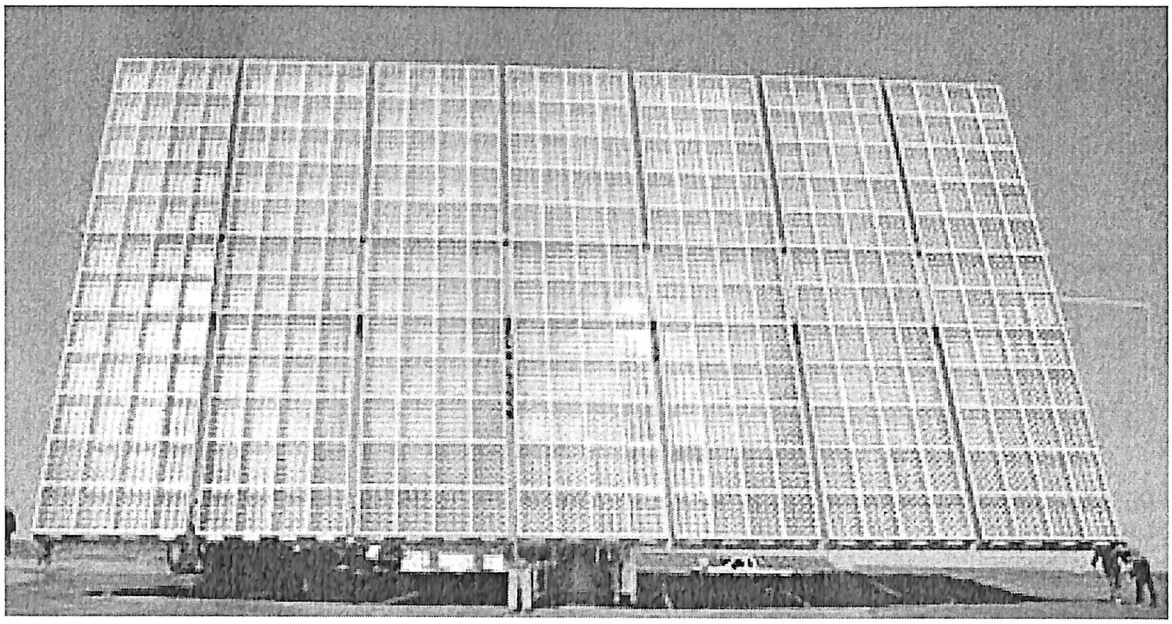

FIGURE – 18: Lens CPV

Lens CPV modules with individually tracking facets have a lower profile than Lens CPV tracking panels as the panel is mounted flat and only the small assemblies track. This results in many moving parts and high potential for mechanical failure and high O&M costs. The tight packing of the facets within one panel can also lead to shading between the facets as they track the sun.

c. *Low concentration PV (LCPV)*

LCPV is the most accessible and available CPV technology presently which applies simple flat reflective surfaces to reflect light onto conventional solar panels. While these systems do require tracking, they can tolerate only single-axis tracking, and they do not require the accuracy that higher concentration CPV/CST technologies. Different configurations of LCPV systems have been developed or commercially deployed, but all are based on the same basic principle of combining low-cost and low-precision reflectors and trackers with a PV panel to increase its performance.

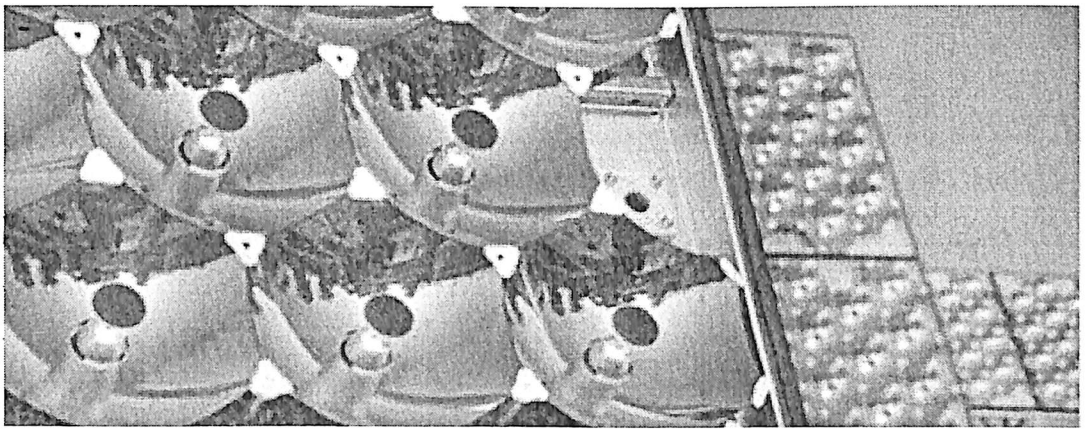

FIGURE – 19: Low concentration PV

d. Non-Tacking CPV

This technology is an approach to developing a product with a lower cost than conventional PV is to develop a CPV panel that looks and acts almost exactly like a conventional PV panel, but contains a third to half of the PV used in a conventional PV panel. Non-Tracking CPV technologies use a variety of internal optical devices that can accept light at a range of angles and direct it toward a small amount of PV. NTCPV offer promising market application as they can be installed and operated like conventional PV panels, with low O&M costs, with a fraction of the PV material used to create PV panels. Furthermore, because these technologies accept light at a range of angles, they are not limited to DNI, but can take advantage of a greater range of the solar resource.

CHAPTER - 6: FINANCIALS OF SOLAR PROJECTS

6.1. BUSINESS MODELS

6.1.1. BUSINESS MODEL 1: FEED IN TARIFF

A feed in tariff is a policy mechanism designed to accelerate investment in renewable energy technologies. It achieves this by offering long-term contracts to renewable energy producers, typically based on the cost of generation of each technology.
FITs typically include three key provisions:

- guaranteed grid access
- long-term contracts
- cost-based purchase prices

A generation tariff pays for every kWh of electricity generated. The level of the tariff depends on the type and size of technology used, and when it was installed. You are "locked into" the tariff level that is current when the equipment is installed for the life of the installation or the life of the tariff (10 - 25 years). An export tariff pays for any electricity exported to the grid. You can either accept a flat rate or try to negotiate a better rate with your electricity supplier.

Any organization or community is eligible to apply for a FIT for systems with a capacity up to 5 MW.
Eligible technologies:

- anaerobic digestion (AD) for biogas used in electricity production
- hydro-electric
- solar electric photovoltaic (PV)
- wind
- small-scale gas-powered combined heat and power (m-CHP)

6.1.2. BUSINESS MODEL 2: APPC + REC

In this model, the project sells power to the DISCOM at the APPC and in addition avails RECs. The viability of such projects is strongly linked to the APPC in the state in which such a project is being considered.

Advantages:
From a regulatory point-of view, this business model is relatively easier when compared to the other business models. In general, most DISCOMs are faced with a genuine shortage of power and would be willing to purchase solar power at APPC. This is much

lower than the price of solar power under the NSM and various state policies. One of the key advantages of this business model is the scale of projects. Individual project sizes can be very large (5MW and above), which can bring significant cost advantages.

Disadvantages:
The major drawback in this model is the poor financial state of most DISCOMs in the country. This seriously jeopardizes the ability of the DISCOMs to adhere to the PPA and ensure timely payments.

6.1.3. BUSINESS MODEL 3: RESCO + REC

In this model, the project enters into an independent PPA with a third party (excluding DISCOMs) and, in addition, RECs are availed. The third party can typically be an industrial, commercial or residential consumer of electricity. The project can either be set up on the customer's premises (land or rooftop) or at another location. In both cases, the project must go through the open access route for a third party sale of power.

The viability of such projects is strongly linked to two factors:

1. PPA price – The negotiated price of power hinges on the current price being paid by the third party. Commercial consumers pay the highest prices for electricity followed by industrial consumers and then residential consumers. The project developer must offer the third party a tariff that is lower than what the consumer pays currently in order for this solution to be attractive.

2. Strength of the third party to adhere to a long term PPA – from a financing perspective, this is a key question.

Disadvantages:
From a regulatory standpoint, there are several bottlenecks in implementing this model currently.

1. Absence of a net metering policy – Since this model involves signing an independent PPA, it must be assured that the third party consumes 100% of the power generated. In practice, this is not feasible since demand varies with time and season and does not match the generation profile of a solar power plant. In such cases where supply exceeds demand, there must be an option of injecting the excess electricity onto the grid during times of peak demand. The regulations for net-metering are under discussion with the CERC and will not be implemented before mid-2013.

2. Interconnection and open access – The current regulations do not allow the connection of such REC projects at the consumer side (LT side) of the bus. Projects must be connected at the high voltage level at the DISCOM side. For projects that are connected at high voltage under current regulations, any third

party sale of power must be registered under open access. However, open access is not an efficient solution when the point of generation and the point of consumption are the same (example: rooftop power projects). Open access involves wheeling charges, banking charges and grid losses for using the distribution network of the DISCOM. These additional costs reduce the viability of such models. The CERC is currently discussing the option of implementing such third party PPA models as off-grid or semi off-grid models, thereby circumventing the need to go through open access. But at the moment there is no clarity on when such regulation will be framed or implemented.

3. Cross Subsidy Surcharge (CSS) – Electricity prices in India are not uniform. Commercial and Industrial consumers subsidize the residential and agricultural consumers by paying higher tariffs. When such high value consumers are lost to other electricity providers, the DISCOMs face disproportionate losses. In order to compensate for this, a CSS is levied. The CSS varies across DISCOMs and is typically in the range of Rs 0.30 to Rs 1.5 per unit. Although there is a strict mandate to reduce the CSS over time, in practice this has not happened and is unlikely to happen in the near future. For the CSS to be completely discarded, the DISCOMs expect an even pricing of power across all consumer categories. This is a politically sensitive matter and is unlikely to be implemented in the near future. In some cases, to promote the development of renewable energy technologies, the CSS can be waived. However, the regulations clearly state that all concessions must be waived off in order to be eligible for REC projects.

4. Wary DISCOMs – Most DISCOMs are wary of losing their high value consumers. Since DISCOMs are authorized to approve such projects, most projects are delayed unnecessarily. This is one of the major barriers to the successful execution of this business model.

Advantages

One of the key advantages of this business model is the independence from the DISCOMs. The PPA risk now lies with the power consumer, which can be managed through strong financial diligence. Although the maximum project sizes will not likely be greater than 2MW, the model is scalable across the country.

6.1.4. BUSINESS MODEL 4: CAPTIVE + REC

In this model, commercial or industrial consumers of grid electricity set up a solar REC project for the self consumption of solar power. The amended regulations allow RECs for self-consumption projects. The following criteria must be satisfied as per the Electricity Act 2003, in order to be considered as a captive user:

1. Minimum of 26% stake in the project from the power consumer
2. Minimum of 51% of the electricity should be self-consumed.

The financial viability of such projects is linked to the current grid tariff which the consumer pays to the DISCOM. The return on investment for such projects is based on the difference between the cost of generation of solar power and the grid price. In addition, RECs are the crucial trigger for the financial viability of such projects.

Advantages

The key advantage of this model is that it significantly reduces the PPA risk since the power consumer is invested in the project. Tax incentives such as accelerated depreciation can be availed by such captive consumers which will drive this segment. Innovative business models with a group of investors (group captive) would also become feasible.

Disadvantages

From a regulatory standpoint, this model is easier to implement compared to the RESCO+REC model. None the less, the following challenges exist:

1. Absence of a net metering policy (as discussed before)
2. Inability to connect the plant at the consumer side of the low voltage (415V) means that the output from the solar plant will have to be stepped up to at least 11kV. This creates additional costs of transformers and switch-gears which would significantly reduce the viability of such models

6.2. BROAD ASSUMPTIONS/FACTORS

In every project finance deal, where everyone's financial security rests on the future performance of a new undertaking, a thorough analysis of the project's finances under a arrange of assumptions is prerequisite for arranging debt and equity funding, financial model play a crucial role in decision-making

The financial model provide a basic analysis, usually based on relatively raw, preliminary data and simplified financing assumptions, to establish weather a given project is worth pursuing further. The required output may be:

1. Basic Project IRR
2. Debt service Coverage Ratios and other debt ratios.
3. Establishing a financial structure that is sustainable by the project.
4. Reassuring lenders and investors as to the attractiveness of the deal as a home for their funds.
5. An indication of tariff levels required for achieving appropriate returns.
6. Preparation of sensitivity analysis.

- **DEFINITIONS:**

1. **Levelised tariff**
   Levelised tariff is net present value of all inflows divided NPV of all energy produced in a particular time period with same base year

2. **CUF/PLF**
   It is the ratio of actual energy generated to the energy the plant would have generated if it was operating at its maximum capacity. It is given as percentage and is usually calculated for a period of one year.

$$PLF = \frac{100^{*} \text{ Energy Generated in a Year}}{\text{Maximum Energy Generated in a Year}}$$

3. **DSCR**
   In corporate finance, it is the amount of cash flow available to meet annual interest and principal payments on debt, including sinking fund payments.
   In general, it is calculated by:

$$DSCR = \frac{\text{Net Operating Income}}{\text{Total Debt Service}}$$

4. **Debt/equity ratio**
   It is the ratio of debt and equity employed in any business. It is a measure of a company's financial leverage calculated by dividing its total liabilities by stockholders' equity. It indicates what proportion of equity and debt the company is using to finance its assets.

5. **IRR**
   The discount rate often used in capital budgeting that makes the net present value of all cash flows from a particular project equal to zero. Generally speaking, the higher a project's internal rate of return, the more desirable it is to undertake the project.

6. **RoE** -

The amount of net income returned as a percentage of shareholders equity. Return on equity measures a corporation's profitability by revealing how much profit a company generates with the money shareholders have invested. ROE is expressed as a percentage and calculated as:

$$\text{RoE} = \frac{\text{Net Income}}{\text{Share-holders Equity}}$$

7. **NPV**

The difference between the present value of cash inflows and the present value of cash outflows. NPV is used in capital budgeting to analyze the profitability of an investment or project.

Formula:

$$NPV = \sum_{t=1}^{T} \frac{C_t}{(1+r)^t} - C_0$$

CHAPTER – 7: CASE STUDY

7.1. 10 MW BASED ON PREFERENTIAL TARIFF/FIT SCHEME

7.1.1. INTRODUCTION

Solar power is the conversion of sunlight into electricity, either directly using photovoltaic (PV), or indirectly using concentrated solar power (CSP). CSP systems use lenses or mirrors and tracking systems to focus a large area of sunlight into a small beam. PV converts light into electric current using the photoelectric effect.

1. *Background*
   This case study covers the planning aspects of setting up of Solar PV Power Project of the capacity of 10 MW in Tehsil Phalodi, Jodhpur district in the state of Rajasthan, India.

2. *Scope*
   Feasibility study of 10 MW Solar PV project in Phalodi, Rajasthan

7.1.2. SITE ASSESSMENT FOR SETTING UP 10 MW SOLAR PV PROJECT

The proposed site is located in Tehsil Phalodi of Jodhpur district in Rajasthan, India

1. *Location*
   Phalodi is a city and a municipality in Jodhpur district in the Indian state of Rajasthan. Geographically it is situated at 27.131° N latitude and 72.364° E longitude. It has an average elevation of 302m.

2. *Land*
   Essentially using the Poly-crystalline Solar PV Technology the land requirement is 5 Acres/MW, so total land required for this project is 50 Acres.
   The Government land required for Solar Power Plant shall be allotted to Solar Power Producer at concessional rate of 10% of the DLC rate (agriculture land) and for setting up SPV on crystalline technology: 2.5 hectares per MW

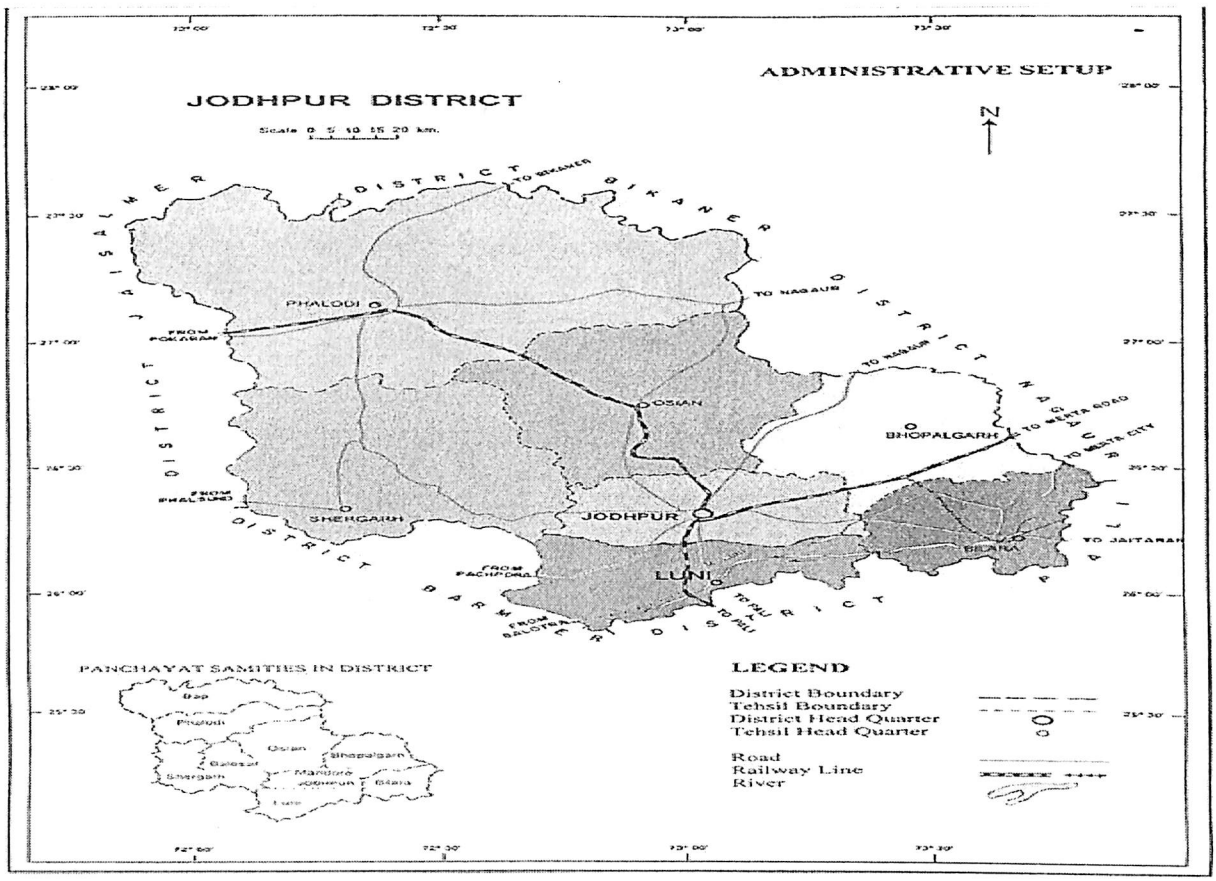

FIGURE – 20: District map of Jodhpur

7.1.3. SOLAR RADIATION RESOURCE ASSESSMENT

1. *Solar radiation over India*

   India being a tropical country is blessed with good sunshine over most parts, and the number of clear sunny days in a year also being quite high. The country receives solar energy equivalent to more than 5,000 trillion kWh per year. India's equivalent solar energy potential is about 6,000 million GWh of energy per year.

2. *Rajasthan*

   Being the largest state of India, Rajasthan encompasses an area of 342,239 km² or 10.4% of the total geographical area of country. Rajasthan has a tropical desert climate. Rajasthan receives maximum solar radiation intensity in India. In addition the average rainfall is minimum in the state, hence best suited for solar power generation. West of Rajasthan and the eastern side of Aravalli Range, in the region of Phalodi, Jaisalmer etc, the maximum daily temperature hovers around 40°C to 45°C. Sometimes, it even reaches as high a 49°C during the summer months.

3. *Phalodi*

   Annual Average Direct Normal Insolation (DNI) is 2240 kWh/m²

   Annual Effective DNI is 2202 kWh/m²

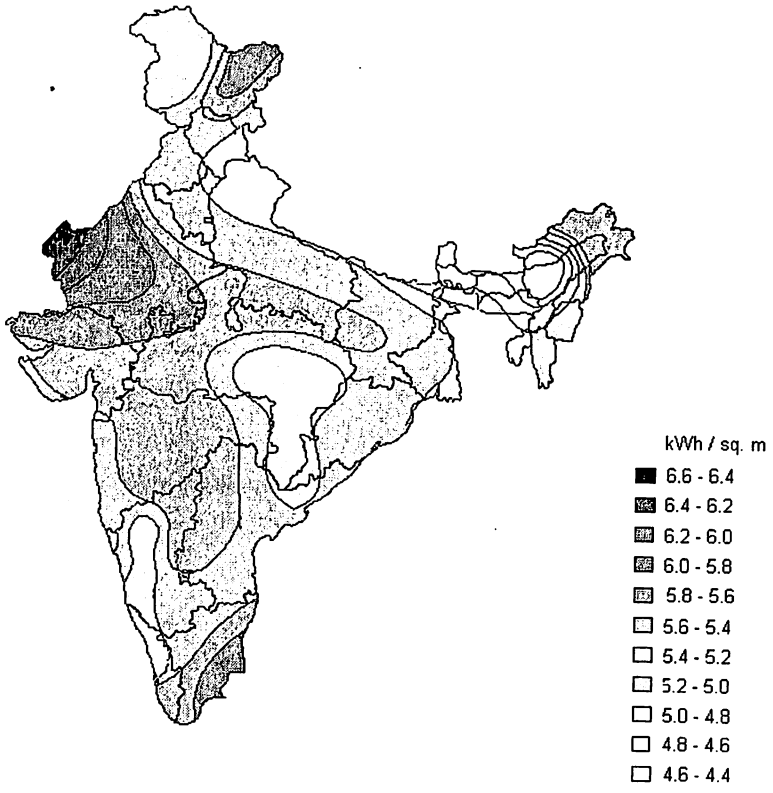

FIGURE – 21: Solar radiation over India

7.1.4. PROPOSED SOLAR PHOTOVOLTAIC TECHNOLOGY

Technology proposed for this project is "Polycrystalline silicon cell solar technology". These cells have module efficiency of around 12-14%. Annual electricity generated for 10 MW capacity plant is around 18 MWh.

7.1.5. PLANT LOAD FACTOR (PLF) OR CAPACITY UTILIZATION FACTOR (CUF)

The Plant Load factor or Plant Capacity Factor or Capacity Utilization Factor (CUF) is defined as the ratio of net electrical generation for the time considered to the energy that could have been generated if the system were generating at continuous full power during the same period. As Solar PV converts solar radiation into electricity only during the day time when sun is available; the plant capacity utilization factor is rather low in comparison to conventional power plants.

PLF for this project is 22%

7.1.6. PROJECT TECHNICAL DETAILS AND DESIGN

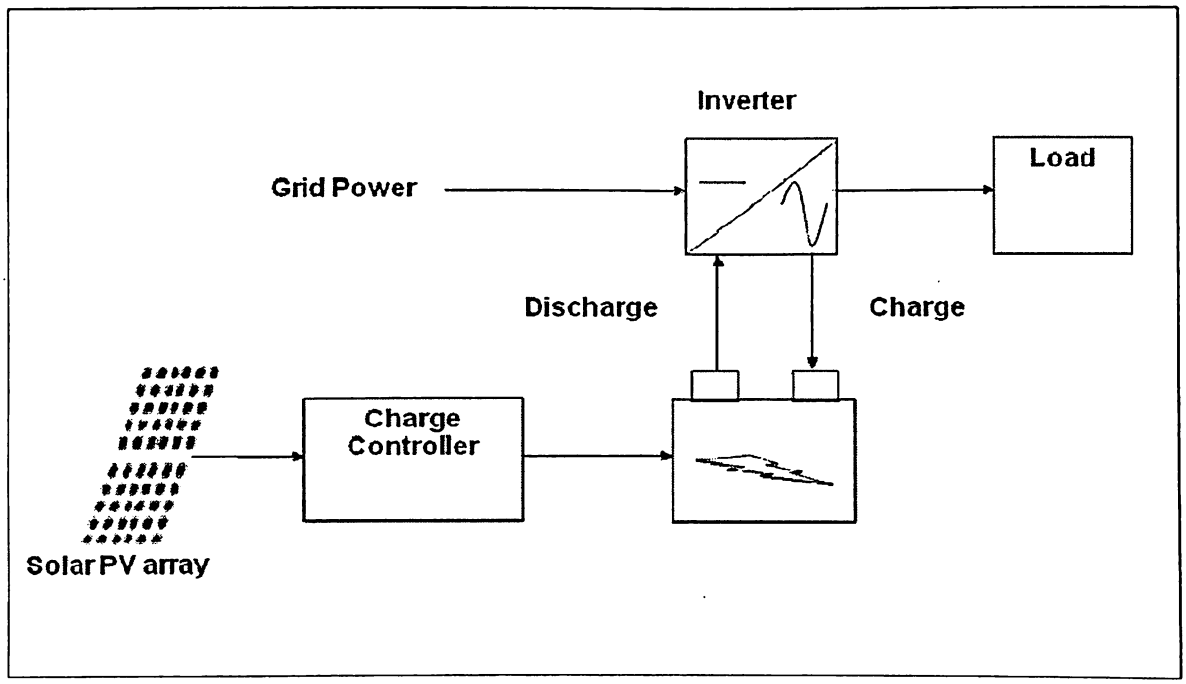

FIGURE -22: Technical design of solar project

1. *Solar PV modules*
   The Si-Poly SPV solar cell of 250Wp has been selected. So for 10 MW project, total number of modules will be 40

2. *Inverter*
   Grid interconnection of PV systems is accomplished through the inverter which converts DC power generated from PV modules to high quality AC power to the utility system at reasonable cost. Inverter selected is of 500 kW, so total number of inverters used is 20.

3. *Step up transformer*
   The high voltage side of the step up transformer will be connected to the switchyard by means of overhead conductors. The step up transformer will be designed to deliver the total output of the plant in to the system. The photovoltaic modules generate low voltage DC power. This power is transformed to 400V, three phases 50Hz AC power in the inverters to facilitate interface with the utility grid supply. 2 transformers of rating 5 MVA are selected.

4. *Plant DC system* -

To supply power to various unit / loads, the following DC Systems (one main and one standby) have been envisaged for the proposed plant:

a. Battery

The Battery shall be high discharge performance type. The plates shall be designed for maximum durability during all service conditions including high rate of discharge & rapid fluctuation of load.

b. Battery Chargers

c. DC Distribution Board (DCDB)

Each DCDB will receive power from its respective DC Battery/battery charger. DCDB incomers will be provided with positive mechanical interlocking facility to ensure that different power supply sources will not operate in parallel to avoid fault level exceeding their designated capability

5. *Cables and Accessories*

Cables will be exposed to ultra violet radiations which would reduce the cable life span. Therefore, cables with UV protection have to be used. Additionally, the cables should be flame, oil Ozone resistant halogen free complying with DIN standards.

6. *Monitoring and Display System*

The PV power plant will be monitored through the SCADA system. This will enable monitoring the status of inverters to gather information on energy generation. Periodic reports of the plant's performance will be provided by the monitoring system. A suitable display system can also be installed suitably in the plant to access live data on the performance of the solar system. Remote data access will be provided through secured gateway connectivity. All protection relays in the plant shall serve as IEDs. Communication ports of the relay / devices shall be connected with SCADA system. The status of all breakers shall also be monitored.

7. *Energy Metering*

Tariff metering panel to be located in the yard as per existing practice shall be provided for the new bays. Check meters can be suitably located in the metering panels

8. *Annual degradation*

The estimated life of PV modules is considered as 25 years. Performance of solar PV modules degrades over its specified lifetime. It has been considered that there will be a reduction of power generation of 0.8% per annum at the output of the inverters.

7.1.7. PROJECT REGISTRATION AND CLEARANCES

1. Land Acquisition
2. MoEF Approval (In case of Forest Land)
3. Connectivity Permission (Transmission/Distribution company)
4. Evacuation agreement
5. Pollution Control Board (Consent to Establish and Consent to Operate)
6. No objection certificate from Civil Aviation Department & Defense Department
7. Permission for laying power evacuation lines by chief electrical inspector
8. Permission for 'Implementation of Metering Code', 'Protection System' to be obtained from host Distribution Utility or the State Transmission Utility

7.1.8. STATE POLICY AND PROMOTIONAL SCHEMES /INCENTIVES

- *Setting up of Solar Power Plants in Rajasthan for direct sale to Discoms of Rajasthan*

The State will promote setting up of solar power projects for direct sale to Discoms of Rajasthan. The total capacity under this category will be distributed equally between SPV and CSP based power plants.
The total maximum capacity under this category for:
Phase-1 (up to 2013): 200MW
Phase-2 (2013-2017): 400MW (additional)
Selection of these Solar Power Projects shall be through tariff based competitive bidding process.
The minimum allocation is 5MW and maximum 10MW for Solar PV.
The minimum allocation is 5MW and maximum 50MW for Solar Thermal

This project comes under the category mentioned above and the other categories which are also under this policy regime are as follows:

1. *Utility Grid Power Projects for Captive use /Direct sale to 3 rd Party/States other than Rajasthan through Open Access for promotion of investment in Rajasthan*
2. *Setting up of Rooftop PV and other Small Solar Power Plants connected to LT/11kVGrid*
3. *Utility Grid Power Projects for sale through RE (Solar) Certificate Mechanism*
4. *Setting up of Solar Power Plant for promotion of manufacturing facilities in the State*
5. *Off-Grid and Decentralized Solar Plants*

7.1.9. FINANCIAL ANALYSIS

ASSUMPTIONS

Project Details:		
Project capacity (MW)	10	
M/C capacity	1	
PLF (%)	23.00%	
No. of M/Cs	10	
Project/Acquisition cost(Cr/MW)	6.5	
O&M rate(lacs/Unit)	10	
Escalation (%)	5%	
life(years)	20	
Financing:		
Debt (%)	70%	45.5
Equity (%)	30%	19.5
Interest rate (%)	12%	
Moratorium (months)	6	
Years of repayment	10	40
Book depreciation rate	5.28%	
Income Tax depreciation rate	80%	
Insurance (%)	1%	
CER Details:		
Emission Factor(tC02/MWh)	0.9275	
CER Rate(euro)	0	
Euro rate	70	
CER Monitoring(Crs)	0	
CER Issuance (% of CER rev.)	2%	
Tax Rates:		
Income Tax rate	33.99%	
MAT rate	11.33%	
CER sharing	0%	

SCHEDULE

No. of years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FY starting	Jan-09	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27
FY ending	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27	Mar-28
Revenue from sale of power																				
Generation MU's	3.257	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148	20.148
Tariff	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5
Revenue(Rs Crs)	2.117	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096	13.096
Revenue from CERs																				
CERs Generated(million CERs)	0.003	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0.019	0	0	0	0	0	0	0	0	0	0
Revenue(Rs Crs)	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0	0	0	0	0	0	0	0
O&M expenses	0	0	1.00	1.05	1.10	1.16	1.22	1.28	1.34	1.41	1.48	1.55	1.63	1.71	1.80	1.89	1.98	2.08	2.18	2.29
CER expenses																				
Monitoring charges	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Issuance charges	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	0	0	0	0	0	0	0	0	0
Total	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0	0	0	0	0	0	0	0	0	0
Insurance expenses	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Loan Repayment																				
Opening balance	45.50	45.50	40.95	36.40	31.85	27.30	22.75	18.20	13.65	9.10	4.55	0	0	0	0	0	0	0	0	0
Principal payment	0	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	0	0	0	0	0	0	0	0	0
Closing balance	45.50	40.95	36.40	31.85	27.30	22.75	18.20	13.65	9.10	4.55	0.00	0	0	0	0	0	0	0	0	0
Interest	2.73	5.19	4.64	4.10	3.55	3.00	2.46	1.91	1.37	0.82	0.27	0	0	0	0	0	0	0	0	0
Book Depreciation	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Book Depreciation(cumulative	3.25	6.50	9.75	13.00	16.25	19.50	22.75	26.00	29.25	32.50	35.75	39.00	42.25	45.50	48.75	52.00	55.25	58.50	61.75	65.00
Income Tax Depreciation																				
Opening balance	65.00	39.00	7.80	1.56	0.31	0.06	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
Depreciation	26.00	31.20	6.24	1.25	0.25	0.05	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
Closing Balance	39.00	7.80	1.56	0.31	0.06	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
Tax benefit on IT depreciaition	8.84	10.60	2.12	0.42	0.08	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
Income Tax Calculation																				
PBT	-4.51	4.01	3.56	4.05	4.54	5.04	5.52	6.01	6.49	6.97	7.45	7.64	7.57	7.49	7.40	7.31	7.22	7.12	7.01	6.90
add Book Depreciation	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
Total Income	-1.26	7.26	6.81	7.30	7.79	8.29	8.77	9.26	9.74	10.22	10.70	10.89	10.82	10.74	10.65	10.56	10.47	10.37	10.26	10.15
less Income Tax Depreciation	26.00	31.20	6.24	1.25	0.25	0.05	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
Net Income	-27.26	-23.94	0.57	6.05	7.55	8.24	8.76	9.26	9.74	10.22	10.70	10.89	10.82	10.74	10.65	10.56	10.47	10.37	10.26	10.15
loss carry forward	0	27.26	51.20	50.64	44.59	37.04	28.80	20.04	10.78	1.04	0	0	0	0	0	0	0	0	0	0
Taxable Income	-27.26	-51.20	-50.64	-44.59	-37.04	-28.80	-20.04	-10.78	-1.04	9.18	10.70	10.89	10.82	10.74	10.65	10.56	10.47	10.37	10.26	10.15
Years of 80IA	0	0	0	0	0	0	0	0	0	1	2	3	4	5	6	7	8	9	10	11
Exempted Income under 80IA	0	0	0	0	0	0	0	0	0	9.18	10.70	10.89	10.82	10.74	10.65	0	0	0	0	0
Taxable Income after 80IA	-27.26	-51.20	-50.64	-44.59	-37.04	-28.80	-20.04	-10.78	-1.04	0.00	0.00	0.00	0.00	0.00	0.00	10.56	10.47	10.37	10.26	10.15
Income Tax	-9.27	-17.40	-17.21	-15.15	-12.59	-9.79	-6.81	-3.66	-0.35	0.00	0.00	0.00	0.00	0.00	0.00	3.59	3.56	3.52	3.49	3.45
MAT	0	0.45	0.40	0.46	0.51	0.57	0.63	0.68	0.74	0.79	0.84	0.87	0.86	0.85	0.84	0.83	0.82	0.81	0.79	0.78
Tax Applicable	0	0.45	0.40	0.46	0.51	0.57	0.63	0.68	0.74	0.79	0.84	0.87	0.86	0.85	0.84	3.59	3.56	3.52	3.49	3.45

PROFIT & LOSS ACCOUNT

No. of years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FY starting	Jan-09	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27
FY ending	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27	Mar-28
Income																				
From sale of Power	2.12	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10
From CERs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0	0	0	0	0	0
Total(Crs)	2.12	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10	13.10
Expenses																				
O&M Expenses	0.00	0.00	1.00	1.05	1.10	1.16	1.22	1.28	1.34	1.41	1.48	1.55	1.63	1.71	1.80	1.89	1.98	2.08	2.18	2.29
CER Expenses	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	0	0	0	0	0	0	0	0	0
Insurance Expenses	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
Total(Crs)	0.65	0.65	1.65	1.70	1.75	1.81	1.87	1.93	1.99	2.06	2.13	2.20	2.28	2.36	2.45	2.54	2.63	2.73	2.83	2.94
EBITDA	1.47	12.45	11.45	11.40	11.34	11.29	11.23	11.17	11.11	11.04	10.97	10.89	10.82	10.74	10.65	10.56	10.47	10.37	10.26	10.15
Interest	2.73	5.19	4.64	4.10	3.55	3.00	2.46	1.91	1.37	0.82	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Depreciation	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25	3.25
PBT	-4.51	4.01	3.56	4.05	4.54	5.04	5.52	6.01	6.49	6.97	7.45	7.64	7.57	7.49	7.40	7.31	7.22	7.12	7.01	6.90
Tax	0.00	0.45	0.40	0.46	0.51	0.57	0.63	0.68	0.74	0.79	0.84	0.87	0.86	0.85	0.84	3.59	3.56	3.52	3.49	3.45
PAT	-4.51	3.55	3.15	3.59	4.03	4.47	4.90	5.33	5.76	6.18	6.60	6.78	6.71	6.64	6.56	3.72	3.66	3.59	3.52	3.45

CASHFLOW STATEMENT

No. of years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FY starting	Jan-09	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27
FY ending	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27	Mar-28
Cash Inflow																				
Debt	45.50																			
Equity	19.50																			
EBITDA	1.47	12.45	11.45	11.40	11.34	11.29	11.23	11.17	11.11	11.04	10.97	10.89	10.82	10.74	10.65	10.56	10.47	10.37	10.26	10.15
Total cash inflow	66.47	12.45	11.45	11.40	11.34	11.29	11.23	11.17	11.11	11.04	10.97	10.89	10.82	10.74	10.65	10.56	10.47	10.37	10.26	10.15
Cash Outflow																				
Capital expense	65																			
Interest on term debt	2.73	5.19	4.64	4.10	3.55	3.00	2.46	1.91	1.37	0.82	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loan repayment	0	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	0	0	0	0	0	0	0	0	0
Tax	0.00	0.45	0.40	0.46	0.51	0.57	0.63	0.68	0.74	0.79	0.84	0.87	0.86	0.85	0.84	3.59	3.56	3.52	3.49	3.45
Total cash outflow	67.73	10.19	9.59	9.10	8.61	8.12	7.63	7.14	6.65	6.16	5.67	0.87	0.86	0.85	0.84	3.59	3.56	3.52	3.49	3.45
Net Cash flow	-1.26	2.25	1.85	2.29	2.73	3.17	3.60	4.03	4.46	4.88	5.30	10.03	9.96	9.89	9.81	6.97	6.91	6.84	6.77	6.70
Cumulative	-1.26	0.99	2.84	5.14	7.87	11.03	14.63	18.66	23.11	27.99	33.30	43.32	53.28	63.17	72.98	79.95	86.86	93.71	100.48	107.18
Depreciation	No																			
For Equity IRR																				
Equity investments	-19.50																			
Free cash flow	-1.26	2.25	1.85	2.29	2.73	3.17	3.60	4.03	4.46	4.88	5.30	10.03	9.96	9.89	9.81	6.97	6.91	6.84	6.77	6.70
Depreciation benefit	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Net equity cash flow	-20.76	2.25	1.85	2.29	2.73	3.17	3.60	4.03	4.46	4.88	5.30	10.03	9.96	9.89	9.81	6.97	6.91	6.84	6.77	6.70
Equity IRR	17.8%																			
NPV	10.33																			
For Project IRR																				
Project cost	65																			
Interest	2.73	5.19	4.64	4.10	3.55	3.00	2.46	1.91	1.37	0.82	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Loan Repayment	0	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	0	0	0	0	0	0	0	0	0
Free cash flow	-1.26	2.25	1.85	2.29	2.73	3.17	3.60	4.03	4.46	4.88	5.30	10.03	9.96	9.89	9.81	6.97	6.91	6.84	6.77	6.70
Net Project Cash flow	-63.53	11.99	11.04	10.94	10.83	10.72	10.60	10.49	10.37	10.25	10.13	10.03	9.96	9.89	9.81	6.97	6.91	6.84	6.77	6.70
Project IRR		15%	15%	15%																
NPV	11.39																			
DSCR Calculation																				
Free cash flow	-1.26	2.25	1.85	2.29	2.73	3.17	3.60	4.03	4.46	4.88	5.30	10.03	9.96	9.89	9.81	6.97	6.91	6.84	6.77	6.70
add: Interest	2.73	5.19	4.64	4.10	3.55	3.00	2.46	1.91	1.37	0.82	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
add: loan repayment	0	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	0	0	0	0	0	0	0	0	0
Total cash available	1.47	11.99	11.04	10.94	10.83	10.72	10.60	10.49	10.37	10.25	10.13	0	0	0	0	0	0	0	0	0
interest	2.73	5.19	4.64	4.10	3.55	3.00	2.46	1.91	1.37	0.82	0.27	0	0	0	0	0	0	0	0	0
loan repayment	0	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	0	0	0	0	0	0	0	0	0
Total debt service	2.73	9.74	9.19	8.65	8.10	7.55	7.01	6.46	5.92	5.37	4.82	0	0	0	0	0	0	0	0	0
DSCR(Debt Service Coverage Ratio)	0.54	1.23	1.20	1.27	1.34	1.42	1.51	1.62	1.75	1.91	2.10	0	0	0	0	0	0	0	0	0

BALANCE SHEET

No. of years	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
FY starting	Jan-09	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27
FY ending	Mar-09	Mar-10	Mar-11	Mar-12	Mar-13	Mar-14	Mar-15	Mar-16	Mar-17	Mar-18	Mar-19	Mar-20	Mar-21	Mar-22	Mar-23	Mar-24	Mar-25	Mar-26	Mar-27	Mar-28
Fixed Assets																				
Land																				
Gross Block	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65	65
Less:Depreciation(cumulative)	3.250	6.500	9.750	13.000	16.250	19.500	22.750	26.000	29.250	32.500	35.750	39.000	42.250	45.500	48.750	52.000	55.250	58.500	61.750	65.000
Net Block	61.750	58.500	55.250	52.000	48.750	45.500	42.250	39.000	35.750	32.500	29.250	26.000	22.750	19.500	16.250	13.000	9.750	6.500	3.250	0.000
Current Assets																				
Cash and Bank balances	-1.26	0.99	2.84	5.14	7.87	11.03	14.63	18.66	23.11	27.99	33.30	43.32	53.28	63.17	72.98	79.95	86.86	93.71	100.48	107.18
Total current assets	-1.26	0.99	2.84	5.14	7.87	11.03	14.63	18.66	23.11	27.99	33.30	43.32	53.28	63.17	72.98	79.95	86.86	93.71	100.48	107.18
Total Assets	60.487	59.492	58.094	57.136	56.616	56.531	56.879	57.657	58.863	60.493	62.545	69.324	76.034	82.672	89.234	92.955	96.613	100.207	103.732	107.185
Liabilities																				
Share capital	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50	19.50
Reserves and surplus	-4.51	-0.96	2.19	5.79	9.82	14.28	19.18	24.51	30.26	36.44	43.05	49.82	56.53	63.17	69.73	73.45	77.11	80.71	84.23	87.68
Net worth	14.99	18.54	21.69	25.29	29.32	33.78	38.68	44.01	49.76	55.94	62.55	69.32	76.03	82.67	89.23	92.95	96.61	100.21	103.73	107.18
Current Liabilities	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Long term debt	45.50	40.95	36.40	31.85	27.30	22.75	18.20	13.65	9.10	4.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Working capital	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total loan	45.50	40.95	36.40	31.85	27.30	22.75	18.20	13.65	9.10	4.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Liabilities	60.487	59.492	58.094	57.136	56.616	56.531	56.879	57.657	58.863	60.493	62.545	69.324	76.034	82.672	89.234	92.955	96.613	100.207	103.732	107.185