ENERGY AUDIT REPORT

Established in 1951

2017-2018

Chhotu Ram Arya College
Sonipat- 131001

Established in 1951

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Preface

An energy audit is a study of a plant or facility to determine how and where energy is used and to identify methods for energy savings. There is now a universal recognition of the fact that new technologies and much greater use of some that already exist provide the most hopeful prospects for the future. The opportunities lie in the use of existing renewable energy technologies, greater efforts at energy efficiency, and the dissemination of these technologies and options.

This report is just one step, a mere mile marker towards our destination of achieving energy efficiency and we would like to emphasize that an energy audit is a continuous process. We have compiled a list of possible actions to conserve and efficiently utilize our scarce resources and identified their savings potential. The next step would be to prioritize their implementation. We look forward with optimism that the institute authorities, staff, and students shall ensure the maximum execution of the recommendations and the success of this work.

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1. Audit Participants on behalf of the Institution

S. No.	NAME	POSITION/DEPARTMENT
1	Dr. Vipin Saini	Assistant Professor/ Electrical Engineering, U.I.E.T., M.D. University Rohtak (Special Invitee)
2	Dr. Meena Kumari	Assistant Professor/ Electrical Engineering, U.I.E.T., M.D. University Rohtak (Special Invitee)
3	Dr. J.S.Phor	Associate Professor/Physics Chhotu Ram Arya College, Sonipat

2. Acknowledgment

Energy Audit Team thanks the management of Chhotu Ram Arya College for assigning this important work of Energy Audit. We appreciate the co-operation of our team in the completion of the study.

Our special thanks are to:

- Administrator, Tika Ram Ed. Society, Sonipat.
- Principal, C.R.A. College, Sonipat.
- Teaching & Supporting Staff of the Institute

For giving us necessary inputs to carry out this very vital exercise of energy Audit. We are also thankful to other staff members, who were actively involved while collecting the data and conducting field measurements.

3. OVERVIEW OF INSTITUTE

With the dawn of independence, there was a dire need to improve opportunities for higher education for the underprivileged section of society; Ch. Tika Ram was inspired by the same spirit when he established ***Chhotu Ram Arya College*** in 1951 on the death anniversary of Ch. Chhotu Ram. The institute is following the ideas of Ch. Tika Ram and Ch. Chhotu Ram and its main objective are to uplift the down-trodden.

Sir Chhotu Ram

Ch. Tika Ram

The institute which claims to be the best for students is committed to provide a quality education through new methods and techniques. The college labs are well equipped and well furnished. One of the best libraries in the state, attracting voracious readers, has a rare collection of more than 30000 books in a unique feature besides 2000 books for competitive examinations.

Chhotu Ram Arya College is known for its great achievements, the students achieved tremendous success in games, cultural activities, and academics. Recently, the college authorities decided to launch different types of courses, including professional ones for the benefit of society. This is a step forward to academic excellence and towards providing the opportunity to the students and teachers of CRA College.

The campus comprises modern lecture theaters, state of art computer labs with more than 120 computers, and round-the-clock internet. The campus provides blanket wireless services (wi-fi) in the institute. One centralized fully AC soundproof Theatre & Multipurpose Hall with a sitting capacity of 200 Students has been completed with ultra-modern latest techniques.

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4. AERIAL VIEW AND LOCATION OF CRA COLLEGE

Chhotu Ram Arya College is spread over a sprawling campus of about 12 acres of land on Sonipat-Kakroi road, which is situated in the heart of Sonipat city. Sonipat city is situated about 45 km. from the National Capital New Delhi and it is well connected by bus and train services with the rest part of the country. The campus of Chhotu Ram Arya Sonipat is situated nearly 1.5 km from the bus stand and 0.5 km from the Railway station.

The geographical coordinate college is:

Longitude- 77°0'26.78"E

Latitude- 28°59'10.28"N

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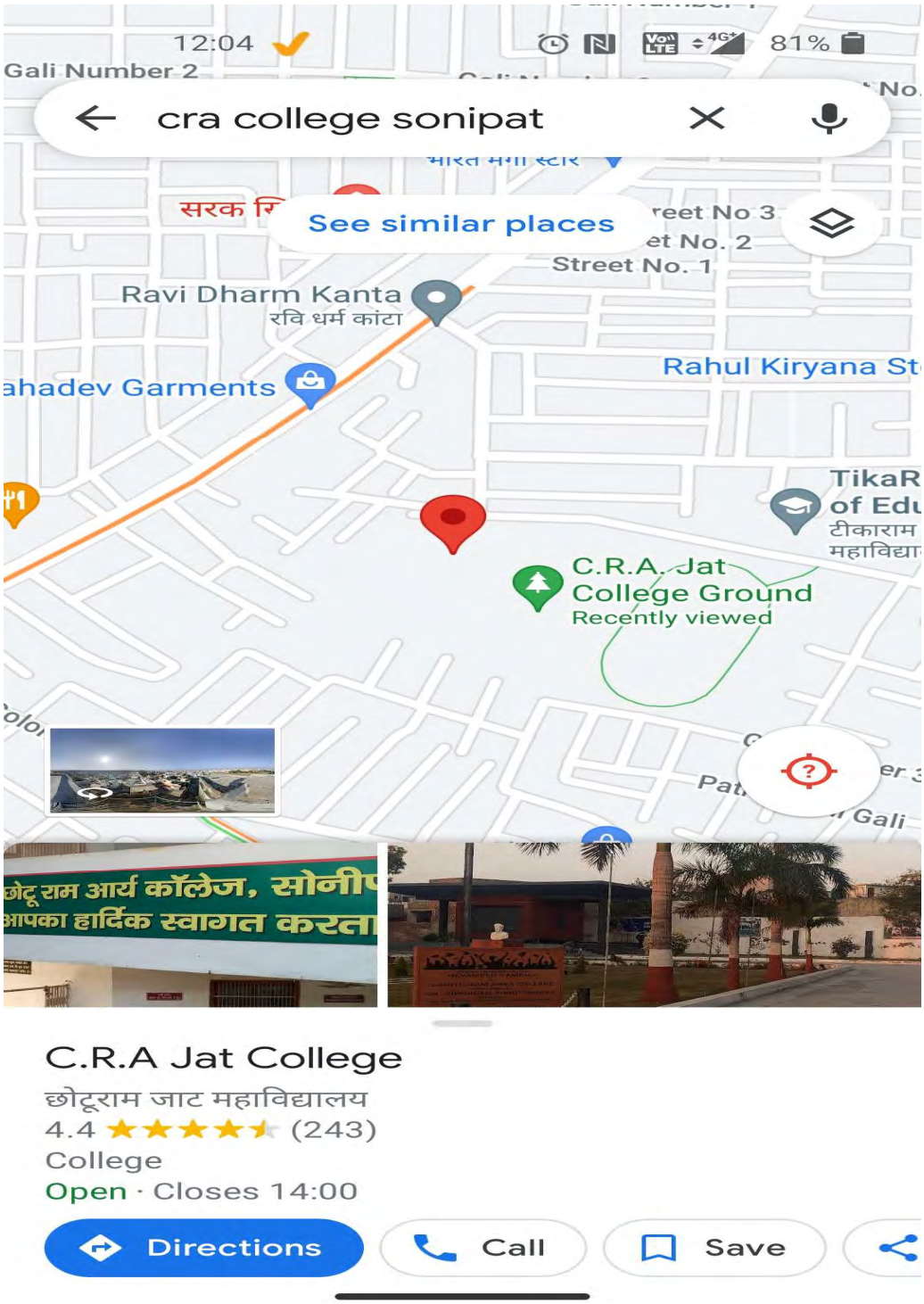
CRA COLLEGE GOOGLE MAP



5. Executive Summary

Energy today has become a key factor in deciding the product cost at the micro level as well as in dictating the inflation and the debt burden at the macro level, Energy cost is a significant factor in economic activity at par with factors of production like capital, land, and labor. The imperatives of an energy shortage situation call for energy conservation measures, which essentially mean using less energy for the same level of activity. Energy Audit attempts to balance the total energy inputs with their use and serves to identify all the energy streams in the systems and quantifies energy usage according to its discrete function. Energy Audit helps in energy cost optimization, pollution control, and safety aspects and suggests the methods to improve the operating & maintenance practices of the system. It is instrumental in coping with the situation of variation in energy cost availability, reliability of energy supply, the decision on appropriate energy mix, and decision on using improved energy conservation equipment's Instrumentation and technology.

Energy Audit is the key to a systematic approach to decision-making in the area of energy management. It attempts to balance the total energy inputs with their use and serves to identify all the energy streams in a facility. It quantifies energy usage according to its discrete functions.

The Energy Audit would give a positive orientation to the energy cost reduction, preventive maintenance, and quality control programs which are vital for production and utility activities. Such an audit program will help to keep the focus on variations that occur in the energy costs, availability and reliability of supply of energy, decide on appropriate energy mix, identify energy conservation technologies, retrofit for energy conservation equipment, etc. The primary objective of an Energy Audit is to determine ways to reduce energy consumption per unit of product output or to lower operating costs. The present report shows the energy audit of CRA College in terms of pre-audit phase, audit phase, and post-audit phase.

The assignment was conducted and the following areas have been covered in the study.

1. Electricity Bill
2. Distribution Network

3. DG Sets
4. Lights
5. Air Conditioning Load
6. Computer Lab Load
7. Solar Power etc.

6. Introduction to energy audit

In a broad sense, Energy Efficiency means economizing on the use of energy without adversely affecting economic growth and development. It includes improving the efficiency of energy extraction, Transmission, and Distribution and increasing the productivity of energy use.

Designated consumers

Govt. specifies the following criteria for energy Intensive Industries and other establishments. (As per EC Act 2001, Section 14(e)), for Industries Electrical connected load 5000 KW and above Designated Consumers to get energy audit by Accredited energy audit firms

Bureau of Energy Efficiency (BEE)

The Bureau of Energy Efficiency is an agency of the Government of India, under the Ministry of Power created in March 2002 under the provisions of the nation's 2001 Energy Conservation Act. The agency's function is to develop programs that will increase the conservation and efficient use of energy in India

7. Energy Audit

As per the Energy Conservation Act, 2001, Energy Audit is defined as "the verification, monitoring, and analysis of the use of energy including submission of technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption". There are three phases of the Energy Audit

1. Pre-audit phase
2. Audit phase
3. Post-audit phase

The above phase includes the following stages

1. **Data Collection** - In the preliminary data collection phase, exhaustive data collection was performed using different tools such as observation, surveys communicating with responsible persons, and measurements.

The following steps were taken for data collection:

- ❖ The team went to each department, Library, canteen, etc.
- ❖ Data about the general information was collected by observation and interview.
- ❖ The power consumption of appliances was recorded by taking an average value in some

2. **Data Analysis**. Detailed analysis of data collected includes:

- o calculation of energy consumption
- o analysis of the latest electricity bill of the campus
- o understanding the tariff plan provided by the Uttar Haryana Bijli Vitran Nigam Limited
- o Data related to water usage were also analyzed using appropriate methodology.

3. Recommendation - Based on the results of data analysis and observations, some steps for reducing power and water consumption were recommended. Proper treatments for waste were also suggested. The use of fossil fuels has to be reduced for the sake of community health. The above target areas particular to the college were evaluated through a questionnaire circulated among the students for data collection. Five categories of questionnaires were distributed. The formats of these are given below.

7.1 Pre-audit Phase

7.1.1 Survey Form for data collection

1) List ways that you use energy in your college. (Electricity, electric stove, kettle, microwave, LPG, firewood, Petrol, diesel, and others).
2) Electricity bill amount for the last five years
3) Amount paid for LPG cylinders for last year
4) Weight of firewood used per month and amount of money spent? Also, mention the amount spent on petrol/diesel others for generators?
5) Are there any energy-saving methods employed in your college? If yes, please specify. If not, suggest some.
6) How much money does your college spend on energy such as electricity, gas, firewood, etc. in a month? (Record monthly for the year 2017-18).

7) How many CFL bulbs has your college installed?
8) How many LED bulbs are used in your college?
9) How many incandescent (tungsten) bulbs has your college installed?
10) How many fans are installed in your college?
11) How many air conditioners are installed in your college?
12) How much electrical equipment including weighing balance is installed in your college?
13) How many computers are there in your college?
14) How many photocopiers are installed by your college?
15) How many cooling apparatuses are installed in your college?
16) Energy used by each cooling apparatus per month?
17) Energy used by each photocopier per month?
18) How many inverters your college installed?
19) Energy used by each inverter per month (Kwh)?
20) How much electrical equipment is used in different labs of your college?
21) How many heaters are used in the canteen of your college?
22) No. of street lights in your college?
23) No. of TV in your college?
24) Do you run "switch off" drills at college?
25) Are your computers and other equipment put in power-saving mode?
26) Does your machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby mode most of the time? If yes, how many hours?
27) What are the energy conservation methods adopted by your college?
28) How many boards are displayed for saving energy awareness?
29) How much ash is collected after burning firewood per day in the canteen?
30) Write a note on the methods/practices/adaptations by which you can reduce the energy use on your college campus in the future.

7.2 Audit Phase

In CRA college energy auditing was done with the help of a team teaching staff. The energy audit began with the teams walking through all the different facilities at the college, determining the different types of appliances and utilities (lights, taps, toilets, fridges, etc.) as well

as measuring the usage per item (Watts indicated on the appliance) and identifying the relevant consumption patterns (such as how often an appliance is used) and general characteristics of certain appliances,

i. **Data collection**

Data collection was done in the sectors such as sources of energy and energy consumption patterns. College records and documents were verified several times to clarify the data received through surveys and discussions.

ii. **Site Tour**

The site inspection was done along with students and staff. Questionnaires were answered during the site tour and relevant documents were collected.

iii. **Review of Documents and Records**

Documents such as electricity bills, registers of electricity, and fuel consumption were collected and reviewed.

iv. **Site Inspection**

The college and its premises were visited and analyzed by the audit-teams several times to gather information. Campus trees were counted and identified. Garden, playgrounds, canteen, library, office rooms, and parking grounds were also visited to collect data. The number and type of vehicles used by the stakeholders were counted and fuel consumption for each vehicle was verified with the user. The number of LPG cylinders used in labs, canteen, and hostel kitchen mess was also counted.

v. Land analysis of college campus

Table 1: Total Campus Area & College Building Spread Area

Total Area of the College	54000 square meter
Total Covered Area At Ground	3268 square meter
Total Covered Area At 1st Floor	3268 square meter

Total Covered Area At 2nd Floor	1266 square meter
Total Covered Area	7802 square meter
Plantation Area, Green Lawns, And Grounds	37800 square meter

8. Energy Sources :

Fig: Generator to the capacity of 62.5 KWH installed in the college.

The transformer of capacity 100 KVA (step down) provided by Uttar Haryana Bijli Vitran Nigam, has been installed on campus for distribution of power to different units.

In case of a power cut, we supply power to fulfill demands with help of a generator which runs on diesel as fuel.

Generator -1 of 62.5 KVA capacity

The power efficiency of the generator is 80%

9. Key Findings and Observations of Energy Usages

The base of the energy audit is that its findings are supported by documents and verifiable information. The audit process seeks, on a sampled basis, to track past actions, activities, events, and procedures to ensure that they are carried out according to systems requirements and in the correct manner. Energy audits form a part of a process. Although they are individual events, the real value of energy audits is the fact that they are carried out, at defined intervals, and their results can illustrate improvement or change over time.

Although audits are carried out using policies, procedures, documented systems, and objectives as a test, there is always an element of subjectivity in an audit. The essence of any energy audit is to find out how well energy management equipment is performing. Each of the three components is crucial in ensuring that the organization's energy performance meets the goals set in its energy policy.

Electricity charges Rs.73358/month

Number of Generators 1(62.5KVA)

Cost of generator fuel - Rs.10000/month

The total cost of the energy app. Rs. 1,00,000/month

Total number of CFL bulbs- 12

Number of LED lights =85+158+35+11+30 = 319

Incandescent bulbs =50

Number of fans =187

Number of Air conditioners =8

Number of Tube lights =73

Total Electrical Equipment in Lab=12

Number of Computers and laptops =106

Number of Photocopiers = 3

Number of Televisions =5

Number of Photocopy Machine= 03

Number of Printers= 10

Number of Air Conditioners= 16

10. Recommendations for Better Energy Efficiency

• Turn off electrical equipment when not in use.

• Master switches to be installed outside rooms.

• CFLs to be replaced by more efficient LEDs

• Use computers and electronic equipment in power-saving mode

Based on the analysis of the power consumption data, certain steps have been recommended for improving the energy efficiency of the campus. Complete cost analysis of the implementation of recommended measures has been performed wherever necessary. Also, several general measures for energy efficiency have been listed.

Described below are some important recommendations for better energy efficiency:

1. Housekeeping

Curtains - Always keep curtains on windows to prevent direct sunlight inside the room to avoid heating of cooled air. This reduces AC load significantly.

3. Better Practices for AC

The institute has in total 3 window type ACs and 13 split type ACs which make up a very large part of the total energy consumption of the campus. But, in many places, it was found that AC is not used with best-recommended practices. Even simple things, such as insulation, are not taken care of. Window panes were found broken in many places. Also, in certain places, ACs were found to be used without keeping curtains. These poor practices account for an increase in AC load and thus consumption.

Summarized below are some guidelines for the most efficient use of ACs:

• Proper Insulation Good quality insulation must be maintained in the air-conditioned rooms by keeping all doors and windows closed properly to prevent cool air go out and hot air from coming in.

• Operating - The ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room.

4. Replacing electric bulbs with LEDs lamps

Electric bulbs to be replaced with LED lights.

5. Solar Panels

College is suggested to install solar panels so that green energy can be generated.

6. Replacement of main transmission cable

The main transmission cable from the transformer to the college building is faulty and has many loose connections. This cable should be replaced.

7. Purchase of star-rated electric equipment

It is recommended that the college should purchase 5* rated electric equipment and inverter A.C. in the future.

Calculations for energy efficiency of college to reduce energy consumption

The dominant light source at most places on the campus is traditional i.e. CFLS and electric bulbs. If these CFLS and bulbs are replaced by LEDs about 5 KW of power can be saved annually.

Cost Analysis of Replacing CFLs with LEDs:-

Total No. of CFLs on Campus = 12

Average Power of CFL 23W

Average Power of LED - 12w

Power saved per LED = (23-12) W=11W

• Total Power saving by changing CFL 12 * 11W=132W =0.132KW(per hour)

Cost Analysis of Replacing Electric bulbs with LEDs:-

Total No. of electric bulbs on Campus = 50

Average Power of electric bulb =100W

Average Power of LED = 12w

The power saved per LED = (100-12) W=88W

• Total Power saving by changing electric bulbs 50 * 88W=4400W =4.4 KW(per hour)

Cost Analysis of Replacing Tube Lights with LEDs:-

Total No. of in Tube Lights Campus = 73

Average Power of Tube Lights =40W

Average Power of LED = 12w

Power saved per LED = (40-12) W=28W

• Total Power saving by changing Tube Lights 73 * 28W=2044W =2.04KW(per hour)

11. Consolidation of Audit Findings

- The communication process for awareness concerning energy conservation is found adequate. Assessment of electrical load calculation has been done by the college with a special invitee from M.D. University Rohtak. The monthly use of electricity in the college is not very high. Objectives for reducing energy, water, and fuel consumption are sufficient.
- Energy-efficient equipment is being used by replacing the old non-energy efficient fans.
- Regular monitoring of equipment and immediate rectification of any problems is being done.

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12. Post audit phase

Follow-Up and Action Plans

Energy audits form a part of an ongoing process. Innovative energy-saving initiatives have to be designed and implemented every year to make the college environmentally sustainable. Follow-up programs of energy auditing recommendations should be done meticulously before the next audit

Dr. Vipin Saini
Assistant Professor
Department of Electrical Engineering
U.I.E.T., M.D. University Rohtak (Special Invitee)

Dr. Meena Kumari
Assistant Professor
Department of Electrical Engineering
U.I.E.T., M.D. University Rohtak (Special Invitee)

Dr. J.S. Phor
Associate Professor
Department of Physics