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Energy Management in Sugar Industry: Renewable Energy Certificates (REC) – a new perspective with a special reference to South Gujarat.

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ABSTRACT

Energy cost as an input is a significant part of the total production cost of any concern enterprise/unit. As mentioned earlier, if you do several things to keep yourself in line with your energy goals, you may find yourself able to really save money here. Energy costs continue to rise and even if they slowdown in that rise, they are not likely to come down. If you want to cut your bill down, then, you must use less energy. Energy cost can be reduced by Energy Management, Energy Conservation, Co-generation, use of renewable energy, etc.The Agro-based industries like Sugar Factories have significant potential for co-generation. Use of Bagasse the residues of sugarcanes after extract ting its juice] as a fuel for Boilers in Sugar Industry instead of Coal is the renewable source of energy.

Key Words: Bagasse, Energy Conservation, Renewable Energy, Kyoto Protocol.

1. INTRODUCTION:

The objective of the present investigation is to make Energy Management analysis of sugar production Sugar Industries in South Gujarat area and identify the major Energy Savings & other Earning potential in this respect.

Energy cost as an input is a significant part of the total production cost of any concern enterprise/unit. As mentioned earlier, if you do several things to keep yourself in line with your energy goals, you may find yourself able to really save money here. Energy costs continue to rise and even if they slowdown in that rise, they are not likely to come down. If you want to cut your bill down, then, you must use less energy. It is now well known and established fact that the Energy cost can be reduced by Energy Management, Energy Conservation, Co-generation, use of renewable energy, etc.

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The Agro-based industries like Sugar Factories have significant potential for co-generation. Use of Bagasse [the residues of sugarcanes after extract ting its juice] as a fuel for Boilers in Sugar Industry instead of Coal is the renewable source of energy.

2. LITERATURE REVIEW:

[1]It is necessary to explore & adopt all possible energy conservation & energy generation techniques to reduce gross energy required for all Sugar plant operations. The information of different forms of energy need viz., steam, electricity, Bagasse, etc. for sugar manufacturing processes provide base for determining the energy demand of the system as well as it also point out the modes of energy losses. It is observed that much can be done in the area of energy conservation without large investment by minimizing energy losses and optimizing the operation of the system which in turn increases energy use efficiency of the process. This approach requires commitment of all from management to plant operator to avoid wastage and steps to conserve the energy.

[1]Sugar is a highly energy oriented sector and consumes energy in all its forms viz. heat, mechanical and electrical. Steam consumption ranges from 45% to 60% depending upon technologies and the power consumption ranges from 20 units / tonne to 23 units per tonne in non cogen units and 28 units per tons cane to 32 units per tons cane in cogeneration units with electrical drives for mills and fibrizers.

Sugar Industries generates power mostly for their self-consumption, from burning renewable sources like Bagasse due to which the emission of SO2 & NO3 gages into the environment is reduced. Therefore, it is a source of Green Energy & today's global demand of reducing Green House Gases (GHG) responsible for Global Worming as per Global treaty like Kyoto Protocol.

The [2]**Kyoto Protocol** is an international treaty which extends the 1992 United Nations Framework Convention on Climate Change (UNFCCC) that commits State Parties to reduce greenhouse gases (GHG) emissions, based on the premise that (a) global warming exists and (b) man-made Carbon Dioxide (CO2) emissions have caused it. The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997 and entered into force on 16, February 2005. There are currently 192 Parties to the Protocol.The Kyoto Protocol implemented the objective of the UNFCCC to fight global warming by reducing greenhouse gas concentrations in the atmosphere to "a level that would prevent dangerous

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anthropogenic interference with the climate system" (Art. 2). The Protocol is based on the principle of common but differentiated responsibilities: it puts the obligation to reduce current emissions on developed countries on the basis that they are historically responsible for the current levels of greenhouse gases in the atmosphere.

[4]**Bagasse** is the fibrous matter that remains after sugarcane or sorghum stalks are crushed to extract their juice. The dry pulpy residue left after the extraction of juice from sugar cane[5]. It is used as a biofuel and in the manufacture of pulp and building materials.For each 10 tons of sugarcane crushed, a sugar factory produces nearly 3 tons of wet bagasse. Since bagasse is a by-product of the cane sugar industry, the quantity of production in each country is in line with the quantity of sugarcane produced.Many research efforts have explored using bagasse as a renewable power generation source and for the production of bio-based materials.Bagasse is often used as a primary fuel source for sugar mills; when burned in quantity, it produces sufficient heat energy to supply all the needs of a typical sugar mill, with energy to spare. To this end, a secondary use for this waste product is in cogeneration, the use of a fuel source to provide both heat energy, used in the mill, and electricity, which is typically sold on to the consumer electricity grid.

The resulting CO_2 emissions are less than the amount of CO_2 that the sugarcane plant absorbed from the atmosphere during its growing phase, which makes the process of cogeneration greenhouse gas-neutral. In many countries (such as Australia), sugar factories significantly contribute 'green' power to the electricity supply. For example, Florida Crystals Corporation, one of America's largest sugar companies, owns and operates the largest biomass power plant in North America. The 140 MW facility uses bagasse and urban wood waste as fuel to generate enough energy to power its large milling and refining operations as well as supply enough renewable electricity for nearly 60,000 homes. Hawaiian Electric Industries also burns bagasse for cogeneration.

Renewable Purchase Obligation (RPO): In [7]Gujarat Electricity Regulatory Commission (GERC), Procurement of Energy from Renewable Sources regulations (Notification No. 3 of 2010), to promote the energy generation from Renewable Energy Sources, distribution licensees like Dakshin Gujarat Vij Company Limited (DGVCL), Torrent SEC Limited have obligation to purchase certain quantum of power under Renewable Purchase Obligation (RPO) as mentioned below.

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4. Quantum of Renewable Purchase Obligation (RPO)

4.1 Each distribution licensee shall purchase electricity (in kWh) from renewable energy sources, at a defined minimum percentage of the total consumption of its consumers including T&D losses during a year.

Similarly, Captive and Open Access user(s)/consumer(s) shall purchase electricity (in kWh) from renewable energy sources, at a defined minimum percentage of his/her total consumption during a year.

The stipulated minimum percentages as per latest [8]Gujarat Electricity Regulatory Commission (Procurement of energy from renewable sources) (first amendment) regulations, 2014 - Notification: No. 2 of 2014 are given below in the Table 1 below.

Table 1, *Minimum Quantum of purchase for* Renewable Purchase Obligation (RPO)

Year (1)	*Minimum Quantum of purchase (in %) from renewable energy sources (in terms of energy in kWh)*			
	Total (2)	*Wind (3)*	*Solar (4)*	*Biomass, bagasse and others (5)*
2010-11	*5 %*	*4.5 %*	*0.25 %*	*0.25 %*
2011-12	*6 %*	*5.0 %*	*0.50 %*	*0.50 %*
2012-13	*7 %*	*5.5 %*	*1.00 %*	*0.50 %*
2013-14	*7 %*	*5.5 %*	*1.00 %*	*0.50 %*
2014-15	*8 %*	*6.2 %*	*1.25 %*	*0.50 %*
2015-16	*9 %*	*7.00 %*	*1.50 %*	*0.50 %*
2016-17	*10 %*	*7.75 %*	*1.75 %*	*0.50 %*

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[7]Gujarat Electricity Regulatory Commission, under clause 5, have also specified regarding Certificates i.e. Renewable Energy Certificates (RECs) as the valid instruments for the discharge of the mandatory obligations of power distribution licensees as mentioned above.

5. Certificates under the Regulations of the Central Commission

5.1 Subject to the terms and conditions contained in these Regulations, the Certificates issued under the Central Electricity Regulatory Commission's (Terms and Conditions for recognition and issuance of Renewable Energy Certificate for Renewable Energy Generation) Regulations, 2010 shall be the valid instruments for the discharge of the mandatory obligations set out in these Regulations for the obligated entities to purchase electricity from renewable energy sources.

Provided that in the event of the obligated entity fulfilling the renewable purchase obligation by purchase of certificates, the obligation to purchase electricity from generation based on renewable energy other than solar can be fulfilled by purchase of non-solar certificates and the obligation to purchase electricity from generation based on solar as renewable energy source can be fulfilled by purchase of solar certificates only. If solar certificates are not available in a particular year, then in such cases, additional non-solar certificates shall be purchased for fulfillment of the RPO in accordance with Table 1.

Renewable Energy Certificate [9.1]**(REC):** The Electricity Act, 2003, the policies framed under the Act, as also the National Action Plan on Climate Change (NAPCC) provide for a roadmap for increasing the share of renewable in the total generation capacity in the country. However, Renewable Energy (RE) sources are not evenly spread across different parts of the country.

On the other hand there are States (like Rajasthan and Tamil Nadu) where there is very high potential of RE sources. In such States there are avenues for harnessing the RE potential beyond the RPO level fixed by the SERCs. However, the high cost of generation from RE sources discourages the local distribution licensees from purchasing RE generation beyond the RPO level mandated by the State Commission. The Electricity Act, 2003, the policies framed under the Act, as also the National Action Plan on Climate

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

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

Central Electricity Regulatory Commission (CERC) has notified Regulation on Renewable Energy Certificate (REC) in fulfillment of its mandate to promote renewable sources of energy and development of market in electricity. The framework of REC is expected to give push to RE capacity addition in the country.

In view of the above, it is clear that Renewable Energy Certificates (RECs) represent the green attributes of electricity generated from Renewable Energy Sources. These attributes are unbundled from the physical electricity and the two products – (1) the green attribute embodied in the certificates & (2) the commodity electricity – may be sold or traded separately. In other words, one REC represents that 1MWh of energy is generated from renewable sources. REC 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. RECs can be used by the obligated entities to demonstrate compliance with Regulatory requirements, such as Renewable Purchase Obligations. These are two categories of Certificates (a) Solar Certificates & (2) Non-Solar Certificates.

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Salient Features of the REC Framework[9]

- There will be a central level agency to be designated by the Central Commission for registration of RE generators participating in the scheme.
- The RE generators will have two options - either to sell the renewable energy at preferential tariff fixed by the concerned Electricity Regulatory Commission or to sell the electricity generation and environmental attributes associated with RE generation separately.
- On choosing the second option, the environmental attributes can be exchanged in the form of REC. Price of electricity component would be equivalent to weighted average power purchase cost of the distribution company including short-term power purchase but excluding renewable power purchase cost.
- The Central Agency will issue the REC to RE generators.
- 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). Pertinently, RPO is the obligation mandated by the State Electricity Regulatory Commission (SERC) under the Act, to purchase minimum level of renewable energy out of the total consumption in the area of a distribution licensee.
- There will also be compliance auditors to ensure compliance of the requirement of the REC by the participants of the scheme.
- Renewable Energy Certificate (REC) mechanism is a market based instrument to promote renewable energy and facilitate compliance of renewable purchase obligations (RPO). It is aimed at addressing the mismatch between availability of RE resources in state and the requirement of the obligated entities to meet the renewable purchase obligation (RPO).
- One Renewable Energy Certificate (REC) is treated as equivalent to 1 MWh.
- There are two categories of RECs, viz., solar RECs and non-solar RECs.

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- Solar RECs are issued to eligible entities for generation of electricity based on solar as renewable energy source, and non-solar RECs are issued to eligible entities for generation of electricity based on renewable energy sources other than solar.
- Revenue for a RE generator under REC scheme includes revenue from the sale of electricity component of RE generation and the revenue from the sale of environmental attributes in the form of RECs.
- A. generating company engaged in generation of electricity from renewable energy sources shall be eligible for participation under REC scheme if it fulfills the following conditions:
    1. It does not have any power purchase agreement to sell electricity, with the obligated entity for the purpose of meeting its renewable purchase obligation, at a tariff determined under section 62 or adopted under section 63 of the Act by Appropriate Commission:

       Provided that in case of renewable energy sources based co-generation plants, the connected load capacity as assessed or sanctioned by the concerned distribution licensee ,shall be considered as the capacity for captive consumption for the purpose of issues of certificates, irrespective of the capacity of such plants covered under the power purchase agreement.

    2. It sells the electricity generated either
        a) To the distribution licensee of the area in which the eligible entity is located, at the pooled cost of power purchase of such distribution licensee as determined by the Appropriate Commission.
        b) To any other licensee or to an open access consumer at a mutually agreed price, or through power exchange at market determined price.
- A Captive Generating Plant (CGP) based on renewable energy sources shall be eligible for the entire energy generated from such plant for self-consumption for participating in the REC scheme subject to the condition that such CGP has not availed or does not propose to avail any benefit in the form of concessional/promotional transmission or wheeling charges and/or banking facility benefit.
- The REC once issued shall remain valid for One thousand and ninety-five days from the date of issuance of such Certificate and up to 31.03.2017, whichever is later.
- Grid connected RE Technologies approved by MNRE would be eligible under this scheme.

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- RE generators will have two options i) either to sell the renewable energy at preferential tariff or ii) to sell electricity generation and environmental attributes associated with RE generations separately.
- The RE generators who fulfil the eligibility criteria can apply for the accreditation to concerned State Agency. After successful accreditation the eligible entity (RE generator) may apply for registration to the Central Agency. After successful registration the eligible entity may obtain REC through the 'process of issuance of REC' by Central Agency. The detailed procedures for Accreditation, Registration, Issuance and Redemption of REC can be downloaded from CERC/NLDC (POSOCO) websites: www.cercind.gov.in, www.nldc.in, www.recregistryindia.nic.in
- REC could be purchased by the obligated entities. REC could also be purchased by entities other than obligated entities on voluntary basis.
- REC would be exchanged only in the CERC approved power exchanges.
- The price of REC would be determined in power exchange. REC would be traded in power exchange within the forbearance price and floor price determined by CERC from time to time. The floor and forbearance price as determined by the Commission are as under:

Table 2, the floor & forbearance price determined by the CERC

Price	**Non solar REC (₹/MWh) w.e.f. - 01.04.12 - 31.03.17)**	**Solar REC (₹/MWh) w.e.f. - 01.01.15 - 31.03.17**
Forbearance Price	3,300	5,800
Floor Price	1,500	3,500

Source: RE Registry of India

- The details of fees and charges for different procedures of REC are as under:

Table 3, fees and charges for different procedures of REC

Fee and Charges towards Accreditation	**Amount in ₹**

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Processing Fees (One Time)	5,000
Accreditation Charges (One Time)	30,000
Annual Charges	10,000
Revalidation Charge at the end of five (5) years	15,000
Fee and Charges towards Registration	**Amount in ₹**
Processing Fees (One Time)	1,000
Registration Charges (One Time)	5,000
Annual Charges	1,000
Revalidation Charge at the end of five (5) years	5,000
Fee and Charges towards Issuance of REC	**Amount in ₹**
Fees per Certificate	04

Source: RE Registry of India

- Auxiliary consumption of the any RE generator (including RE CGP is not entitled for issuance of REC. Only net generation of any RE generation project will be entitled for the issuance of REC.
- As per CERC REC Regulations, only grid connected RE Technologies are eligible under REC Mechanism. Since, the RE Generating unit for which REC benefits are sought is not connected to the grid, it is not eligible to participate under REC Mechanism.
- Eligible RE Generating Projects can apply for Accreditation under REC Mechanism six months prior to proposed date of Commissioning. Eligible RE Generating Projects can apply for Registration under REC Mechanism three months prior to proposed date of Commissioning.

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- The eligible entities shall apply to the Central Agency for Certificates within Six months after corresponding generation from eligible renewable energy projects provided that the online application for issuance of certificates may be made on 10th /20th or last day of the month.

3. METHODOLOGY:

3.1 The Main Objective of the Study was to make Energy Management analysis of sugar production Sugar Industries in South Gujarat area and identify the earning potential form Renewable energy in this respect.

3.2 Comparative study of various units nearby, based on generation of surplus energy for sale and to inject into the electricity grid &also earning revenue with Renewable Energy Certificates.

4. METHODS OF DATA COLLECTION:

4.1 Research is made by direct visits of Sugar Industries nearby Surat area & collecting real time data.

4.2 The Data collected/available from the public documents available from websites of Sugar Federations/Associations, Govt. of India & State Govt. concerned Depts.

4.2 Data collected by personal Interviews with Sugar Factories Personnel.

4.3 Secondary Study by referring national &international literatures, journals, Magazines, Reports of Government, Sugar associations, Regulations of the Regulatory Commissions, Guidelines of Bureau of Energy Efficiency, public documents of Ministry of New and Renewable Energy Sources, Renewable Energy Certificates Registry of India, etc.

Tools & techniques for statistical and scientific analysis used as per requirement of study.

5. ANALYSIS:

[9.3]As per REC Registry of India, New Delhi, presently there are 7 nos. Accredited RE Generators in Gujarat State, with Total Capacity of 25.05 MW, out of which 6 nos. are bagasse based cogeneration Sugar Plants as mentioned in table 2 below.

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Table 4, Accredited Renewable Energy Generators Sugar Factories in Gujarat State

Sr. No.	RE Generator	Capacity (MW)	Date of Accreditation	Date of Registration
01	Shree Chalthan Vibhag Khand Udhyog Sahakari Mandali	4	23.10.2013	18.02.2014
02	Shree Narmada Khand Udhyog Sahakari Mandali Limited	3.8	21.10.2013	27.03.2014
03	Shree Maroli Vibhag Khand Udhyog Sahakari Mandali	3	15.04.2013	28.08.2013
04	Sahakari Khand Udhyog Mandali ltd. Gandevi	4	15.04.2013	05.07.2013
05	Shree Khedut Sahakari Khand Udhyog Mandali, Pandvai	3	15.04.2013	17.09.2013
06	Shree GaneshKhandUdhyogSahakariMandali Limited	3	12.04.2012	29.06.2012

Source: RE Registry of India

As per REC Registry of India, New Delhi, Source-wise break-up as on 22.04.2016 is as under shows second highest accreditations & Registrations are of Bio-fuel (Bagasse) Cogeneration after Wind Power, as mentioned below. Till now, under Bio-fuel (Bagasse) Cogeneration with 894.06 MW Capacity, there are 104 nos. Registrations and 34,06,589 nos. Renewable Energy Certificates.

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Table 5, RE Source-wise break-up of Registrations as on 22.04.2016

Sr. No.	Source-wise	Accreditation		Registration		Nos. of RECs issued	RECs Redeemed by Power Exchanges	RECs Redeemed by Retention	Closing Balance
		Capacity (MW)	Unit	Capacity (MW)	Unit				
1	Wind	2499.79	629	2301.45	598	11919281	6192056	570359	5156866
2	Urban or Municipal Waste	8	1	0	0	72892	21769	0	51123
3	Solar-Thermal	3	1	0	0	0	0	0	0
4	Solar-PV	662.84	327	635.55	314	4301767	892394	21722	3387651
5	Small Hydro	327.19	39	299.69	35	2819372	1437195	5962	1376215
6	Others	1.67	1	1.67	1	14219	9353	0	4866
7	Geothermal	0	0	0	0	0	0	0	0
8	Biomass	707.52	75	699.02	74	6969186	3523992	63259	3381935
9	Bio-fuel Cogeneration	965.28	110	894.06	104	5704207	2294522	3096	3406589
	Total	**5175.29**	**1183**	**4831.44**	**1126**	**31800924**	**14371281**	**664398**	**16765245**

Source: RE Registry of India

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6. RESULTS & DISCUSSION

Chalthan Cooperative Sugar Factory gets benefit of REC in both cases, either inject power in to the Grid or not. As per condition, an installation for synchronizing of Generating set with Grid is arranged along with Auxiliary Meter & Availability Based Tariff (ABT) Meter.

Auxiliary Meter records power generated from Generating set & it is not entitled for REC benefits.

Chalthan Cooperative Sugar Factory has Low Tension Generation, therefore it gets REC benefit for 4 MW (4000kW) only.

Considering 160 days of Sugarcane crushing season in a year, the revenue earing from REC is worked out as under:

- Gross Generation per Hour= 4000 x 85%* = 3400 kW …….. (A)
  (*As 15% Auxiliary Consumption is not eligible for REC).
- Total Aux. Consumption per Hour = 700 kW ……..……(B)
- Net Captive Consumption (A-B) = 2700 kW
- Total Generation for 160 days of Sugarcane crushing season in a year
  = 2700 kW x 24 Hrs. x 160 Days= 1,03,68,000 kWh.
- Now, 1 REC = 1000 kWh (1MWh),
  therefore Net RECs for season = 1,03,68,000/1000 = 10,368 Nos.
- Floor Price of 1 REC is Rs. 1500/-, therefore the revenue earning from one season
  = 10,368 Nos. x Rs. 1500/- = Rs. 1,55,52,000/-
- Professional fees to be paid for REC is 7% of Rs. 1,55,52,000/- comes out to Rs.10,88,640
- Fees & charges of issuance of REC is Rs.10/- plus fees towards transaction of REC at exchange is Rs.20/- totaling to Rs.30/-, therefore total fees towards issuance & transaction of REC is Rs. 10,368/- x Rs.30/- = Rs. 3,11,040/-
- Total REC Revenue for the season is :
  Revenue of Season – Professional fees – issuance & transaction fees

  = 1,55,52,000 – 10,88,640 – 3,11,040 = Rs.1,41,52,320/-

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In actual, since June-2014, Chalthan Cooperative Sugar Factory has earned revenues of Total Rs.82,12,037.58 from RECs as tabulated below.

Table 6, Revenue earned by Chalthan Cooperative Sugar Factory during year 2014-15 & 2015-16

Period	REC Sale, NOs.	Rate of REC, Rs./No.	Trade Value, Rs.	REC Issuance fees, Rs.	Transaction charges, Rs.	Service Tax @ 12.36 %	Total Amount, Rs.
June-2014 to May-2015	711	1500	1066500	2844	22344	2761.72	10,41,394.28
June-2015 to Dec-2015	1793	1500	2689500	7172	57087	7625.74	26,24,787.28
Jan-2016 to Mar-2016	3105	1500	4657500	12420	98075	13568.99	45,45,856.02
Total	**5609**						**82,12,037.58**

Similarly, REC sold by Maroli Sugar Factory from July' 2014 to March'2017 are 8667 nos. and hence revenue earned are approximately Rs. 1.25 Crores.

7. CONCLUSION.

1) On the above example, there is good potential for Sugar factories in South Gujarat for revenue earnings by way of Renewable Energy Certificates.
2) Other Sugar factories shall have the connectivity with the Sate Grid for injection of Surplus Power & they can also earn revenue from the Renewable Energy Certificates.

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