SUSTAINABLE LIVING INC

Certificate of Completion

This is to certify that

Anurag Engineering College

has successfully completed

Energy Audit and Carbon Footprint Study

The study was completed by Sustainable Living Inc

Hiran Prashanth

Hiran Prashanth
Environmental Sustainability Auditor
Sustainable Living

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Ananthagiri (V&M), Suryapet Dt. T.S.

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Sustainable Living Inc

ANURAG

Anurag

ENGINEERING COLLEGE

(An Autonomous Institution)

Carbon Footprint and Energy Audit

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Acknowledgment

Sustainable Living Inc

Hiran Prashanth
Environmental Sustainability Auditor

30 Aug 2020

Carbon footprint and Energy audit

he Sustainable Living Inc acknowledges with thanks the cooperation extended to our team for completing the study at Anurag Engineering College (AEC).

We are sure that the recommendations presented in this report will be implemented and the AEC team will further improve their environmental performance.

Kind regards,

Yours sincerely,
Hiran Prashanth

Hiran Prashanth
Environmental Sustainability Auditor
Sustainable Living In

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Executive Summary

The growth of countries across the world is leading to increased consumption of natural resources. There is an urgent need to establish environmental sustainability in every activity we do. In a modern economy, environmental sustainability will play a critical role in the very existence of an organization.

An educational institution is no different. Built environment, especially an educational institution, has a considerable footprint on the environment. Impact on the environment due to energy consumption, water usage and waste generation in an educational institute is prominent. Therefore, there is an imminent need to reduce the overall environmental footprint of the institution.

As an Institution of higher learning, AEC firmly believes that there is an urgent need to address the environmental challenges and improve their environmental footprint. True to its belief, the institution has already installed 50 kWp solar rooftop. Sustainable Living congratulates the team for its excellent efforts.

Keeping AEC's work in energy efficiency, we recommend the following to be taken by the competent team at AEC:

Work towards achieving carbon neutrality: INDC puts emphasis on creating an additional carbon sink of 2.5 to 3 billion tonnes of CO2 equivalent through additional forest and tree cover by 2030. Presently, AEC's scope 2 carbon emission is 32.8 MT CO2e. AEC should focus on energy efficiency, renewable energy and carbon sequestration as tools that will enable them to offset the present carbon emissions and achieve carbon neutrality.

Improve energy efficiency of the college: It is recommended to adopt latest energy efficient technologies for reducing energy consumption in fans. We recommend the following projects to be implemented at the earliest:

- Replace conventional 80W ceiling fans with energy efficient BLDC fans of 30W

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Carbon Footprint and Energy Audit

AEC and Sustainable Living Inc are working together to identify opportunities for improvement in energy efficiency and carbon reduction. This report highlights all the potential proposals for improvement through the audit and analysis of the data provided by AEC for lighting, air conditioning, ceiling fans and biogas potential.

The report also details the carbon emissions from college operation. For carbon emissions, scope 2 emissions are calculated from the data submitted by AEC. The report emphasizes on the GHG emission reduction potential possible through reduction in power consumption.

Submission of Documents

Carbon footprint and energy audit at AEC was carried out with the help data submitted by AEC team. AEC team was responsible for collecting all the necessary data and submitting the relevant documents to Sustainable Living Inc for the study.

Carbon Footprint and Energy Audit

Data submitted and collected during the visit was used to calculate carbon footprint of the campus nd assess energy consumption and finally provide necessary recommendation for environmental improvement.

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OPPORTUNITIES FOR IMPROVEMENT

Scope 2: Electricity Indirect GHG Emissions

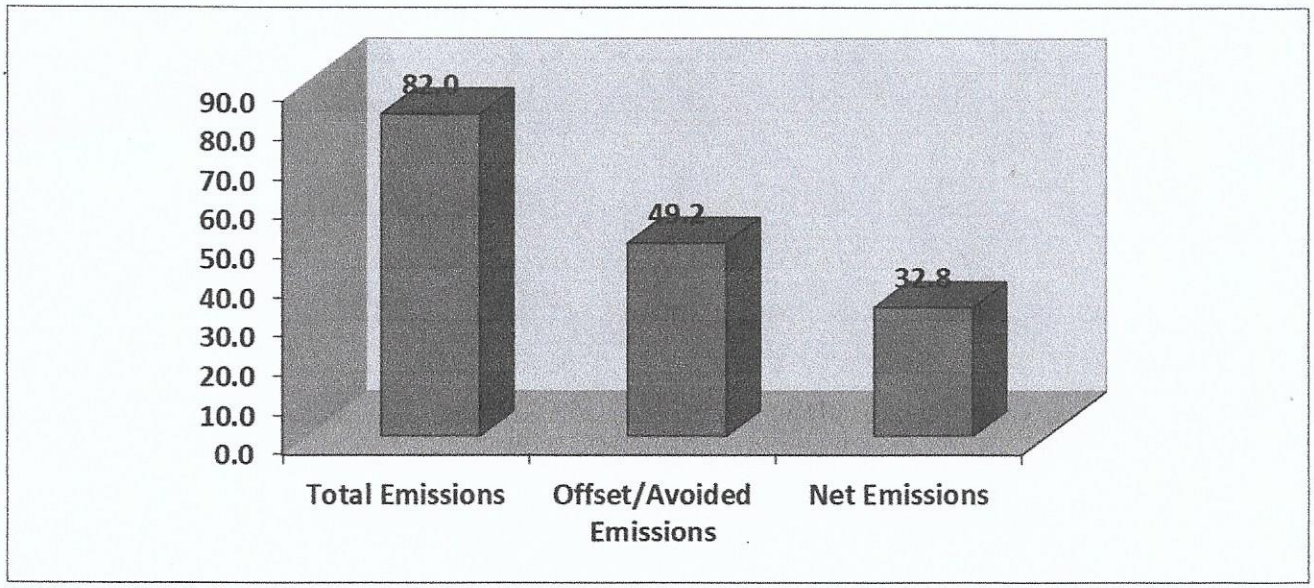
Scope 2 accounts for GHG emissions from the generation of purchased electricity consumed by a company. Purchased electricity is defined as electricity that is purchased or otherwise brought into the organizational boundary of the company. Scope 2 emissions physically occur at the facility where electricity is generated.

AEC Scope 2 emissions for 2019:

Electricity purchased from grid : 40,000

nergy produced from solar pv : 60,000

Scope 2 Breakup



Total Emissions	82.0	MT CO2 eq.
Offset/Avoided Emissions	49.2	MT CO2 eq.
Net Emissions	32.8	MT CO2 eq.

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Develop a roadmap to increase contribution of renewable energy in the overall energy consumption

To have a continued focus on increasing renewable energy utilization to 100% which will also lead to reduction in GHG emissions, it is suggested to develop a detailed roadmap on RE utilization. The road map should broadly feature the following aspects -

- Renewable energy potential of AEC and the maximum offset that can be achieved at AEC
- Percentage substitution with renewable energy that AEC wants to achieve in a specified time frame
- Key tasks that needs to be executed to achieve the renewable energy target
- Specific financial break up for each of the projects highlighting the amount required, available and the utilization status as on date
- A regular review mechanism to ensure progress along the lines of the roadmap should be framed
- The roadmap should also highlight important milestones/key tasks, anticipated bottlenecks & proposed

Renewable energy roadmap should be used as a base to frame GHG emissions reduction target

It is suggested to use the developed renewable energy roadmap to correlate the GHG reduction that each of the renewable energy project will achieve. This approach will provide a base to set targets for reduction in GHG emissions. The action plan for renewable energy will shoulder the action plan for GHG emissions reduction and work towards achieving carbon neutrality.

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Explore the option of other onsite and offsite renewable energy projects

The renewable energy field has been witnessing many private investors due its increased market demand and attractive policies in many states. There are Renewable Energy Independent Power Producers (RE IPPs) who have installed RE based power plants like wind, small hydro and solar PV. GOC can consider having a long-term power purchase agreement with these RE IPPs in purchasing fixed quantity of power for a period of 5 to 10 years.

Evolve a system to monitor the implementation of various GHG mitigation opportunities

AEC has an action plan to reduce its GHG emissions. AEC should also evolve a system to monitor the implementation of various GHG mitigation opportunities. It is recommended to use a Gantt chart to mark out the action plan for the activities and track its implementation. Gantt chart will serve as an excellent way to instantly monitor and comprehend all different tasks in one place which would ease tracking of implementation.

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ENERGY EFFICIENCY

Annual energy consumption of AEC campus is 44,232 units. There are major blocks in the campus which consumes energy for their operation. Major energy consumers are:

1. Air conditioners
2. Fans
3. Lighting

Replace Conventional Ceiling Fans with Energy Efficient BLDC Fans

During the Energy Audit at AEC, a detailed study was carried out to identify the potential for replacing the existing ceiling fans with BLDC super fans. There are 400 fans operating in AEC campus.

Instead of conventional ceiling fans, latest technology BLDC fans which consume only 30W can be installed in the newly constructed building. A brushless DC (BLDC) motor is a synchronous electric motor powered by direct-current (DC) electricity and having an electronic commutation system, rather than a mechanical commutator and brushes. A BLDC motor has an external armature called the stator, and an internal armature called the rotor.

The rotor can usually be a permanent magnet. Typical BLDC motor-based ceiling fan has much better efficiency and excellent constant RPM control as it operates out of fixed DC voltage. The proposed BLDC motor and the control electronics operate out of 24V DC through an SMPS having input AC which can vary from 90V to 270V. The operational block diagram of a BLDC motor is as follows:

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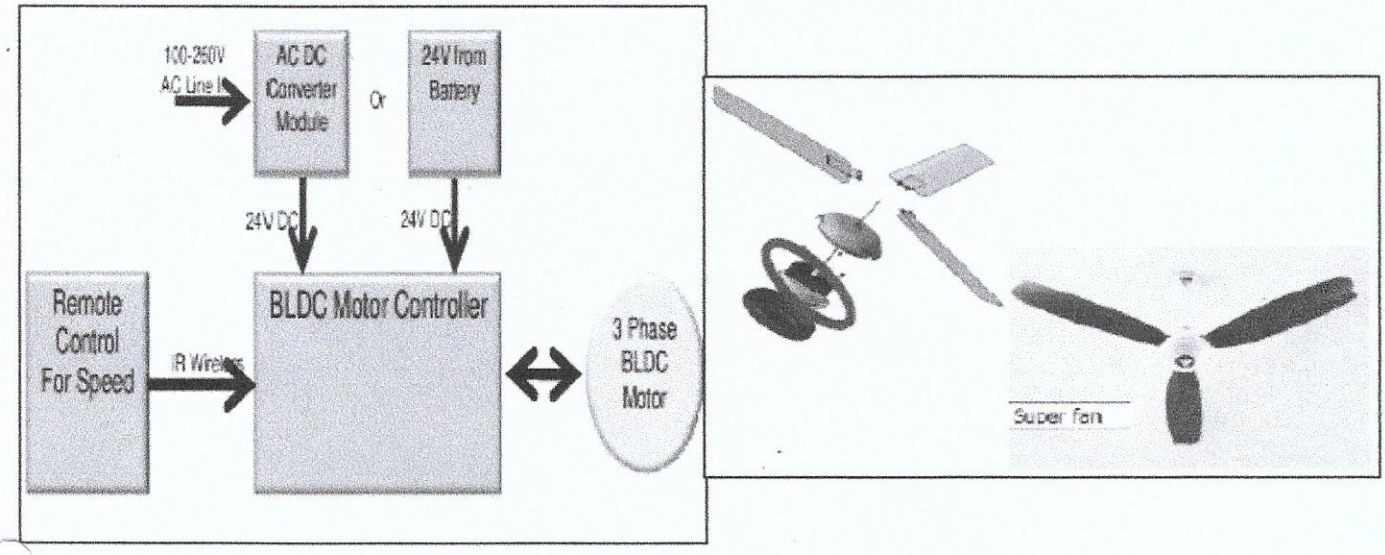
Calculations:



With the replacement of existing ceiling fans with Super Fans the energy consumption is likely to reduce by 55% per fixture. Considering 200 fans being replaced with super-efficient BLDC fans, 14 kW can be saved. Considering the average operating hours to be 2000 and unit cost as Rs. 7.50, the calculations are as follows:

Total no. of fans in college	:	400
No. of fans considered for calculation	:	200
Energy consumption per fan	:	70 W
Total energy consumption of fans	:	70W X 200 fans
	:	14 kW
uper-efficient BLDC fans energy consumption	:	30 W
Savings from 70W to 30 W	:	55%
Total savings in fans energy consumption	:	55% of 14 kW
	:	7.7 kW
Savings per year	:	7.7 kW X 2000 hrs X Rs. 7.50 / unit
	:	Rs. 1.50 Lakhs
Investment	:	Rs. 3, 50, 000
	:	28 months
Annual emission reduction potential	:	12.00 T CO2

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Replace Conventional Lamps with LED Lamps

As per the data submitted, the total number of all the lighting fixtures installed are 2800 tube lights.

The campus should be keen in harnessing the day lighting available thereby reducing the use of artificial lighting.

Based on the occupancy, monitoring should be ensured to reduce excessive consumption of energy.

Major savings in energy through lighting fixtures can be achieved by replacing all the above existing fixtures with LED's meeting the required LUX levels. The LED's being less energy consuming while maintaining the equivalent lux is the more sustainable option. The replacement of lighting fixtures should be done as per failure replacement policy i.e. change the old fixture with LED when it fails

Advantages of LED

- Lower energy consumption: The energy consumption of LEDs is low when compared to the other conventional sources for the same amount of Lumen output.

Performance comparison of different type lights

Type of Lamp	Lumen/ Watt	CRI	Life hours
HPSV lamps	90-120	Bad (22-25)	15,000-20,000
Metal Halide lamps	65-00	Good (65-90)	18,000
LED lamps	100-150	Very Good (> 80)	10,000 – 12,000

- **High S/P ratio**: LEDs have higher scotopic/photopic ratio (S/P ratio). The eye has two primary light sensing cells called rods and cones – cones function in day light and process visual information whereas rods function in night light. The cone dominated vision is called photopic and the rod dominated vision is called scotopic. The S/P ratio indicates the measure of light that excites rods compared to the light that excites cones. In office environments, illumination

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is more effective if the S/P ratio is high as it is under scotopic region. LEDs hence are ideally suited for these applications as they have a high S/P ratio.

- **Longer life-time**: LEDs have longer life time of around 1,00,000 hours. This is equivalent to 11years of continuous operation or 22 years of 50% operation.
- **Faster switching**: LED lights reach its brightness instantly upon switching and can frequently be switched on/off without reducing the operational life expectancy.
- **Greater durability and reliability**: As LEDs are solid-state devices and uses semi-conductor material; they are sturdier than conventional sources that use filaments or glass. LEDs can also withstand shock, extreme temperatures and vibration as they don't have fragile materials as components.
- **Good Colour Rendering Index (CRI)**: The color rendering index, i.e., measure of a light sources' ability to show objects as perceived under sunlight is high for LEDs. The CRI of natural sunlight is 100 and LEDs offer CRI of 80 and above.
- LED offers more focused light and reduced glare. Moreover, it does not contain pollutants like mercury. LED technology is highly compatible for solar lighting as low-voltage power supply is enough for LED illumination.

Conclusion

AEC has initiated few energy efficiency activities in their campus. While Sustainable Living Inc appreciates the plant team for their efforts, we would like to emphasize that opportunity exists to further reduce the energy consumption. Installation of renewable energy is to be given major focus. RESCO model can be adopted to install renewable energy without upfront capital investment. We in Sustainable Living Inc are sure that all the recommendations mentioned in the report will be implemented by AEC team and the overall environmental performance of the campus will be improved.

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List of Vendors

Equipment	Supplier Name	Contact Person	Mail Address	Contact Number
AC Energy Saver	Gloabtel Convergence Ltd	Mr Chirag Morakhia	chirag@gloabtel.com	9324176440
AC Energy Saver	Magnatron International	Mr Kishore Mansata	indiaenergysaver@gmail.com	9748727966
BLDC Ceiling Fans	Atomberg Technologies Pvt Ltd	Ms Roshni Noronha	roshninoronha@atomberg.com	9987366655
BLDC Ceiling Fans	Versa Drives	Mr Sathish	sathish@versadrives.com	94885 94382
LED	Havells India Ltd	Mr. Sunil Sikka	sunil.sikka@havells.com	0120-4771000
LED	Kwality Photonics Pvt. Ltd.	Mr. K. Vijay Kumar Gupta	kwality@kwalityindia.com	+ 91 40 2712 3555
LED	OSRAM Lighting Pvt. Ltd.	Mr Nitin Saxena	N.saxena@osram.com	+91 124 626 1300
LED	Reckon Green Innovations Pvt Ltd	Mr Krishna Ravi	krishna@reckongreen.com	9985333559

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