



# Energy Audit Report for Sacred Heart College, Thevara

ENERGY AUDIT REPORT FOR SACRED HEART COLLEGE, THEVARA.

REPORT DATE : 23/03/2019

PROJECT LOCATION : THEVARA, KOCHI

CLIENT NAME : SACRED HEART COLLEGE

RENQ POWER SOLUTIONS INDIA PRIVATE LIMITED  
222/XVII College Road, Aruvithura P. O. Erattupetta, Kottayam - 686 122

## DECLARATION

I, M. T. Thomas, hereby declare that this audit report entitled “Energy Audit for Sacred Heart College, Thevara” is a bonafide and genuine report of an energy audit carried out by me in the premises of Sacred Heart College, Thevara, Kochi.

M. T. Thomas

PLACE : Kochi

BEE Certified Energy Auditor

DATE : 23/03/2019

EA - 14723

A handwritten signature in blue ink, appearing to read 'M. T. Thomas', is written over a blue circular stamp.

**M. T. Thomas**  
Certified Energy Auditor  
EA-14723

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## Introduction

### Objective of the Report

The Sacred Heart College located at Thevara, Ernakulam aims at holistic education and has introduced several innovative ideas in the campus. The management has been considering introducing renewable energy options that will align with their aim of imbibing green practices, providing educational exposure to the pupils and will also help them manage their energy consumption balance. To take this concept further; Renq Power Solutions, a leading clean and green technology solution provider company located in Cochin, was contacted and several rounds of meetings and discussion were held. As the first step for designing an optimized renewable energy system Renq suggested to conduct an energy audit and submit a report with recommendations. Based on the outcome of the report various recommendations can be implemented at once or stage wise. This report will be the basis for designing an optimized renewable energy system.

### About SH College

The Sacred Heart College established in 1944 by the CMI missionary fathers – reputed educational pioneers managing over 500 educational institutions across India and abroad - on the enchanting shores of Vembanadu backwaters on Thevara Island in Kochi, surrounded by lush greenery and located away from urban bustle, the 3-storeyed majestic structure on the eleven acre campus, spacious in dimensions, simple and elegant in design, is an aesthetic treat. Ever since its origin, the college - fondly called 'Thevara College'- has followed its core philosophy: holistic vision, i.e., harmony of the intellectual, physical and spiritual endeavors enshrined in its motto, *cor rectum inquit scientiam* (a righteous heart seeks after wisdom). The college, fondly nurtured and ably steered by visionary leadership, having evolved into a premier centre of higher education through its 72 year old fruitful academic journey, is now poised at a momentous threshold of its growth.

A multi-faculty, autonomous, coed College affiliated to MG University, Kottayam, Kerala, it offers a variety of conventional and vocational programs for diverse mix of students from urban, semi urban and rural milieux. Accolades, awards and honours have bolstered its morale in its triumphant march from the modest origin with 29 students in 1944 to the present strength of 2399 (69% girls), spread across 16 UG and 16 PG departments and 6 research centres. The College was chosen as **College with Potential for Excellence** in 2004 by the UGC; the status was extended in 2010 and is

still continuing. The college was granted Autonomous Status by the UGC and the State government in 2014.

The college was awarded the highest rating of FIVE STAR in the NAAC accreditation in 2000, and in the 2007 re-accreditation, the feat was replicated with A+ (91.7). In the national surveys, for the Best Fifty Colleges, undertaken by prestigious media agencies such as The Week, and India Today, Sacred Heart College was ranked one among the best 30 colleges for science, 40 for arts and 30 for Commerce in the country, while notching up the commendable I rank consistently since 2006, among colleges in Kerala.

Proactive measures for environmental protection are organized and executed passionately by the college. An abiding concern for environment in tune with the global concern, underscores the college's present ethos and culture. A part of its energy needs are met by nonconventional sources such as solar and wind power. Visible in every SH act, this concern further reinforces its holistic approach.

## Vision and Mission

### Vision

Fashioning of an enlightened society founded on a relentless pursuit of excellence, a secular outlook on life, a thirst for moral values as well as an unflinching faith in God.

### Mission

To provide an environment that facilitates

- The holistic development of the individual
- Enables the students to play a vital role in the nation building process and contributes to the progress of humanity.
- Disseminates knowledge even beyond the academia
- Instills in the students a feel for frontier disciplines and cultivates a
- concern for the environment by setting lofty standards in the ever-evolving teacher learner interface.

## Why Energy Audit?



In recent years there is quite an interest in the areas of rational use of energy and energy saving. The well-known reasons are the increasing percentage of energy costs in the final cost of a product, increased global market competition and increased environmental problems. The systematic planning and application of energy saving- efficiency measures has proved savings in the order of 5 to 25%, according to the methodology and the type of saving actions. Additionally, energy savings lead to reduce polluting emissions, an effect that became very important during last years. It has been calculated that the combustion of one ton of oil-fuel frees three tons of CO<sub>2</sub> to the atmosphere, having an adverse role on the greenhouse effect.

Energy efficiency is not solely the result of technological measures and thereby capital investments. The main factors/elements in any energy saving plans are the following: Sound structure, energy consciousness and, finally, the application of modern technology.

Educational institutions have an added responsibility of becoming role models for the future generation by demonstrating acceptance to sustainable practices and renewable energy is certainly one of the areas.

The objective of the energy audit report is to minimise the energy demand and maximize the efficiency of the facility by means of making changes in the loads, Time of Operation if possible and exploring potential for alternative sources. This report aims at studying the loads and consumption of the facility on a broader term and thereby obtaining suitable inference from them. The possibility of alternative energy solutions will also be reflected in the report.

## Project Location

Location	Thevara, Kochi
Latitude	9.94 ° N
Longitude	76.29 ° E
Elevation	2m above Sea Level

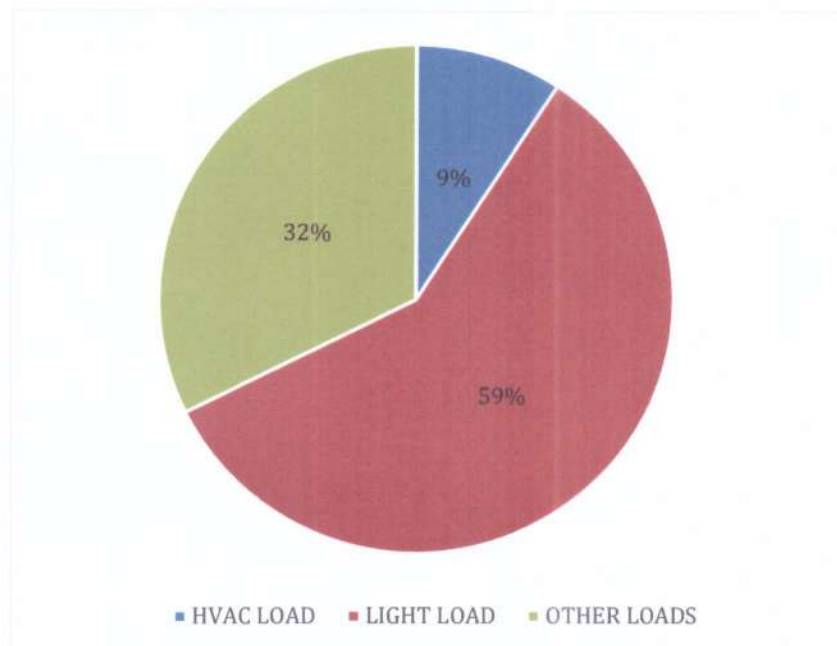
## Load Analysis and Recommendations

### Load Analysis

A detailed and exhaustive load list was taken and the same is attached as Annexure. The nature of the loads and their distribution within the facility was analyzed and categorized under

- a. HVAC Loads – only Air Conditioners
- b. Other power loads – High power equipment including motors for pump, coolers, kitchen equipment, lab and workshop equipment etc
- c. Lighting and other miscellaneous loads – Fans, Lights, Cameras, Networking devices, Computers etc.

Their distribution is as shown



### Recommendations

- a. Air Conditioning Loads
  - i. Old AC's to be replaced with energy efficient inverter type AC's.
  - ii. All new AC's to be of inverter type especially ones with higher time of operation.

b. Power Loads

- i. The majority of the power loads are laboratory equipment and do not contribute much towards the energy consumption pattern as their time of operation is very limited,
- ii. UPS battery – The number of UPS devices are huge and as the facility was retrofitted through out its history an implementation of a centralized system maynot be practical. However in case a revamp of the electrical distribution network is done this can be looked into to avoid redundant capacity.
- iii. Weightage to be given to BEE star rating while considering Purchase of new equipment or replacement of existing ones.

c. Lighting and other miscellaneous loads

- i. Along with the rich and long history of the SH college it has inherited a lot of lighting and fans that are still very prevalent and needs to be changed. It is recommended to carry out the upgradation in a phased manner as and when the service life of that particular item comes to an end to minimize the e-waste generated. The details of the loads to be changed are listed below

List of lighting fixtures to be replaced at old block					
		Existing		Recommended	
	Qty	Wattage	Load	Wattage	Load
	Nos	W	W	W	W
<b>Tube Light</b>	815	40	32600	18	14670
<b>CFL</b>	613	15	9195	7	4291
<b>Incandescent Bulb</b>	20	60	1200	7	140
			<b>42995</b>		<b>19101</b>

- ii. Retrofitting of occupancy sensors for hall way lights, classroom fans and bathroom exhaust etc can be done to minimize wastage.

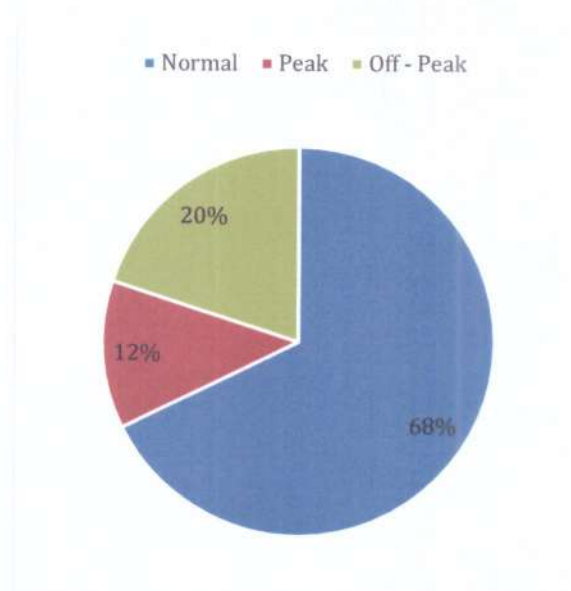


## Current Energy Scenario & Recommendations

### Current Energy Scenario

The energy bills of SH College is analyzed and tabulated below

	(31/03/2018 to 28/02/2019)
Normal	131993 kWh
Peak	24094 kWh
Off - Peak	38889 kWh
<b>Total Consumption</b>	<b>194976 kWh</b>
No of days	334 days
<b>Avg Per day Consumption</b>	<b>571.78 kWh</b>



### Recommendations

- 1 – Energy cost can be reduced by replacing the existing CFL and traditional tube lights with latest LED lights and tubes and estimated 5-7% savings can be achieved.
- 2 – The potential of the facility to alternative sources like solar and wind energy needs to be explored.
- 3 – The power factor recorded in the bills seem to be low and it is recommended to service the APFC panel board to improve the same.

## Renewable Energy Alternative

### Irradiance and wind data for the location

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	Annual Avg
Avg Temp °C	27.83	29.82	31.16	30.38	28.87	26.73	25.68	25.62	26.09	26.52	26.51	26.49	27.64
Solar Irr (W/m <sup>2</sup> )	5.68	6.24	6.66	6.12	5.49	4.04	4.25	4.72	5.36	4.85	4.92	5.22	5.3
Avg Wind (m/s)	2.24	2.36	2.65	2.9	3.61	4.43	4.36	4.04	3.47	2.72	2.14	2.37	3.11

(As per NASA data)

The above data from NASA for Thevara location shows that the wind potential of the location is not favorable for wind turbine installation as the favorable wind speed for the same would be an average value of 5 m/s.

The solar irradiance is an indicator for solar energy potential of the location. Although there is a dip in the levels during the monsoons the average solar energy potential of the location is above the global average. Any location with Solar Irradiance above 4 W/m<sup>2</sup> stands a business case.

## Solar Photovoltaic System

Considering the favorable solar irradiance and the free energy banking facility extended by KSEB we can look into utilizing solar photovoltaic technology to power the institution. In the given area the college requires to generate maximum energy from solar in excess to the current energy need of the facility so as to keep it future equipped due to the current constructions taking place.

### Existing Solar PV System

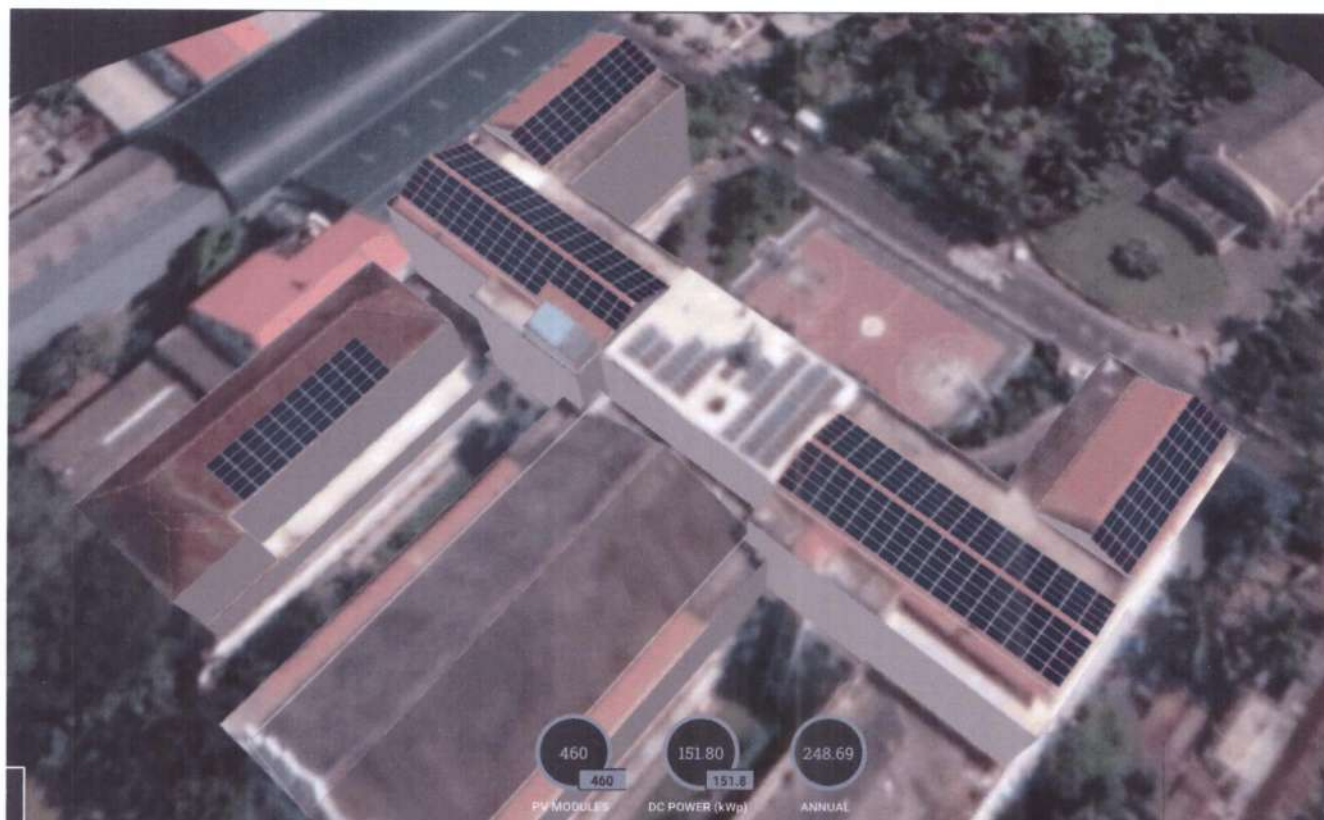
The existing 20kWp solar system

### Area Available

The available roof areas were surveyed and shade free areas available on each roof have been identified and are mentioned in following table. Note the areas mentioned are south facing shade free usable area only.



## Solar Module Mounting Location



A total of 460 modules of 2m x 1m can be fixed on the current roofs excluding the asbestos roofs of the auditorium. So in short we have more than sufficient area available for generating the entire power required for the college even after accounting for future requirement.



## Solar PV System Sizing and Design

Energy Requirement per day	580 units
Estimated contribution from existing 20kWp after commissioning	80 units
Total units to be produced to achieve Net zero	500 units
Capacity of Solar Plant proposed in terms of power	120 kWp

The system can be designed around the energy banking facility being extended by KSEBL, specially for solar energy where in excess energy produced from the system is exported to KSEB grid and is adjusted against energy consumed from the KSEB during shortfall. Also if the total energy exported during a billing period is in excess to the total energy imported during a billing period the excess credit will be carried forward to the next billing period. However there is an annual settlement of the same thereby saving the energy.

The facilities load pattern indicates the increase in load during the functioning hours and hence it will match with the typical production pattern from a Solar PV of 120 KW, the excess which is produced during the day is banked with KSEB and credit for which can be obtained from KSEB at the time of billing with the Net meter arrangement.

### Salient Features – Solar PV Project

- This projected enables the college with a badging of Net Zero Energy Institution
- Optimal utilization of Roof area – Various customized structure designs including a one of kind space frame structure which provides for a partially covered roof garden was implemented.
- Safety measures including walkways, indicators, safety ropes, barricades etc were diligently incorporated into the design and execution of the project.
- The heat gain on the roof slab will be reduced significantly with the presence of solar panels thereby reducing the load on the air-conditioners on the top floor.
- Protection from inflation in energy cost (currently at 6-7% per annum)

## Additional Recommendations

- Scope for detailed energy audits are only in the following areas
  - Existing UPS battery assessment
  - Electrical Distribution Network
- Apart from the above areas, general awareness classes on energy efficiency may be carried out for Staff and Students.
- Boards, Signs and indicators may be designed and adopted regarding efficient use of Lifts, Lights, Air-conditioners, Water and energy conservation.
- Every unit conserved is one unit generated - Energy efficiency should be of paramount importance especially even after the implementation of alternative/renewable sources of energy.

## Summary

The energy audit conducted at Sacred Heart College, Thevara indicates the following

- There is scope for reducing energy consumption by means of changing light loads though 6-7%, as well as there is scope for improvement by changing the air-conditioners and other equipment to more energy efficient inverter type.
- The implementation of renewable power source like Solar PV can considerably decrease the reliance on grid and thereby achieving net zero energy concepts.
- The process will also enable the students to appreciate the practices of sustainable practices and initiatives towards green energy, which is critical for a global citizen.