

# ENERGY AUDIT REPORT

2021-22

in compliance with the statutory requirements under the NAAC accreditation procedures



Rashtriya Shikshana Samithi Trust's

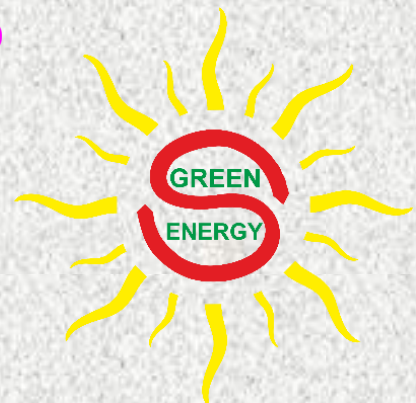
**R V College of Engineering. (Autonomous)  
Bangalore**

Principal Lead Auditor:  
Mallikarjun A Kambalyal. CEA, ISO 50001, 14001 Lead Auditor.

## SUNBSHUBH TECHNOVATIONS PVT LTD

120-2, LGF, 'A' wing, IT Park,  
Hubli – 580029. Karnataka. India.  
German off: Neuer Weg 166, 47803 Krefeld,  
Dusseldorf. Germany Anbieter-Nr 1041388

Website: [www.sunshubhrenewables.ocm](http://www.sunshubhrenewables.ocm)  
Email: [ceo@sunshubhrenewables.com](mailto:ceo@sunshubhrenewables.com)



# ENERGY AUDIT REPORT

---

## THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

## ABOUT SUNSHUBH TECHNOVATIONS PRIVATE LIMITED

Sunshubh Technovations Private Limited is registered in the year 2020 and has evolved from initial proprietary concern, Sunshubh Renewables & Research Centre. Sunshubh has been in operation since 2008. Sunshubh today is led by a team of well experienced Certified Energy Auditors and tech- savvy young engineers.

We believe in Identifying opportunities and executing solutions based on need with highest priority to Energy conservation over efficiency.

Since beginning, Sunshubh has been growing and today, we have wide range of clientele In the field of Industry : Tool room, Chemicals and refinery, Mining, Health, Hospitality, Food processing, Infrastructure and Educational institutions under NAAC compliance. Our approach has been very aggressive in equipping ourselves with the latest instruments.

After decade of professional experience, we restructured ourselves and thus the formation of a Private Limited company on 22<sup>nd</sup> July 2020.

Today we have with us the technical team comprising three Certified Energy Auditors, One Certified Energy Manager and support team of young and enthusiastic engineers to comply to the client requirements.

## POLICY MATTERS

Learning from our training in Germany and their policies, SUNSHUBH does not supply any energy saving equipment's or systems. However, we do stand up to support and execute the measures to prove our findings right. This is mandatory to assure the client that we do not market any self-centred product or orient the Audit assignment to sell any third party product. Meaning to say **we stand neutral to all methodologies in the interest of adopting best technologies.**

We strongly believe in sharing our knowledge and training inhouse manpower for continual improvement in energy flow.

We have set a policy not to hire the instruments from third party but to procure every small or big ones to do justice to our clients.

## CONTENTS

LIST OF ONSITE PHOTOS AND DISCUSSIONS.....	6
EXECUTIVE SUMMARY .....	7
CRITERION VII – INSTITUTIONAL VALUES AND BEST PRACTICES .....	9
PART 1 – GENERAL .....	18
CARBON FOOTPRINT - GREEN PLEDGE.....	18
ACKNOWLEDGEMENT:.....	19
ENERGY AUDIT COMPLETION CERTIFICATE.....	21
ONGOING STATUS: .....	27
WHY IS THIS AUDIT BEING CARRIED OUT? .....	27
WHAT IS AN ENERGY AUDIT? .....	27
WHY SHOULD YOU GET AN ENERGY AUDIT? .....	28
ENERGY AUDIT OBJECTIVES .....	29
THE GOALS OF ENERGY AUDIT .....	30
UNDERSTAND THE SCOPE OF AUDIT .....	31
Geography .....	33
Climate .....	34
Pollution control .....	35
Waste management .....	36
Culture .....	38
LIMITATIONS:.....	40
PART 2 -TECHNICAL .....	41
DISCUSSIONS ON EXECUTIVE SUMMARY:.....	41
RENEWABLE ENERGY .....	42
SENSOR TECHNOLOGY .....	43
NATURAL LIGHTING.....	47

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

LIGHT INTENSITY SENSOR REQUIREMENT. ....	47
BATTERY MANAGEMENT. ....	48
BATTERY PLACEMENT: .....	48
BATTERY REGENERATION .....	52
NECESSITY AND ISSUES .....	53
RISK IDENTIFICATION OF LEAD-ACID BATTERIES .....	54
LEAD .....	56
SULFURIC ACID .....	57
CADMIUM .....	57
SAFETY TIPS .....	58
VENTILATION .....	58
NATURAL VENTILATION. ....	59
WHY SUPER ENERGY EFFICIENT CEILING FANS? .....	60
SAFETY. ....	63
WHERE CAN PANELBOARDS AND LOAD CENTERS BE LOCATED IN MY BUILDING? ....	64
ELECTRICAL INSULATING MATS .....	66
LIST OF INSTRUMENTS: .....	68
ACTION PLAN SUMMARY: .....	70
MODE OF ACTION: .....	70
NOTES: .....	71



**LIST OF ONSITE PHOTOS AND DISCUSSIONS.**

Figure 1 - Ecological pyramid .....	9
Figure 2 - Innovation key pointers.....	10
Figure 3 - Bureau of energy Efficiency Regd No: EA3485 .....	22
Figure 4- ISO Certified Lead Auditor. Certificate No: 47730.....	23
Figure 5- ISO Certified Lead Auditor. Certificate No: ENR-00253448.....	24
Figure 6 - Manager training programme, Germany .....	25
Figure 7 - Fit for partnership with Germany.....	26
Figure 8 - Thermographic images of 11 kV substation.....	42
Figure 9 - Need for occupancy sensor .....	44
Figure 10 - Lighting need for sensor.....	44
Figure 11 - T5 & T8 tube lights with Electromagnetic choke.....	45
Figure 12 - Equipment load management .....	45
Figure 13 - Use of natural lighting where possible .....	47
Figure 14 - Use of Light colored curtains and avoided blocades .....	48
Figure 15 - Battery placement, Need cross ventilation. ....	49
Figure 16 - Thickly populated & stacking in unventilated area .....	50
Figure 17 - Galvanic reaction causing damage to battery life .....	51
Figure 18 - Thermal inspection of the battery bank.....	51
Figure 19 – Blocked cross ventilated class room.....	60

## EXECUTIVE SUMMARY

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
1	Power Consumption	PF Penalty	Energy & revenue loss	Install Capacitor bank.	Rs.50,000/- approximately	Avoided revenue penalty	
2	Solar Power	Suggest to install Solar Power to minimise use of energy during Offgrid times.					7.1.2
3	Occupancy sensor	Wastage of power	High	Occupancy sensor based switching	₹1500 per room	Resulted ROI of one year.	7.1.2
4	Battery placement	Concealed enclosure. Battery shell in conductor loop	Low performance & self-discharge.	Design the stacking arrangements.	In house resources	25% of the cost of the batteries.	7.1.2, 7.1.6
5	Battery regeneration.	Short life span	300% of the cost of the battery.	Subject all batteries to regeneration made.	Rs.20.00 Lacs or as per user agreement	300 %	7.1.2, 7.1.6
6	Electrical	Old tube lights	High energy consumers	LED lights of appropriate ratings.	Rs.80/- to Rs.250/- per unit	Rs.175/- per tube per annum. ROI of 1 years.	7.1.6

## THOUGHT FOR EVERY MOMENT

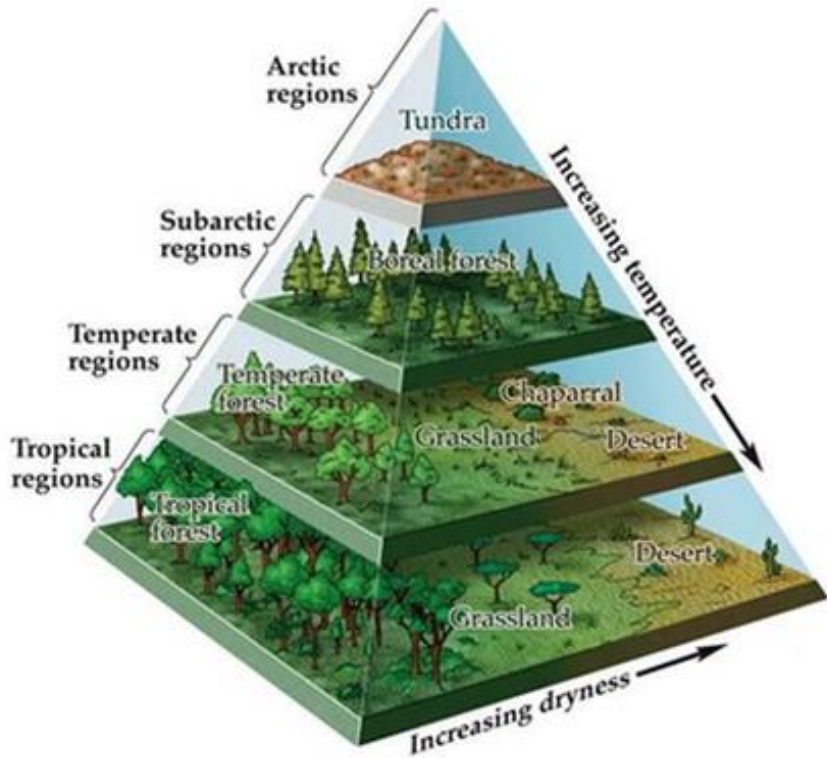
There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
7	Natural Lighting	Un cleaned windows and ventilators, forced switching on of tube lights	High energy bills	Clean the windowpanes and allow maximum natural light penetration.	Nil, part of routine, In house manpower .	Substantial cost of energy bills on lighting.	7.1.2, 7.1.6
8	Natural Ventilation	Permanently closed ventilators.	Creation of hot air pockets below the ceiling.	Open the Ventilators for easy exit of hot/warm air from the rooms.	Nil, In house manpower .	Eliminates use of Electrical Fans and Substantial cost of energy bills	7.1.2, 7.1.6

\* For details, please follow the discussions in the report.



**CRITERION VII – INSTITUTIONAL VALUES AND BEST PRACTICES****Key Indicator - 7.1 Institutional Values and Social Responsibilities**

Metric No.	Description	Compliance	Initiatives required
7.1.1  QIM	<p>Measures initiated by the Institution for the promotion of gender equity during the last five years.</p> <p>Annual gender sensitization action plan</p> <p>Specific facilities provided for women in terms of:</p> <p>Safety and security - Energy</p>	Partly  Complied	<p>Our The concept of home energy management may be initiated for the women. The typical illustration is reproduced.</p>
	 <p>Figure 1 - Ecological pyramid</p>		

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



Figure 2 - Innovation key pointers

	Environmental Consciousness and Sustainability		Discuss on why the recent calamities keep occurring more often than before.
7.1.2 Q <sub>n</sub> M	<p>The Institution has facilities for alternate sources of energy and energy conservation measures</p> <ul style="list-style-type: none"> <li>• Solar energy</li> <li>• Biogas plant</li> <li>• Wheeling to the Grid</li> <li>• Sensor-based energy conservation</li> <li>• Use of LED bulbs/ power efficient equipment</li> </ul>	Complied through parent society.	<p>Considering the cost of energy use, serious consideration may be taken up for,</p> <p>Solar</p> <p>Biogas plant in Hostel mess.</p> <p>If solar is installed the power can be exported to grid on non-working hours.</p> <p>Sensor based control is a must for energy use optimization.</p> <p>Complete the ongoing work at faster pace.</p>

7.1.3 Q <sub>1</sub> M	Describe the facilities in the Institution for the management of the following types of degradable and non-degradable waste (within 500 words)  Solid waste management Liquid waste management Biomedical waste management E-waste management Waste recycling system Hazardous chemicals and radioactive waste management	Complied partially wrt minimising .	Energy consumption details need to be monitored and the benefits of avoided accumulated energy use and power demand should be established.
7.1.4 Q <sub>n</sub> M	Water conservation facilities available in the Institution:  Rain water harvesting Borewell /Open well recharge Construction of tanks and bunds Waste water recycling Maintenance of water bodies and distribution system in the campus	Complied . Open ground percolation, Open well restoration. Percolation pond near to open well	The institution should consider in measuring the energy and power demand at various ground water table to demonstrate the impact of increased water table by rainwater harvesting methods. Kindly refer to the article listed at the end of the table.
7.1.5	Green campus initiatives include (4)	Partially complied.	With disciplined vehicle parking the reduction in fuel

Q <sub>n</sub> M	<p>7.1.5.1. The institutional initiatives for greening the campus are as follows:</p> <p>Restricted entry of automobiles</p> <p>Use of Bicycles/ Battery powered vehicles</p> <p>Pedestrian Friendly pathways</p> <p>Ban on use of Plastic</p> <p>landscaping with trees and plants.</p>		consumption can be demonstrated in the college campus. The students can be given a task of conducting such practical on field and a competition should educate the society.
7.1.6 Q <sub>n</sub> M	<p><i>Quality audits on environment and energy are regularly undertaken by the institution (5)</i></p> <p>7.1.6.1. The institutional environment and energy initiatives are confirmed through the following</p> <ol style="list-style-type: none"> <li>1.Green audit</li> <li>2. Energy audit</li> <li>3.Environment audit</li> <li>4.Clean and green campus recognitions/awards</li> <li>5. Beyond the campus environmental promotional activities</li> </ol>	Complied .	The audit findings should be predominantly projected by action from all stake holders of the institution.
7.1.7 Q <sub>n</sub> M	<p><i>The Institution has disabled-friendly, barrier free environment</i></p>	The initiatives have been	The demand for muscle power to climb the ramp may be considered as one such case

	<p>Built environment with ramps/lifts for easy access to classrooms.</p> <p>Disabled-friendly washrooms</p> <p>Signage including tactile path, lights, display boards and signposts</p> <p>Assistive technology and facilities for persons with disabilities (Divyangjan)</p> <p>accessible website, screen-reading software, mechanized equipment</p> <p>Provision for enquiry and information: Human assistance, reader, scribe, soft copies of reading material, screen reading</p>	considered.	and ideally establish the gradient of the ramp.
7.1.9 QIM	<p><i>Sensitization of students and employees of the Institution to the constitutional obligations: values, rights, duties and responsibilities of citizens</i></p> <p>Describe the various activities in the Institution for inculcating values for being responsible citizens as reflected in the Constitution of India within 500 words.</p>	Need to explore.	<p>The sensitization of switching off the non-required electrical appliances and devices should be encouraged. Like organizing the inhouse competition.</p> <p>Every student to table their energy bills in the previous year. The savings in the forth coming year should be recorded and an energy ambassador award be shouldered on the top</p>

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

			students. This activity brings in the sense of responsibility, accountability and importantly knowing their energy use and abuse.
7.1.10 QnM	<p><i>The Institution has a prescribed code of conduct for students, teachers, administrators and other staff and conducts periodic programs in this regard.</i></p> <p>The Code of Conduct is displayed on the website There is a committee to monitor adherence to the Code of Conduct Institution organizes professional ethics programs for students, teachers, administrators and other staff Annual awareness programs on Code of Conduct are organized</p>	Complied .	A range of activities can be brought in just as discussed in 7.1.9 above.
7.1.11 QiM	<i>Institution celebrates / organizes national and international commemorative days, events and festivals</i>	Complied	In today's practices, the celebration has been formal. The actual celebration has to be yearlong. The theme for the year has to be laid and the activities should be conducted



	Describe the efforts of the Institution in celebrating /organizing national and international commemorative days, events and festivals during the last five years within 500 words		and on the day of celebration the selective activities be carried out. Just to illustrate, Consider the Republic Day. We celebrate the flag hoisting and with cultural activities. Consider the week-long program where in, students can discuss what is the Republic Day. How the final draft got to be written and who all are the members of the draft committee. <a href="https://en.wikipedia.org/wiki/Constitution_of_India">https://en.wikipedia.org/wiki/Constitution_of_India</a>
7.2.1 Q/M	Describe two best practices successfully implemented by the Institution as per NAAC format provided in the Manual.	Complied .	When the listed activities from 7.1.1 to 7.1.11 are complied, the institute can have many creative best practices and the achievements can really bring in the name, fame and the recognition and appreciation not just on records but on monetary contributions as well.

# The Bulletin on BEEnergy Efficiency

August 2005 Vol 6 Issue 1

## EDITORIAL BOARD

Patron-in-Chief: Shri Vilas Muttemwar,

Hon'ble Minister of State (MNES)

Patron: Shri A.M. Gokhale, Secretary, MNES

Editor-in-Chief: Shri Debashish Majumdar,

Managing Director, IREDA

Executive Editor: Dr P. Venkata Ramana, Winrock

International, USA

Editorial Coordinator: Mr Arvind Reddy, Winrock

International India

## MEMBERS

Ms Anita Ahuja, Conserve

Shri A.K. Asthana, National Productivity Council

Ms Leena Mehendale, PCRA

Shri B.V. Rao, IREDA

Shri Brahmanand Mohanty, Energy Efficiency

Specialist

Shri Bhaskar Natarajan, India-Canada Environment

Facility

Shri S. Padmanaban, USAID/India

Shri V. Raghuraman, Confederation of Indian Industry

Shri S. Ramaswamy, GTZ - India

## WINROCK EDITORIAL TEAM

Content Copyedit Layout & Design

Mathews Thayil Bhawani Shankar Jaison Jose

The views expressed in the articles are those of the authors and do not necessarily reflect those of IREDA or WIL.

इन लेखों में प्रकट विचार मूलतः लेखकों के हैं तथा यह आवश्यक नहीं है कि इरेडा या विनरॉक भी इन विचारों से सहमत हो ।

This publication is supported by

Indian Renewable Energy Development Agency

IREDA is a financial institution set up by MNES to provide concessional financial support to energy efficiency/conservation and renewable energy sectors. For more information, see IREDA web site [www.iredatd.com](http://www.iredatd.com) or contact:

Core-4A, East Court, 1<sup>st</sup> Floor  
India Habitat Centre, Lodhi Road, New Delhi-110003  
Tel: 91-11-2468 2214-21 Fax: 91-11-2468 2204  
E-mail: [efficiency@rediffmail.com](mailto:efficiency@rediffmail.com)  
Website: [www.iredatd.com](http://www.iredatd.com)

FROM THE EDITOR-IN-CHIEF

## The simple economics of water and energy security



It is estimated that the global annual use of commercial energy is about 400 Quads (quadrillion BTUs). The sun pours an additional 6 million Quads of radiant energy into the Earth's atmosphere each year. Thus in absolute terms, energy available is several orders of magnitude higher than demand. Yet, the world continues to struggle against an acute energy crisis. This leads one to believe that the problem is not merely of energy availability but rather a problem of affordability. Energy is a matter of pure economics, of demand and supply – at a cost.

A similar principle applies to water. Though roughly 80 percent of the Earth's surface is water, cheap potable and clean water is simply beyond the reach of millions across the world. Potable water sourcing, treatment, and distribution require considerable amounts of energy. Access to water is therefore closely linked to energy availability and affordability.

This close interdependence between energy and water needs to be clearly recognized and the nexus addressed suitably at the policy level. The first and foremost priority of any energy policy should be the wise, efficient use of whatever energy supplies are available. Similarly, priority should be given to the efficient use of whatever water supplies exist. Once the issue of efficient use has been tackled, focus can then be shifted on creating new energy and water supplies that meet sustainability and environmental requirements. And this may not be as difficult to achieve as it appears.

As in the case of energy use, the difficult part is reducing the quantum of water use while maintaining the level of benefits both for the customer and the utility. If this can be addressed, water utilities can save money as the reduced demand effectively creates more system capacity. With decreasing demand, the water utility effectively avoids additional investments in new facilities and equipment. Reduced volume of water flowing through the system has the attendant advantage of reduced frictional energy losses, thereby reducing the cost of pumping. This leads to a win-win situation for both the consumer and the utility, with the consumer benefiting through the reduced cost of delivery, diminished chances of water shortfalls, and the utility benefiting from decreased likelihood of major investment expenditures.

Needless to say that all this also saves energy. In rural areas, a large number of irrigation pump sets are either operated at highly subsidized electricity tariff from the power utilities or at no cost at all, encouraging the use of poorly designed inefficient pump sets which are over-rated and over-used. Replacing these pump sets with energy-efficient ones is one option, but who bears the cost? Another option is rainwater harvesting. For every one foot increase of the water table one achieves an approximate savings of 1 percent power.

Which means one gets more for the same energy use. That's simple economics.

*Debashish Majumdar*  
Debashish Majumdar  
Managing Director, IREDA

## Water–Energy: two faces of a coin

*There is a direct relationship between water and power. A reduced water table is directly proportional to the square of the increased electrical power consumption, says the author*

We all presume that if the dams and reservoirs are full then electrical power could be available in plenty. However, we tend to ignore that the demand for electrical power has been growing at a much faster rate than what we can produce and, hence, any amount of rain and or electrical power generated is insufficient to meet our demand. Most thermal power plants are running low owing to a short supply of coal. So where are we?

The recent changes in temperature and erratic rainfall has a direct relationship with urbanization. With increased urbanization and industrialization, we have only created a greater need for energy. This energy is sourced primarily from fossil fuels such as coal and nuclear power plants. In the absence of rains, the only means of generating electrical power is by burning fossil fuels. The burning releases emissions into the atmosphere, resulting in increased CO<sub>2</sub> concentration in the troposphere, and subsequently the greenhouse effect. The disturbed rainfall pattern is a result of this global warming.

The demand for power can be classified into four areas: agricultural need-based; industrial need-based; commercial need-based; and domestic need-based.

Today, a number of agencies such as the Bureau of Energy Efficiency (BEE), Petroleum Conservation Research Association (PCRA), the National Productivity Council (NPC) and a host of voluntary organizations, are working at ensuring energy efficiency in industries. But while the commercial and domestic need-based sectors have the potential, little is being done in this area. These sectors need a lot of education, motivation and awareness.

The agricultural industry needs the greatest attention, mainly in irrigation pump-sets (IPs). Most IPs are being operated free or on highly subsidized electricity supply. But eventually they consume a lot of power.

For instance, there are 16,000 irrigation pumps reportedly being operated under the HESCOM (Hubli Electric Supply Company), a division in North Karnataka. If, on an average each 5 HP pump consumes 3.73 kW of power per hour (there are actually a greater number of 10 HP pumps), the total consumption is as below:

For 10 hours per day = 37.30 kWh  
For 200 days of watering = 7,460 kWh (7.46 MWh/pumpset)  
For 16,000 sets, it is 119,360 MWh which means, 358,080 MWh of power generation at the power plant.

To reduce this consumption, should the IP users be asked to change over to energy-efficient sets? The question is:

- can the users afford the change?
- are they willing to accept the new brands of sets imposed on them?
- can the sale of inefficient IP sets be controlled?

Or should measures be adopted where the users may not use the IPs at all? Or can power consumption be reduced?

One good method is to reduce power consumed by IP sets by increasing the water table. If the water table can be increased by, say, 13 ft, then for the same 150 LPM delivery we will need a 4 HP (2.984 kW), and the savings for 16,000 IP sets would be 23,872 MWh, which is 20 percent – approximately 1.5 percent power saving for every feet of increase in the water table. This increase in water table can be achieved by adopting rainwater harvesting – through either bunds or by natural

filtration tanks or by preventing pumping of water by making use of rainwater.

Now who meets the cost of these programs is one big question. Let us see how the electrical supply company benefits: If the organization spends around Rs 5,000 per IP set, we have Rs 800 crore as the capital investment on rainwater harvesting. For an annual savings of 23,872 MWh of electrical power, a savings of Rs 9.55 crore at the rate of Rs 4 per kWh for every feet increase in the water table.

It is always better not to use energy than try and save energy.

When a process industry utilizes water for its operations, then this water has to be demineralized or softened. To do this, it will need electrical power. Also due to dissolved solids and increased concentration, repeated breakdowns may happen, demanding periodic maintenance and scraping of industrial components, which means more energy consumption.

Now, greater the amount of rainwater harvested, lesser will be the dissolved solids, which means less breakdowns and increased fuel savings. Once the fuel consumption comes down, the release of CO<sub>2</sub> into the atmosphere is also reduced. Reduced CO<sub>2</sub> means lesser effect on global warming. This will then lead to stable weather conditions and predictable monsoons. Once the ecological cycle is renewed, achieving a balance between industrial, agricultural and environmental growth is easy.

Water is a renewable source of energy and must be conserved.

*Courtesy: Mallikarjun A. Kambalyal, President, Sunshubh Renewable Energy Foundation  
E-mail: mallu\_solar@yahoo.co.uk*

**CARBON FOOTPRINT - GREEN PLEDGE**

(PROPOSED)

We the Principal, the staff and students, adopt responsible practices in our daily activities with due regard to the environment. We set and continually review objectives and targets for achieving our goal to protect our entire college premises in front, backyard and all other non-approachable areas of all primary and secondary pollutions.

We seek to compile with safety and environmental regulations to implement inhouse standards to improve our environmental performance. We commit ourselves to the safe operation of all our working habits, be it in classrooms, library, canteen, on road, off road, in-campus out-campus as well as at our place of stay. We adhere to reduce environmental load by efficiently using resources, saving energy, reducing waste, encouraging material recycle, with special emphasize to minimising emissions of greenhouse gases, ozone depleting substance and particle matter.

We endure to minimise environmental loads and adopt environmentally friendly technologies when ordering and purchasing necessary products and resources. We endure to attend educational programs and promulgate our close friends and colleagues to follow suite We endure to ensure that we recognize the essence of this Green policy by actively and aggressively conducting workshops and training to all in environmental concepts. We make wide ranging social contribution to close association with the students, teaching staff, administrative staff, housekeeping staff by disclosing environmental information and supporting environmental consumption.

-Sd-

Principal

*(Indicative templet for display at all prominent areas, waiting rooms, canteen, library, relaxing areas in the campus.)*THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,





Wishing the team, a great success we deeply express our gratitude and heartfelt "THANKYOU" for allowing us to assess the energy flow scenario there by the ENERGY STATUS.

We acknowledge the involvement of HODs & Coordinator

Dr K N Subramanya

Principal

Col Ishwar Doddamani

Deputy Director-Administration

Sunil Murthy

Civil Engineer – RV Campus.

Mallikarjun A. Kambalyal. B.E.(E&C).

Certified Energy Auditors (EA-3485)

SUNSHUBH TECHNOVATIONS PVT LTD.

ENERGY AUDIT REPORT

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



**ENERGY AUDIT COMPLETION CERTIFICATE**

I, Mallikarjun A Kambalyal, endorse and confirm that the Energy Audit has been carried out on 29<sup>th</sup> Oct 2021 under the instructions of Principal, Dr K N Subramanya for R V College of Engineering, Bengaluru. This report is generated based on the site visits and evidence collected from the site.

All attempts have been made to evaluate the scope for development and inculcate green practices in the campus and extended throughout the campus. The focus is also laid to make positive impact on the society for a better living.

I also confirm and sign this certificate, in case the institution needs demonstration, my team of professionals shall be happy to do so.

We present this report to much more than the legal or mandatory compliances. This report is tabled in two parts. The first forms the core discussions which are general in nature. The second section is subject specific under the statutory requirements of the NAAC accreditation norms. They are Audit reports on, Green aspects, Energy aspects, Environment aspects, Health aspects and the discussions on net CARBON FOOTPRINT & the CARBON HANDPRINT initiatives.

Any modifications, changes, omissions after the site visit shall be exclusive.

**Authorised Auditor.**

**Mallikarjun A. Kambalyal** B.E (E&C)

**Certified Energy Auditors EA-3485& ISO 50001:2011 & ISO14001:2015 Lead Auditor.**



## BUREAU OF ENERGY EFFICIENCY



Examination Registration No. : **EA-3485** Serial Number **2838**

Certificate Registration No. : **2838**

### Certificate For Certified Energy Manager

This is to certify that Mr./Mrs./Ms. **Mallikarjun A Kambalyal** Son/Daughter of Mr./Mrs. **Andanappa V Kambalyal** who has passed the National Examination for certification of energy manager held in the month of **April 2006** is qualified as certified energy manager subject to the provisions of Bureau of Energy Efficiency (Certification Procedures for Energy Managers) Regulations, 2010.

This certificate shall be valid for five years with effect from the date of award of this certificate and shall be renewable subject to attending the prescribed refresher training course once in every five years.

His /Her name has been entered in the Register of certified energy manager at Serial Number **2838** being maintained by the Bureau of Energy Efficiency under the aforesaid regulations.

Mr./Mrs./Ms. **Mallikarjun A Kambalyal** is deemed to have qualified for appointment or designation as energy manager under clause (I) of Section 14 of the Energy Conservation Act, 2001 (Act No.52 of 2001).

Given under the seal of the Bureau of Energy Efficiency, this **7<sup>th</sup>** day of **February, 2013**

Secretary  
Bureau of Energy Efficiency  
New Delhi

Dates of attending the refresher course	Secretary's Signature	Dates of attending the refresher course	Secretary's Signature
<b>28.01.2020</b>			

Figure 3 - Bureau of energy Efficiency Regd No: EA3485

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



Figure 4- ISO Certified Lead Auditor. Certificate No: 47730

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



Figure 5- ISO Certified Lead Auditor. Certificate No: ENR-00253448

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



## Teilnahmebescheinigung

**Mr. Mallikarjun Andanappa Kambalyal**

has successfully completed the

**Manager Training Programme  
of the Federal Ministry of  
Economics and Technology**

Germany, September 02 – 28, 2013

*Energy Efficiency in Industrial Enterprises*

Cologne, September 28<sup>th</sup>, 2013



Dr. Steffi Artl  
(Geschäftsführerin)



Hubert Smarowos  
(Geschäftsführer)

TÜV Rheinland Akademie GmbH • Alboinstr. 56 • 12103 Berlin

© TÜV, TÜV und TÜV sind eingetragene Marken. Eine Nutzung und Verwendung bedarf der vorherigen Zustimmung durch das Unternehmen.

Figure 6 - Manager training programme, Germany

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



Figure 7 - Fit for partnership with Germany

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



## ONGOING STATUS:

It's an optimistic & highly dedicated team effort lead by the Principal & the senior staff who have dedicated all their wits & free time to initiate Green Carpet the entire college premises. It is also a fact that there do exist few short comings which however is unintentional & on being trained & educated the campus should look for continued minimized waste generation. With all due appreciation to the management, staff involved & cooperation by the students, we have made few suggestions which on implementation, will reduce, demand for water & electrical power. It will also reduce the existing level of pollution to bear minimum.

**NO WASTE – NO POLLUTION – NO HEALTH HAZARD.**

## WHY IS THIS AUDIT BEING CARRIED OUT?

Whether you own or manage a small business, a large commercial facility, or a manufacturing operation, it's important to take advantage of any tips, programs and incentives that will help you save money on your energy bills. There are measures that will generate savings to positively impact your bottom line immediately, as well as longer-term strategic initiatives to assess your needs and stabilize your energy spend in the longer term – which is great news for your budget!

One such initiative is an energy audit. Energy audits reveal your usage patterns, identify waste, over-expenditure and, generally, make you fully cognizant of where your energy dollars are going. This knowledge will enable you to be more efficient with your energy use and be able to track and accelerate savings. Energy Audits may sound expensive or complicated, but they can be free and are easier than you think.

## WHAT IS AN ENERGY AUDIT?

An energy audit is an analysis of a facility, indicating how and where that facility can reduce energy consumption and save energy costs. Its insight to energy efficiency and conservation can lead to significant savings on the company's utility bill.

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

## WHY SHOULD YOU GET AN ENERGY AUDIT?

Energy costs are soaring and your business can be at considerable risk if you do not take the guesswork out of your energy usage and the budget you need to cover it. Energy audits identify where your business is wasting energy. Residential and commercial properties account for around 10% of carbon emissions in the US, according to the EPA, which means they are very inefficient and waste huge amounts of energy and... revenue. An energy audit helps by revealing just how and where energy is being wasted. With thousands of commercial energy customers nationwide, we are well-qualified to advise you on which methods are best used for reducing energy waste and overall energy consumption. Let's start with a simple free evaluation of your bills and show you how we have been found to save between 5% and 35% for many of our customers.

In the case of energy, less is more. Lower energy consumption equals lower energy costs. And, of course, less energy consumption is obviously good for the environment.

As you can see, to be truly effective, energy management requires a strategy just like the other aspect of your operation and measures to curb costs can be simple and in some cases free. Gaining more control over your energy costs will improve the general health of your budget. Not only that but reducing your CARBON FOOTPRINT is great for the environment too!

---

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

## ENERGY AUDIT OBJECTIVES

Energy Audit was initiated in the beginning of 1970's, with the motive of inspecting the work executed within an organization, whose exercises could cause risk to the health of inhabitants and the environment. It exposes the genuineness of the proclamation made by the organisation with the concern on health issues. As a consequence of their operations with respect to environmental pollution it is the duty of the organisation to carry out the Energy Audit of the ongoing processes for various reasons, such as,

- To make sure whether one is performing in accordance with the relevant rules and regulations,
- To improve the procedures and aptness of material in use,
- To analyse the potential duties and to determine a way which can lower the cost and to the revenue.

Through Energy Audit one gets adoration as to how to improve the condition of the environment. There are various factors that were forced upon and determine the growth of/or conduct of Energy Audit. Incidents like,

- Decades old Bhopal gas tragedy, that has left its residual effect which still haunts us.
- Our buildings catching fire due to various reasons,
- Industries blowing off taking valuable human lives etc
- People going sick, feeling tired, after long hours of operations in the organization,
- Increased demand of generators due to inconsistent power supply, which has resulted or lead into recent floods and droughts,

are some of the situations to ponder about!

To address various issues in context with human health, Energy Audit is assigned to "Criteria 7" of NAAC (National assessment and accreditation council) accreditation. NAAC is a self-governing organization in India that declares the institutions as Grade "A++", "A+", "A", Grade "B", .... according to the scores assigned at the time of accreditation.

The other intention of organising Energy Audit is to update the environment conditions in and around the institutions i.e., within the compound and outside the

compound. It is carried out with the aid of performing certain tasks like waste management, energy consumed, diesel burnt it performing the objective of the organization. Lastly to self-assess the net carbon footprint of the conduct of process in the organization.

## THE GOALS OF ENERGY AUDIT

- The purpose of carrying out Energy Audit is securing the environment and cut down the threat posed to human health.
- To Make sure that rules and regulations are complied with.
- To avoid the environmental interruptions that are more difficult to handle and their corrections call for high cost.
- To suggest the best protocol for adding to sustainable development.
- To execute the process of the organisation utilising minimum natural resources and efficient use of those resources contributing to minimum waste generation.

How is the Energy Audit conducted?

- Pre-audit
- Planning
- Selecting the team of auditors both internal and external
- Schedule the audit facility
- Acquire the background information
- Visit areas under audit

## UNDERSTAND THE SCOPE OF AUDIT

- Analyse the strengths and weaknesses of the internal controls
- Conduct audit with end user comfort focused and making it easy to perform.
- Collect necessary evidence so that the stakeholders stand to understand how and where they are going wrong in the process of their conduct.
- Post audit draw the report based on the data collected.
- On confirmation of the preliminary report, draw a final report of the observations and inference with accuracy more near to implementable way.
- Discuss various remedial measures for alternatives if required.
- Prepare an action plan to overcome the shortcomings with continual observation on the action plan initiated.

### Steps under Energy Audit

- Water is one of the cheapest commodities next to the Air we breathe. Although we Indians, use less water in comparison to western countries. However, the extent of pollutants that we leave behind has polluted all the resources including the deep well.
- Rainwater harvesting is one of the best techniques that can be adopted by harvesting the rainwater and using it at the time of scarcity. the audit team to observe and investigate the relevant methods that can be adopted and implemented and draw the balance of use of water.
- The point of generation of waste, the type of waste generated, i.e., hazardous, recyclable and organically compostable wastes and segregating method at the point of generation for easy and best way to handle the same. Evaluating such methods to minimise the use of resources in the process of their management.
- It deals with use of energy in the conduct of the process. The priority is topmost for conservation over efficiency; hence, energy auditor should always consider not to use the energy if necessary. At best it can be used judiciously.
- It analyses air quality, noise level and the programs undertaken by the institution for plantation creating awareness of trees around us and how nature provides us with remedial measures within its framework.

- In the process of use of resources and conduct of the activities, they can develop impact on human health, that might be off minutely harmful, cause permanent disorder or may even cause death. Occupational health hazards are discussed in detail and the stakeholders are informed of the same and required necessary remedial measures indicated.
- To make in organisation net zero net zero carbon emission use of renewable resources including energy such as solar wind biogas geothermal energies are put into ooh utilisation.
- The net impact All the above energy audits should be to make an organisation contribute zero emissions which are called bye bhai use of water generation of waste use of energy e environmental damage health damage and finally to explore if the campus or direction can go in in contributing to third-party emissions minimising
- To draw home the benefits, the system has been separated out into various audits as listed above. In doing so, and if audit findings are effectively implemented there are many advantages that can be practised in the process
- Recognise the cost saving methods through waste minimising and managing technologies.
- Point out the prevailing and forth coming complications.
- Authenticate conformity with the legal requirements.
- Empower the organisation to frame a better environmental performance.
- Portray a good image of the institution which helps build better relationships with the group's organisations, stakeholders in and around its operations
- Enhance the alertness for environmental guidelines duties and conduct of preparedness for any eventualities due to environmental disasters proposed)
- Indicative templet for display at all prominent areas, classrooms, waiting rooms, canteen, library, relaxing areas in the campus.



**FACTORS CONSIDERED**

Source : <https://en.wikipedia.org/wiki/Bangalore>

**GEOGRAPHY**

Main article: [Bangalore geography and environment](#)

The [Hesaraghatta Lake](#) in Bangalore

Bangalore lies in the southeast of the [South Indian](#) state of Karnataka. It is in the heart of the [Mysore Plateau](#) (a region of the larger [Precambrian Deccan Plateau](#)) at an average elevation of 900 m (2,953 ft).<sup>[63]:8</sup> It is located at [12.97°N 77.56°E](#) and covers an area of 741 km<sup>2</sup> (286 sq mi).<sup>[64]</sup> The majority of the city of Bangalore lies in the [Bangalore Urban district](#) of Karnataka and the surrounding rural areas are a part of the [Bangalore Rural district](#). The Government of Karnataka has carved out the new district of [Ramanagara](#) from the old Bangalore Rural district.<sup>[65]</sup>

The topology of Bangalore is generally flat, though the western parts of the city are hilly. The highest point is [Vidyaranyapura Doddabettahalli](#), which is 962 metres (3,156 feet) and is situated to the north-west of the city.<sup>[66]</sup> No major rivers run through the city, although the [Arkavathi](#) and [South Pennar](#) cross paths at the [Nandi Hills](#), 60 kilometres (37 miles) to the north. [River Vrishabhavathi](#), a minor tributary of the Arkavathi, arises within the city at Basavanagudi and flows through the city. The rivers Arkavathi and Vrishabhavathi together carry much of Bangalore's [sewage](#). A [sewerage](#) system, constructed in 1922, covers 215 km<sup>2</sup> (83 sq mi) of the city and connects with five [sewage treatment](#) centres located in the periphery of Bangalore.<sup>[67]</sup>

In the 16th century, Kempe Gowda I constructed many lakes to meet the town's water requirements. The Kempambudhi Kere, since overrun by modern development, was prominent among those lakes. In the earlier half of 20th century, the Nandi Hills [waterworks](#) was commissioned by [Sir Mirza Ismail](#) ([Diwan](#) of Mysore, 1926–41 CE) to provide a water supply to the city. The river [Kaveri](#) provides around 80% of the total water supply to the city with the remaining 20% being obtained from the Thippagondanahalli and Hesaraghatta reservoirs of the Arkavathi

**THOUGHT FOR EVERY MOMENT**

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

river.<sup>[68]</sup> Bangalore receives 800 million litres (211 million [US gallons](#)) of water a day, more than any other Indian city.<sup>[69]</sup> However, Bangalore sometimes does face water shortages, especially during summer- more so in the years of low rainfall. A [random sampling](#) study of the [air quality index](#) (AQI) of twenty stations within the city indicated scores that ranged from 76 to 314, suggesting heavy to severe air pollution around areas of traffic concentration.<sup>[70]</sup>

Bangalore has a handful of freshwater lakes and [water tanks](#), the largest of which are Madivala tank, [Hebbal](#) lake, [Ulsoor](#) lake, Yediyur Lake and [Sankey Tank](#). Groundwater occurs in [silty](#) to [sandy](#) layers of the [alluvial](#) sediments. The [Peninsular Gneissic Complex](#) (PGC) is the most dominant rock unit in the area and includes [granites](#), [gneisses](#) and [migmatites](#), while the soils of Bangalore consist of red [laterite](#) and red, fine [loamy](#) to [clayey](#) soils.<sup>[71]</sup>

Vegetation in the city is primarily in the form of large [deciduous canopy](#) and minority [coconut](#) trees. Though Bangalore has been classified as a part of the seismic zone II (a stable zone), it has experienced quakes of magnitude as high as 4.5.<sup>[71]</sup>

## **Climate**

Bangalore has a [tropical savanna climate](#) ([Köppen climate classification](#) Aw) with distinct [wet](#) and [dry](#) seasons. Due to its high elevation, Bangalore usually enjoys a more moderate climate throughout the year, although occasional heat waves can make summer somewhat uncomfortable.<sup>[72]</sup> The coolest month is January with an average low temperature of 15.1 °C (59.2 °F) and the hottest month is April with an average high temperature of 35 °C (95 °F).<sup>[73]</sup> The highest temperature ever recorded in Bangalore is 39.2 °C (103 °F) (recorded on 24 April 2016) as there was a strong El Niño in 2016.<sup>[74]</sup> There were also unofficial records of 41 °C (106 °F) on that day. The lowest ever recorded is 7.8 °C (46 °F) in January 1884.<sup>[75][76]</sup> Winter temperatures rarely drop below 14 °C (57 °F), and summer temperatures seldom exceed 36 °C (97 °F). Bangalore receives rainfall from both the northeast and the southwest [monsoons](#) and the wettest months are September, October and August, in that order.<sup>[73]</sup> The summer heat is moderated by fairly frequent [thunderstorms](#), which occasionally cause power outages and local flooding. Most of the rainfall occurs during late afternoon/evening or night and rain before noon is infrequent.

November 2015 (290.4 mm) was recorded as one of the wettest months in Bangalore with heavy rains causing severe flooding in some areas, and closure of a number of organisations for over a couple of days.<sup>[77]</sup> The heaviest rainfall recorded in a 24-hour period is 179 millimetres (7 in) recorded on 1 October 1997.<sup>[78]</sup>

Climate data for Bangalore (1981–2010, extremes 1901–2012)													
Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Record high °C (°F)</b>	32.8 (91.0) )	35.9 (96.6) )	37.3 (99.1) )	38.3 (100.9) )	38.9 (102.0) )	38.1 (100.6) )	33.3 (91.9) )	33.3 (91.9) )	33.3 (91.9) )	32.4 (90.3) )	31.7 (89.1) )	31.1 (88.0) )	38.9 (102.0)
<b>Average high °C (°F)</b>	27.9 (82.2) )	30.7 (87.3) )	33.1 (91.6) )	34.0 (93.2) )	33.3 (91.9) )	29.6 (85.3) )	28.3 (82.9) )	27.8 (82.0) )	28.6 (83.5) )	28.2 (82.8) )	27.2 (81.0) )	26.5 (79.7) )	29.6 (85.3)
<b>Average low °C (°F)</b>	15.8 (60.4) )	17.5 (63.5) )	20.0 (68.0) )	22.0 (71.6) )	21.7 (71.1) )	20.4 (68.7) )	19.9 (67.8) )	19.8 (67.6) )	19.8 (67.6) )	19.6 (67.3) )	18.0 (64.4) )	16.2 (61.2) )	19.2 (66.6)
<b>Record low °C (°F)</b>	7.8 (46.0) )	9.4 (48.9) )	11.1 (52.0) )	14.4 (57.9) )	16.7 (62.1) )	16.7 (62.1) )	16.1 (61.0) )	14.4 (57.9) )	15.0 (59.0) )	13.2 (55.8) )	9.6 (49.3) )	8.9 (48.0) )	7.8 (46.0)
<b>Average rainfall mm (inches)</b>	1.9 (0.07) )	5.4 (0.21) )	18.5 (0.73) )	41.5 (1.63) )	107.4 (4.23) )	106.5 (4.19) )	112.9 (4.44) )	147.0 (5.79) )	212.8 (8.38) )	168.3 (6.63) )	48.9 (1.93) )	15.7 (0.62) )	986.9 (38.85)
<b>Average rainy days</b>	0.2	0.4	1.1	3.1	6.7	6.2	7.2	9.9	9.8	8.3	3.8	1.4	58.1
<b>Average <u>relative humidity</u> (%) (at 17:30 <u>IST</u>)</b>	41	32	29	35	47	62	65	67	64	65	61	53	52
<b>Mean monthly <u>sunshine</u> hours</b>	262.3	247.6	271.4	257.0	241.1	136.8	111.8	114.3	143.6	173.1	190.2	211.7	2,360.9
Source 1: <a href="#">India Meteorological Department</a> <sup>[79][80]</sup>													
Source 2: <a href="#">NOAA</a> (sun: 1971–1990) <sup>[81]</sup>													

## Pollution control

Bangalore generates about 3,000 tonnes of solid waste per day, of which about 1,139 tonnes are collected and sent to composting units such as the Karnataka Composting Development Corporation. The remaining solid waste collected by the municipality is dumped in open spaces or on roadsides outside the city.<sup>[134]</sup> In 2008,

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

Bangalore produced around 2,500 [metric tonnes](#) of [solid waste](#), and increased to 5000 [metric tonnes](#) in 2012, which is transported from collection units located near [Hesaraghatta Lake](#), to the garbage dumping sites.<sup>[135]</sup> The city suffers significantly with dust pollution, hazardous waste disposal, and disorganised, unscientific waste retrievals.<sup>[136]</sup> The IT hub, Whitefield region is the most polluted area in Bangalore.<sup>[137]</sup> Recently a study found that over 36% of diesel vehicles in the city exceed the national limit for emissions.<sup>[138]</sup>

Anil Kumar, Commissioner Bruhat Bengaluru Mahanagara Palike BBMP, said: "The deteriorating Air Quality in cities and its impact on public health is an area of growing concern for city authorities. While much is already being done about collecting and monitoring air quality data, little focus has been given on managing the impacts that bad air quality is having on the health of citizens."<sup>[139]</sup>

## **Waste management**

In 2012 Bangalore generated 2.1 million tonnes of [Municipal Solid Waste](#) (195.4 kg/cap/yr).<sup>[143]</sup> The waste management scenario in the state of Karnataka is regulated by the Karnataka State Pollution Control Board (KSPCB) under the aegis of the Central Pollution Control Board (CPCB) which is a Central Government entity. As part of their Waste Management Guidelines the government of Karnataka through the Karnataka State Pollution Control Board (KSPCB) has authorised a few well-established companies to manage the [biomedical waste](#) and hazardous waste in the state of Karnataka.<sup>[citation needed]</sup>

## **Economy:**

Recent estimates of the economy of Bangalore's metropolitan area have ranged from \$45 to \$83 billion ([PPP GDP](#)), and have ranked it either [fourth- or fifth-most productive metro area](#) of India.<sup>[10]</sup> In 2014, Bangalore contributed US\$45 billion, or 38 per cent of India's total IT exports.<sup>[144]</sup> As of 2017, IT firms in Bengaluru employ about 1.5 million employees in the IT and IT-enabled services sectors, out of nearly 4.36 million employees across India.<sup>[145]</sup>

With an economic growth of 10.3%, Bangalore is the second fastest-growing major metropolis in India,<sup>[146]</sup> and is also the country's fourth largest [fast-moving consumer](#)

[goods](#) (FMCG) market.<sup>[147]</sup> Forbes considers Bangalore one of "The Next Decade's Fastest-Growing Cities".<sup>[148]</sup> The city is the third largest hub for [high-net-worth individuals](#) and is home to over 10,000-dollar millionaires and about 60,000 super-rich people who have an investment surplus of ₹45 million (US\$630,900) and ₹5 million (US\$70,100) respectively.<sup>[149]</sup>

The headquarters of several [public sector undertakings](#) such as [Bharat Electronics Limited](#) (BEL), [Hindustan Aeronautics Limited](#) (HAL), [National Aerospace Laboratories](#) (NAL), [Bharat Earth Movers Limited](#) (BEML), Central Manufacturing Technology Institute (CMTI) and [HMT](#) (formerly Hindustan Machine Tools) are located in Bangalore. In June 1972 the [Indian Space Research Organisation](#) (ISRO) was established under the Department of Space and headquartered in the city. Bangalore also houses several research and development centres for many firms such as [ABB](#), [Airbus](#), [Bosch](#), [Boeing](#), [General Electric](#), [General Motors](#), [Google](#), [Liebherr-Aerospace](#), [Microsoft](#), [Mercedes-Benz](#), [Nokia](#), [Oracle](#), [Philips](#), Shell, [Toyota](#) and [Tyco](#).

Bangalore is called as the *Silicon Valley of India* because of the large number of information technology companies located in the city which contributed 33% of India's ₹1,442 billion (US\$20 billion) IT exports in 2006–07.<sup>[150]</sup> Bangalore's IT industry is divided into three main [clusters](#) – [Software Technology Parks of India](#) (STPI); [International Tech Park, Bangalore](#) (ITPB); and [Electronics City](#). UB City, the headquarters of the [United Breweries Group](#), is a high-end commercial zone.<sup>[151]</sup> [Infosys](#) and [Wipro](#), India's third and fourth largest software companies are headquartered in Bangalore, as are many of the global *SEI-CMM Level 5 Companies*.

The growth of IT has presented the city with unique challenges. Ideological clashes sometimes occur between the city's IT moguls, who demand an improvement in the city's infrastructure, and the state government, whose electoral base is primarily the people in rural Karnataka. The encouragement of high-tech industry in Bangalore, for example, has not favoured local employment development, but has instead increased land values and forced out small enterprise.<sup>[152]</sup> The state has also resisted the massive investments required to reverse the rapid decline in city transport which has already begun to drive new and expanding businesses to other centres across



India. Bangalore is a hub for [biotechnology](#) related industry in India and in the year 2005, around 47% of the 265 biotechnology companies in India were located here; including [Biocon](#), India's largest biotechnology company.<sup>[153][154]</sup>

## CULTURE

Main article: [Culture of Bengaluru](#)

[Bangalore Karaga](#), one of the oldest and most important festivals in Bangalore [Yakshagana](#) – a theatre art of coastal Karnataka is often played in town hall Bangalore is known as the "Garden City of India" because of its greenery, broad streets and the presence of many public parks, such as [Lal Bagh](#) and [Cubbon Park](#).<sup>[172]</sup> Bangalore is sometimes called as the "[Pub](#) Capital of India" and the "Rock/Metal Capital of India" because of its underground music scene and it is one of the premier places to hold international rock concerts.<sup>[173]</sup> In May 2012, [Lonely Planet](#) ranked Bangalore third among the world's top ten cities to visit.<sup>[174]</sup>

Bangalore is also home to many [vegan](#)-friendly restaurants and vegan activism groups, and has been named as India's most vegan-friendly city by [PETA](#) India.<sup>[175][176]</sup> [Biannual](#) flower shows are held at the [Lal Bagh](#) Gardens during the week of [Republic Day](#) (26 January) and [Independence Day](#) (15 August). [Bengaluru Karaga](#) or "Karaga Shaktyotsava" is one of the most important and oldest festivals of Bangalore dedicated to the Hindu Goddess [Draupadi](#). It is celebrated annually by the [Thigala](#) community, over a period of nine days in the month of March or April. The Someshwara Car festival is an annual procession of the idol of the [Halasuru Someshwara Temple](#) (Ulsoor) led by the [Vokkaligas](#), a major land holding community in the southern Karnataka, occurring in April. [Karnataka Rajyotsava](#) is widely celebrated on 1 November and is a public holiday in the city, to mark the formation of [Karnataka](#) state on 1 November 1956. Other [popular festivals](#) in Bangalore are [Ugadi](#), [Ram Navami](#), [Eid ul-Fitr](#), [Ganesh Chaturthi](#), [St. Mary's feast](#), [Dasara](#), [Deepawali](#) and [Christmas](#).<sup>[177][178]</sup>

The diversity of cuisine is reflective of the social and economic diversity of Bangalore.<sup>[179]</sup> Bangalore has a wide and varied mix of restaurant types and cuisines and Bangaloreans deem eating out as an intrinsic part of their culture. Roadside vendors, [tea stalls](#), and South Indian, North Indian, [Chinese](#) and Western fast food are

all very popular in the city.<sup>[180]</sup> [Udupi](#) restaurants are very popular and serve predominantly vegetarian, regional cuisine.<sup>[181]</sup>

## **Education:**

### **Universities**

[National Law School of India University](#), a premier law university

The [Central College of Bangalore](#) is the oldest college in the city, it was established in the year 1858. It was originally affiliated to [University of Mysore](#) and subsequently to [Bangalore University](#). Later in the year 1882 the priests from the [Paris Foreign Missions Society](#) established the [St Joseph's College, Bangalore](#). The [Bangalore University](#) was established in 1886, it provides affiliation to over 500 colleges, with a total student enrolment exceeding 300,000. The university has two campuses within Bangalore – Jnanabharathi and Central College.<sup>[211]</sup> [University Visvesvaraya College of Engineering](#) was established in the year 1917, by [Sir M. Visvesvaraya](#). At present, the UVCE is the only engineering college under the [Bangalore University](#). Bangalore also has many private engineering colleges affiliated to [Visvesvaraya Technological University](#).

Some of the professional institutes in Bengaluru are:

- [International Centre for Theoretical Sciences](#)
- [Indian Institute of Astrophysics](#)
- [Indian Institute of Science](#), which was established in 1909 in Bangalore
- [Jawaharlal Nehru Centre for Advanced Scientific Research](#) (JNCASR)
- [National Centre for Biological Sciences](#) (NCBS)
- [National Institute of Mental Health and Neuro Sciences](#) (NIMHANS)
- [Raman Research Institute](#)
- [National Law School of India University](#) (NLSIU)
- [Indian Institute of Management, Bangalore](#) (IIM-B)
- [Indian Statistical Institute](#)
- [Institute of Finance and International Management](#) (IFIM)
- [Institute of Wood Science and Technology](#)
- [International Institute of Information Technology, Bangalore](#) (IIIT-B)
- [National Institute of Design](#) (NID),

- [National Institute of Fashion Technology](#) (NIFT),
- [University of Agricultural Sciences, Bangalore](#) (UASB)
- [Bangalore Medical College and Research Institute](#) (BMCRI)
- [Sri Jayadeva Institute of Cardiovascular Sciences and Research](#) (SJICR)

Some famous private institutions in Bangalore include [Symbiosis International University](#), [SVKM's NMIMS](#), [CMR University](#), [Christ University](#), [Jain University](#), [PES University](#), [Dayananda Sagar University](#) and [M. S. Ramaiah University of Applied Sciences](#). Some famous private medical colleges include [St. John's Medical College](#) (SJMC), [M. S. Ramaiah Medical College \(MSRMC\)](#), [Kempegowda Institute of Medical Sciences](#) (KIMS), [Vydehi Institute of Medical Sciences and Research Centre](#) (VIMS), etc.<sup>[212][213]</sup> The [M. P. Birla Institute of Fundamental Research](#) has a branch located in Bangalore.<sup>[214]</sup>

#### **LIMITATIONS:**

Our recommendations are in the interest of conservation of Electrical Energy and Green Culture i.e., the reduction in CARBON FOOTPRINT. The compliance to the recommendations will be subjected to meeting the safety and Environmental rules and guidelines.

## PART 2 -TECHNICAL

### DISCUSSIONS ON EXECUTIVE SUMMARY:

#### POWER CONSUMPTION

Sr No	Observation*	Benefits/ Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
1	Power Consum ption	The power demand of the college should be fixed and an energy meter should be placed and monitored on regular basis.					

The college has availed 600KVA electrical power from the grid. The Society has also installed solar power for meeting inhouse demand. Some observations are,

1. The recorded MD is found to be 303KVA which indicates that the institute is under utilising the existing demand.
2. The replacement of the T5, T8 and T12 tubelights in the campus if replaced with LED luminaries, there will be further reduction of Power demand and reduction in energy use as well.
3. It would be appropriate to define the fixed share of the Solar power and the grid power. During the audit and post audit, no official data/ information has been shared, we learn that the college has installed solar Power and is being used inhouse.

**Bangalore Electricity Supply Company Limited**  
BESCOM GSTN No: 29AACCB1412G176  
Office of the Asst. Executive Engineer (EL), C. DAM Sub-division - K1 KENGERI

RR No.	Account ID	Bill No.	Billing Period	Bill Date	Due Date	Disconnection Date
9420605330 (06/12/20)	9420605000	942960813552	01-08-2021 - 01-09-2021	01-09-2021	15-09-2021	01-10-2021

Name & Address: K.V. COLLEGE OF ENGINEERING, EDUCATIONAL INSTITUTION, HIRNAGUR KAR

Type: Educational Institutions - HT/2C

Tariff	Contract Demand (KVA)	80% of CD (KVA)	Recorded Demand (KVA)	Billing Demand (KVA)	Wheeling Energy	High Cost Energy	Special Energy	State Consumption	Power Cost	Energy & Equipment	Demand	Penalties
HT/2C	600	480	303	303								

100 meter readings for meter 421256254

Time Zone	Name of the Zone	Present Readings	Previous Readings	Consumption	MD Reading
06:00 hrs to 10:00 hrs	Morning Peak	2000	2000	1000	2000
10:00 hrs to 18:00 hrs	Normal	1000	1000	1000	1000
18:00 hrs to 22:00 hrs	On Peak	1000	1000	1000	1000
22:00 hrs to 06:00 hrs	Off Peak	100	100	1000	1000

Details for Bill Payment Only:  
This Bill Payment Only  
Billing Cycle Name: BESCOM  
Account Number: 9420605000  
Name: Bank of India  
Branch: Cantonment  
IFSC: BICR00BSCOM  
Amount: ₹95400.00

Your Detailed Bill:

Particulars	Amount (Rs.)
Energy Charges	1,10,000.00
Power Charge	1,10,000.00
Losses Charge	1,10,000.00
Substation Charge	1,10,000.00
Transmission Charge	1,10,000.00
Generation Charge	1,10,000.00
Other Charges	1,10,000.00
Current Bill Amount	1,14,400.00
Amount Paid	1,14,400.00
Balance Due	0.00
Net Payable Amount	0.00

Signature of Assistant Executive Engineer (EL) K-1 Sub Division, BESCOM, Kengeri, Bangalore-560 060

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

4. There exist loose contacts in the 11KV substation and the system could blow out very soon considering the temperature at the point of Tapping at the pothead. The three points of contact are measured to be in the range of 163°C, 111°C and 270°C from a measured distance of 30 feet (approximate)



Figure 8 - Thermographic images of 11 kV substation

In actual situation the temperature would be atleast around 200°C, 150°C and 340°C respectively. This calls for immediate attention.

5. The electrical panel room should be used exclusively for housing the switchgear. Nothing other than the switchgear devices should be placed on or below the panel which may give catalytic effect in case of fire.

## RENEWABLE ENERGY

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
2	Solar Power	Suggest to install Solar Power to minimise use of energy during Off grid times.					7.1.2

Although the institute has installed solar power, the same is not connected to grid as seen from the Energy bill made available., The institute has good space to explore rooftop Solar power and export to grid during the non peak working hours.

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

However, we understand and believe that the administration should look for technical consultancy to meet the Specific demand on

1. Maximum power.
2. Maximum energy usage during the active days
3. Avoided use of grid for charging the batteries in the campus which account for 20% of the energy demand. And 10% of the peak power demand is the Recorded Maximum demand.
4. If the above three are addressed, the use of Diesel Gensets should be a feasible option, resulting savings from use of diesel, avoided NOISE & AIR pollution.

## SENSOR TECHNOLOGY

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
3	Occupancy sensor	Wastage of power	High	Occupancy sensor based switching	₹1500 per room	Resulted ROI of one year.	7.1.2

It is also observed that the lights are left switched ON at majority of places during daylight, thus calling for wastage of electrical power, causing financial losses to the management and energy loss to the country.

It may also be noted that during the day hours with direct sunlight, the lights remain on. Hence it is important that the sensing system should take care of monitoring the LUMEN and the human presence in the hall to operate the lights.





Figure 10 - Lighting need for sensor



Figure 9 - Need for occupancy sensor

**Solution:**

It is therefore required to install Light Intensity Sensors in all the rooms. Lighting improvements should be carried out by using LED or The Induction Light systems in lieu of normal tube lights. If the finance department permits, it is advised to install 40W Induction lamps in all classrooms.

Source : Can be locally procured, However the load-based selection is key aspect in its installation. To set the visibility, the intensity of natural light is much stronger and hence LUX based setting doesn't work. Hence the technical supervision is key aspect.

We suggest to allocate this to the Electronics & Electrical stream students to understand the science and application of technology.

Need based light energy utilisation should be imparted to the children so as to take it forward to the society.

The other aspect to the light energy is the task based lighting.

ie., Task – normal or critical. General lighting ie open area or living room lighting.

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

External lighting ie yard lighting for security reasons.

We find use of T5, T8 & T12 tube lights. It is wise to replace the same with LED tube lights on immediate basis. Considering the energy savings, the wait for their failure may not be justified.



Figure 11 - T5 & T8 tube lights with Electromagnetic choke

## ENERGY CONSERVATION:



Figure 12 - Equipment load management

Let us understand the issues in the proprietary equipment. When the equipment is supplied, the supplier considers that the equipment would be put to full use at all

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

times. Since we are discussing the application in a laboratory conditions, the samples put to test are very few and seldom full loading is done.

In the present situation, the samplings were randomly placed and in traces. On discussion with the staff incharge, we understand that they could be placed in one or two selves and the rest of the area be put off. IN doing so, the 18 T\* &T!@ tube lights each consuming around 40 to 55Wats could be put off. Ie 850Watts of power could be saved and 20 Units of energy.

Considering the above evidence The staff can be educated on the use of equipment.

Awareness, leads to energy conservation. This is one such example. Similar applications could be observed in day-today practice. Thus the staff and students could be educated and trained in identifying such opportunities. This should help in minimising the present load conditions and the reduced energy consumption as well.

ENERGY AUDIT REPORT

---

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



**NATURAL LIGHTING****LIGHT INTENSITY SENSOR REQUIREMENT.**

	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
5	Electric al	Old tube lights	High energy consumers	LED lights of appropriate ratings.	Rs.80/- to Rs.250/- per unit	Rs.175/- per tube per annum. ROI of 1 years.	7.1.6
6	Natural Lighting	Un cleaned windows and ventilators , forced switching on of tube lights	High energy bills	Clean the windowpanes and allow maximum natural light penetration.	Nil, part of routine , In house manpower.	Substantial cost of energy bills on lighting.	7.1.2, 7.1.6

It may be seen that the Light is illuminated. However, the brightness on the students is seen to be coming from the sides. The shadow indicates natural light coming from the windows is brighter. Natural light is more predominant than the tube light. Hence tube light being switched off has no adverse effect. However, it would save on the energy consumption and contribute to green practices.



Figure 13 - Use of natural lighting where possible

NATURAL LIGHTING: Category 7.1.1, 7.1.2, 7.1.3 and 7.1.5

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

We observe that the placement of the cupboards prevent natural lighting. The placement should be such that the use of electrical lighting is avoided. Also for normal and safe operation, the source of light rays should be coming from the sides and not from front.

It is also seen that the dark curtains prevent natural light and creates darkening effect. Selection or placement of such obstructions leads to use of electrical lighting causing heavy energy demand.



Figure 14 - Use of Light colored curtains and avoided blocades

## BATTERY MANAGEMENT.

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
3	Battery placement	Battery shell in conductor loop	Low performance & self-discharge.	Design the stacking arrangements.	In house resources	25% of the cost of the batteries.	7.1.3

Criteria 7.1.1, 7.1.2, 7.1.3 and 7.1.5

## BATTERY PLACEMENT:

The batteries should be placed on an insulated platform not touching any of the metal frames with top clearance of 6". It may be known to all the stored energy users

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

that, the batteries breath. The acidic fumes are breathed out and for ease of handling and breathing.

Provision for periodical checking and maintenance should be made possible without major obstacles.

The safe distance between two batteries placed on an insulated rubber mat or the wooden platform is important and very much necessary. Typical case of galvanic reaction shows self-discharging effect of the batteries.

In the below images, it is very evident that the Battery placement and handling has not been proper.



*Figure 15 - Battery placement, Need cross ventilation.*



THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,





Figure 16 - Thickly populated & stacking in unventilated area

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,





Figure 18 - Galvanic reaction causing damage to battery life

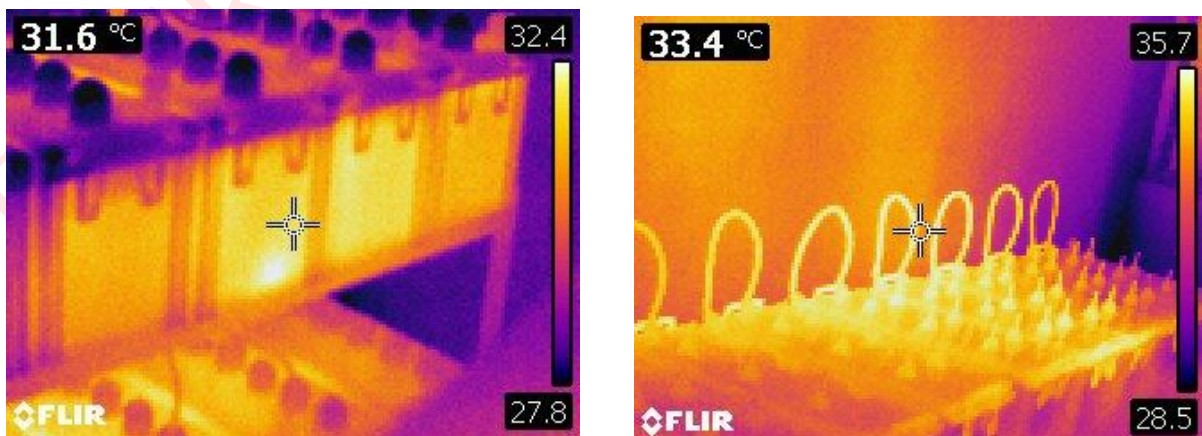


Figure 17 - Thermal inspection of the battery bank

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

Thermal inspection shows the impact of self-discharging effect and heating effect on each of these batteries. The weak batteries will eventually lose their working performance and soon the rest of the batteries would join the failure line.

In absence of the above placement conditions,

The batteries will discharge faster leading to Loss of energy.

The charging time and current will increase as there is the return path for self-discharge leading to Increased Energy Demand.

A well-maintained battery is known to serve for more than 5-7 years.

The presence of corrosion marks at the point of contact as seen should be prevented over the time.

We strongly advice for regenerating the batteries once every 2 to 4 years so that they serve over 15 years in Liew of 3-5 years under present conditions.

A well-maintained battery will draw less charging power, i.e., saves on energy consumption, delivers more energy per charge thus resulting in better serviced life.

Batteries should be placed well ventilated and avoid dumping of any material on the breathers provided.

For more information on battery regeneration, Contact

Sunshubh Technovations Pvt Ltd, Hubli [ceo@sunshubhrenewables.com](mailto:ceo@sunshubhrenewables.com).

## **BATTERY REGENERATION**

Battery regeneration is very popular. 80% of the batteries breaking down and losing capacity are sulphated, but can be restored with the right equipment. Battery regenerator successfully replaces sulphation by active material thanks to an electrical high-frequency pulsation process. This process restores the battery capacity, giving you the ability to reuse old and sulphated batteries. You can also use the battery regenerator for annual maintenance to considerably prolong the lifespan of your batteries. The battery regenerator can be used in every lead-acid-based battery: starter batteries, stationary batteries, traction & semi-traction batteries, Ni-Cad batteries ... Since the college uses BATTERIES in large numbers, the management can consider to procure one unit at the centralised station in the college campus.

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
4	Battery regeneration.	Short life span	300% of the cost of the battery.	Subject all batteries to regeneration made.	Rs.20.00 Lacs or as per user agreement	300 %	7.1.2, 7.1.6

## NECESSITY AND ISSUES

It is customary in the present energy scenario to use Batteries either in our office or working environment. In continuation, The old week batteries are a nuisance as they need to be discarded in to the environment for further process. Which is a costly option both in terms of Health and pollution issues. Let us review our use of application and consider if we can improve our battery use methods. A brief note, before we consider to take corrective step.

Lead-acid batteries are widely used as important power supply devices that include automotive, uninterruptible power supply (UPS), telecommunication systems and various traction duties.

Lead-acid batteries are the workhorse of the rechargeable battery systems for its reliability, low cost, and good operational life. Predictably, approximately million tons waste batteries are generated every year and the production of lead-acid batteries will continue to rise even more sharply with sustained and rapid development of economy. The lead-acid battery is a complex industrial product, constituted by several different materials, the consequence was very serious which often caused much property loss, casualties and environment pollution once accidents happen Based on "Technical Guidelines for Environmental Risk Assessment on Projects" and in consideration of the characteristics of the chemical compositions and contents, a framework of environmental risk assessment framework on lead-acid batteries

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

was established. The work procedure included risk identification, sources analysis, pollution forecast, and defensive measures. By analysing the environmental risk assessment of lead-acid batteries, the study opined for directions both for the preventive measures and safe use, according to the forecast results of lead-acid batteries.

## RISK IDENTIFICATION OF LEAD-ACID BATTERIES

Lead-acid batteries generally consist of four parts, which are electrolyte, lead and lead alloy grid, lead paste, and organics and plastics, which included lots of toxic, hazardous, flammable, explosive substances that can easily create potential risk sources. The materials contained in lead-acid batteries may bring about lots of pollution accidents such as fires, explosions, poisoning and leaks, contaminating environment and damaging ecosystem. The main chemical compositions and contents of spent lead-acid batteries are listed below.

The main chemical compositions and contents of spent lead-acid batteries

Compositions	Contents (wt.%)
Electrolyte	11–30%
Lead and lead alloy grid	24–30%
Lead paste	30–40%
Organics and plastics	22–30%

The recognition & scope of lead-acid batteries, mainly focused on the pollutants involved in the process of centralized recovery, Storage areas and transport. Based on “Technical Guidelines for Environmental Risk Assessment on Projects” and “Identification of hazard installations for dangerous chemicals

**Environmental effects of lead** can end up in water and soils through corrosion of leaded pipelines in a water transporting system and through corrosion of leaded paints. ... **Lead** accumulates in the bodies of water organisms and soil



With change in times, new solutions keep coming up. One such option is to Regenerate the dead or non-usable batteries. Energic Plus battery regenerator successfully removes sulphating due to an electrical high-frequency pulsation process.

This process restores the battery capacity, giving you the ability to reuse old and sulphated batteries. You can also use the battery preconditioner for annual maintenance to strongly prolong the lifespan of your batteries.

Main Benefits are :

- Removes excessive sulphate
- Prolongs the lifespan of your battery
- Generates detailed reports in Word, Excel or PDF
- Fully automatic, easy to handle
- Free software included with wireless data transfer to computer
- Combination of charging/discharging

Works with all types of lead-acid-based batteries:

- Gel batteries,
- Traction(semi-) batteries,
- Starter batteries,
- Stationary Batteries.

Concealed batteries in operation or used batteries should be properly named and placed in proper order. The used batteries should be considered for REGENERATION for the second and subsequent cycles and prolong the disposal as the chemicals cause high level of damage to the environment.

We will discuss the regenerative system of used and week batteries to enhance the life. It is important to know few points on handling of batteries.

BU-703: Health Concerns with Batteries.





Become familiar with the do's and don't's when handling batteries. Batteries are safe, but caution is necessary when touching damaged cells and when handling lead acid systems that have access to lead and sulfuric acid. Several countries label lead acid as hazardous material, and rightly so. Lead can be a health hazard if not properly handled.

## LEAD

Lead is a toxic metal that can enter the body by inhalation of lead dust or ingestion when touching the mouth with lead-contaminated hands. If leaked onto the ground, acid and lead particles contaminate the soil and become airborne when dry. Children and foetuses of pregnant women are most vulnerable to lead exposure because their bodies are developing. Excessive levels of lead can affect a child's growth, cause brain damage, harm kidneys, impair hearing and induce behavioural problems. In adults, lead can cause memory loss and lower the ability to concentrate, as well as harm the reproductive system. Lead is also known to cause high blood pressure, nerve disorders, and muscle and joint pain. Researchers speculate that Ludwig van Beethoven became ill and died because of lead poisoning. By 2017, members of the International Lead Association (ILA) want to keep the lead blood level of workers in mining, smelting, refining and recycling below 30 micrograms per decilitre (30µg/dl). In 2014, the average participating employee checked in at 15.6µg/dl, but 4.8 percent were above 30µg/dl. (Source Batteries & Energy Storage Technology, Summer 2015.)

In 2019, the University of Southern California published the detection of lead in teeth of children living near the Exide Technologies battery recycling plant in Vernon, California.

Lead occurs naturally in soil at 15–40mg/kg level. This level can increase multi-fold near lead battery manufacturing and recycling plants. Soil levels in developing countries, including on the continent of Africa, recorded lead contamination levels of 40–140,000mg/kg.

## SULFURIC ACID

The sulfuric acid in a lead acid battery is highly corrosive and is more harmful than acids used in most other battery systems. Contact with eye can cause permanent blindness; swallowing damages internal organs that can lead to death. First aid treatment calls for flushing the skin for 10–15 minutes with large amounts of water to cool the affected tissue and to prevent secondary damage. Immediately remove contaminated clothing and thoroughly wash the underlying skin. Always wear protective equipment when handling sulfuric acid.

## CADMIUM

Cadmium used in nickel-cadmium batteries is considered more harmful than lead if ingested. Workers at NiCd manufacturing plants in Japan have been experiencing health problems from prolonged exposure to the metal, and governments have banned disposal of nickel-cadmium batteries in landfills. The soft, whitish metal that occurs naturally in the soil can damage kidneys. Cadmium can be absorbed through the skin by touching a spilled battery. Since most NiCd batteries are sealed, there are no health risks in handling intact cells; caution is required when working with an open battery.

Nickel-metal-hydride is considered non-toxic and the only concern is the electrolyte. Although toxic to plants, nickel is not harmful to humans.

Lithium-ion is also benign — the battery contains little toxic material. Nevertheless, caution is required when working with a damaged battery. When handling a spilled battery, do not touch your mouth, nose or eyes. Wash your hands thoroughly.

Keep small batteries out of children's reach. Children younger than four are the most likely to swallow batteries, and the most common types that are ingested are button cells. Each year in the United States alone, more than 2,800 children are treated in emergency rooms for swallowing button batteries. According to a 2015 report, serious injuries and deaths from swallowing batteries have increased nine-fold in the last decade.

The battery often gets stuck in the oesophagus (the tube that passes food). Water or saliva creates an electrical current that can trigger a chemical reaction producing hydroxide, a caustic ion that causes serious burns to the surrounding tissue. Doctors often misdiagnose the symptoms, which can reveal themselves as fever, vomiting, poor appetite and weariness. Batteries that make it through the oesophagus often move through the digestive tract with little or no lasting damage. The advice to a parent is to choose safe toys and to keep small batteries away from young children.

## SAFETY TIPS

Keep button batteries out of sight and reach of children. Remote controls, singing greeting cards, watches, hearing aids, thermometers, toys and electric keys may contain these batteries.

Similar to pharmaceutical products, keep loose batteries locked away to prevent access by small children.

Communicate the danger of swallowing button batteries with your children, as well as caregivers, friends, family members and babysitters.

If you suspect your child has ingested a battery, go to the hospital immediately. Wait for a medical assessment before allowing the child to eat and drink.

## VENTILATION

Charging batteries in living quarters should be safe, and this also applies to lead acid. Ventilate the area regularly as you would a kitchen when cooking. Lead acid produces some hydrogen gas but the amount is minimal when charged correctly. Hydrogen gas becomes explosive at a concentration of 4 percent. This would only be achieved if large lead acid batteries were charged in a sealed room.

Over-charging a lead acid battery can produce hydrogen sulphide. The gas is colourless, very poisonous, flammable and has the odour of rotten eggs. Hydrogen sulphide also occurs naturally during the breakdown of organic matter in swamps

---

### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

and sewers; it is present in volcanic gases, natural gas and some well waters. Being heavier than air, the gas accumulates at the bottom of poorly ventilated spaces. Although noticeable at first, the sense of smell deadens the sensation with time and potential victims may be unaware of its presence.

As a simple guideline, hydrogen sulphide becomes harmful to human life if the odour is noticeable. Turn off the charger, vent the facility and stay outside until the odour disappears. Other gases that can develop during charging and the operations of lead acid batteries are arsine (arsenic hydride,  $\text{AsH}_3$ ) and (antimony hydride,  $\text{SbH}_3$ ). Although the levels of these metal hydrides stay well below the occupational exposure limits, they are a reminder to provide adequate ventilation.

Regeneration of week batteries for the second lease of life.

#### NATURAL VENTILATION.

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
7	Natural Ventilation	Permanently closed ventilators.	Creation of hot air pockets below the ceiling.	Open the Ventilators for easy exit of hot/warm air from the rooms.	Nil, In house manpower.	Eliminates use of Electrical Fans and Substantial cost of energy bills	7.1 .2, 7.1 .6

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

The natural ventilators are missing below the roofing. We also see that the roof is of Galvalume sheets. This makes the room hotter and more intolerable during the summer days. In absence of cross ventilation, the room turns out to be a oven. WE strongly suggest that the rooms be provided with cross ventilation just below the roof, making it easy for the hot air to vent out by thermosyphon.

Illustrative.



*Figure 19 – Blocked cross ventilated class room.*

We also suggest to use BLDC fans in Liew of normal ceiling fans which are energy intensive.

### WHY SUPER ENERGY EFFICIENT CEILING FANS?

Regular old ceiling fans.

Ceiling fans escape one's mind when thinking about reducing electricity cost. This forgotten appliance contributes significantly to electricity consumption due to its numbers and hours of usage. The following estimation supports this claim. A regular ceiling fan (1200 mm span) consumes about 75 W at the highest speed. There are

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

over 100 regular ceiling fans in the institute and each of them creates an electricity demand about 39W\* (consumption at medium speed).



### Super energy efficient ceiling fans

At present Brushless Direct Current (BLDC) ceiling fan is the popular choice of super energy efficient ceiling fans in India. There are two premier BLDC ceiling fan brands in India – Superfan (Versa Drives Private Limited) and Gorilla fans (Atomberg Technologies) \*\*. These ceiling fans (1200mm span) consume 35W at the highest speed so they save over 50% of electricity consumption.

The higher efficiency comes with no compromise in air delivery. Now consider replacing all the ceiling fans in the institute with best energy saving ceiling fan. The reduction in electricity demand created by ceiling fans will be:

No of fans (Approximated for computation): 100 Units

Maximum power drawn: 75W/Fan, ie 7500 W ie 7.5 KW

If these fans were to operate for 5 Hours per day, we have 7.5KW x 5 Hours ie **37.5Units per day.**

In the event of replacing these normal fans with BLDC energy efficient fans,

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



Maximum power drawn by BLDC fans: 35W/Fan, ie 3500 W ie 3.5 KW

If these BLDC fans were to operate for 5 Hours per day, we have 3.5KW x 5 Hours ie **17.5 Units per day.**

The net savings per day would be 20 Units per day. For working of 200 days in a year, the total savings would be 4000 Units.

When converted to revenue, it leads to a savings of ₹28000/-

Now consider, the capex, cost of each fan as ₹3000/-. The net outflow would be ₹3.00 Lacs.

The capex would yield a Return on Investment of around 6 years.

From the finance department point of view, the ROI of 6 years may not be acceptable, but here, we are in an institute where we educate. Hence the ROI discussions are for the purpose of discussions and should not to be seen from business view.

If the same is to be considered for their application in the residence, we find the fans being in operation for over 15 Hours. Leading to ROI of 2 years.

For actual capex, please contact one of the suppliers.,

M/s VERSA DRIVES PRIVATE LIMITED

38 B, Vadakku Thottam Part, Idikarai, Coimbatore. Tamil Nadu, India 641022

☎ Tel: 0422-2972798 / 2972799 / 2972800

Reference to the audit report may be made to avail educational institute's discount.

**SAFETY.**

Sr No	Observation*	Problems*	Resulting losses*	Remedial measures*	Capital*	Projected savings*	Category 7
8	Electric safety	Failure of electrical equipment	Loss of valuable data and assets.	Proper earthing and periodical maintenance with measurement.	Nil, In house manpower.	Eliminates electrical hazards and threat to life. Substantial cost of energy bills	7.1 .2, 7.1 .6

As a technical institution, It is important that the students and visitors are educated on the significance of Earthing, Grounding, Bonding and Shielding. Only if we discuss some of these terms will the students understand the basics of engineering. In view of this, we suggest that all the buildings in the campus be provided with well labelled Earthing, All the machinery are bonded with each other through grounding system and the buildings are shielded from lightning and the sensitive equipment and electronical driven system are safe.

Name plate :	Computer room.	
Earth pit connected to :	xxxx system.	
Date of inspection :	dd/mm/yyyy	
Next due date :	Dd/(mm+6)/yyyy	
Values	Measured values.	Required values.
Reasistance:	xx $\Omega$	< 5 $\Omega$
Leakage current :	aa Amps.	< 3.5mA

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

Monitoring of Earthing is very significant considering the dryness factor. Regular monitoring should be carried out to make sure that the electrical mishaps don't occur.

Electrical mishaps, may be Internal fire due to various faulty connections, It may be failure of light fixtures, loss of computer data, failure of devices, non-switching on of devices or even the abrupt failure of devices during lightning.

A perfect earthing should avoid all of them.

While we discuss about earthing, it is equally important to understand the significance of Bonding and shielding.

Special mention is to be noted that, the earthing of electronic devices such as computer loads, UPS loads and other non-electronic devices should be separately followed. More discussions within the institute should be conducted on,

### **Concept of shielding, bonding, Grounding and/or earthing with respect to energy saving.**

In addition the placement of insulating mat is also equally important for the safety of all the students and staff working on electrical systems. Be it electrical or mechanical or appliances in other areas.

#### **WHERE CAN PANELBOARDS AND LOAD CENTERS BE LOCATED IN MY BUILDING?**

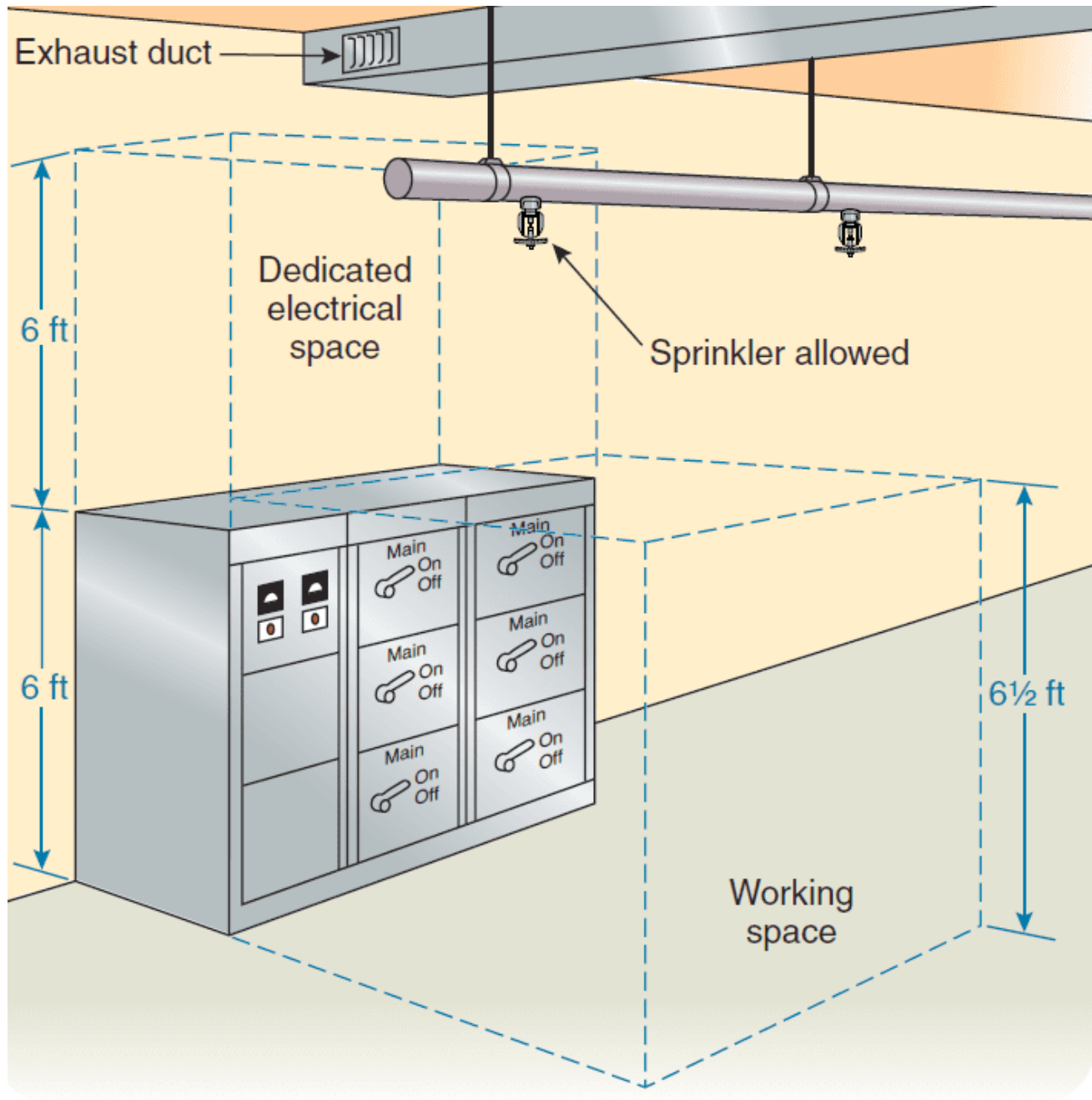
In a commercial like building it is typical for space to be dedicated for electrical panels and equipment. We have listed the requirements:

A **panelboard** (also sometimes referred to as a **load center**) is an enclosure which contains overcurrent devices such as fuses or circuit breakers.

In a commercial building it is typical for space to be dedicated for electrical panels and equipment. Often a commercial building will have a main electrical service room and smaller electrical rooms on other floors.

The National Electrical Code requires "clear space", referred to as working space around the panelboard to ensure easy access to the overcurrent devices and to provide adequate space for maintenance and inspection. Working space will vary

as a function of the voltage of the electrical equipment and the surrounding equipment and walls as shown in the graphic below.



### Working Space & Dedicated Electrical Space According to NFPA 70 (NEC)

Dedicated working space must be provided in front of and above the panelboard. The width of the working space in front of the equipment must be at least 30" or the width of the equipment, whichever is greater. The working space also extends

#### THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

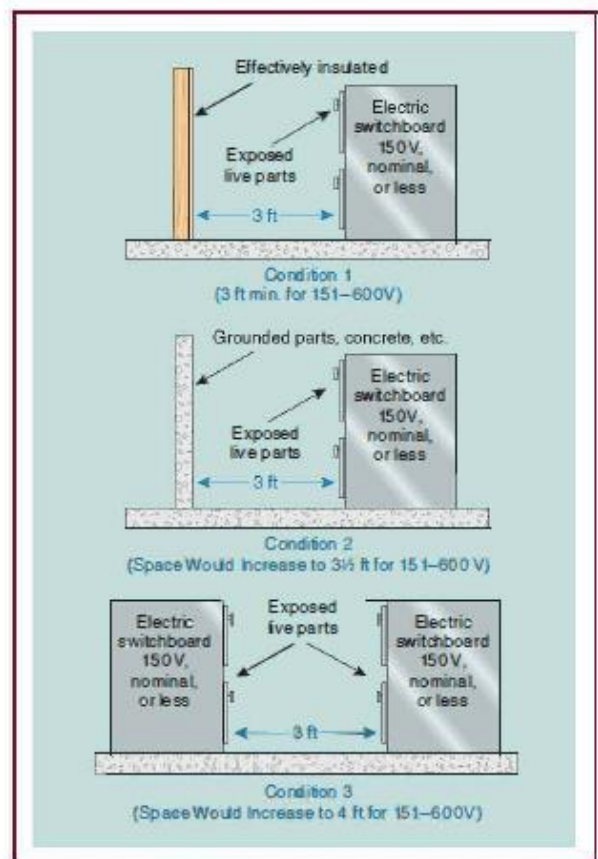
Description of Clearance	Distance (min)
Left to Right the minimum clearance	0.9 Meter (3 Ft)
Distance between Panel and wall	1.0 Meter
Distance between Panel and Ceiling	0.9 Meter
Clear Height in front of Panel >480V	2.0 Meter
Clear Height in front of Panel <480V	0.9 Meter (3 Ft)
Clearance When Facing Other Electrical Panels <480V	0.9 Meter (3 Ft)
The width of the working space in front of the Panel	The width of Panel or 0.762 Meter which is Greater.
Headroom of working spaces for panel boards (Up to 200Amp)	Up to 2 Meter

vertically from the floor or grade to a height of at least 6-1/2' or the height of the equipment, whichever is greater. These requirements are found in article 110.26 and table 110.26(A)(1) of the National Electrical Code.

Panelboards may be installed indoors or outdoors. Panelboards must be installed using the appropriate NEMA rating for the environment in which they are used. Panelboards installed indoors typically have NEMA 1 rating while panelboards installed outdoors typically have a NEMA 3R rating to summarise, the table lists the basic dimensions, under NEC 110.26

## ELECTRICAL INSULATING MATS

Installing electrical insulating mats in your workplace are necessary for prevention against current leakage while working on DC or AC installations. Insulating mats

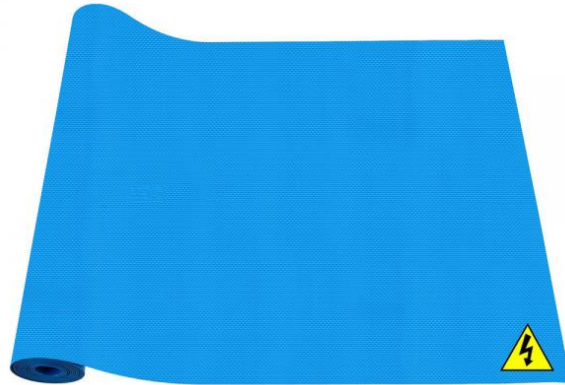
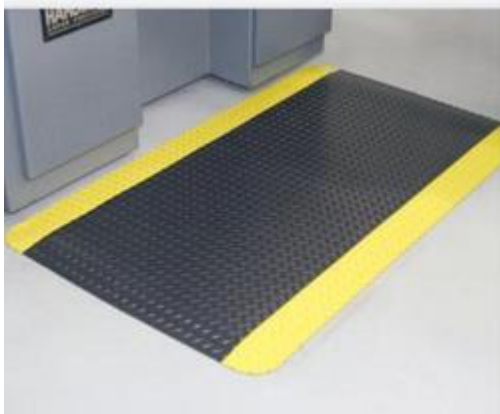


THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

ensures the safety of the workers who operate on live electronic equipment. These insulating mats must meet all the requirements of IS 15652 Standard and to be approved by third party NABL accredited testing agencies.

These insulating mats are manufactured with elastomer (rubber, pvc and elastomeric compounds). It also comes with anti-skid aberrations to avoid slippage. The dotted anti-skid design makes the appearance of these electrical safety mats more appealing.



ENERGY AUDIT

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



**LIST OF INSTRUMENTS:**

During the process of the Audit, the following lists of instruments were used.

Sr No.	INSTRUMENT	MAKE	APPLICATION
1	Digital Power Analyser (PC Interfaced)	SCHIVAN ARNOX	Electrical Machinery.
2	Accessories -3000 Amps	ARNOX	Higher load UPTO 3000 Amps,
3	Accessories -200 Amps	ARNOX	UPTO 200 Amps,
4	Thermal Imager	FLIR	Identify loose contacts and bearing losses
5	Power Analyser (Manual)	MECO	Electrical Machinery.
6	Infrared Thermometer	METRAVI	Thermal (Fuel) Energy.
7	Digital (Contact) Temperature & Humidity Meter.	METRAVI	Electrical Machinery. (A/C's and Cooling Towers)
8	Digital Tachometer	METRAVI	Electrical Machinery. (A/C's and Cooling Towers)
9	Lux Meter	METRAVI	General & Task Lighting.
10	Sound Level Meter	METRAVI	Electrical Machinery. Generator Sound Proofing
11	Digital Anemometer	METRAVI	Electrical Machinery. (A/C's and Cooling Towers)
12	Digital KW Meter	METRAVI	Electrical Machinery.
13	Digital Power Factor Meter	METRAVI	Electrical Machinery.
14	Lap Top Computer	HP	To Interface the Instruments For More Accurate -Sophisticated Readings In Sensitive Equipments.

15	Ultrasonic flow meter		Measure liquid flow.
16	Portable Vibration Meter.	METRAVI	Effect Of Filtration - Sewing System. Structural Stability
17	Live cable detector probe	-	Detect hidden cables for safety audit.
18	Power Analyser – EMM 5	Beluk	For remote communication and detailed audit.
19	Power Analyser – ELITE PRO	Beluk	Power Analyser.
20	ETV meter, KWh & PF meters for site recording.	Secure	
21	PT's for Transformer audits.	KALPA	On field auditing of transformer loading and imbalance evaluation.

Only appropriate instruments will used wherever necessary.

**ACTION PLAN SUMMARY:**

- Earmark the action plan.
- Invite subject experts for Tec talks,
- Organize in person panel discussions and interaction to propagate the knowledge and mitigate the problems in practicing the same.
- Prioritize the initiatives and execute.
- Observe the benefits and shortcomings.
- Workout further improvement by involving the staff and students.

**MODE OF ACTION:**

The process of ENERGY AUDIT & ENERGY CONSERVATION should be carried out in three steps.

- Good housekeeping practices using available manpower.
- Minor alterations using in house work culture with minimum investments on accessories as discussed.
- Capital investments, which may be required for installation of new methodologies may be taken up on phased manner.

We will be happy to assist you for any further advice/consultancy if required either on Rainwater management or on any of the measures discussed in the report.

We hope the measures are implemented in good spirit and to human convenience and comfort.

For SUNSHUBH TECHNOVATIONS PVT LTD.,

Mallikarjun A. Kambalyal. B.E. (E&C)

Certified Energy Auditors EA-3485

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

**NOTES:**

ENERGY AUDIT REPORT

---

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,

Notes:

ENERGY AUDIT REPORT

---

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,



Notes:

ENERGY AUDIT REPORT

---

THOUGHT FOR EVERY MOMENT

There are about 19,00,00,000 students in INDIA. If every student saves one sheet per day, 19,00,00,000 sheets of paper meaning 988 ton of paper will be saved every day. This is equivalent to saving 2748.54 ton of wood a day. This will lead to saving about 33,00,678 trees per year,