

“Energy Certificates: RECs and PAT Mechanism Analysis”

Final year project report submitted in partial fulfilment of the requirement
for the award of the degree of

MASTER OF BUSINESS ADMINISTRATION IN ENERGY TRADING



REFERENCE COPY

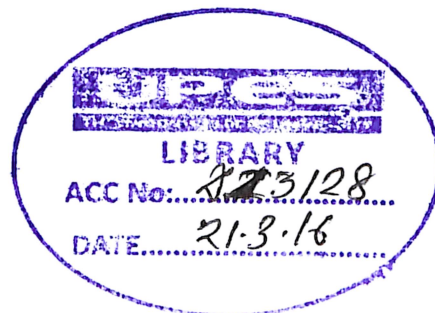
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DECLARATION

I, **Sagar Katkar** Roll No. R590212016, Batch 2012-14, MBA (Energy Trading) of the University of Petroleum and Energy Studies (UPES), Dehradun hereby declare that the dissertation report entitled

“Energy Certificates: RECs and PAT Mechanism Analysis”

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



(Sagar Katkar)



UNIVERSITY OF PETROLEUM & ENERGY STUDIES

(ISO 9001 : 2008 & ISO 14001 2004 Certified)

BONAFIDE CERTIFICATE

This is to certify that Mr. Sagar Katkar, student of University of Petroleum & Energy Studies, Dehradun, pursuing M.B.A. (Energy Trading) has successfully completed his dissertation project. As part of his curriculum the project report entitled, "Energy Certificates: RECs and PAT Mechanism Analysis" submitted by student to undersigned is an authentic record of his original work carried out by him, under my supervision and guidance.

I wish him all the best.

Date:

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Acknowledgement

This Dissertation got materialized and happened with the help of valuable contribution and efforts provided by many people in my organization. I would like to name a few of them, but there are likely to be many more persons who have unknowingly and inadvertently not been mentioned here. Apologies, for all those I have failed to mention, but your inputs have been recognized and incorporated in the research work that has been carried out.

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Executive Summary

Renewable Energy Certificates (REC)

Renewable energy is derived from sources which are continually replenished over a period of time. It is available in various forms such as sunlight, wind, rain, tides, waves and geothermal heat. Sun is considered to be primary source of all these energies. In amidst of uncertainty of oil, gas prices many countries are looking at renewable energy as an option for energy security.

At global level 16% of final energy consumption comes from renewables, with 10% from traditional biomass, which is mainly used for heating, and 3.4% from hydroelectricity. New renewables such as small hydro, modern biomass, wind, solar, geothermal, and biofuels account for 3%. The share of renewables in electricity generation is around 19%, with 16% of global electricity coming from hydroelectricity and 3% from new renewables.

In India, 10% of electricity is generated from renewables only. Of which wind shares 71.3% and growing faster, solar contribute 4.68%, biomass contributes 3.39%, and small hydro contributes 6.18%. Climate change concerns, along with high oil prices, peak oil, and increasing government support, are driving increasing renewable energy legislation, incentives and commercialization.

Renewable Energy sources are not evenly spread across different parts of the country. On the one hand there are States (like Delhi) where the potential of RE sources is not that significant. On the other hand there are States (like Rajasthan and Tamil Nadu) where there is very high potential of RE sources. In March 2011, the Government of India launched the renewable energy certificates a market based mechanism – to drive renewable energy development and spur further investments.

In India, Renewable Energy Certificate mechanism is a regulatory tool to achieve goal of the National Action Policy on Climate Change (NAPCC). The plan set target of 5% for 2009-10, & then 1% increase for every year, set a target of 15% of electricity via renewable energy sources by 2020. This mechanism helps to manage the mismatch between availability of RE sources and the requirement of the obligated entities to meet their RPO. The SERCs in respective States specify Renewable Purchase Obligation (RPO) to each individual entity. Central Electricity Regulatory Commission (CERC) has notified Regulation on Renewable Energy Certificate

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(REC) in fulfillment of its mandate to promote renewable sources of energy and development of market in electricity.

The value of REC will be equivalent to 1 MWh of electricity injected into the grid from renewable energy sources. The REC will be exchanged only in the Power Exchanges approved by CERC within the band of a floor price and a forbearance (ceiling) price to be determined by CERC from time to time. The distribution companies, Open Access consumer, Captive Power Plants (CPPs) will have option of purchasing the REC to meet their Renewable Purchase Obligations (RPO).

Perform Achieve Trade (PAT)

India energy import bill increased by 40% to \$140 billion in financial year 2011-12. It is also estimated that a sustained \$10 increase in oil prices lead to a 1.5 per cent reduction in the GDP of developing countries. India must ensure energy security without jeopardizing growth & reduce foreign exchange outflow.

India announced its first National Action Plan on Climate Change (NAPCC) that address climate change mitigation and adaptation in year 2008. The plan identifies eight core national missions. Under the National Mission Enhanced Energy Efficiency (NMEEE) Perform Achieve Trade (PAT) was announced, it is aimed for enhancing energy efficiency measure for large energy intensity consumers in country. These consumers were responsible for 60% of greenhouse gas emissions in 2007. It is estimated that the NMEEE will enable about 23 million tons oil-equivalent of fuel savings- in coal, gas, and petroleum products by 2015. The mission has commenced implementation from April, 2011 under the flagship of the 'Perform Achieve and Trade (PAT)' initiative. Total nine designated consumers were considered out of 15 consumers, mentioned in energy conservation act 2001.

These designated consumers are given target to complete by March 2014. Designated consumers who achieve given target or for extra achievement will earn tradable certificate. One certificate is equal to one Mtoe. This certificate will be traded with those having under achievement. This trading will start from April 2014.

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1. Introduction

1.1 Renewable Energy Certificates (RECs)

The National action plan on climate change (NAPCC), released on 30 June 2008, to contribute towards fight against climate change as mentioned in eight national missions. The Renewable Energy Certificates (REC) mechanism was prescribed as a regulatory instrument. The plan sets targets of 5 per cent renewable energy purchase from FY 2009-10.

According to this mechanism the green electricity is split in to two components, electricity and green attributes. The CERC made provision to sale electricity to local distributors at average power purchase cost (APPC) or through power exchange; whereas green attributes can be converted in to REC, which can be sold to state utilities. APPC is fixed by respective SERC's and REC prices are decided by demand & supply in market.

One REC is equivalent to a unit of electricity (1 MWh). REC is again categorized in to parts solar REC and non-solar REC. the validity of REC is 730 days (2 years). Certificates are traded in energy exchanges on last Wednesday of every month. Here banking or borrowing is not allowed as well as single transfer is considered.

Renewable Energy Certificate (REC) has been used to promote growth of Renewable Energy (RE) under a supportive policy and regulatory regime in Australia, Sweden, Italy, Germany and UK. It is estimated that the midterm potential (till 2032) of RE (non-solar) in India is in the range of 85,000–90,000 MW and the total potential of RE is in the range of 140,000 – 150,000 MW. But as on 31 Dec, 2013 only 30,000 MW of installed capacity (grid interactive) of electricity generation was from RE sources, which was around 10-12% of the total installed electricity generation capacity in the country.

Electricity generation from RE is relatively costlier than generation by conventional generation such as coal and hydropower. Many countries implemented various policies to make electricity generation from RE financially attractive, to encourage investment from private players in the RE sector. Generation of electricity from RE can be enhanced in primarily three ways providing 1) financial incentives which are investment based 2) production based and having a supporting legal or regulatory framework. Investment based financial incentives are proportional to capital

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expenditure and include accelerated depreciation, sales tax and central excise tax exemption, reduced VAT, loan guarantees, investment tax credit, subsidies, income tax holidays (5–10 years), concessional import duties, long term land lease and soft loans. Production based financial incentives which are proportional to the energy generated. These include minimum feed in- tariff and generation based incentives (GBIs), production tax credits, and low power wheeling charges, banking of power, electricity duty and state sales tax exemption. Some of these financial incentives like subsidies do place an additional burden on the state exchequer but are essential to kick start the investment in RE technology deployment. In India to stimulate the RE sector include permission to invest 100% Foreign Direct Investment (FDI) in RE generation projects, providing infrastructure and preference to off take electricity generated from RE and these project can earn carbon credits under Clean Development Mechanism (CDM).

Sl. No.	States/ UTs	Wind Power (MW)	Small Hydro Power (MW)	Bio-Energy - Biomass Power (MW)	Bio-Energy - Bagasse Cogeneration (MW)	Bio-Energy - Waste To Energy (MW)	Total
1	Andhra Pradesh	14497	978	578	300	123	16476
2	Arunachal Pradesh	236	1341	8	NA	NA	1586
3	Assam	112	239	212	NA	8	570
4	Bihar	144	223	619	300	73	1359
5	Chhattisgarh	314	1107	236	NA	24	1681
6	Goa	NA	7	26	NA	NA	32
7	Gujarat	35071	202	1221	350	112	36956
8	Haryana	93	110	1333	350	24	1910
9	Himachal Pradesh	64	2398	142	NA	2	2606
10	Jammu & Kashmir	5685	1431	43	NA	NA	7158
11	Jharkhand	91	209	90	NA	10	400

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12	Karnataka	13593	4141	1131	450		19315
13	Kerala	837	704	1044	NA	36	2622
14	Madhya Pradesh	2931	820	1364	NA	78	5193
15	Maharashtra	5961	794	1887	1250	287	10180
16	Manipur	56	109	13	NA	2	181
17	Meghalaya	82	230	11	NA	2	325
18	Mizoram	NA	169	1	NA	2	171
19	Nagaland	16	197	10	NA	NA	223
20	Orissa	1384	295	246	NA	22	1948
21	Punjab	NA	441	3172	300	45	3958
22	Rajasthan	5050	57	1039	NA	62	6208
23	Sikkim	98	267	2	NA	NA	367
24	Tamil Nadu	14152	660	1070	450	151	16482
25	Tripura	NA	47	3	NA	2	51
26	Uttar Pradesh	1260	461	1617	1250	176	4763
27	Uttarakhand	534	1708	24	NA	5	2271
28	West Bengal	22	396	396	NA	148	962
29	Andaman & Nicobar	365	8	NA	NA	NA	373
30	Chandigarh	NA	NA	NA	NA	6	6
Total	Total	102772	19749	17536	5000	2554	147612

Table 1: State wise distribution of Renewable Energy Sources

Source: www.recregistryindia.com

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1.1.1 Renewable purchase obligations (RPO) mandated by SERCs across India.

India aims to derive 15% of its energy requirements from RE sources by the year 2020. However, RE sources are not evenly spread across different parts of the country. In this policy measure, SERCs determines the obligated entities, which generally includes distribution companies, captive consumers and any open access users. SERCs decide the RPO by taking into account the availability of resources and its impact on electricity tariffs, and then these SERCs fix a certain proportion of electricity consumption, as shown in Table

From the table, on one hand High availability of hydro and wind in the states of Himachal Pradesh, Uttarakhand and Tamil Nadu encouraged non – RPO standards for over 10% on the other hand due to low RE potential in states of Haryana, Goa, West Bengal, Jharkhand, Meghalaya, Punjab, and Tripura have RPO standard less than 5%.

The solar RPO varies from 0.02% to 1% for different states. Due to relatively higher production cost of solar electricity states have kept it low. For example, Gujarat has declared tariff Rs. 13/kWh and Rs. 3.57/ kW h for solar and wind electricity, respectively. Most of the states have declared very short-term commitment towards RPOs either due to weak financial condition of their distribution companies.

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State	RPO (%)					
	2010– 2011	2011– 2012	2012– 2013	2013– 2014	2014– 2015	2015– 2016
Andhra Pradesh ^a	5.00	5.00	5.00	5.00	5.00	5.00
Assam	1.40	2.80	4.20	5.60	7.00	
Bihar	1.50	2.50	4.00	4.50	5.00	
Chhattisgarh	5.00	5.25	5.75			
Delhi ^a	2.00	3.40	4.80	6.20	7.60	9.00
Gujarat	5.00	6.00	7.00			
Haryana	1.50	2.00	3.00			
Himachal Pradesh	10.01	10.01	10.25	10.25	10.25	10.25
Jammu & Kashmir	1.00	3.00	5.00			
Goa & UT	1.00	2.00	3.00			
Jharkhand	2.00	2.50	3.10			
Karnataka	0.25	0.25	7.25	7.25	7.25	7.25
Kerala	5.25	5.25	5.25	5.25	5.25	5.25
Madhya Pradesh	0.80	2.50	4.00	5.50	7.00	
Maharashtra	6.00	7.00	8.00	9.00	9.00	9.00
Manipur	2.00	3.00	5.00			
Meghalaya	0.50	0.75	1.00			
Mizoram	5.00	6.00	7.00			
Nagaland	6.00	7.00	8.00			
Orissa	5.00	5.00	5.50	6.00	6.50	7.00
Punjab	2.40	2.86	3.44	3.94	4.00	
Rajasthan	8.50	9.50	7.10	8.20		
Tamil Nadu	10.15	9.05				
Tripura	1.00	1.00	2.00			
Uttar Pradesh	4.00	5.00	6.00			
Uttarakhand	10.00	11.00				
West Bengal	2.00	3.00	4.00			

Table 2: non solar RPO targets

Source specific RPOs for different states.

State	Source	RPO (%)							
		2010– 2011	2011– 2012	2012– 2013	2013– 2014	2014– 2015	2015– 2016	2016– 2017	
Bihar	Solar	0.25	0.25	0.25	0.50	0.75	1.00	1.25	
Chhattisgarh	Biomass	3.75	3.75	3.75					
	Solar	0.25	0.25	0.50					
Delhi	Solar		0.1	0.15	0.20	0.25	0.30	0.35	
Gujarat	Solar	0.25	0.50	1.00					
Jammu & Kashmir	Solar	0.02	0.10	0.25					
Karnataka	Solar	0.25							
Kerala	Solar	0.25	0.25	0.25	0.25	0.25	0.25	0.25	
Madhya Pradesh	Solar		0.40	0.60	0.80	1.00			
Maharashtra	Solar	0.25	0.25	0.25	0.50	0.50	0.50		
Rajasthan	Solar		0.50	0.75	1.00				
Uttar Pradesh	Solar	0.25	0.50	1.00					
West Bengal	Solar				0.25	0.30	0.40	0.50	

Table 3: Solar RPO targets,

Source: www.mnre.gov.in

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1.1.2 Projects registered under Renewable Energy Certificates scheme

The table given below presents top 5 states for renewable energy registration and accreditation up to February 2014. Tamilnadu tops for registration and accreditation, most of the projects are from wind projects. Tamilnadu is followed by Maharashtra.

	Registered (MW)	Accredited (MW)
Gujarat	368.5	426.4
Maharashtra	890.51	994.99
Tamil Nadu	1055.71	1035.26
Uttar Pradesh	678.13	682.13
Andhra Pradesh	160.55	149.55
Rajasthan	300.12	300.12
Others	666.83	831.07

Table 4: Registered and Accredited capacity of top 6 states

Fig 1, detailed analysis of state wise registered renewable energy projects shows that wind projects are majorly concentrated in Gujarat, Maharashtra, Tamilnadu only, whereas biomass, bio fuels projects are from Uttar Pradesh and Chhattisgarh.

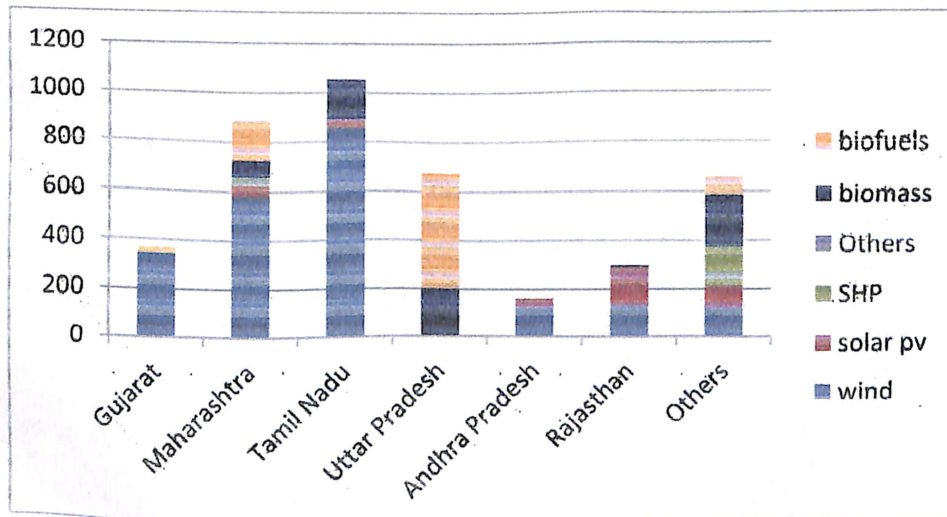


Figure 1: State wise registered capacity (MW) of Renewable

Source: www.recregistryindia.nic.in

Energy Certificates: RECs & PAT Mechanism Analysis

The following graph presents that, about 90% of the new RE projects in over 5 states. Renewable Energy Certificate scheme allows accreditation up to 6 months in advance of the state and registration up to 3 months with a load Dispatch Centre (NLDC) before the anticipated date of commissioning. We can conclude that these states will be major driver for renewable energy in India.

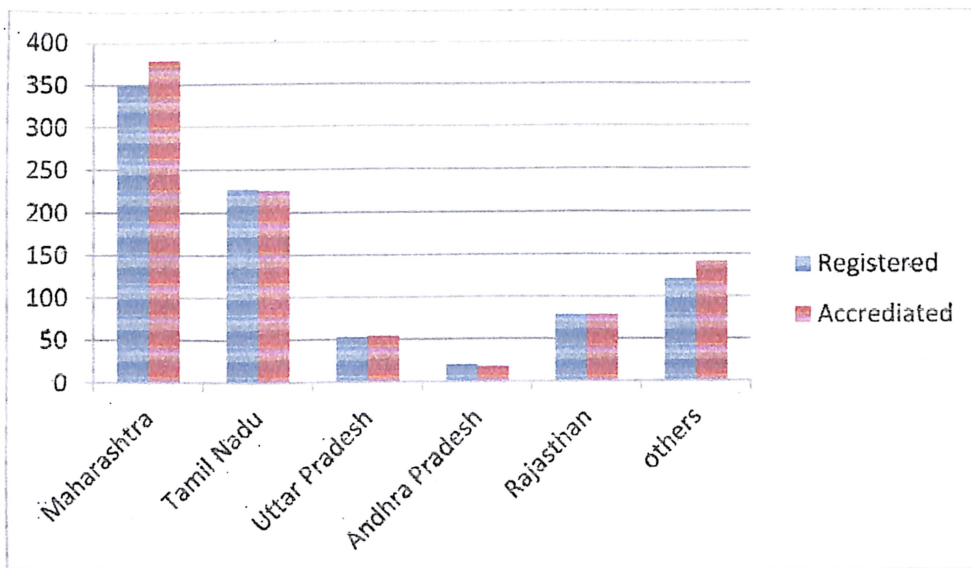


Figure 2 Projects registered under renewable energy schemes

Sources: www.recregistryindia.nic.in

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1.2 Conceptual framework for Renewable Energy Certificates

The cost of electricity generation from RE sources is classified as cost of electricity generation equivalent to conventional energy sources and the cost for green attributes. As shown in Fig 3 the RE generators will have two options

- 1) Sell the RE at preferential tariff fixed by the concerned SERC
- 2) Sell the electricity generated and environmental attributes associated with RE generation separately.

The environmental attributes can then be exchanged in the form of RECs. The RE generator may sell the electricity component to the distribution company and REC component separately to the OE in or outside the state.

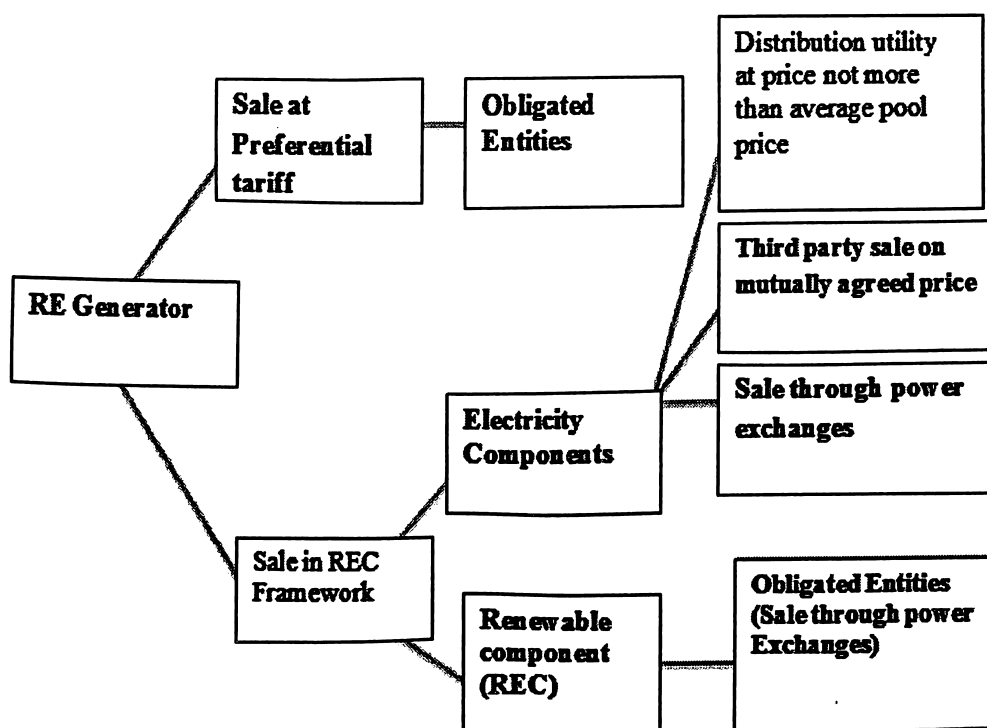


Figure 3: Framework for Renewable Energy Certificates

Source: Central Electricity Regulatory Commission.

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Eligibility:

- 1) Grid connected RE Technologies with minimum capacity of 250 kW and approved by Ministry of New and Renewable Energy (MNRE).
- 2) RE generators with existing Power Purchase Agreements (PPAs) and RE sale at preferential tariff are not eligible for REC mechanism.
- 3) All REC based captive power produces shall be eligible for their entire energy generation including self-consumption.
- 4) Any other licensee or an open access consumer at a mutually agreed price or through power exchange at a market determined price.

1.2.1 Operational Framework for Renewable Energy Certificates

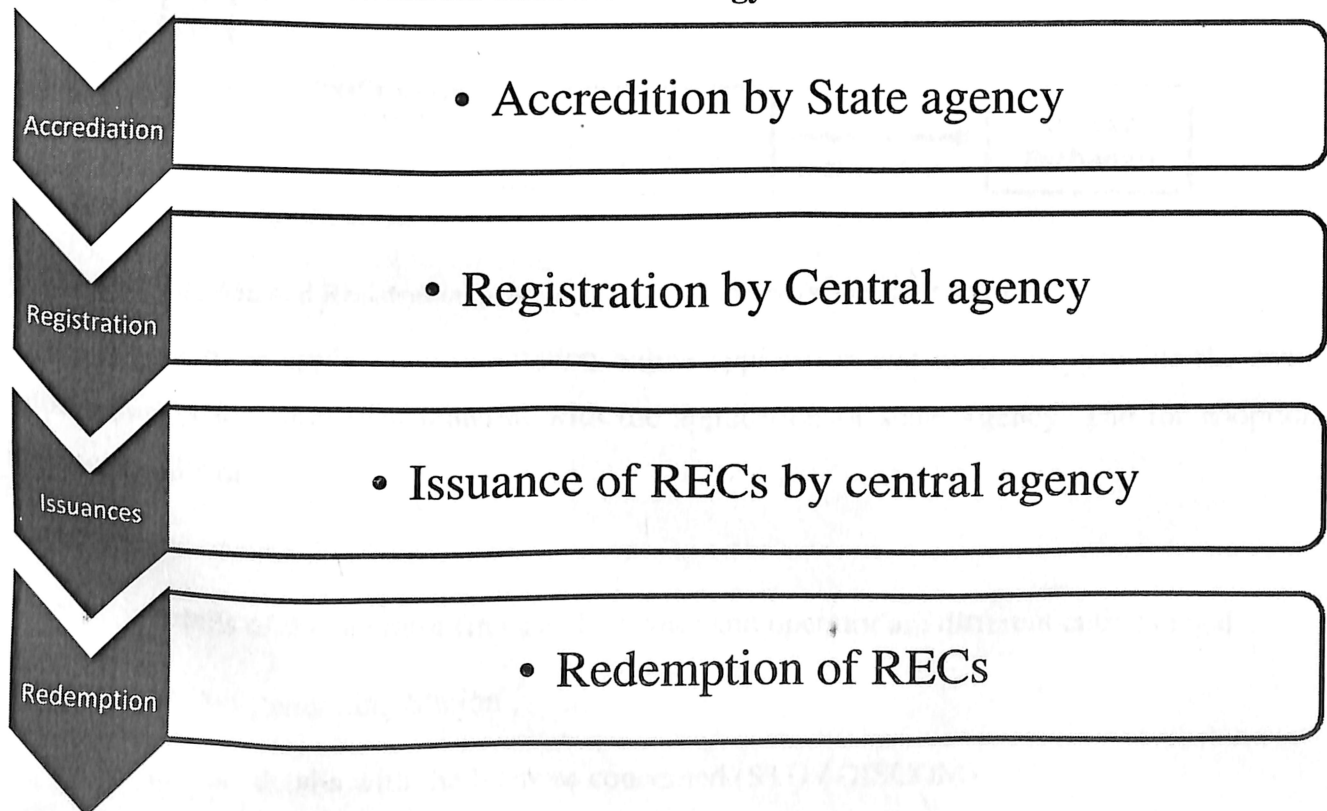


Figure 4: Operational Framework Source: www.recregistryindia.nic.in

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Operational frame work list outs four major steps that has to be followed by project developers. First step, Accreditation, where project developer approach to state agency to get it accredited, and it is granted by state agency, e.g. for Maharashtra state agency is MEDA. Second step is registration, upon approval from by state agency, project developer approach central agency for registration. Third step is issuance of RECs by central agency, where upon successful registration of project of REC, central agency issues REC credit to project developers, these credits are confirmed by third party. Fourth step is redemption of RECs; RECs can be redeemed through power exchanges.

1.2.1.1 Accreditation and Registration process for Renewable Energy Certificates

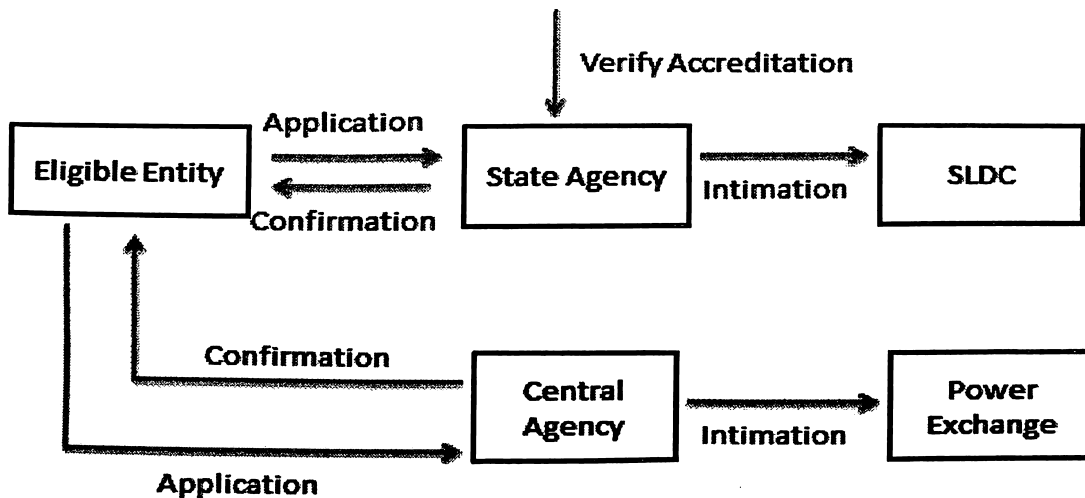


Figure 5: Accreditation and Registration process

Source: www.recregistryindia.nic.in

The applicant must apply for accreditation online application and must also provide the same information in the form of a material with the application of state Agency. The for adoption includes details of

- the owners ,
- details of the operator (in case the owner and operator are different entities legal
- Details generating Station ,
- contact details with the licensee concerned (STU / DISCOM),
- Details of measurement, Legal details clearance.

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Should the government agency set the number of recognition unique to each applicant's request for the adoption of the draft renewable energy generation have, for any future correspondence.

The state should do the audit agency for the initial application within 5 working days from the date of receipt of the application. After an initial audit, the government agency must intimate in writing to the applicant to provide any additional information, if necessary, for further consideration of the application for accreditation or reject the request.

When considering any application for adoption of the draft to generate renewable energy, the government agency must verify and ensure the availability of the following information:

Pledged to availability of land in the possession of the power plant to create, So the message of power evacuation arrangement of the host country to help transfer or distribution licensee concerned, as the case may be Confirmation for the order of measurement and measurement site The date of commissioning of the project's RE project re- qualify existing or proposed date of commissioning for the adoption of the new RE Pledge on Purchase Agreement Off-take/Power

It's the government agency , after inspection developed by assets / Terms of verification in granted " certification " for the applicant concerned to project generation RE proposed and customize the code number of the project -specific in this regard , which should be used by the applicant that (qualified entities) for all future correspondence with the state agency . Usually completed the accreditation process within 30 days from the date of receipt of complete information by the government agency

The applicant must submit an application for registration in building a Web application and must also provide the same information in the form of a material with the Central Agency. Must include the application for registration the following information as presented for the adoption of a construction project RE:

- (a) Details of the owner,
- (b) Details of renewable energy generation plant,
- (c) Certification by the state agency
- (d) Generating facility commissioning schedule.

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Must be attached to the application made to register the company with the generation of RE Central also eligible entity by a non-refundable registration fee / annual fees and charges / fees. The Central a preliminary examination to ensure the completeness of the application form in all respect along with necessary documents and registration fees applicable and agency charges. The Central, and after inspection by asset / verification of the terms and conditions set in, granted a certificate of registration for the applicant on entity eligible asserting the right to obtain renewable energy certificates for the construction project RE proposed and set a certain number code entity wise and project wise for this purpose, which are used by the applicant that for all future correspondence with the Central. The Central also registered intimate eligible entity for a certain project to generate renewable energy for the following entities Host State Agency State load dispatch center.

1.2.1.2 Issuance of Renewable Energy Certificates Procedure

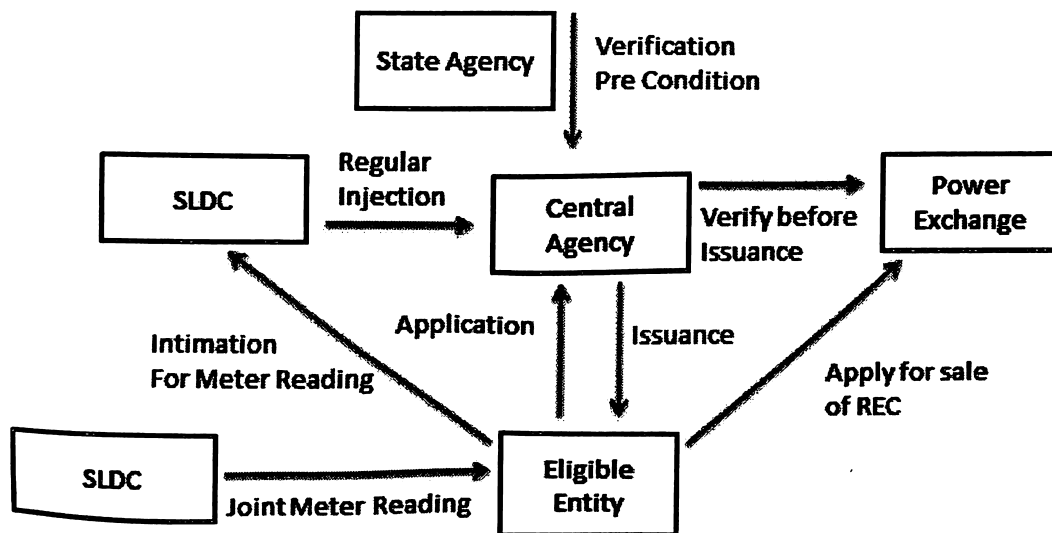


Figure 6: Issuance of Renewable Energy Certificates Procedure

Source: www.recregistryindia.nic.in

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Fig 6, Unit on web based application shall apply for the issuance of renewable energy certificates in physical form and submit the same information to the central agency. Application for issue of certificate certified by the concerned State

- Energy Injection Report
- The registration certificate shall be in the prescribed form and shall include Load Dispatch Centre

The application shall be accompanied by the applicable fees and charges. After confirming the central agency renewable energy certificate shall be issued to the eligible unit, SLDC with the report submitted by the energy injection, the claims made by the eligible entity. Applications received by the State Load Dispatch Centre steady energy injection from the central agency reports attached by the eligible unit with energy injection in the case of any discrepancy in the report

1.3 Power Trading:

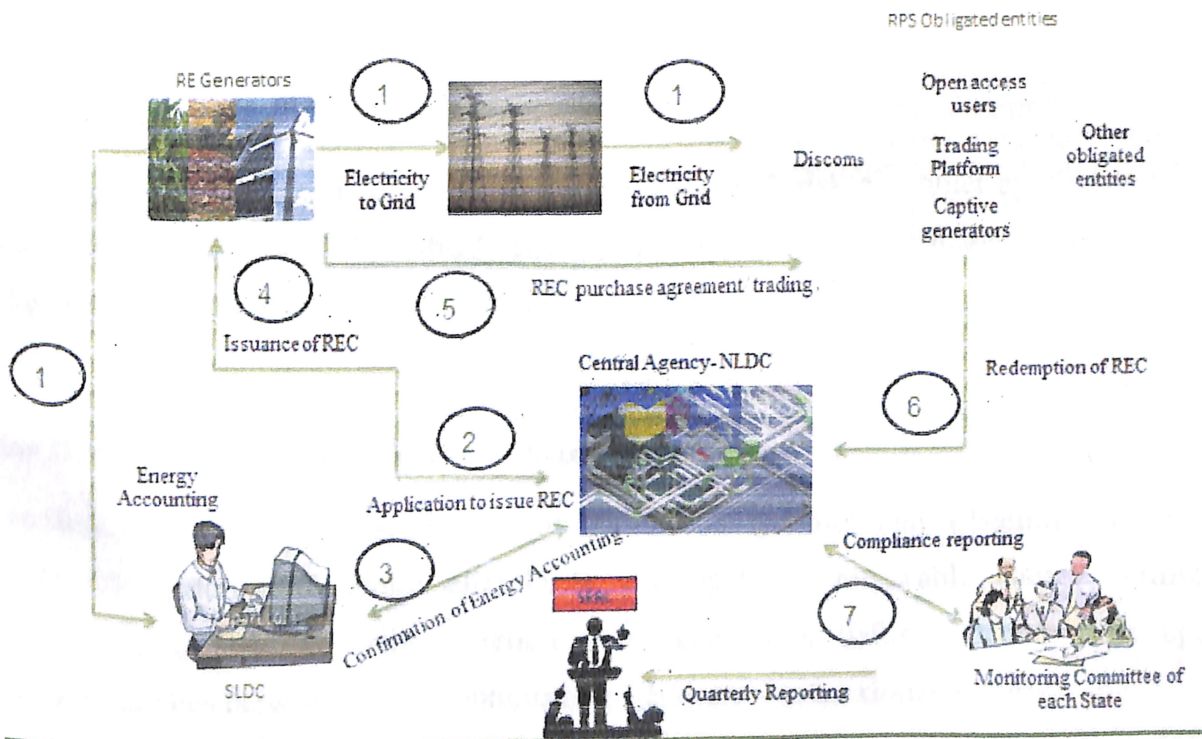


Figure 7: Power Trading .

Source: Gensol Consultants Pvt. Ltd

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1.4 Options to sale RE electricity

After introduction of REC prices companies have options to sale renewable energy electricity, so as to maximize returns. However, each option has its own advantages and disadvantages.

Options A: sale to DISCOM at Preferential Tariffs

Power Purchase Agreement (PPA) is a basic option that assures guaranteed returns on investments (ROI) over a longer period of time.

Option B: Sale to DISCOM at Average Power Purchase Cost

Sale of power to DISCOM at average power purchase cost (APPC) can assure guaranteed return. But tariff is low when compared to preferential tariff. This gap is compensated by additional revenues from renewable energy certificates. Under this provision generators get tradable certificates and make money. This is APPC+REC model.

Option C: Third Party Sale/ Open Access

Third party sale involves higher risk as this involves high risk and other applicable charges, such as wheeling charges. Cross subsidy charges also applicable. Advantages are that that tariff may be higher and generator is allowed to avail renewable energy certificates.

Option D: Captive and group captive consumption

RE generations is used for captive consumptions and (promotional wheeling charges and banking). RE generator becomes eligible to participate in renewable energy certificates mechanism. A detailed analysis is required by generators before selecting this option. Comparative studies between various options help generators to maximize returns.

Energy Certificates: RECs & PAT Mechanism Analysis

2. Perform Achieve & Trade (PAT)

India's Energy security is highly dependent on import of hydrocarbons and the challenges of sustainable coal mining, large hydro projects and social issues have prompted to reduce energy intensity without jeopardizing development.

Energy conservation and energy efficiency have offered the best opportunities to reduce import dependence. India is growing faster than developed countries, if Indian economy grows by 9% on an average from now on to 2025, more than 70 % of all assets created will be new, whereas in the developed world more than 70% assets will be stranded and about 10 - 19% assets will be replaced.

The Energy Conservation Act 2001 came into effect to have effective monitoring and verification of the energy intensity trends. The act is a manifestation of India's commitment to a planned initiative to reduce energy consumption, examples, labeling of energy appliances mandatory energy audits in industry sectors. Energy audits are used to identify measures to reduce energy consumption by improved standard practices, technology up gradation.

In June 2008, the Indian government declared National Action Plan on Climate Change, which listed eight core missions. One of the eight is the National Mission on Enhanced Energy Efficiency, aimed at reducing emissions and energy intensity through efficiency. India will follow protocol, monitoring, reporting and verification (MRV).

Energy Certificates: RECs & PAT Mechanism Analysis

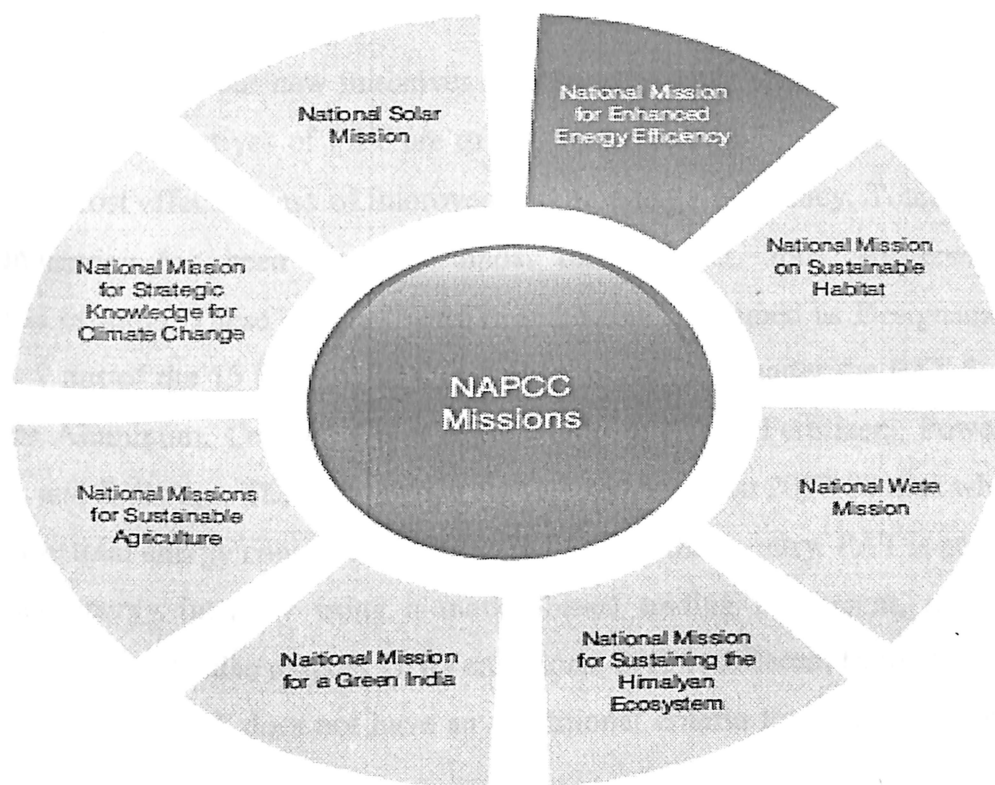


Figure 8: NAPCC Missions

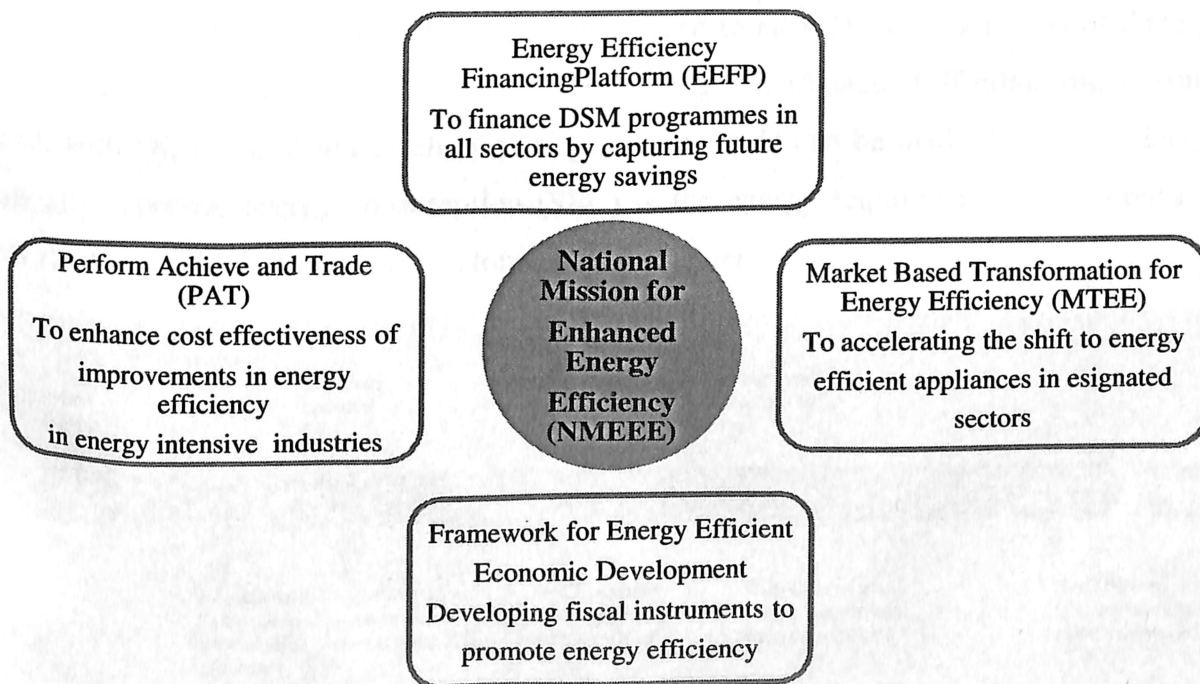


Figure 9: Initiatives under NMEEE.

Source: National Action Plan for Climate Change

Energy Certificates: RECs & PAT Mechanism Analysis

2.1 The National Mission for Enhanced Energy Efficiency (NMEEE)

NMEEE has considered four new initiatives to enhance energy efficiency in India, along with other schemes. The objectives of PAT are to trade certificates of energy savings that could be earned through cost effectiveness of improvements in energy efficiency. Total 15 large Energy Intensive Industries has been identified under the EC Act, 2001, for energy efficiency improvements in India. These energy intensive industries are named as Designated Consumers (DCs). Only 9 out of the 15 Designated Consumers are covered under the PAT Scheme. These industries are Aluminum, Cement, Chlor-Alkali, Pulp & Paper, Fertilizers, Power Generation Plants, Steel, and Railways. These industries are selected based on 2007-08 data which estimates that 54% of the total energy consumed by these industry in the country. PAT is an experiment to reduce India's energy intensity using a market-based trading instrument, namely, ESCerts. Reduced energy intensity also reduces GHG emissions. PAT is different from clean development mechanism (CDM) as PAT does not have any additional criteria for getting the benefits and is not a carbon-trading platform.

2.2 Working of PAT

Specific Energy Consumption (SEC) targets are given to each DC over a period of three years. The saving in consumption will earn Energy Saving Certificates (ESCerts), which could be traded, with DC's who could be short of targets. This trade can be made through exchanges or bilaterally. Specific energy consumption (SEC) is the energy required in metric tonnes of oil equivalent to produce one unit or one tonne of the product

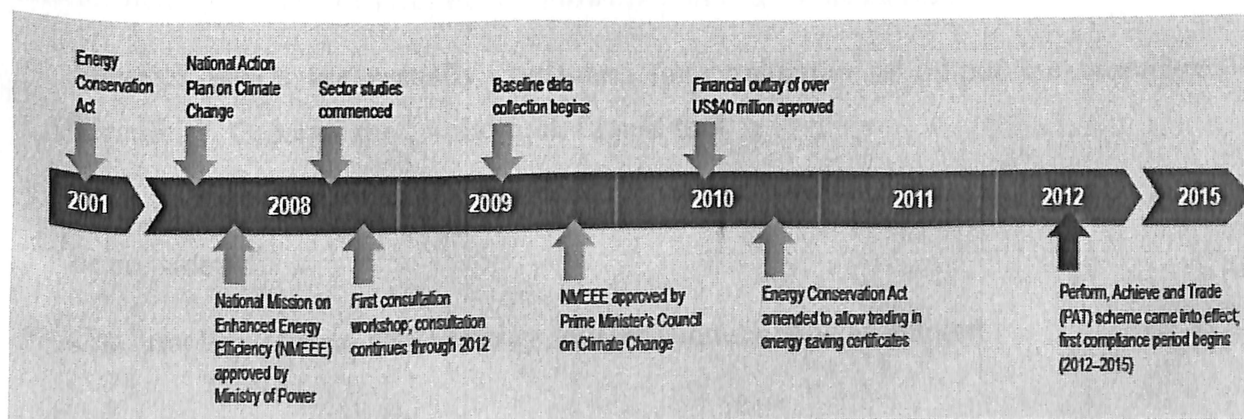


Figure 10: Timeline for India's PAT

Source: India PAT inside story.pdf

Energy Certificates: RECs & PAT Mechanism Analysis

Sector	Minimum annual energy consumption for the DC (tonnes of oil equivalent)	No. of probable DCs
Aluminium	7500	11
Cement	30000	83
Chlor-alkali	12000	20
Fertilizer	30000	23
Iron and steel	30000	101
Pulp and paper	30000	51
Railways (diesel loco sheds and workshops)		8
Textiles	3000	128
Thermal power plants	30000	146

Table 5: Minimum annual energy consumption and estimated number of Designated Consumers (DCs)

2.3 Establishment of Baseline SEC

1. Calculation of specific energy consumption of any industry.

Gate-to-Gate concept is used to calculate SEC of an industry.

$SEC = \text{Total energy input to the plant boundary} / \text{Quantity of the Product.}$

For calculation purpose all energy sources converted to MTOE (metric ton of oil equivalent).

While calculating energy consumptions following points are considered.

- Energies which are actually consumed for production of output are considered e.g. Electricity, Gaseous fuel, Solid fuel, Liquid fuel
- Energy consumed in premises and for transportation system (inside or outside) should not be considered.
- Consumption of renewable energy sources should not be accounted.

Energy Certificates: RECs & PAT Mechanism Analysis

2.3.1 Plant Areas:

The plant area is where total energy input and product output will be fully captured. It does not include transportation system and residential complex. In case of mining operations Cement, iron, Aluminum sector are not included in plant boundary. Once the plant boundary has been fixed it should be considered for entire PAT cycle. Ideally, plant boundary should not change during the entire cycle.

2.3.2 Baseline SEC and Base Year

1. It is mandatory under the EC Act, 2001 to all DCs to submit the details of production and annual energy consumption since 2005-6 to 2009-10.
2. Sector specific information is to be collected e.g. process technology, process flow, raw material.
3. Reported SEC will be normalized.

Normalized SEC = f (Reported SEC, Normalization factors)

4. The base line SEC will be estimated by taking the average normalized SEC of last 3 years i.e. 2007-8, 2008-9, and 2009-10.
5. The base year may be defined as 2009-10.

2.3.3 Target Setting

The target will be defined in the 'percentage' form. It is the percentage reduction of SEC from baseline value to that of target year. The target-setting of a plant is done based on statistical analysis of the 5-year annual data collected by BEE, and the actual energy saving potential of the plant. Also, like in any other sector, the wide variations in energy consumption among plants will have to be accounted for while setting targets.

Energy Certificates: RECs & PAT Mechanism Analysis

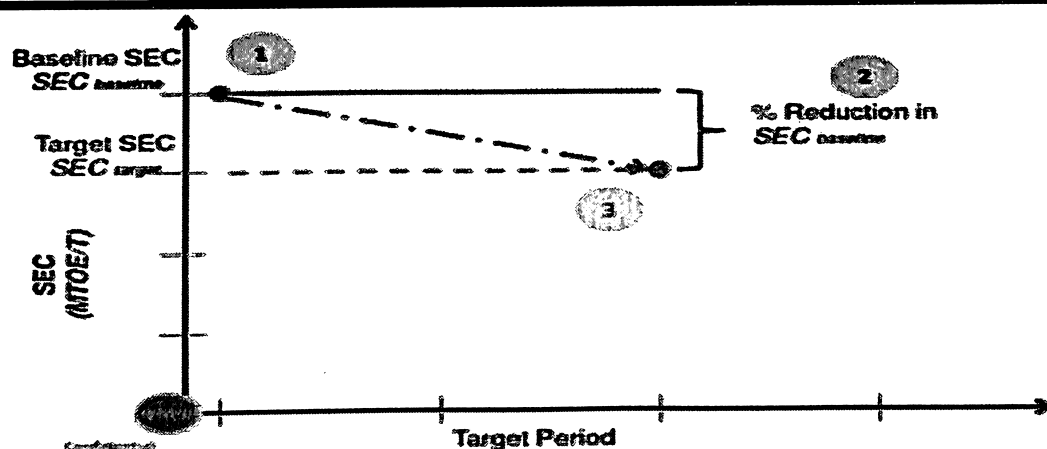


Figure 11: Target setting

2.4 Effect of PAT

According to study conducted by Government of India, this entire scheme could be amounted is more than 600 Billion Indian Rupees or approximately more than 15 Billion US Dollars and will lead to around 100 million tons of GHG mitigation. The role of BEE is to set up the framework for the scheme and role of Energy Efficiency Services Limited (EESL) to look after as an implementation and monitoring agency for the entire scheme.

2.5 Time Period of PAT

Three years, April 2011 to March 2014 will be first target period of PAT. Each target period will be of three years. March 2014 would be end of first target period. Third party auditors will assess DC's performance for reduction of consumption of fuels, and will submit their verification reports to EESL. Verification and allotment of the first target period would be completed post which the trading will start on exchanges.

Target Setting Phase:	March 2011
Target Achieve Phase:	April 2011 to March 2014
M&V Phase:	April 2012 and beyond
Trading Phase:	After M&V Phase

Energy Certificates: RECs & PAT Mechanism Analysis

3. Literature Review

Renewable energy certificate mechanism in India: A preliminary assessment: by Mr. Sandeep Kumar Gupta

In this paper a preliminary attempt has been made to assess the performance of existing REC mechanism in India. After highlighting the salient features of the Indian renewable energy policy framework a brief description of renewable purchase obligation (RPO) and source specific RPOs for different states is discussed along with an overview of REC market in India to date.

Renewable energy certificate markets in India—A review: by Mr. Gireesh Shrimali

This paper critically examine the design and implementation of the REC market in India as well as its effectiveness in meeting the desired objectives in the context of international best practices. Paper analyses REC market best practices that reveled, though forward markets, banking and price bounds are recommended for stable markets, best-of-class methods for determining the optimal length of banking, the level of floor and forbearance prices.

Energy certificates REC and PAT sustenance to energy model for India : by Mr. Rajesh Kumar

This paper reviews the design of an energy model at a specific location, with the consideration of solar, wind and ground sources for renewable energy and fossil fuel, to gain optimum performances in energy certificate scenario. The key design issues about boundary and target settings for REC and PAT energy certificates are discussed to review the financial performance of the schemes taking into considerations energy generators, designated consumers and traders in the market.

Renewable Energy Certificates (RECs) in India – A performance analysis and future outlook: by Mr. Kapil Narula

This paper analyses the performance of the REC market for the FY 2011–12. Compare the financial viability for sale of RE by project developers in certain key states, the paper shows that

Energy Certificates: RECs & PAT Mechanism Analysis

REC mechanism is more profitable than entering into a Power Purchase Agreement (PPA) for sale of RE at Preferential Tariff (Feed-in-Tariffs).

Can the Learning's from International Examples Make the 'Perform Achieve and Trade (PAT) Scheme' Perform Better for India: by Mr. Sanjay Dube, Mr. Ritesh Awasthi

This paper presents qualitative analysis of PAT scheme with international experience such as Clean Development Mechanism, Climate Change Levy and Climate Change Agreements, European Union Emission Trading Scheme. This paper analyses PAT design & present recommendations.

Renewable Energy Certificates by Platt

This paper discusses renewable energy certificates (RECs) as an essential tool for tracking and selling environmental attributes associated with renewable energy. It provides an overview of how REC markets operate.

Part one contains a definition of RECs and need of RECs. Part two discusses the different REC products, lists the main buyers and sellers, and describes how trading occurs. Part three discuss the forces behind supply and demand and the attendant impact on prices. Part four provides the link between the concepts outlined in the paper with actual REC markets.

Falling Short: An Evaluation of the Indian Renewable Certificate Market by Gireesh Shrimali Sumala Tirumalachetty ISB

This paper analyses the market design and performance of the Indian REC market study whether government will achieve objectives or not? This paper focus light on that though the design of the REC mechanism is adequate, the performance of the market not satisfactory.

Stakeholder Analysis Report on "Perform, Achieve and Trade (PAT)" Scheme of Government of India by Confederation of Indian Industry (CII).

PAT consultation document by Bureau of Energy Efficiency.

Energy Certificates: RECs & PAT Mechanism Analysis

4. Objectives

- Study REC mechanism implemented in India
- Analysis of RECs traded at IEX & PXIL (Analysis of the demand and supply drivers for REC mechanism during period the Jan 2013–Feb 2014)
- Analyze REC trend & Forecast REC prices
- Analysis of trading data, Market Clearing Volumes (MCVs) and Market Clearing Prices (MCPs) on PXIL, IEX to derive trends which are then used for forecasting supply and demand in REC market
- Comparative analysis of REC, GBI and FiT for wind power projects
- Analyze constraints, limitations of PAT schemes

4.1 Research gap

There have been a number of valuable studies on Indian REC mechanism, its design issues about boundary, target setting, financial performance, and financial viability of projects. However, none of these studies provides comparison of Indian REC with those of international RECs & financial performance based on generation based incentives (GBI)

Energy Certificates: RECs & PAT Mechanism Analysis

5. Research Methodology

5.1 Type of research:-

The research to be conducted is a descriptive research using secondary data. Study policies of schemes and analysis or reports published in journals.

5.2 Source of Data:-

Secondary Data:-

The data collected will be secondary data. The task of data collection begins after a research problem has been defined and the research design/plan chalked out.

These are the data which is already been published in journals or research papers or articles, which have already been passed through the statistical process. The secondary data is also collected from IEX, PXIL in order to get the statistical information.

Energy Certificates: RECs & PAT Mechanism Analysis

6. Data Analysis:

6.1 Renewable Energy Certificates, India market Overview

In India, trade in CERs began in March 2011, on the platform of the Indian Energy Exchange (IEX) and Power Exchange of India (PXI). Both exchanges came into existence with the aim of carrying out day-ahead term electricity trade. The activities of the Exchange are regulated by rules of energy markets (2010).

Table 5, the status of development of renewable energy in India from March 2014 Note that the RE capacity registered (3752MW) for the REC Registry of India is only a small fraction (0.635%) of the estimated potential (see: Table 1) until March 2014. This could be the reason for the volatile and inadequate supply of renewable energy certificates. But in the long run, India has enormous potential for the addition of capacity that can lead to large increases in the volume of REC, based on research-Region Wise.

	RE Potential	Capacity Installed	RES Registered
wind	102772	20149.5	2164.1
SHP	25090.41	3763	195
Bio energy	19749	3896.56	1393
solar	500000	2180	366.5
total	647612	29989	4118

Table 6: - Present status of RE development in India (as of March 2014).

Source: - www.recregistryindia.nic.in

	REC prices till 2011		REC prices for 2012-2015	
	Non-solar Solar	solar Solar	Non-solar Solar	solar Solar
Forbearance price	3900	17000	3300	13400
Floor price	1500	12000	1500	9300

Table 7: REC, Non REC prices.

Sources: Power Exchange India Ltd.

Energy Certificates: RECs & PAT Mechanism Analysis

6.2 Renewable Energy Certificates Market Analysis for 2013-14

Dramatic plunge was seen during 2013-14 the capacity of the non- solar project under Renewable Energy Certificates mechanism. Up to March 28, 2014, the total accredited capacity was approximately 4569 MW. The total number of projects registered by the central agency is above 900, it means the ability to stand, recorded in the project to about 4.5 MW / project.

Power Source wise break-up shows that wind technology contributes nearly half of the projects

- Wind power projects accounted for 52.4 % of the total registered capacity.
- Solar PV account for 8.8 % of the total registered capacity
- Accounts for small hydropower 4.9% of the total registered capacity

The decrease of 67% was observed during the third year (2013-14), decrease was up to 43 MW per month for the first two years, the average solar capacity is not added under REC mechanism was 132 MW per month. This means that not only demand but also supply were struck during the year under review. Tamil Nadu under REC across India has been overtaken by Maharashtra and Rajasthan, which added 172 MW and 168 MW, respectively, in 2013-14.

On the other hand , the solar capacity and number of solar projects had significantly increased , the main reasons for this is that the solar industry has been a substantial accelerated depreciation (AD) market supported even if there is high cost and with poor takeoffs.

Energy Certificates: RECs & PAT Mechanism Analysis

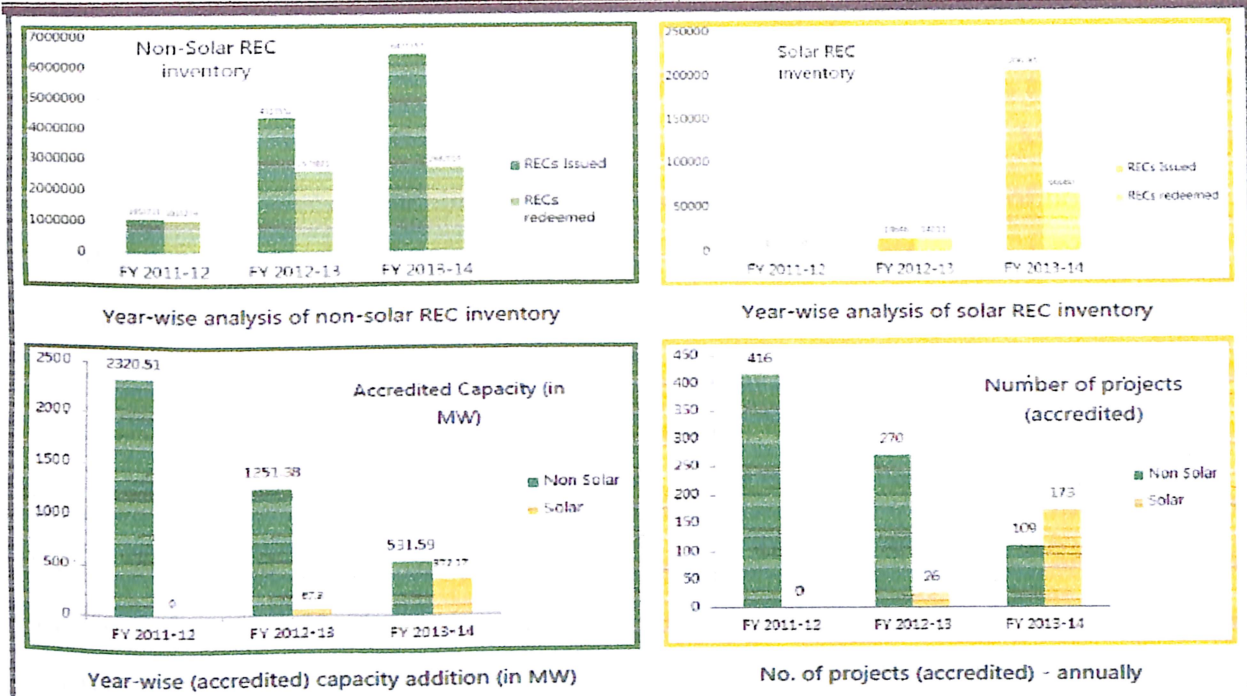


Table 8: solar, non-solar Certificates inventory

Source: www.reconnectenergy.com

REC Issued 2013-14			REC Redeemed 2013-14		
Solar	Non Solar	Total	Solar	Non Solar	Total
153485	5125650	5279135	55078	2418622	2473700

Table 9: REC issued and redeemed during 2013-14

Source: IEX, PXIL sites.

Above table shows that Total REC issued by central agency, during 2013-14 is 5279135 while only 2473700 RECs are redeemed REC, leaving back 2805435 RECs in inventory. The lower demand in market can be attributed to noncompliance of REC from state distribution utilities and inefficient enforcement of REC mechanism. State distribution utilities are less willing to participate in trade can be attributed to poor financial status or inefficient tariff collection from consumers, losses in distribution network.

Energy Certificates: RECs & PAT Mechanism Analysis

6.2.1 Market Analysis (lower Demand / over Supply market)

Fig8, for the period 2013-14 markets did not performed as per expectations as renewable energy certificates were exchanged floor price for one year. REC trading session March 26, 2014, has completed another year of compliance 12 months long. REC market price of non - solar balance remained at floor price (Rs 1,500 per REC) for 12 months, while for solar RECs , trading floor price (Rs. 9300 by CCC) has to be came a trend since the last 9 consecutive months. The total market value of RECs traded during the year was 41.2 % of the total value of the RECs issued at the same time and the total value traded was Rs. 464 cores.

For non - solar quarterly demand 2012-13 compared to 2013-14 was better in the first 2 quarters. While in Q3 and Q4, the demand for FY14 exceeded that of 2012-13. 's Total annual demand for FY13 was close to 3.1 million, more than the total annual demand for 2013-14. In the case of solar RECs in 2013-14, the demand for solar RECs increased by 191 %. Total annual demand for 2013-14 was high compared to 2012-13.

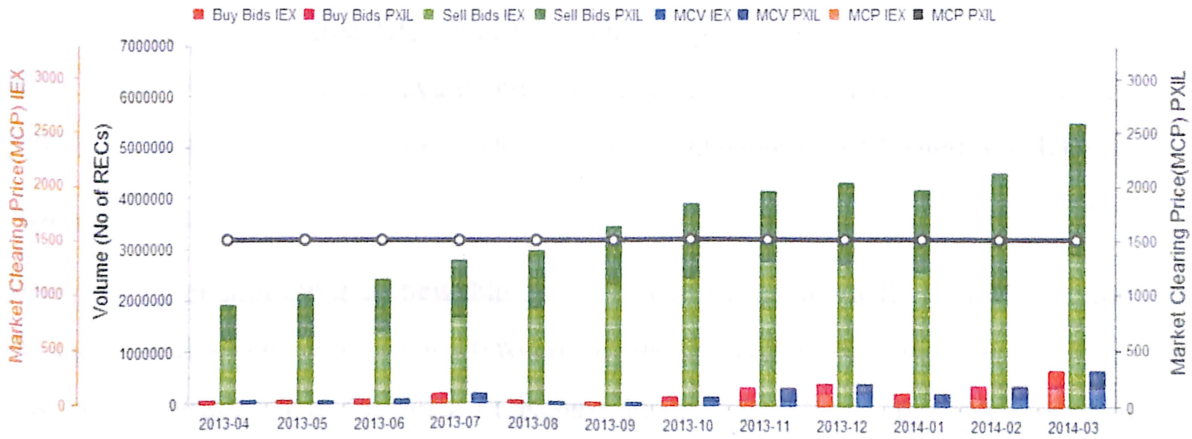


Figure 12: Non-Solar trade statistics—FY 2013-14

Energy Certificates: RECs & PAT Mechanism Analysis

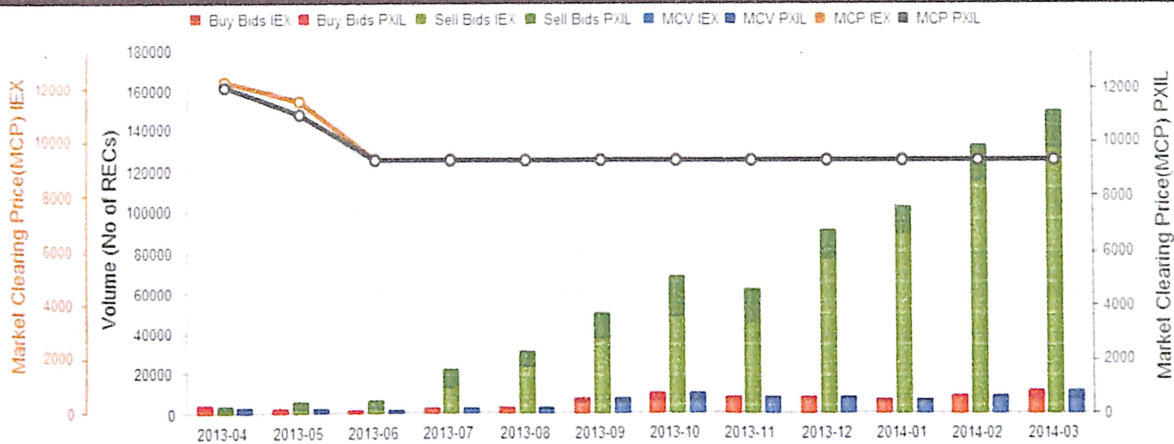


Figure 13: Solar trade statistics - FY 2013-14

Source: open access Reconnect energy

6.2.2 Renewable Energy Certificates mechanism, Performance

Traditionally, for RE policy performance assessment, measures considered like cost of RE, CO2 reduction, industry, innovation RE penetration and employment, etc. in this paper performance of Indian REC mechanism is evaluated by parameters, like RE portfolio diversity, cost competitiveness of promoted RE source, Decentralized Distribution of Generation(DDG)

Cost competitiveness

The objective of encouraging Renewable Energy is to bring down its unit production cost by passing the available RE technologies through different learning phases so as to. So this would result in large investment in the form of Renewable Energy Certificates price or premium for green attributes of electricity. The calculated weighted average prices, Rs. 1784 per MW h and Rs. 1578 per MWh on IEX and PXE, respectively.

Conclusions are drawn based on their performance, considered parameters are coefficient of determination (R2) and weighted average price of Renewable Energy Certificates. Table 9 presents a comparative analysis of REC prices at IEX and PXI. Table 9 shows that the variation Renewable Energy Certificates price cannot be explained by any of the variables considered on an individual basis.

Energy Certificates: RECs & PAT Mechanism Analysis

6.2.3 Comparative analysis of REC prices at IEX and PXIL

	IEX		PXIL	
	Solar	Non solar	Solar	Non solar
	Buy bid and REC price	Buy bid and REC price	Buy bid and REC price	Buy bid and REC price
R²	0.049073741	1	0.415439734	1
Weighted average price	1784.429392		1578.194324	

Table 10 : Comparative analysis of REC prices at IEX and PXIL

Source; IEX & PXIL sites

6.2.4 Comparative analysis of REC and FIT for wind power projects

It is observed that the market does not work well on the basis of cost competitiveness. For example, the table shows the comparative analysis of REC and fit for wind energy based electricity from the investor's viewpoint. For different states, the total cost under REC mechanism is higher than the state-wise preferential tariffs for wind energy based electricity (table), when considered the average of the weighted average prices of REC price. The average price paid was Rs 4.87/kWh RE electricity under the Renewable Energy Certificates scheme while Rs 4.37/kWh under tariff existing FiT. This means that the profit is about Rs 0.5 higher & was poured into the market mechanism of the existing REC but compared to last year Rs. 2.16 profit was earned, those results in to 77% loss, which is lost in to market.

Energy Certificates: RECs & PAT Mechanism Analysis

State	APPC	REC weighted avg. price	GBI	Total under REC	FIT	Profit over preferential tariff
Andhra Pradesh	3.28	1.5	0.5	5.28	4.72	0.56
Gujarat	3.27	1.5	0.5	5.27	4.23	1.04
Karnataka	3.07	1.5	0.5	5.07	3.7	1.37
Kerala	1.80	1.5	0.5	3.80	4.77	-0.96
Maharashtra	3.3	1.5	0.5	5.3	4.65	0.65
Rajasthan	2.75	1.5	0.5	4.75	5.01	-0.26
Tamilnadu	2.63	1.5	0.5	4.63	3.51	1.12
Avg. 2013-14	2.87			4.87	4.37	0.50
Avg. 2011-12	2.56			5.74	3.58	2.16

Table 11: APPC and REC price comparison,

Source: Reconnect Energy

Energy Certificates: RECs & PAT Mechanism Analysis

6.2.5 Comparative analysis of Renewable Energy Certificates prices at IEX and PXIL

It describes the results of t-test and F-test. This statistical test showed that the difference between the average price of REC significant at the 5% significance level, with a correlation coefficient of 0.975. In addition, the difference between the variance is also found to be significant at the 5% significance level.

t-Test: Two-Sample Assuming Equal Variances

	IEX	PXIL
Mean	1920.73	1743.23
	7	7
Variance	84058.1	66442.6
	7	5
Observations	13	13
Pooled Variance	75250.4	
	1	
Hypothesized Difference	Mean	0
df	24	
t Stat	1.64968	
	2	
P(T<=t) one-tail	0.05601	
	8	
t Critical one-tail	1.71088	
	2	
P(T<=t) two-tail	0.11203	
	7	
t Critical two-tail	2.06389	
	9	

F-Test Two-Sample for Variances

	IEX	PXIL
Mean	1920.73	1743.23
	7	7
Variance	84058.1	66442.6
	7	5
Observations	13	13
df	12	12
F	1.26512	
	4	
P(F<=f) one-tail	0.34513	
	5	
F Critical one-tail	2.68663	
	7	

Energy Certificates: RECs & PAT Mechanism Analysis

6.2.6 Portfolio Diversity Index of Renewable Energy

Renewable energy portfolio should be diversified enough to cover the risk of supply variable because of its dependence on climatic conditions. Figure 9 shows the percentage distribution of the different RE sources in the portfolio of installed capacity, ability and potential RE registered estimated. To assess the diversity of these portfolios, this study has developed a portfolio diversity index (PDI), which is based on the following assumptions:

- The contribution of each constituent must be greater than zero
- The most diverse portfolio containing the same proportion of all constituents,
- The number of constituencies should be the same when making any comparison between the portfolio

Portfolio Diversity Index (PDI) can be calculated as followed considering above assumptions,

$$PDI_k = \frac{P_1 \times P_2 \times P_3 \times \dots \times P_n}{(1/n)^n} = \frac{\prod_{i=1}^n P_i}{(1/n)^n}$$

where P_i represents the proportion of i th RE source in a given portfolio ($P_i > 0$), n the number of energy sources and ($n=n_1=n_2=\dots=n_k$) and k the number of portfolios compared with each other.

Range of PDI may vary in 0 to 1 only.

Energy Certificates: RECs & PAT Mechanism Analysis

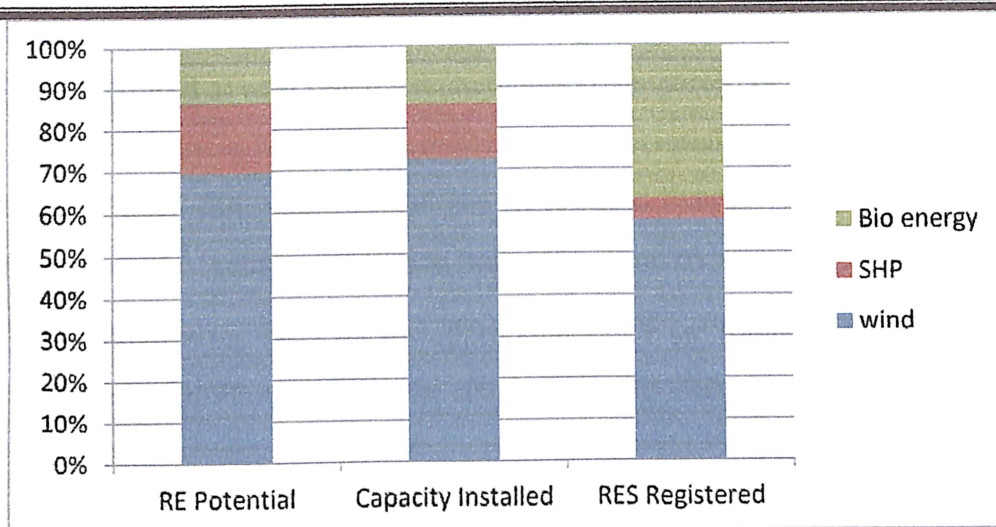


Figure 14: Source wise distribution of renewable energy.

Source: REC Registry India.

	RE Potential	Capacity Installed	RES Registered
wind	102772	20150	2164
SHP	25090.41	3763	195
Bio energy	19749	3897	1393
total	147612	27809	3752

Table 12: Renewable energy potential, RES registered.

Source: Ministry of New & Renewable Energy, India

	RE Potential PDI	Capacity Installed PDI	RES Registered PDI
Year 2013-14	0.428	0.371	0.300
Year 2011-12	0.702	0.393	0.301

Table 13: comparison of Portfolio Diversity Index with previous last year

Energy Certificates: RECs & PAT Mechanism Analysis

PDI for RE potential has been decreased significantly, whereas Capacity Installed PDI, RES Registered PDI almost remained unchanged over period of one year. During year 2013 there were major differences among renewable energy potential and renewable energy installed or registered portfolios. The main reasons are Renewable Energy Certificates trading platform design, and the renewable energy promotion policy designed by states.

Year 2014, the difference has been narrowed, though RECs are traded at floor price for one year it could be attributed to promotion policy of states for preferential tariff, generic tariff etc.

6.3 Analysis of PAT design

Successful implementation and operation of the scheme is mainly dependent on the design phase of a cap and trade scheme. Based on the implementation and operation experience, changes will be carried out over period of time. A better design of PAT would avoid major modifications ensuring continuity in the scheme.

Three areas namely, Area setting, target setting and market mechanism are considered for better design of cap and trade. These three areas are again analyzed on three parameters namely industry, units, activity.

Areas:

It should have clearly defined about Areas

Industry – Designated Sectors that are considered under the scheme

Out of 15, only 9 sectors covered under PAT for energy intensive sectors identified in The EC Act 2001. There is no justification given for exclusion of sectors like chemicals, sugar, transport, petrochemicals and inclusion of sectors like chlor alkali and textile.

Individual Unit. - Individual units that are considered under the scheme

Scheme has defined threshold energy consumption for units to be included under the scheme.

Energy Certificates: RECs & PAT Mechanism Analysis

Business Activity - Activities at individual units covered under the scheme

PAT's has not defined properly 'gate to gate' boundary definition, results in too much confusion for interpretation. The 'gate to gate' definition of boundary may lead to several complications.

Target:

It should have clear target for well-designed cap and trade.

Industry - Total energy to be saved in a given time under this scheme

There was no detailed study is carried out to determine energy savings through this schemes.

Sector – Amount of energy saving to be realized in given time in a particular sector.

The total energy savings to be saved is summation of distributed energy savings across each sector. But there is no detailed study is carried out to determine energy savings across sectors under these schemes.

Unit - Energy saving to be realized at each individual unit in a given time, so that it helps to contributes in meeting industry energy saving target.

PAT has used cluster approach for energy savings across industry, but lacks on boundary issues for units.

Energy Certificates: RECs & PAT Mechanism Analysis

Market:

The successful implementation of cap and trade mechanism and market participation targets should not be too easy or too difficult to achieve. Other options like credit auction or minimum guarantee price (both roof and floor) to be considered to enhance faith in the market.

1. There is no any study conducted regarding price variability of ESCerts based on the targets being set. If the targets are too easy then market may collapse, & if they are too difficult they would result in default.
2. The penalties defined in the EC Act 2001 should not deter DCs from noncompliance. BEE is in the process to develop a structure for imposing financial penalties.
3. PAT scheme does not define any floor or ceiling price for Energy Saving Certificates.

Energy Certificates: RECs & PAT Mechanism Analysis

7. Recommendations (RECs Mechanism)

- Appropriate actions to be taken to remove market distortion.
 - Increase number of players i.e. number of buyers and number of players
 - Increase liquidity
 - Improve market structure by regulator
- Compliance of Renewable Energy Obligation by obligated entities, mainly by Discoms.
- Penalty to be levied for noncompliance of Renewable Purchase Obligation.
- Penalty levied should be Renewable Energy Certificates ceiling prices.

Energy Certificates: RECs & PAT Mechanism Analysis

8. Recommendations (PAT Mechanism)

1. A second structural Tier

In UK the Climate Change Agreements (CCAs) have been successfully implemented two-tier structure. Two tier structures has wide spread involvement of sector & trade association for the purpose of target setting and base lining. Example, in Climate Change Agreements (CCAs) there is a sector-level agreement between the Department of Energy and Climate Change, UK (DECC, UK) and the sector/trade associations.

2. Setting of Boundaries

Instead of geographical constraints i.e. gate to gate definition, BEE should consider activity based definition that are carried inside or outside the organization.

3. Unit Group

Different units located at different location but under control of same individual or organization should be grouped and combine SEC is to be given for all units. It helps organization due to greater flexibility. Reduce fixed cost (administrative cost) of operations for SEC i.e. registry verifier etc. Grouping will help in reduction of dispute resolution to single organization instead of multiple units under consideration.

4. Setting of Targets

Study for the energy saving potential to be conducted across each sectors, units and geographical locations. The approach should be top to bottom or bottom to top so that differentiated saving potentials to be realized.

5. Price Determination

Study is to be carried out to determine the price range for ESCerts based on market forces, the possible available supply and demand. Study is too conducted to find out floor or forbearance price. The penalty charges should be high enough so as to discourage participants from non-compliance. The current penalty levied by BEE does not deter participants and penalty should be revised time to time.

Energy Certificates: RECs & PAT Mechanism Analysis

9. Conclusion

Renewable Energy Trading in last year has been discouraging, it has been traded at floor price, it was not performing as per industry expectations and it signals that confidence level in REC mechanism is shaken. In order to make market work, there is urgent need of regulatory intervention, from central and state level regulators. Due to oversupply, it is sellers' market. This study shows that installed capacity portfolio and registered capacity portfolio are well diverse when compared to renewable energy potential portfolio and diversification has been improved compared to previous year. This has been concluded based on the values of portfolio diversity index which are 0.702, 0.392, and 0.301 for renewable energy potential, installed and registered portfolio, respectively. It is difficult to forecast REC prices in short term till regulatory intervention. Due to its poor performance it indicates it is still immature market in India, it has long way to go.

The PAT mechanism has potential to increase energy efficiency in designated consumers. There is need of detailed study to bridge loop holes. PAT mechanism may be hindered by lack of availability of funds for industry. Managerial skills/ decisions and technological challenges may be problem for large organizations.

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