ENVIRONMENT AUDIT REPORT

PREPARED BY

EHS ALLIANCE SERVICES

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AUDIT CERTIFICATE

EHS alliance

CERTIFICATE

PRESENTED TO

INSTITUTE OF HOME ECONOMICS

F-4, Sri Krishna Chaitanya Mahaprabhu Marg, Hauz Khas, New Delhi, 110016

Has been assessed by EHS Alliance Services for the comprehensive study of environmental impacts on institutional working framework to fulfill the requirement of

ENVIRONMENT AUDIT

The environment legal compliances and initiatives carried out by the College have been verified on the report submitted and was found to be satisfactory.

The efforts taken by management and faculty towards environment and sustainability are highly appreciated and noteworthy.

EHS ALLIANCE SERVICES GURGAON

SIGNATURE

23.06.2022
DATE OF AUDIT

EHS ALLIANCE SERVICES, PLOT A-72, SURYA VIHAR, GURUGRAM, 122001
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ACKNOWLEDGEMENT

EHS Alliance Services would like to thank the management of **Institute of Home Economics, Delhi University** for assigning this important work of Environment Audit. We appreciate the co-operation to the teams for completion of assessment.

We would like to specially thank ***Prof. (Dr.) Geeta Trilok Kumar, Director, IHE*** for giving us an opportunity to evaluate the environmental performance of the campus.

We would also like to *thank* ***the Environment and Community Outreach Committee, NSS, Eco-Club and all the departments*** for their Continuous Support and guidance, without which the completion of the project would not have been possible. We are also thankful to other administration, non-teaching and gardening staff members who were actively involved while collecting the data and conducting field measurements.

We are also thankful to

Dr. Pratima Singh, Convenor, Environment and Community Outreach Committee, &Programme Officer NSS-IHE

Ms. Nitika Nagapl, Member, Environment and Community Outreach Committee, Co-Convenor, Environment NAAC visit Committee

Dr. Rachna Kapila, Co-Convenor, Environment and Community Outreach Committee

Dr. Parveen Pannu, Convenor, IQAC Committee

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Dr. Reema Chaurasia, Member, Environment and Community Outreach Committee

Dr. Sonal Jain, Member, Environment and Community Outreach Committee

Dr. Bhupinder Kaur, Member, Environment and Community Outreach Committee

DISCLAIMER

EHS Alliance Services Audit Team has prepared this report IHE based on input data submitted by the representatives of College complemented with the best judgment capacity of the expert team.

While all sensible care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the conclusions are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

If you wish to distribute copies of this report external to your organisation, then all pages must be included.

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EHS Alliance staff, agents and accreditation bodies have signed individual confidentiality undertakings and will only receive confidential information on a 'need to know' basis.

Signature

LEAD AUDITOR

CONCEPT AND CONTEXT

In India, the process for environmental audit was first mentioned under the Environment Protection Act, 1986 by the Ministry of Environment of forests on 13th march, 1992. As per this act, every person owning an industry or performing an operation or process needs a legal consent and must submit an environmental report or statement.

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory from the academic year 2019–20 onwards that all Higher Educational Institutions should submit an annual Green, Environment and Energy Audit Report. Moreover, it is part of Corporate Social Responsibility of the Higher Educational Institutions to ensure that they contribute towards the sustainable environment.

In view of the NAAC circular regarding environment auditing, the College management decided to conduct an external environment assessment study by a competent external professional auditor.

The term 'Environmental audit' means differently to different people. Terms like 'assessment', 'survey' and 'review' are also used to describe similar activities. Furthermore, some organizations believe that an 'environmental audit' addresses only environmental matters, whereas others use the term to mean an audit of health, safety and environment-related matters. Although there is no universal definition of Environment Audit, many leading companies/institutions follow the basic philosophy and approach summarized by the broad definition adopted by the International Chambers of Commerce (ICC) in its publication of Environmental Auditing (1989).

The ICC defines Environmental Auditing as:

"A management tool comprising a systematic, documented, periodic and objective evaluation of how well environmental organization, management and equipment are performing with the aim of safeguarding the environment and natural resources in its operations/projects."

This audit focuses on the environment legal compliances and implementation of rules defined by MoEFCC or state pollution control board. The concepts, structure, objectives, methodology, tools of analysis, and objectives of the audit are discussed below.

INTRODUCTION

Nature is very precious gift for all life forms. Disturbance in the nature causes environmental Problems. These are increasing day by day as a result of development of urbanization and industrialization on earth. Because of unplanned utilization of resources, our planet is facing tremendous pressure results a sharp rise in temperature. Therefore, there is an urgent need to plan the consumption of the resources in sustainable manner in order to conserve natural resources for future generation.

Sustainable development is becoming popular in the world for saving the earth. Utilizing resources in judicially can save the earth's precious resources. Measurement of environmental components is the most effective step to conserve and protect natural resources.

Environmental auditing had begun in the early 1970s with provision of civil lawsuits for non- compliance with environmental regulations. Environment auditing involves on site visit, collection of samples, performing analyses, and report results to competent authorities.

Industry, the corporate world is initiating auditing for saving natural resources. Academic institutions also can contribute to the preservation and conservation of resources within their premises.

In thin "Environment Audit" report would help everyone to think about preserving resources, show willingness to learn their importance, adopt steps to minimize resource use and set an example for others to follow the path of eco-friendly practices to achieve the goal of sustainable development. Effective implementation of environmental auditing helps in minimization of environmental risks at low cost.

OVERVIEW OF THE CAMPUS

The Institute of Home Economics started in the year 1961 by a Registered Co-operative Society conducting a two-year Diploma course in Home Science.

Dr (Mrs.) S. Malhan was the founder Director of the college. Her dynamism and keen involvement in the college affairs led to the recognition conferred by the University of Delhi and in 1969, Institute of Home Economics became a constituent college of University of Delhi.

The college continued to expand under the energetic leadership of Mrs. Malhan. In the year 1972, a one year Post-Graduate Diploma in Dietetics and Public Health and Nutrition was started. This was followed by a three-year B.Sc. Home Science (Hons) programme in 1973.

The year 1987 saw another landmark in the history of the college. The foundation stone for the new college building at Hauz Khas was laid by Late Honorable Giani Zail Singh, the then President of India. The year also marked the introduction of a two-year M.Sc. (Home Science) in Textiles and Clothing at the Institute. 2001, when the institute shifted to the present campus at Hauz Khas Enclave. With brand new facilities, more classrooms, better laboratories and workspace, the staff and students bid farewell to the old campus. In a period of three years, in 2004, a four year degree course was started in Elementary Education (B.El.Ed). The college celebrated 50 years of existence and academic excellence in 2011

The college continues to grow with ever increasing enthusiasm and vigour under the able leadership of the Director, Prof. Geeta Trilok-Kumar. The members of IHE family continue to be guided by a spirit of professionalism and dedication to a meaningful teaching learning relationship.

VISION

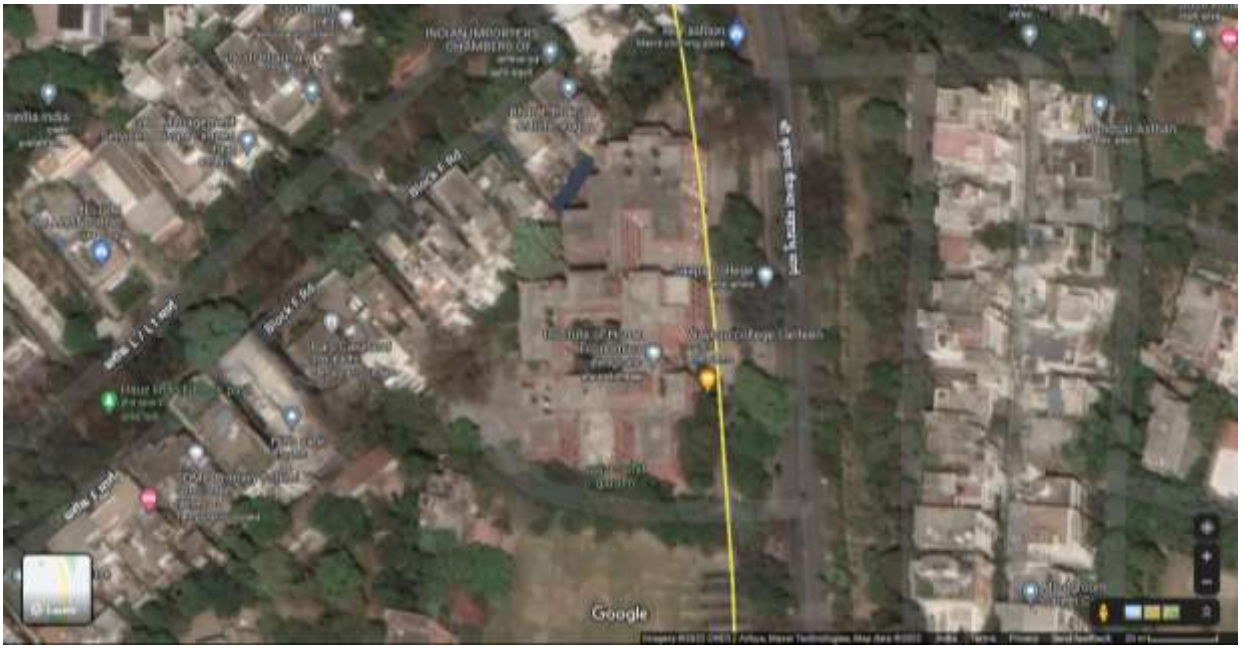
To empower girl students to contribute to the intellectual, professional and capacity building endeavors of the nation and to face the challenges of a globalized world while remaining rooted in the values and practices of their own culture.

MISSION

To provide quality and value based holistic education, facilitated by the use of technology and to focus on the development of young women as autonomous, critical thinking and humane individuals; to inculcate discipline, desire for excellence and foster all-round growth.

IHE provides education from under graduates to doctoral programmes. The various departments run by college are as follows:

Biochemistry	Human Development & Childhood Studies
Development Communication, Extension & Journalism	Microbiology
Elementary Education	Physical Education
English	Physiology & Promotive health
Fabric & Apparel Science	Resource Management & Design Application
Food & Nutrition and Food Technology	Sciences



Geo Coordinates from Google maps: 31.3103279, 75.6005209,289

AUDIT PARTICIPANTS

On behalf of IHE

Name	Designation/Department
Prof. (Dr.) Geeta Trilok-Kumar	*Director IHE*

On behalf of EHS Alliance Services

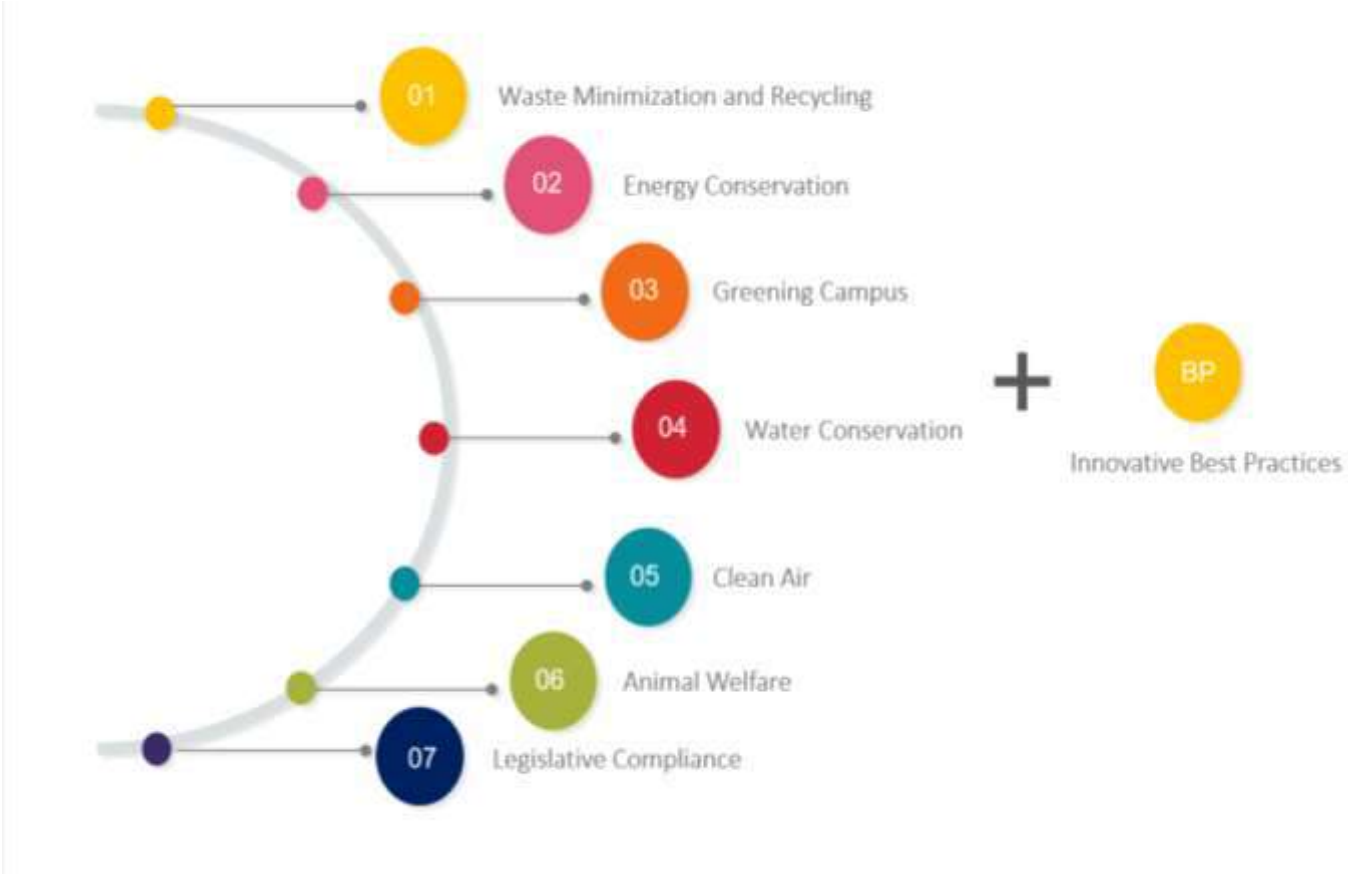
Name	Position	Qualifications
Dr. Uday Pratap	*Lead-Auditor*	*Ph.D. , PDIS, QCI – WASH, Lead Auditor ISO 14001:2015*
Ms. Pooja Kaushik	*Co-Auditor*	*M.Sc., Field Expert, Post Diploma in Climate change*

EXECUTIVE SUMMARY

The environment audit is a snapshot in time, in which one assesses campus performance in complying with applicable environmental laws and regulations. Though a helpful benchmark, the audit almost immediately becomes out-dated unless there is some mechanism in place to continue the effort of monitoring environmental compliance. Our approach to promote a Green Campus to inculcate the sustainable value systems among the students, so that they carry the learning and practices them in their future endeavours. This will ensure that Sustainability and Environmental practices get embedded in all the institutions and organizations in the country.

A Green Campus is a place where environmentally friendly practices and education combine to promote sustainability in the campus which ultimately offers an institution the opportunity to take the lead in redefining its environmental culture and developing new paradigms by creating sustainable solutions to environmental, social and economic needs of the mankind.

This is very first environment audit of College for doing their bit towards environmental protection and environmental awareness at local and global front. Audit criterion is environmental cognizance, waste minimization and management, biodiversity conservation, water conservation, energy conservation and environmental legislative compliance by the campus. A questionnaire is used during audit. This audit report contains observations and recommendations for improvement of environmental consciousness.



WASTE MANAGEMENT

TYPES OF WASTE ON COLLEGE CAMPUS

To create effective waste management plans, university first need to know the types of waste they produce. Below, we have compiled a list of various kinds of waste commonly generated on institutional campus:

1. **Food Waste** - College campus generates food waste. The canteen generates approximately 2-3 kg of food waste a day. The reasons for food waste in an educational campus may be because of over purchasing food to ensure a sufficient supply, or less sale due to reduced footfall of students on certain days. Immediate attention is given to the food waste minimization techniques. The raw food waste of vegetable peels is converted into compost. Also, students and staff are regularly made aware about preventing food wastage through posters and signage displayed at college premises.

2. **Recyclable Paper, Cardboard, Plastic, Glass and Cans** - Campus tends to produce vast quantities of these recyclables. Even in the digital age, many students, professors and staff members still prefer handwritten notes and end up with piles of unwanted paper once their courses and projects are complete. Shipments of necessary items throughout the year are likely to arrive in recyclable plastic and cardboard packaging. As far as possible, used A4 papers are reused for rough work, assignments, notices, applications etc. and some of the empty cardboard cartons are reused as waste paper collection boxes. Students are also encouraged to reuse old newspapers for making covers for their assignments, or use in teaching assignments and practicals like tower making games. The rest of the leftover waste is sold/auctioned to the scrap vendors time to time.

3. **Student Clothes and Housewares** - Students and faculty members are encouraged to donate or recycle their old cloths instead of throwing away. NSS unit of college carries out such donation drives time to time.

4. **E – Waste - Student and facility electronics often form a large portion of a campus's waste** — As campus continually upgrade their computing facilities and office computers to keep up with the latest technology, the old computers have to go somewhere. So do old printers, phones, copy machines and other electronics that receive upgrades over the years. Discarded student electronics often become part of a College's waste stream as well. IHE believes in recycling of e-waste which is much Students may throw away old phones, TVs, tablets, laptops and printers, along with cords and other accessories. Recycling is a much more eco-friendly option — the metals in old electronics often have a high reuse value. Thus, the College is in the process to has tie-up with external authorized agency which manages e-waste through proper procedures details mentioned in legislation compliances.

5. **Chemical Waste -** Chemical waste on the campus may come from numerous sources. Campus laboratories generate waste chemicals, as do cleaning services. Much of these chemical substances are hazardous waste under Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 and must undergo specific disposal processes according to state environmental rules and regulations. Standard SOPs for chemical disposal are being followed by various departments in college.

6. **Maintenance Waste -** In the maintenance department, spent paints, solvents, adhesives and lubricants all form potentially hazardous waste. Because they are difficult to recycle, spent incandescent light bulbs usually become landfill waste. Spent fluorescent light bulbs, which contain small amounts of mercury, typically require special handling because of the environmental and health risks they pose.

7. **Biological Waste** - Biological waste from laboratories and campus medical centres room will require special handling and disposal as per BMW Rules, 2016. Tissue and microbes from biology, microbiology, and biochemistry and cadaver labs forms biological waste, as do tissue samples, contaminated bandages and used sharps from medical facilities. The institute has signed a contract with an agency 'Biotic Waste Solutions Pvt. Ltd' to collect and dispose-off bio-medical and bio-hazardous waste generated in college.

8. **Furniture** - Furniture waste on a College campus has a couple different sources. The campus itself may also get rid of old furniture as it modernizes its classrooms, cafeterias, computer labs and study spaces. Old and broken furniture is sold to junk dealer as and when required.

9. **Books/Magazines/Newspapers -** Books accounted for solid waste generation and College often generate large quantities of textbook waste. Students of IHE carries out book donation drives and also sometimes donates their text books and notes to junior students, or else are sold to resellers.
10. **C & D Waste -** Due to expansion of College campus building and renovation works result significant amount of construction and demolition waste that should be either used for back filling or disposed off through authorised dumping site by CPCB/SPCB.

11. **Solid Waste -** The College is managing solid waste by providing it to the MCD.

12. **Horticulture Waste** – College campus has a lot of greenery and grounds that results in significant horticulture waste which is managed by in-house composting system.

ENERGY CONSERVATION

1. List ten ways that you use energy in your institute. (Electricity, LPG, firewood, others). Using this list, try to think of ways that you could use less energy every day.

- *Lights, fans and AC are turned off before leaving the room*
- *Peons have duty to continuous check & turn off electric appliances when not in use.*
- *Old bulbs and tube lights are being replaced by power efficient LED lights as and when required.*
- *Motion sensor LED lights are also used at strategic places.*
- *22 Solar Power street lights efficient LED Lights have been used in the campus.*
- *As for as possible day light is utilized by keeping window open for natural ventilation.*
- *Old electric appliances like ACs, computers etc. are replaced with ones having energy efficient certifications, so that power consumption is less.*
- *AMC of electric appliances like ACs, computers, and computer accessories is being done annually in the institute.*

2. Are there any energy saving methods employed in your institute? If yes, please specify. If no, suggest some

Yes, IHE has adopted energy saving techniques

- *Power efficient LED Lights have been used in the campus.*
- *Solar lights are used for Street lights and open areas.*
- *Old computers have been replaced with ones having energy efficient certification.*
- *Keep the computers and ACs on power saving mode.*
- *Signage like 'Switch off lights when not in use'*

3. How many CFL/LED bulbs has your institute installed?

IHE has replaced almost 20% of conventional bulbs and tube lights with LED Lights.

4. Do you run "switch off" drills at institute?

No

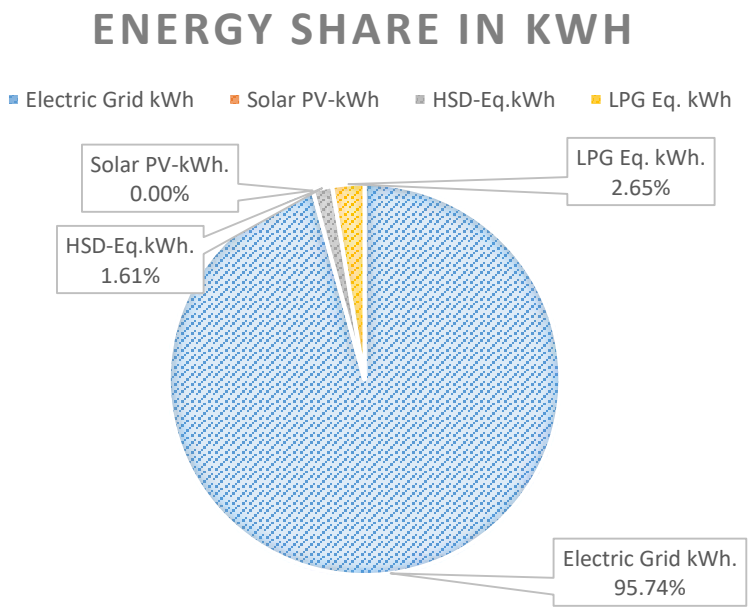
5. Are your computers and other equipment's are on power-saving mode?

Yes, IHE put the computers on power saving mode

6. Does your machinery (TV, AC, Computer, weighing balance, printers, etc.) run on standby modes most of the time? If yes, how many hours?

No

Energy Share	kWh	Percentage
Electric Grid kWh	195425	95.74
Solar PV-kWh	0	0
HSD-Eq.kWh	3288.00	1.61
LPG Eq. kWh	5402.52	2.65
Total -kWh	204115.52	100



WATER AND WASTE WATER MANAGEMENT

1. List uses of water in your institute

Basic use of water in campus are for drinking purpose, toilets, cleaning, gardening, canteen and hostel. Below is the monthly consumption details

Basic use of water in campus:

***Drinking** – 54.53 KL/month*

***Gardening** – 8.36 Kl/month*

***Kitchen and Toilets** – 358.91 KL/month*

***Others** – 154.92 KL/month*

Total = 576.73 KL/Month

2 How does your institute store water? Are there any water saving techniques followed in your institute?

1 Underground tank of 1,27,000 litres storage capacity

6 tanks of 5000 litres

7 tanks of 2000 litres

2 tanks of 1000 litres

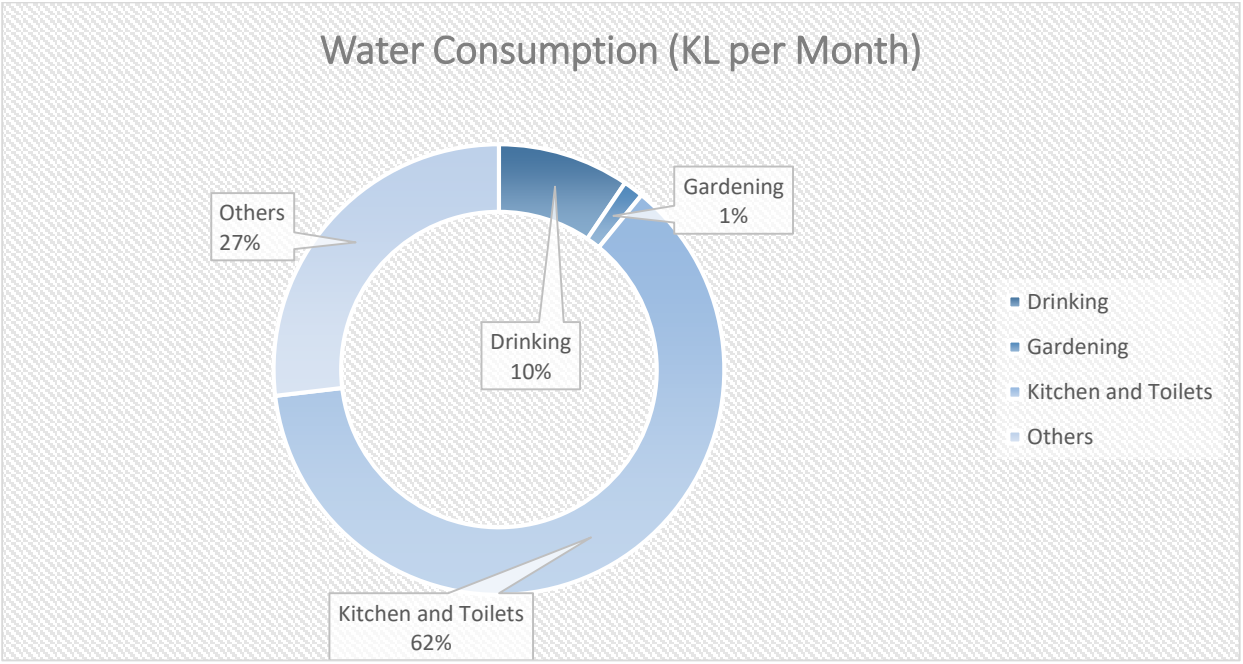
Saving Techniques

- ✓ *Minimizing water run off by attaching faucets*
- ✓ *Reducing evaporation losses and recharging ground water by planting and maintaining trees.*
- ✓ *The RO water outlets discharged water is used for watering plants*

3. Locate the point of entry of water and point of exit of waste water in your institute. (Entry and Exit)

Entry – Water supply comes from Delhi Jal Board, and 3 metered connections are there.

Exit- From Canteen, Toilets, bathrooms, labs, etc. through covered drainage which is connected to sewage



4. Write down ways that could reduce the amount of water used in your institute

Basic ways:

- ✓ *Maintenance and monitoring of valves in supply system to avoid overflow, leakage and spillage*
- ✓ *The IHE ensures that the faucets in the washrooms and water filtration units are checked regularly and do not have any leakages.*

5. Does your institute harvest rainwater?

Yes, there is one unit for rain water storage.

6. Is there any water recycling System?

No

Rainwater harvesting (RWH) is the collection and storage of rain, rather than allowing it to run off. Rainwater is collected from a roof-like surface and redirected to a tank, cistern, deep pit (well, shaft, or borehole), aquifer, or a reservoir with percolation, so that it seeps down and restores the ground water. Total 2 RWH units have been installed in campus but college is in process to reconstruct the same.

AIR QUALITY MANAGEMENT

1. Are the Rooms in Campus Well Ventilated?

Yes, as per National Building Code, guidelines

2. Window Floor ratio of the Rooms?

Very Good, ample daylight utilization because of big windows.

3. What is the ownership of the vehicles used by your campus?

Campus owns one petrol vehicle.

4. Provide details of college-owned vehicles?

1 vehicles

5. PUC done?

Yes

6. Specify the type of fuel used by your campus's vehicles

College owns 1 petrol car.

8. Air Quality Monitoring Program (If, Any)

Yes

ENVIRONMENT LEGISLATIVE COMPLIANCE

1. Are you aware of any environmental Laws Pertaining to different aspects of environmental management?

Yes

2. Does your institute have any rules to protect the environment? List possible Rules you could include.

Yes, below are some rules

- *Four Wheelers for students are not allowed in the campus.*
- *Segregation of waste into Biodegradable & non-biodegradable is in practice.*
- *Commutation of vehicles by faculty, staff & students within the campus.*
- *Posters displaying 'NO Smoking Zone'.*

- *Burning of biomass/ dry leaves is banned in college campus.*
- *Display boards saying 'Do Not Pluck Plants'.*

3. Does Environmental Ambient Air Quality Monitoring conducted by the Institute?

Yes, the college has air quality monitors.

4. Does Environmental Water and Waste water Quality monitoring conducted by the Institute?

Yes

5. Does stack monitoring of DG sets conducted by the Institute?

No

6. Is any warning notice, letter issued by state government bodies?

No

7. Does any Hazardous waste generated by the Institute?

Yes, it is being disposed though the authorized external agency.

GENERAL

1. Are students and faculties aware of environmental cleanliness ways? If Yes Explain

Yes, The Environment and Community Outreach Committee, NSS, Eco-club and different departments of IHE organizes several environmental awareness campaigns to make faculty and students aware about importance of environmental cleanliness. One of the regular features is conduct of cleanliness drives like "Swatchh Bharat Abhiyaan", 'Tide Turner Challenge', 'My 10 Kg Plastic Waste', Skits on Air Pollution and creating awareness through IEC materials, short films, radio programmes, podcasts, radio jingles etc. on different environmental issues etc.

3. Does Important Days Like World Environment Day, Earth Day, and Ozone Day etc. eminent in Campus?

Yes, World Environment Day, International Earth Day, Polar Bear Day, World Conservation Day, World Tiger Day, National Pollution Control Day, World Malaria Day, World Food Security Day, Ozone Day, Earth Day, Earth Hour and many more are celebrated by campus college. Furthermore, IHE organises different activities like Create wealth from Waste, Book Donation drives, Food Donation Drives, Cloth Donation Drives, Medicines donation Drive, Swachhta Campaigns and many more.

4. Does Institute participate in National and Local Environmental Protection Movement?

Yes, Institute has signed MoUs with national and international agencies like Indian Pollution Control Association, WWF-Nature India, Green Peace etc.

5. Does Institute have any Recognition or certification for environment friendliness?

Yes, attached in annexure I

7. Does Institution conduct a green or environmental audit of its campus?

This is the first external audit carried out by the College.

8. Has the institution been audited /accredited by any other agency such as NABL, NABET, TQPM, NAAC etc.?

Yes

BEST PRACTICES AND INITIATIVES

- Maintaining green belt across campus.
- Tree plantation drives is a regular feature.
- Under its green initiative, the Environment committee added approximately 100 planters containing different plant varieties in college campus.
- Environment committee successfully converted all the organic waste generated in college canteen, departments and lawns into nutrient rich organic manure.
- To revive and recreate herbal garden in college campus, approximately 16 varieties of medicinal and herbal plant saplings were planted to educate students about the importance of herbal gardening.
- In order to minimize carbon footprint of college and become an environmentally conscious academic institute, college has installed 22 solar lights in its premises as sustainable replacement for traditional street lights with the help and support of Innovative Power Solutions, Safdarjung Enclave.
- Installation of air quality monitors in college premises with the support of the Society for Indoor Environment (SIE) for real-time monitoring of air quality parameters such as PM2.5, PM10, CO2, Temperature and Humidity
- Organized a two days International Conference on 'Environment, Health and Sustainable Development' on 25th and 26th September 2020.
- Signed contract with 'Biotic Waste Solutions Pvt. Ltd' to collect and dispose-off bio-medical and bio-hazardous waste generated in college.
- Faculty and students' participation in 'My 10 Kg Plastic Waste' campaign in collaboration with Indian Pollution Control Association (IPCA).
- Running mass campaigns like 'Adopt a Plant', 'Tide Turners Challenge', 'Plastic Strike', 'I Pledge to Protect My Environment' etc.
- Creating Green Vertical Patch in college with the help of Tears of Earth NGO.
- Social Sensitization Programmes such as say no to plastic campaigns, follow traffic rules, say no to drug awareness campaigns, organic waste management, water conservation etc.
- Students' participation in 'Swacchta Sarthi Fellowship' Scheme, Government of India.
- Faculty and student projects on environment like:
- Sustainable Option of Developing Kitchen Gardens Based on Air Pollution Tolerance Index (APTI) Method of Plants with Edible Leaves for Health and Well Being.
- Mapping the vulnerability of women in India to climate change at the sub-national scale.
- Making of Herbal face masks using used cotton cloth at home during Covid-19 lockdown. The fabric was given an herbal soothing, cooling and antimicrobial finish with aloe vera gel, neem, clove and tulsi followed by dyeing with turmeric.

RECOMMENDATIONS

- Green building guidelines with ECBC compliance should be adopted for future expansion projects of the College.

- Environmental Monitoring i.e. (Stack Monitoring of DG sets, Water monitoring need to be conducted by State Pollution Control Committee, approved laboratory) should be conducted periodically.

- Environmental parameters should be included in purchase policy to achieve cradle to grave approach for sustainability.

- Provide sanitary waste disposal facility as per the CPCB guidelines for management of sanitary waste (as per Solid Waste Management Rules, 2016). Installation of Incinerator is recommended in campus. The college has initiated to purchase 1 incinerator.

CONCLUSION

This audit involved extensive consultation with all the campus team, interactions with key personnel on wide range of issues related to environmental aspects. Overall 60% of College campus is for landscaping. The audit has identified some observations for making the campus premise more environment friendly. The recommendations are mentioned for College campus team to initiate actions. The audit team opines that the overall site is well-maintained from environmental perspective. Still there are few things that are important to initiate urgently which includes DG stack height monitoring and periodic inspection of buildings to increase the energy efficiency.

REFERENCES

- **The Environment [Protection] Act – 1986 (Amended 1991) & Rules-1986 (Amended 2010)**
- **The Petroleum Act: 1934 – The Petroleum Rules: 2002**
- **The Central Motor Vehicle Act: 1988 (Amended 2011) and The Central Motor Vehicle Rules:1989 (Amended in 2005)**
- **Energy Conservation Act 2010.**
- **The Water [Prevention & Control Of Pollution] Act – 1974 (Amended 1988) & the Water (Prevention & Control of Pollution) Rules – 1975**
- **The Air [Prevention & Control Of Pollution] Act – 1981 (Amended 1987) The Air (Prevention & Control of Pollution) Rules – 1982**
- **The Gas Cylinders Rules – 2016 (Replaces the Gas Cylinder Rules – 1981**
- **E-waste management rules 2016**
- **Electrical Act 2003 (Amended 2001) / Rules 1956 (Amended 2006)**
- **The Hazardous Waste (Management and Handling and Trans-boundary Movement) Rules, 2008 (Amended 2016)**
- **The Noise Pollution Regulation & Control rules, 2000 (Amended 2010)**
- **The Batteries (Management and Handling) rules, 2001 (Amended 2010)**
- **Relevant Indian Standard Code practices**

ANNEXURE I – RECOGNITIONS AND AWARDS

Certificate

Where there is Rural Wellbeing there is Universal Prosperity

This is to appreciate that the Institutional Success Story of INSTITUTE OF HOME ECONOMICS, South Delhi, New Delhi has been showcased in our monthly Swachhta Action Plan Implementation Program of February 2022 with the support of Prof. (Dr) Geeta Trilok Kumar, Head of the Institution. The Swachhta team of the institution has completed the activity based program "Showcase! The Success of Sustainability". The Swachhta Action Plan of the Higher Education Institution is elevated in the sustainability components: Greenery, Water, Energy, Waste Management and Land use Management. The program is organized by Mahatma Gandhi National Council of Rural Education, Hyderabad.

Date of Issue:
16/3/2022

B Sharath Chandra Naveen Kumar
SAP 2021-22 Project, National Monitoring Officer
MGNCRE MoE GoI mgncre.org

Mahatma Gandhi National Council of Rural Education
Department of Higher Education, Ministry of Education
Government of India

Certificate No.: MoE/SESREC/N/50 *kavita.sagar@ihe.du.ac.in*

UMEED-A DROP OF HOPE

Ref.No: "UD22/FI-3019" Date: 27-03-2022

TO WHOM IT MAY CONCERN

We, hereby would like to recommend **National Service Scheme of Institute of Home Economics, University of Delhi** and attest that this letter will act as the formal letter of recommendation on behalf of Umeed NGO.

They organized an event on the advent of World Poetry Day on 27th March 2022 in our adopted slum. They empowered the kids through fun educational activities and donated more than 100 stationery kits. Their work and vision to bring change lead us to collaborate with them.

The event went extremely smooth because of the the sheer passion and active participation of their volunteers. The constant interaction with the children made it easy for the kids to open up and enjoy the event. Various activities were held like reciting poem with actions for age group of 8 to 12 years old. They also encouraged the kids by rewarding them for their great performance which helped boost morale of the kids.

Their vision that education is for all and that a power of one child, one pen and one teacher can bring significant change in the world. And by helping these kids in our slum they proved that change can be brought.

It has been a pleasure working with **National Service Scheme of Institute of Home Economics**. We appreciates the volunteers of **NSS IHE** and the **NSS IHE** itself for their hardwork and their dedication to their vision. Umeed NGO wishes them all the success in their future endeavors. We believe they will be able to achieve their goals and help bring change in the society.

Sincerely,

Subhrajeet Gautam
(Founder & Secretary)
Umeed A Drop Of Hope (NGO)

WASTE TO WEALTH
Swachh Bharat Unnat Bharat

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Fellowship Award Letter

Ref. No. II/W2W/SSF 21-B/175 June 30th ,2021

Dear Palak Nagpal,

Sub.: Award of "Swachhta Saarthi Fellowship (SSF) 2021"

This is with reference to your application submitted under "**Swachhta Saarthi Fellowship (SSF) 2021**" of the Waste to Wealth Mission, spearheaded by The Office of the Principal Scientific Adviser to the Government of India, housed at Invest India.

We are pleased to inform you that your application has been selected by our expert committee for award of the SSF 2021 for a period of one-year w.e.f. **1st of July 2021**. You are requested to start your activities as proposed by you in the application.

Fellowship amount disbursement will be made on monthly basis to you at the rate of Rs. 1000/- per month (in Words: Rupees One Thousand Only), basis the submission of your monthly activities/ reports online along with the relevant pictures/ videos etc. (as per Annexure-I). The detailed terms and conditions of the SSF 2021 are attached as Annexure-II.

We now request you to commence the activities that you proposed in your application. We wish you all the best for your participation in this endeavor.

With best regards,

Your sincerely,

Malyaj Varmani
Malyaj Varmani (Jul 1, 2021 11:38 GMT+5.5)

(Malyaj Varmani)
Vice President
Invest India

To,
Palak Nagpal
#167 , Nagpal'S
C Block ,,
Sirsa 125055
Haryana
Email: Palaknagpal23@gmail.com
Encl.: a/a

Office of the Principal Scientific Adviser to the Government of India

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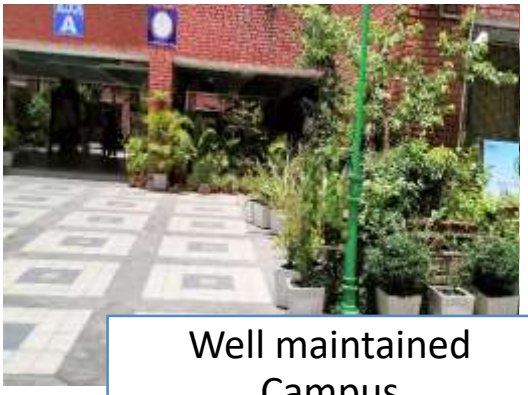
ANNEXURE II - PHOTOGRAPHS



Well maintained Campus

Lush Green Campus

Indoor plants

wall plants

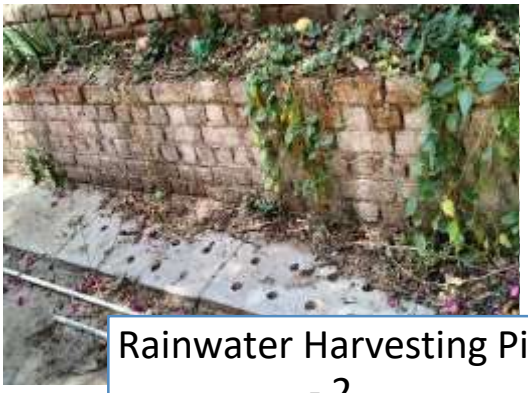
Nursery

Green net nursery

Herbal garden with plant name plate

Paved pathways

Rainwater Harvesting Pit - 1



Rainwater Harvesting Pit - 2

Recycle Activiy - 1

Swachhata Pakhwada Activiy - 2

Food Donation Drive

Clothes donation Drive

Colored coded dustbins in the campus

Composting for bio degradable waste

Classrooms with ample natural light

Solar lights installed in campus

Plantation Drive

Awareness Campaign

Plastic Free Campaign

Plastic Free Campaign

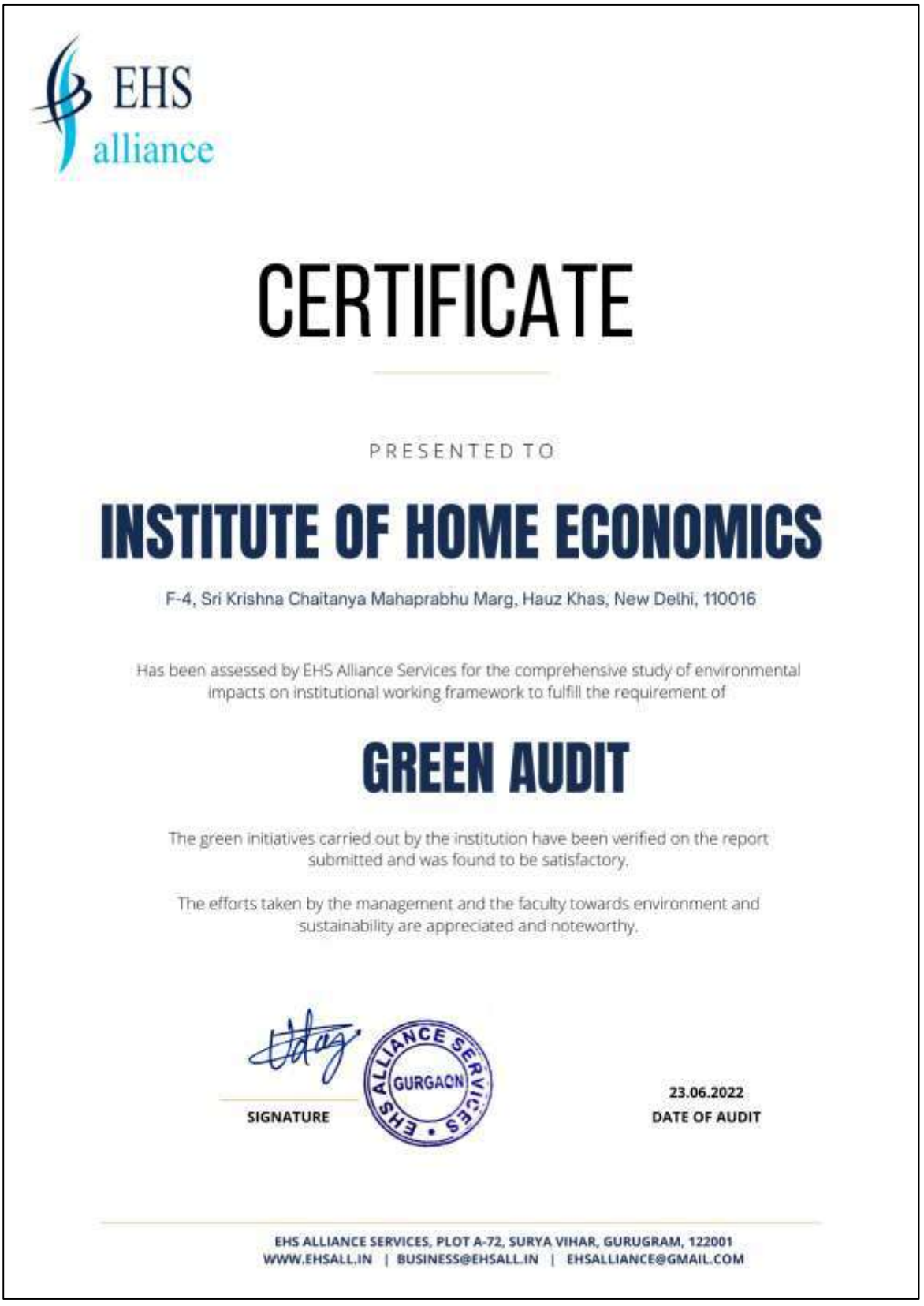
********** **END OF THE REPORT** **********

GREEN AUDIT REPORT

PREPARED BY
EHS ALLIANCE SERVICES

CONTENT

CERTIFICATE



EHS alliance

CERTIFICATE

PRESENTED TO

INSTITUTE OF HOME ECONOMICS

F-4, Sri Krishna Chaitanya Mahaprabhu Marg, Hauz Khas, New Delhi, 110016

Has been assessed by EHS Alliance Services for the comprehensive study of environmental impacts on institutional working framework to fulfill the requirement of

GREEN AUDIT

The green initiatives carried out by the institution have been verified on the report submitted and was found to be satisfactory.

The efforts taken by the management and the faculty towards environment and sustainability are appreciated and noteworthy.

SIGNATURE

EHS ALLIANCE SERVICES GURGAON

23.06.2022
DATE OF AUDIT

EHS ALLIANCE SERVICES, PLOT A-72, SURYA VIHAR, GURUGRAM, 122001
WWW.EHSALL.IN | BUSINESS@EHSALL.IN | EHSALLIANCE@GMAIL.COM

ACKNOWLEDGEMENT

EHS Alliance Services would like to thank the management of **Institute of Home Economics, Delhi University** for assigning this important work of Green Audit. We appreciate the co-operation to the teams for completion of assessment.

We would like to specially thank ***Prof. (Dr.) Geeta Trilok Kumar, Director, IHE*** for giving us an opportunity to evaluate the environmental performance of the campus.

We would also like to thank ***the Environment and community outreach committee, NSS, Eco Club, and other related departments*** for their continuous support and guidance, without which the completion of the project would not have been possible. We are also thankful to other Non-Teaching, Administrative and Gardening staff members who were actively involved while collecting the data and conducting field measurements.

We are also thankful to

Dr. Pratima Singh, Convenor, Environment and Community Outreach Committee, Programme Officer NSS-IHE

Ms. Nitika Nagapl, Member, Environment and Community Outreach Committee, Co-Convenor, Environment NAAC visit Committee

Dr. Rachna Kapila, Co-Convenor, Environment and Community Outreach Committee

Dr. Parveen Pannu, Convenor, IQAC Committee

Dr. Manjula Suri, Member, Environment and Community Outreach Committee

Dr. Archana Bhagat, Member, Environment and Community Outreach Committee

Dr. Bhavna Negi, Member, Environment and Community Outreach Committee

Dr. Ruchira Das, Member, Environment and Community Outreach Committee

Dr. Nidhi Gulati, Co-Convenor, IQAC Committee

Dr. Mamta Singhal, Member, IQAC Committee

Dr. Shantanu Mandal, Member, Environment and Community Outreach Committee

Dr. Sneha Abhishek, Member, Environment and Community Outreach Committee

Ms. Kavita Sagar, Member, Environment and Community Outreach Committee

Dr. Reema Chaurasia, Member, Environment and Community Outreach Committee

Dr. Sonal Jain, Member, Environment and Community Outreach Committee

Dr. Bhupinder Kaur, Member, Environment and Community Outreach Committee

DISCLAIMER

EHS Alliance Services Audit Team has prepared this report for IHE based on input data submitted by the representatives of IHE complemented with the best judgment capacity of the expert team.

While all sensible care has been taken in its preparation, details contained in this report have been compiled in good faith based on information gathered.

It is further informed that the conclusions are arrived following best estimates and no representation, warranty or undertaking, express or implied is made and no responsibility is accepted by Audit Team in this report or for any direct or consequential loss arising from any use of the information, statements or forecasts in the report.

If you wish to distribute copies of this report external to your organisation, then all pages must be included.

EHS Alliance, its staff and agents shall keep confidential all information relating to your organisation and shall not disclose any such information to any third party, except that in the public domain or required by law or relevant accreditation bodies.

EHS Alliance staff, agents and accreditation bodies have signed individual confidentiality undertakings and will only receive confidential information on a 'need to know' basis.

Signature

LEAD AUDITOR

CONCEPT AND CONTEXT

The National Assessment and Accreditation Council, New Delhi (NAAC) has made it mandatory from the academic year 2019–20 onwards that all Higher Educational Institutions should submit an annual Green, Environment and Energy Audit Report. Green Audit is assigned to the Criteria 7 of NAAC, National Assessment and Accreditation Council which is a self-governing organization of India that declares the institutions as Grade A, Grade B or Grade C according to the scores assigned at the time of accreditation. Moreover, it is part of Corporate Social Responsibility of the Higher Educational Institutions to ensure that they contribute towards the reduction of global warming through Carbon Footprint reduction measures.

In view of the NAAC circular regarding Green auditing, the university management decided to conduct an external environment assessment study by a competent external professional auditor. The green audit aims to examine environmental practices within and outside the IHE campus, which impact directly or indirectly on the atmosphere. Green audit can be defined as systematic identification, quantification, recording, reporting and analysis of components of university/college environment. It was initiated with the intention of reviewing the efforts within the institutions whose exercises can cause risk to the health of inhabitants and the environment.

Through the green audit, a direction as how to improve the structure of environment and inclusion of several factors that can protect the environment can be commenced. This audit focuses on the Green Campus, Waste Management, Water Management, Air Pollution, Energy Management & Carbon Footprint etc. being implemented by the institution. The concepts, structure, objectives, methodology, tools of analysis, objectives of the audit are discussed below.

INTRODUCTION

Now days, the educational institutions are becoming more thoughtful towards the environmental aspects and as a result new and innovative concepts are being introduced to make them sustainable and eco-friendly. To preserve the environment within the institution, a number of viewpoints are applied by the several educational institutes to solve their environmental problems such as promotion of the saving the energy, waste recycle, water consumption reduction, water harvesting and many more...

The activities carried out by the institution can also create adverse environmental impacts. Green audit is defined as an official inspection of the effects a university has on the environment. Green Audit is conducted to evaluate the actual scenario at the institution campus. Green audit can be a useful tool for a college/university to determine how and where they are using the most of the energy or water or resources; the college can then decide how to implement changes and make savings. It can also be used to determine the nature and volume of waste, which can be used for a recycling project or to improve waste minimization plan.

Green auditing and the application of mitigation measures is a win-win situation for all the institutions, the learners and the mother earth. It can also result in health awareness and can promote the environmental awareness, values and beliefs. It provides a better understanding to staff and students about the Green impact on institution. Green auditing also upholds financial savings through reduction of resource usage. It gives an opportunity to the students and teachers for the development of ownership of the personal and social responsibility. The audit process involves primary data collection, site walk through with the team of College/University including the assessment of policies, activities, documents and records.

OVERVIEW OF THE CAMPUS

The Institute of Home Economics started in the year 1961 by a Registered Co-operative Society conducting a two-year Diploma course in Home Science.

Dr (Mrs.) S. Malhan was the founder Director of the college. Her dynamism and keen involvement in the college affairs led to the recognition conferred by the University of Delhi and in 1969, Institute of Home Economics became a constituent college of University of Delhi.

The college continued to expand under the energetic leadership of Mrs. Malhan. In the year 1972, a one year Post-Graduate Diploma in Dietetics and Public Health and Nutrition was started. This was followed by a three-year B.Sc. Home Science (Hons) programme in 1973.

The year 1987 saw another landmark in the history of the college. The foundation stone for the new college building at Hauz Khas was laid by Late Honorable Giani Zail Singh, the then President of India. The year also marked the introduction of a two-year M.Sc. (Home Science) in Textiles and Clothing at the Institute. 2001, when the institute shifted to the present campus at Hauz Khas Enclave. With brand new facilities, more classrooms, better laboratories and workspace, the staff and students bid farewell to the old campus. In a period of three years, in 2004, a four year degree course was started in Elementary Education (B.El.Ed). The college celebrated 50 years of existence and academic excellence in 2011

The college continues to grow with ever increasing enthusiasm and vigour under the able leadership of the Director, Prof. (Dr.) Geeta Trilok-Kumar. The members of IHE family continue to be guided by a spirit of professionalism and dedication to a meaningful teaching learning relationship.

Vision | Mission

VISION

To empower girl students to contribute to the intellectual, professional and capacity building endeavors of the nation and to face the challenges of a globalized world while remaining rooted in the values and practices of their own culture.

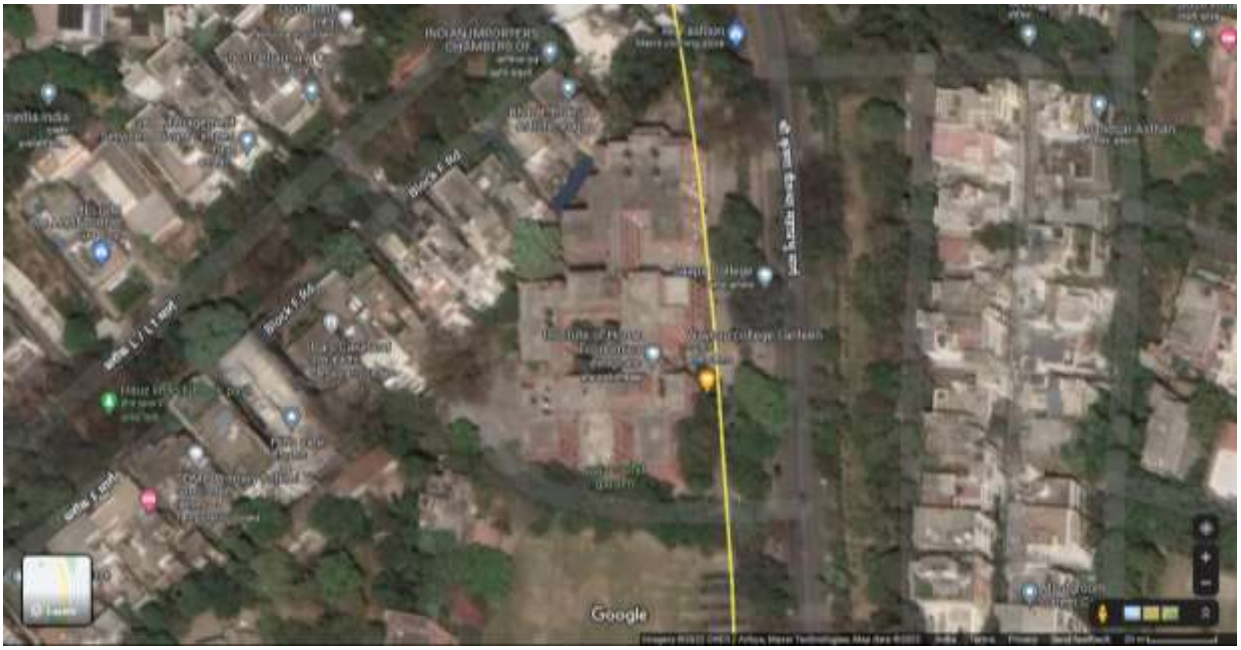
MISSION

To provide quality and value based holistic education, facilitated by the use of technology and to focus on the development of young women as autonomous, critical thinking and humane individuals; to inculcate discipline, desire for excellence and foster all-round growth.

IHE provides education from under graduates to doctoral programmes.

The various departments run by college are as follows:

Biochemistry	Human Development & Childhood Studies
Development Communication, Extension & Journalism	Microbiology
Elementary Education	Physical Education
English	Physiology & Promotive health
Fabric & Apparel Science	Resource Management & Design Application
Food & Nutrition and Food Technology	Sciences



Geo Location: Geo Coordinates from Google maps: 28.5465901, 77.2064641

AUDIT PARTICIPANTS

On behalf of IHE

Name	Designation/Department
Prof. (Dr.) Geeta Trilok-Kumar	*Director, IHE*

On behalf of EHS Alliance Services

Name	Position	Qualifications
Dr. Uday Pratap	Lead-Auditor	*Ph.D. , PDIS, Lead Auditor ISO 14001:2015, QCI – WASH, Field expert*
Ms. Pooja Kaushik	Co-Auditor	*M.Sc., Field Expert, Post Diploma in Climate change*

EXECUTIVE SUMMARY

Green auditing is an essential step to identify and determine whether the institutions practices are sustainable and ecological. Traditionally, we were upright and efficient users of natural resources. But over the period of time, excessive usage of resources like water, electricity, petrol, etc. have become habitual for everyone especially, in urban and semi-urban areas. It is actually the right time to check if we (our process) are consuming more than required resources? Whether we are using resources sensibly?

Green audit standardizes all such practices and provides an efficient way to use natural resources. In the time of climate change and resource exhaustion it is necessary to re-check the processes and convert it in to green and sustainable. Green audit provides an approach for it. It also increases overall awareness among the individuals working in institution towards the eco-friendly environment.

This is the first attempt to conduct a green audit of the IHE campus for fulfilment of NAAC criteria. This audit was mainly focused on greening indicators like consumption of energy in terms of electricity and fossil fuel, quality of soil, water usage, vegetation, waste management practices and carbon foot print of the campus. Initially a questionnaire was shared to know about the existing resources of the campus and resource consumption pattern of the students and staffs in the IHE.

GREEN AUDIT – ANALYSIS

1.1 GENERAL INFORMATION

1. Does any Green Audit conducted earlier?

Internal audits have been carried out in past by the members of Environment and Community Outreach committee. However, this is very first time IHE has gone for External Green Audit in a systematic way of monitoring their environmental importance.

2. What is the total strength (people count) of the Institute?

Students
Male: 0 Female: 1686 Total: 1686

Teachers (including guest faculty)
Male: 10 Female: 91 Total: 101

Non-Teaching Staff
Male: 75 Female: 28 Total: 103

Total Strength
Male: 85 Female: 1805 Total: 1890

3. What is the total number of working days of your campus in a year?

There are one hundred eighty (180) working days in a year.

4. Where is the campus located?

F-4, Sri Krishna Chaitanya Mahaprabhu Marg, Hauz Khas, New Delhi, 110016

5. Which of the following are available in your institute?

Garden area	*Not Available*
Playground	*Available*
Kitchen	*Available*
Toilets	*Available*
Garbage Or Waste Store Yard	*Available*
Laboratory	*Available*
Canteen	*Available*
Hostel Facility	*Not Available*
Guest House	*Not Available*

6. Which of the following are found near your institute?

Municipal dump yard	*Not in vicinity of institute*
Garbage heap	*No Garbage heaps*
Public convenience	*Public convenience is available*
Sewer line	*Approximately 400 m sewer line within campus*
Stagnant water	*No stagnant water*
Open drainage	*No*
Industry – (Mention the type)	*No*
Bus / Railway station	*Hauz Khas Metro Station*
Market / Shopping complex	*Available*

1.2 WASTE MINIMIZATION AND RECYCLING

1. Does your institute generate any waste? If so, what are they?

Yes, following types of wastes are generated by the campus

- *Biodegradable waste,*
- *Non-biodegradable waste*
- *Biomedical waste*
- *Hazardous waste*
- *E-waste*

2. What is the approximate amount of waste generated per day? (in KG approx.)

Biodegradable waste – 5 Kg
Non-Biodegradable waste - 2 Kg
Hazardous Waste < 0.5 Kg (per Month)
E-waste < 1 Kg (per month)

3. How is the waste generated in the institute managed? By Composting, Recycling, Reusing, Others (specify)

- *Vermicomposting and composting through Aerobin composter are done by the environment waste management committee.*
- *Work for tying up with an authorized agencies for the management of e-waste is in progress. The e-waste generated from computer labs, administration, different departments etc. are collected in separate and would be sent to recycling units through proper procedures.*
- *MCD take away general waste of the campus.*
- *Use of Single use plastic by students and staff is banned on the campus*
- *All the waste generated during the process of making & serving food, snacks & beverages in canteen is segregated and put into different color bins. Dry and wet waste is then picked up by vendor Organic waste generated in canteen is converted into manure using Aerobin.*
- *Bio-medical and bio-hazardous waste is collected and disposed off by authorized vendor 'Biotic Waste Solutions Pvt. Ltd'.*

4. Do you use recycled paper in institute?

No

5. How would you spread the message of recycling to others in the community?

- *Demonstrations through paper recycling unit installed in RMDA department*
- *Workshops on recycling/ reuse/ up-cycling of used old cloths*
- *Running campaigns like 'Plastic Strike in College', 'My 10 Kg Plastic Waste', 'Tide Turner Challenge' etc.*
- *Seminars and webinars for students and faculty*
- *Reuse waste paper for poster makings, official printouts, assignments, product making etc.*
- *Nukkar-Natak by Students to increase awareness*

6. Can you achieve zero garbage in your institute? If yes, how?

Not yet achieved. IHE is in process to achieve the same by doing following waste management
1. E-waste management through responsible reuse and recycling.

2. Installation of Incinerator in the Girls Washrooms for sanitary waste management.

3. Re-use of one sided used papers for rough prints and printing on both sides of paper.

4. Dry/garden and canteen organic waste management by making organic manure in a compost pit, vermi-compost bins and aerobin using it for gardening needs.

1.3 GREENING THE CAMPUS

1. Is there a garden in your institute?

Yes, but not a grass covered area.

2. Do students spend time in the garden?

Yes, students spend around 2-4 Hours during winters.

3. Total number of Plants in Campus?

Plant type with approx. count	
Full grown Trees	*154*
Small Trees	*430*
Hedge Plants	*669*
Grass Cover SQM	*0*

4. Is the IHE campus having any Horticulture Department? (If yes, give details)

Yes, total 2 gardener staff deployed in horticulture

5. How many Tree Plantation Drives organized by campus per annum?

Two Plantation Drives were organized in last Financial Year 2021-2022.

6. How many trees and plants were planted in last drive? And, what is the survival rate?

A total of 141 plants and trees were planted in last financial year, and the survival rate is more than 80%

7. Is there any Plant Distribution Program for Students and Community?

IHE has a practice where guests and invitees are felicitated by giving a planter as a gift rather than a bouquet of flowers.

8. Is there any Plant Ownership Program?

Adopt a plant campaigns are being run by college to encourage students and staff to become environmental conscious and take ownership of the plants they adopt.

1.4 WATER AND WASTEWATER MANAGEMENT

1. List uses of water in your institute

Basic use of water in campus:

***Drinking** – 54.53 KL/month*

***Gardening** – 8.36 Kl/month*

***Kitchen and Toilets** – 358.91 KL/month*

***Others** – 154.92 KL/month*

Total = 576.73 KL/Month

2. How does your institute store water? Are there any water saving techniques followed in your institute?

1 Underground tank of 1,27,000 litres storage capacity

6 tanks of 5000 litres

7 tanks of 2000 litres

2 tanks of 1000 litres

Saving Techniques

- ✓ *Minimizing water run off by attaching faucets to garden pipe.*
- ✓ *Reducing evaporation losses and recharging ground water by planting and maintaining trees.*
- ✓ *The RO water outlets discharged waste water is used for water needs in coolers and cleaning, and mopping.*

3. Locate the point of entry of water and point of exit of waste water in your institute.

Entry *– Water supply comes from Delhi Jal Board, and 3 metered connections are there.*

Exit*- From Canteen, Toilets, bathrooms, labs, etc. through covered drainage which is connected to sewage*

4. Write down ways that could reduce the amount of water used in your institute

Basic ways:

- ✓ *Close the taps after usage*
- ✓ *Maintenance and monitoring of valves in supply system to avoid overflow, leakage and spillage*
- ✓ *The IHE ensures that the faucets in the washrooms and water filtration units are checked regularly and do not have any leakages.*

1.5 ANIMAL WELFARE

1. List the animals (wild and domestic) found on the campus (dogs, cats, squirrels, birds, insects, etc.)

20+ Squirrels, 10+ species of Birds including parrot and shark crows 4 cats are found in campus. A variety of bird's species and other flora and fauna available.

2. Does your institute have a Biodiversity Program or a KARUNA CLUB?

Yes. Environment and community Outreach Committee, NSS-IHE and Eco-Club Prakritik participates in activities including feeding the birds , planting fruit based plants for birds, organizes biodiversity awareness campaigns, etc. Students of NSS IHE :

- *visited birds hospital*
- *celebrated World Animal Welfare Day to create awareness about animal rights and animal welfare,*
- *conducted nest making activity on World Conservation Day.*

1.6 CARBON FOOTPRINT - EMISSION & ABSORPTION

1. Electricity used per year - CO2 emission from Electricity

(electricity used per year in kWh/1000) x 0.84
195425 kWh/1000 x 0.84

= 195425/1000x0.84
= 164.16 tons

2. LPG/PNG used per year - CO2 emission from LPG/PNG

(LPG/PNG used per year in Kg) x 2.99
774 x 2.9

=2.31 tons

3. Diesel used per year - CO2 emission from HSD (Diesel)

Carbon absorption per litre = 2.68
=300 x 2.68
=0.8 tons

4. Transportation per year (car) CO2 emission from transportation (Bus and Car)

IHE has 1 car
=1x2x2x180/100x0.02
= 0.14 tons

Total CO2 emission per year cumulative by electricity usage + LPG consumption + Diesel usage + bus and car transportation (164.16 + 2.31 + 0.8 + 0.14 = 167.42 tons)

Carbon absorption by flora in the institution

There are 154 full grown trees and 430 semi grown trees of different species and approximately 669 shrubs/hedge plants.
Carbon absorption capacity of one full grown tree 22 kg CO2 Therefore Carbon absorption capacity of 154 full-grown trees 154 x 22 kg CO_2 = 3.39 tons of CO_2.

The carbon absorption capacity of 430 semi-grown trees is 50% of that of full-grown trees. Hence the carbon absorption 430 x 6.8 kg of CO_2 = 2.92 tons of CO_2.

There are approximately Hedge Plants 669 of various species being raised in the gardens and grown in the areas where no buildings are built Carbon absorption of bush plants varies widely with their species. Certain bushes absorb very high level of CO_2 where as some others absorb very low level of CO_2. In the absence of a detailed scientific study, 200g of CO_2, absorption is taken per bush (in consultation with Environmental Science specialists). Based on this, total carbon absorption of bushes is 669 x 200 g = 0.13 tons of CO_2

Grand total of carbon absorption capacity of the campus is 6.45 tons.

GREEN INITIATIVES BY CAMPUS

- **Renewable Energy** – IHE has 22 solar lights, and is using for streets and open areas.
- **Tree Plantation Drives** – Two Plantation drives were carried out in the current year in the Campus.
- **Air Pollution Reduction** - Personal Vehicles (Students) are not allowed in the campus. And, IHE has collaborated with third party agency and procured 4 Air quality monitoring systems.
- **Solid Waste Management** – Waste management is done by composting. There is ban on single use plastic in the campus.
- **Environment Committee Initiatives** – IHE has an environment committee. Below are the highlights of their work on environment consciousness.
    - The organic waste is collected from all the departments and canteen and is being converted into organic manure using Aerobin and through composting pits.
    - Vermicomposting is done for solid waste management. The garden waste (all the dried leaves of the plant) generated in campus is converted into nutrient rich compost using earthworms.
    - Students are being instructed to submit assignments and other projects in either newspaper covers, newspaper bags or simply stapled in order to avoid plastic usage in form of files and folders
    - Use of plastic spoons, glasses and forks has also been reduced considerably in college canteen. Further, 'Plastic Strikes' are being conducted by the students and staff wherein, they take out rally in college campus and collect the plastic waste from different sources in college
    - Workshop and Demonstration on vertical landscaping in association with 'Tears of Earth (TOE) NGO' was conducted for the students with the concept to implement green walls in college.
    - Environment committee volunteers are participating in the Swacchta Sarthi Fellowship scheme of Office of Principal Scientific Advisor to the Government of India under its 'Waste to Wealth Mission'.
    - A capacity building training session on Sustainable Waste Management Practices: ' My 10 Kg Plastic Waste' campaign was organized in online mode in December 2020. Students and staff were briefed about issues pertaining to single use plastic waste problems and were encouraged to participate in this mass campaign to segregate their plastic waste at household level, and send it to recycling/ co-processing unit with the help of IPCA.

- A webinar was organised in collaboration with WWF India to make students aware about the Tide Turners Plastic Challenge, which is a global youth movement to fight plastic pollution around the world.

- Running of paper recycling unit is the sustainable practice adopted by the Department of RMDA in collaboration with the Eco-club 'Prakritik', IHE for recycling waste paper generated in the different departments of the college.

- Members of the eco-club and students also participated in the conclave on "Circular Economy of Plastic Waste and Livelihood Opportunities & Excellence Awards for Academia and Community", on the occasion of the birth anniversary of Pandit Deendayal Upadhayay.

- Department of RMDA in collaboration with Eco-club 'Prakritik' has organised a webinar on 'Our Fundamental duties' on 10th September 2020 (Thursday) from 11-12:00 PM.

- Different workshops on topics such as Making Recycled Paper Products, International Polar bear day, environment day, Our fundamental duties, Video-Clip Contest on 'Ozone Protection', Poster-Making Competition On Wetlands & Water, etc.

- Mass Campaigns and plantation drives on topics such as 'Adopt a plant campaign', Mass Pledge Campaign on 'I Pledge to Protect My Environment' and more.

RECOMMENDATIONS

- Solar power plant should be installed on building roof that will supply at least 60 % of total power in campus.
- Water Meter should be installed at every building of institute for monitoring of water consumption per capita.
- More awareness posters should be displayed at various places in campus for water and energy saving.
- Plant distribution program in nearby villages and societies should be initiated periodically.
- Eco-friendly parameters should be included in the purchase of articles and goods for the IHE campus.
- IHE should start drip irrigation for gardening purpose to save water in campus
- Flow rate of taps should be checked, it should not be more than 2.5 litres/minute.

CONCLUSION

This audit involved extensive consultation with all the teams, interactions with key personnel on wide range of issues related to Environmental aspects. IHE has environment committee for sustainable use of resources. Overall 60% of IHE campus is for landscaping. The audit has identified a few observations for making the campus premise more environment friendly. The recommendations are mentioned with observations for IHE campus team to initiate actions. The audit team opines that the overall site is well-maintained from the environmental perspective. Few things that are important to initiate urgently includes installation of solar PV, initiation of drip irrigation and checking of water flow of taps. We also highly recommend for installation of water meters at each building/block and water balancing report.

REFERENECE:

- The Environment [Protection] Act – 1986 (Amended 1991) & Rules-1986 (Amended 2010)
- The Petroleum Act: 1934 – The Petroleum Rules: 2002
- The Central Motor Vehicle Act: 1988 (Amended 2011) and The Central Motor Vehicle
- Rules:1989 (Amended in 2005)
- Energy Conservation Act 2010.
- The Water [Prevention & Control Of Pollution] Act – 1974 (Amended 1988) & the Water (Prevention & Control of Pollution) Rules – 1975
- The Air [Prevention & Control Of Pollution] Act – 1981 (Amended 1987) The Air (Prevention & Control of Pollution) Rules – 1982
- The Gas Cylinders Rules – 2016 (Replaces the Gas Cylinder Rules – 1981
- E-waste management rules 2016
- Electrical Act 2003 (Amended 2001) / Rules 1956 (Amended 2006)
- The Hazardous Waste (Management and Handling and Trans-boundary Movement) Rules, 2008 (Amended 2016)
- The Noise Pollution Regulation & Control rules, 2000 (Amended 2010)
- The Batteries (Management and Handling) rules, 2001 (Amended 2010)
- Relevant Indian Standard Code practices

Transparency of Green Audit Report

Green audit report is one of the useful means of demonstrating an organization's commitment to openness and transparency. If an Organisation believes it has nothing to hide from its stakeholders, then it should feel confident enough to make its green audit reports freely available to those who request them. As a basic rule, green audit reports should be made available to all stakeholders.

ANNEXURE I – PHOTOGRAPHS OF ENVIRONMENT CONSCIOUSNESS

Seminar on Water Conservation

Food Donation Drive With 'Dadi Ki Rasoi'

Well ventilated building structure

Well maintained IHE campus

Lush green campus

Green Campus

Plantation drive in IHE

Plantation drive in the campus

In-House nursery in campus

Active participation in plantation drive

Bird Feeding Drive by college students

Webinar with WWF

Classrooms as per NBC guidelines with more than 40% window ratio

Spacious and well equiped labs

Worls Environment Day "Echosystem Restoration"

International Mother Earth Day

Ozone Day Celebration

World Sparrow Day Celebrations

Create From waste Activity

Create from Waste activity

Poster making activity

Poster making activity

Nukkad - Natak for social awareness

Plastic waste collection campaign

Workshop on water conservation

Webinar on sustainable waste management with Aerobins

Webinar on Urban Forestry for pollution abatement

Plastic free campaign in local area of Delhi

Save Water awareness - Comic Book

Awareness on Climate Change - Puppet Show

********** END OF THE REPORT **********

ENERGY AUDIT REPORT

OF

Institute of Home Economics

University of Delhi

F-4, Hauz Khas Enclave, Hauz Khas, New Delhi, Delhi 110016

PREPARED BY

URS VERIFICATION PRIVATE LIMITED

F – 3, Sector – 06,

Noida

201301Uttar

Pradesh

JULY, 2022

ACKNOWLEDGEMENT

URS Verification Private Limited expresses their gratitude for the work awarded of conducting Energy Audit of Institute of Home Economics, New Delhi. The energy audit was conducted from **04/07/2022 to 05/07/2022** with the active involvement of the Senior Management and concerned staff of IHE.

We acknowledge with gratitude the wholehearted support & unstinted co-operation given by-

Dr. Geeta Trilok Kumar, Director, IHE

Dr. Pratima Singh, Convenor, Environment and Community outreach Committee & Programme officer NSS-IHE

Ms. Nitika Nagpal, Member, Environment and Community outreach Committee, Co-Convenor Environment NAAC visit committee

Dr. Rachna Kapila, Co-Convenor, Environment and Community outreach Committee

Dr. Parveen Pannu, Convenor, IQAC Committee

Dr. Manjula Suri, Member, Environment and Community outreach Committee

Dr. Archana Bhagat, Member, Environment and Community outreach Committee

Dr. Bhavna Negi, Member, Environment and Community outreach Committee

Dr. Ruchira Das, Member, Environment and Community outreach Committee

Dr. Nidhi Gulati,Co- Convenor, IQAC Committee

Dr. Mamta Singhal, Member, IQAC Committee

Dr. Shantanu Mandal, Member, Environment and Community outreach Committee

Dr. Sneha Abhishek, Member, Environment and Community outreach Committee

Ms. Kavita Sagar, Member, Environment and Community outreach Committee

Dr. Reema Chaurasia, Member, Environment and Community outreach Committee

Dr. Sonal Jain, Member, Environment and Community outreach Committee

Dr. Bhupinder Kaur, Member, Environment and Community outreach Committee

The team members of URS Verification Pvt. Ltd. sincerely thank the management and support staff members of IHE, who have rendered their all-possible co-operation and assistance during the entire period of assignment.

For URS Verification Pvt. Ltd

Ashok Kumar (AGM – Energy & Sustainability)

CERTIFICATE

We certify the following

- The data collection has been carried out diligently and truthfully.
- All data measuring devices used by the auditor are in good working condition, have been calibrated and have valid certificate from the authorized approved agencies and tampering of such devices has not occurred.
- All reasonable professional skill, care and diligence had been taken in preparing the energy audit report and the contents thereof are a true representation of the facts.

Signature

Name: Ashok Kumar
Designation: AGM – Energy & Sustainability

ABBREVIATIONS

A	Ampere
AC	Alternating Current
Avg.	Average
AVR	Automated Voltage Regulator
CFL	Compact Fluorescent Lamp
CFM	Cubic Feet Minute
DG	Diesel Generator
FTL	Florescent Tube Light
GT	Generator Transformer
DTL	Double Tube Light
KL	Kilo Liter
KV	Kilo Volt
kVA	Kilo Volt Ampere
kW	Kilo Watts
kWh	Kilo Watt Hour
LED	Light Emitting Diode
Lit	Liters
M or m	Meter
Max.	Maximum
Min.	Minimum
MT	Metric Ton
MW	Mega Watt
PNG	Piped Natural Gas
No.	Number
PF	Power Factor
PL	PL is holder Type of CFL Tube
TR	Ton of Refrigerant
V	Voltage
CFM	Cubic Feet per Minute

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EXECUTIVE SUMMARY

This report is an attempt of URS to provide an overview on existing energy consumption at Institute of Home Economics, New Delhi. This report also highlights the major energy saving opportunities available in the premises. A set of recommendations which will assist the management of IHE in improving energy efficiency has also been highlighted in this report conducted on 04/07/2022 to 05/07/2022. The brief description is shown below:

Project Title:	**URS Project Report Number:**
Energy Audit in Institute of Home Economics, New Delhi	CCMS141869
Client:	
Institute of Home Economics, New Delhi	
Contact Persons:	
Dr. Geeta Trilok Kumar, Director, IHE Dr. Pratima Singh, Convenor, Environment and Community outreach Committee & Programme officer NSS-IHE Ms. Nitika Nagpal- Member, Environment and Community outreach Committee, Co-Convenor Environment NAAC visit committee	
Date of Audit	**Source of Electricity**
04/07/2022 to 05/07/2022	BSES Rajdhani Power Limited, New Delhi
Date of this Report:	**Date of Approval:**
08/07/2022	08/07/2022

Work carried out by: (Team Composition)	Mr. Rohit Dutt Paliwal- Team Lead Mr. Mohd. Javed – Engineer	No Distribution without permission from the client or responsible organization unit
Final Report Verified: (Scheme Manager)	Insert Signature Name: Ashok Kumar — Date: 08/07/2022	Unrestricted Distribution

HIGHLIGHTS OF THE ENERGY AUDIT

- IHE receives electricity supply from BSES Rajdhani Power Limited, New Delhi and from open access with 11 KV as the input voltage that comes under Non Domestic/above 3KVA (supply upto 11kv) Category. The Contract Demand is 295 kVA. It is observed from electricity bills of last year that the average power factor is 0.83. Existing power factor can be improved from 0.83 to 0.99 by installing 80 KVAR APFC panel. Therefore, the annual energy saving will be 2275 KVAh which result in annual monetary saving of INR 2.32 Lakh and payback period will be 5 months.

- The performance assessment of All AC's has been done and all AC's shows satisfactory performance. Detailed analysis is given its relevant chapter.

- The performance assessment of all motor and pumps which were running during the audit has been done and found satisfactory.

- Replacement of conventional tube light with LED tube light will give **4103 Kwh** annual energy saving, **INR 0.35 lakh** monetary saving and payback period will be around **18 months.**

- IHE is running awareness campaign on regular interval for energy conservation like seminar and competition of poster making on energy conservation, use of solar energy etc. IHE also implemented various measures for energy saving in institution building which involve installation of Solar Street light, use of start rated appliances and adopted regular maintenance activity to avoid any energy loss.

- IHE has been shifted around 20% lights to LED, using sunlight during day time as far as possible and also in process to use motion sensitive light at strategic location.

• An In house survey by faculty and students on energy conservation has been conducted from June 2020 to July 2021. This proactive approach shows IHE keen interest to save energy and aware faculty & students about energy conservation.

Based on the Energy Audit, following areas are identified for reducing energy consumption. Also, the investment required and payback period are detailed in below table:

Table 1: Summary of Energy Conservation Measures (ENCONs)

S. No.	Energy Conservation Measures	Annual Energy Saving		Investment	Monetary	Simple Payback Period (Months)
		Natural Gas	Electricity	(Rs.INR)	Savings	
		SCM	(kVAh)		(Rs.INR/year)	
Low Investment						
1	Installing APFC Panel for Power Factor Correction		27297	88000	232024.2	5
Medium Investment						
2	Replacing Conventional Choke Tubelight with LED Tubelight		4103	51800	34871.76	18
High Investment						
3	NA	NA	NA	NA	NA	NA
	Total		**31400**	**139800**	**266895.96**	

CHAPTER: 1
INTRODUCTION

1.1 THE PROJECT

The Institute of Home Economics (IHE) is a premier institution of the University of Delhi, imparting holistic value-based education to women students. It was established in 1961 by Dr. (Mrs) Surjit Malhan. The college offers undergraduate courses, viz.,B.Sc. Home Science (Hons. and Pass), B.Sc. (Hons) Microbiology, B.Sc. (Hons) Biochemistry, B.El.Ed, B.Sc. (Hons) Food Technology and BA (Hons) Journalism. IHE also offers post - graduate courses viz., M.Sc. in Fabric and Apparel Sciences and M.Sc. in Food and Nutrition, PG Diploma in Dietetics and Public Health Nutrition and PG Diploma in Health and Social Gerontology. A number of students have been enrolled for Ph.D under faculty members for doctoral research. Of the many achievements of college, the most important ones during the last few years include NAAC 'A' certification, FIST Grant (2016-2021) from DST and Star College Scheme grant from Department of Biotechnology.

During the year 2020-2021, college undertook various green practices and sustainability initiatives. Organic Composting and Vermicomposting with the use of Aerobins was taken up. To revive and recreate Institute of Home Economics, University of Delhi herbal garden, approximately 16 varieties of medicinal and herbal plant saplings were planted in college campus. Solar lights were put up in the campus of the college as part of 'go green' initiative. The IHE has taken many initiatives to redefine its environment culture and develop new ways of making the campus eco-friendly. The faculty, staff, and students worked together to develop a sustainable campus and spread the idea of eco-friendly culture to the nearby community as well. These include activities such as tree plantation in the campus during the rainy season, segregating and recycling of waste material, vertical gardening activities, and vermicomposting pits that have been developed using garden waste. The activity of organic

compost formation from wet waste of the canteen has also been started in collaboration with Indian Pollution Control Association under the project SORT (Segregation of Organic Waste for Recycling and Treatment). The Institute also conducts programs such as 'Say No to Plastics' and encourages 'paperless' communication at all levels.

Energy Audit of Institute building situated at F-4, Hauz Khas Enclave, Hauz Khas, New Delhi, Delhi 110016 was conducted by URS Verification where audit team covered all the utilities available in institution building.

The main source of energy is electricity. Institute also using natural gas for practical purpose in laboratories.

1.2 SCOPE OF WORK

URS Verification Pvt. Ltd. was entrusted with the work for conducting Energy Audit in Institute of Home Economics, New Delhi. The audit team has carried out the performance assessment and reviewed operational philosophy of the various Motors, Pumps, AC, Lighting, loading profile of Transformers and Bill Analysis for Electricity.

1.3 METHODOLOGY

The following step by step methodology and approach were adopted to carry out the specified energy audit for Institute of Home Economics, New Delhi. URS team visited the plant on 04/07/2022 for the field measurement and conducting the audit. The team had a meeting/ discussion with senior officials and concerned department heads. The broad methodology adopted for the Energy Audit in Institute of Home Economics, New Delhi is furnished below:

• Pre-Audit Meeting (opening meeting) with management, senior officials of all concerned departments.

• Measurements of electrical/thermal parameters, wherever possible, using portable instruments were carried out.

• Review of documents/ records and operational philosophy (All the relevant maintenance documentation, test records, OEM (Original Equipment Manufacturer) service manuals of electrical installations).

• Submission of Energy Audit Draft Report.

• Review meeting with client on Draft Report.

• Submission of Final Energy Audit Report to Client.

The Detailed Energy Audit covers the following areas:

(i) Study of Electricity Bills, Contract Demand & Power Factor & Loading Pattern.
(ii) Power Distribution Study
(iii) Electrical Systems Study
(iv) Power Quality Analysis
(v) Motor Loading Study
(vi) Air Conditioning Study
(vii) Pump Systems
(viii) Study of Lighting System
(ix) Projects for Implementing the Energy Saving Measures

Building Cover-Up Area:

Table: Building cover-up area

Area	Square Meter
Block A and Block B	2750

Existing Connected Loads:

The electrical energy consumption is mainly in AC's, Lighting and Fan. The inventory list of the same is listed below:

Table 2: Details of connected load

Load Type	UOM	Block A	Block B	Total Connected Load
AC's	KW	56.10	12.30	68.40
Fan	KW	24.25	10.22	34.47
Light	KW	14.42	4.24	18.66
Miscellaneous	KW	17.50	11.00	28.50
Total		**112.27**	**37.76**	**150**

Sr. No	Category	Load in kW	Load Distribution
1	AC's	68.40	45.59
2	Fan	34.47	22.97
3	Light	18.66	12.44
4	Miscellaneous	28.50	19.00
	Total	**150.0**	**100**

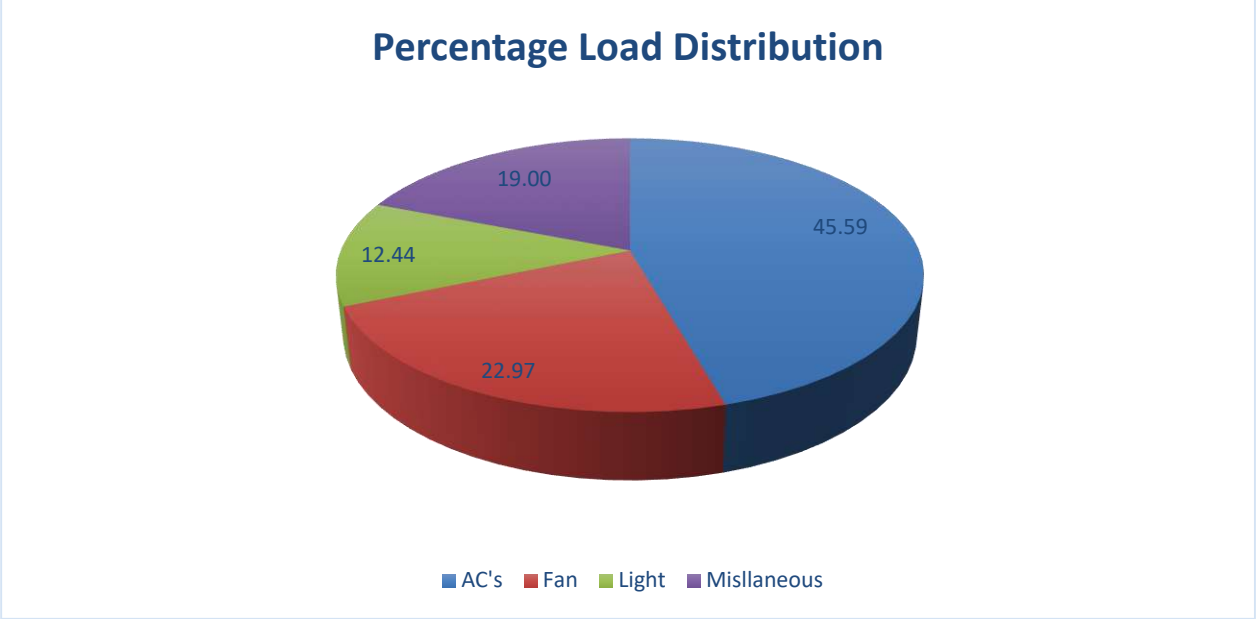

Figure 1: Percentage Distribution of Load

Technical Resources:

The following major instruments were commissioned for the field study:

Table 3: Instruments commissioned for the audit

Sr. No.	Instrument Name	Make	Nos.
1	Three Phase Power Analyzer	ALM 31 KRYKARD	2
2	Single Phase Power Analyzer	ALM 10	1
3	Digital Power Clamp Meter	TESTO	1
4	Ultrasonic Flowmeter	TUF - 2000H	1
5	Pressure Gauge	BAUMER	1
6	IR gun	METRAVI MT-16 and FLUKE	1
7	Rubber Gloves		2
8	Lux Meter	PRECISE LX 804	1
9	Digital Distance Meter	FLUKE	1

Performance Evaluation Of Major Utilities and Process Equipment

- **Electricity Bills Analysis & Supply and Distribution System**
- **Energy Utilization Index**
- **HVAC System**
- **Pump System**
- **Motor System**
- **Lighting System**

CHAPTER: 2
ELECTRICITY BILLS ANALYSIS

2.1 ONE YEAR ELECTRICITY BILLS

Electricity is purchased from BSES Rajdhani Power Limited, from open access with 11 KV as the input voltage that comes under HT supply type (supply upto 11kv) Category. The Contract Demand is 295 kVA.

Table 4: Analysis of one year Electricity Bills

Month & Year	Contract Demand (KVA)	Maximum Demand (KVA)	MD Charges Rs/KVA	Energy Charges Rs/Kwh	Total Energy Consumption		PF	Fixed Charges (Rs)	Energy Charges (Rs)	Current Gross Amount (Rs)	Bill Amount Payable	Average Electricity Cost (Rs/Kwh)
					KWh	KVAh						
2021-NOV	295	66	250	8.5	11406.00	14160.00	0.81	76763.44	116382.00	260867.66	256793.48	22.87
2021-DEC	295	30	250	8.5	8286.00	10722.00	0.77	70736.56	87473.50	213743.13	210680.94	25.80
2022-JAN	295	42	250	8.5	10272.00	12366.00	0.83	70736.56	102720.00	234254.77	234254.77	22.81
2022-FEB	295	54	250	8.5	11478.00	13686.00	0.84	80547.24	112157.50	260050.55	256124.25	22.66
2022-MAR	295	48	250	8.5	12402.00	14778.00	0.84	83605.99	121278.00	276600.21	272354.63	22.30
2022-APR	295	72	250	8.5	16230.00	18738.00	0.87	83605.99	162300.00	332932.22	332932.22	20.51
Average	**295.00**	**52.00**			**11679.00**	**14075.00**	**0.83**	**77665.96**	**117051.83**	**263074.76**	**260523.38**	**22.82**

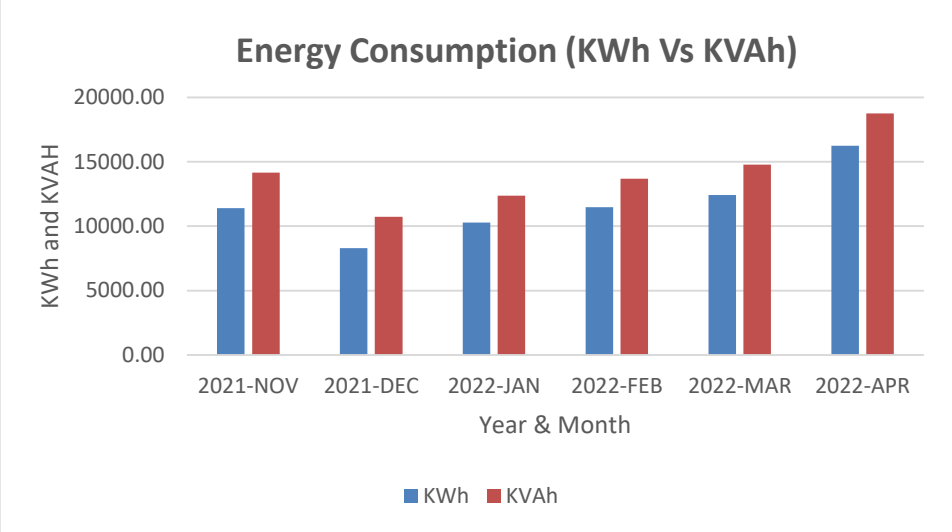

Figure 2: Monthly Energy Consumption KWh & KVAh

It can be seen from the above figure that the maximum energy consumption for the building is in April 2022 and the minimum on December 2021.

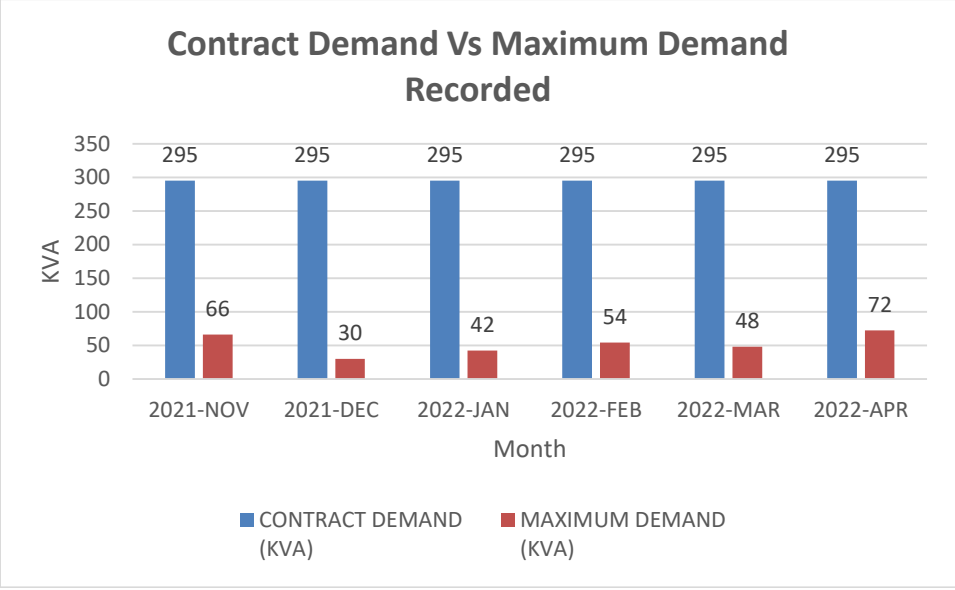

Figure 3: Contract Demand vs. Maximum Demand

From the above figure it is observed that although the Contract Demand is 295 kVA but the highest Maximum Demand was 72 kVA on December 2021 for the FY year 2021-22.

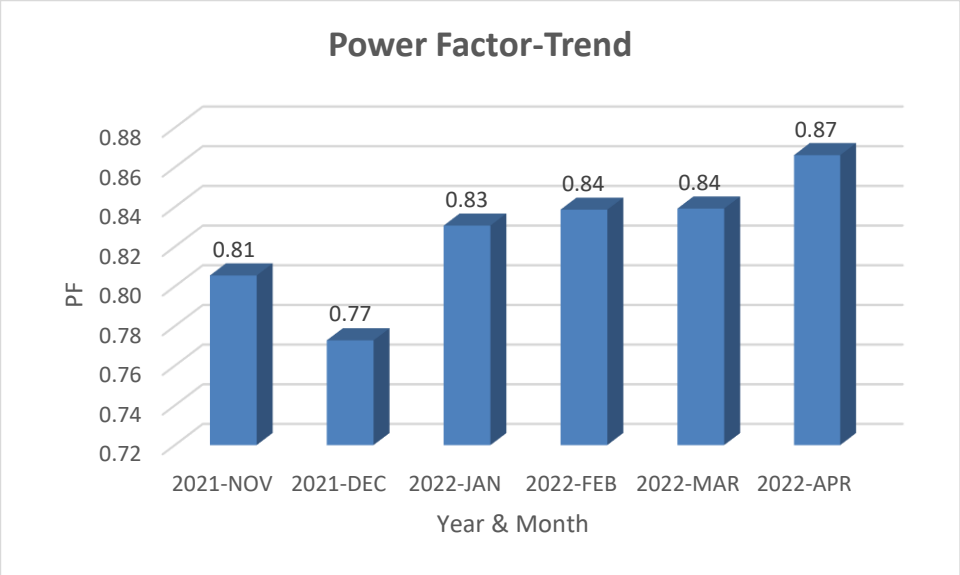

Figure 4: Power Factor

From the above figure it is observed that power factor is varying from 0.77 to 0.87.

2.2 RECOMMENDATIONS

- ***Improving Existing Power Factor:*** Savings in Power Factor improvement can be achieved by installing 80 KVAR APFC which will improve PF from 0.83 to 0.99.

Table 5: Calculation of Savings from Energy Reduction

Particular	UOM	Value
Present Operating Power Factor		0.83
Non Corrected Load (Avg. Monthly)	KVA	150
Actual Load (Avg. Monthly)	KW	124.5
Desired Power Factor		0.99
Proposed Capacitor Bank	KVAR -- KW*(Tan(Cos-1 (ø1))-Tan(cos-1(ø2)))	80

Particular	UOM	Value
Energy Consumption (Average/Month)	KVAh	14075
Actual Energy Consumption (Average/Month)	KWh	11682
Energy Consumption at Desired PF (@0.99) (Average/Month)	KVAh	11800
Energy Saving	KVAh	2275
Annual Energy Saving	KVAh	27297
Annual Moneatry Saving in Energy	Rs/Year	232024.2
Total Monetary Saving	Rs/Year	232024.24
Investment	Rs	88000
Payback (Months)	Months	5

CHAPTER: 3
LOAD PROFILE OF TRANSFORMERS AND POWER QUALITY ANALYSIS

3.1 TRANSFORMERS

At present 500 kVA, 11 kV/ 433V transformer is installed to cater LT power of the electrical system. IHE has two building block which are having separate distribution panel in each block.

Audit team installed power analyser on main incomer panel and recorded transformer loading which loading pattern is shown below

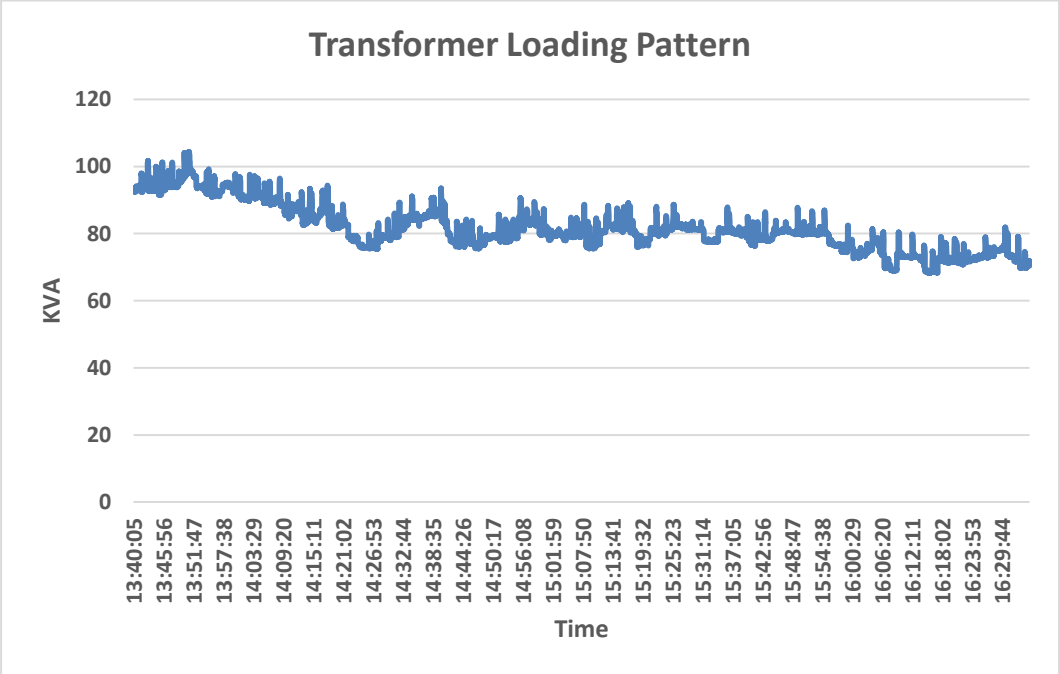

Figure 5: Loading Pattern of Transformer

From Data analysis it is observed that presently above transformer is loaded up to 21% and in good working condition. Average running load on transformer is 81 kVA and Maximum running load on transformer is 104 kVA.

3.2 BLOCK A LOAD PROFILE ANALYSIS

Block A has 3 floors, the connected load in Block A are AC, Fan, Light and other laboratories instruments. Major and continuous running load is of AC, fan and light.
Audit team recorded loading pattern of Block A which are shown in below graphs.

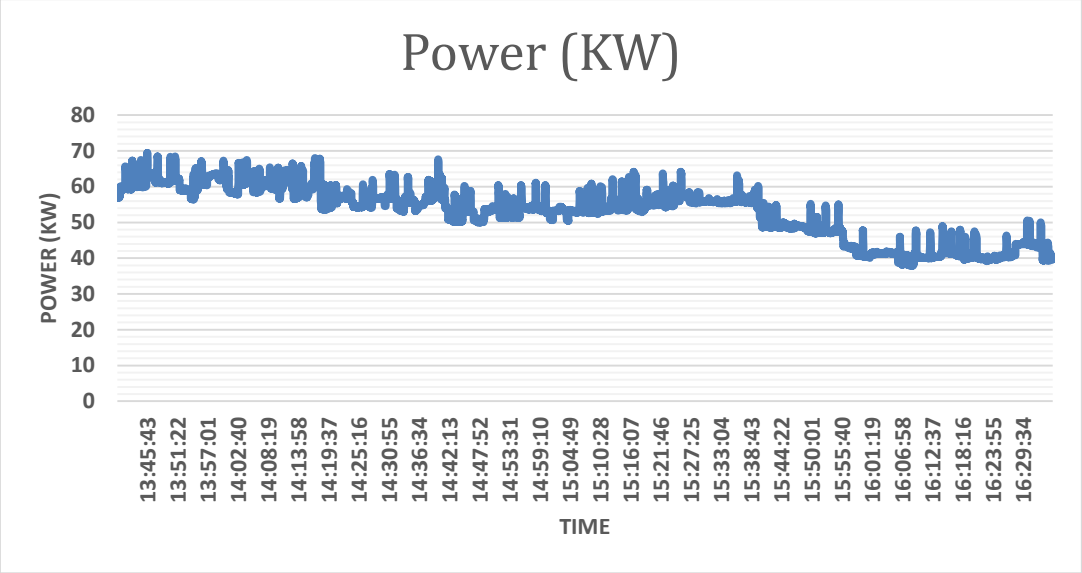

Figure 6: Power profile of Block A

The figure above shows the Power profile of the Block A building during the audit period and it was observed that the maximum load during the audit was 69 KW.

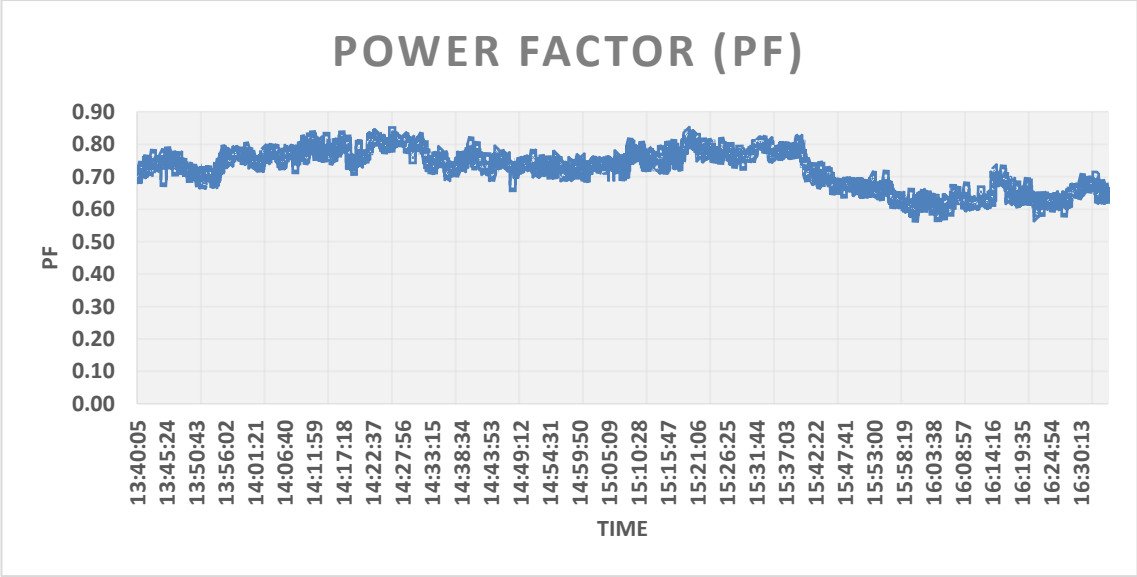

Figure 7: Power Factor profile of Block A

The figure above shows the power factor profile of the Block A building during the audit period and it was observed that the maximum PF during the audit was 0.87 and minimum was 0.57.

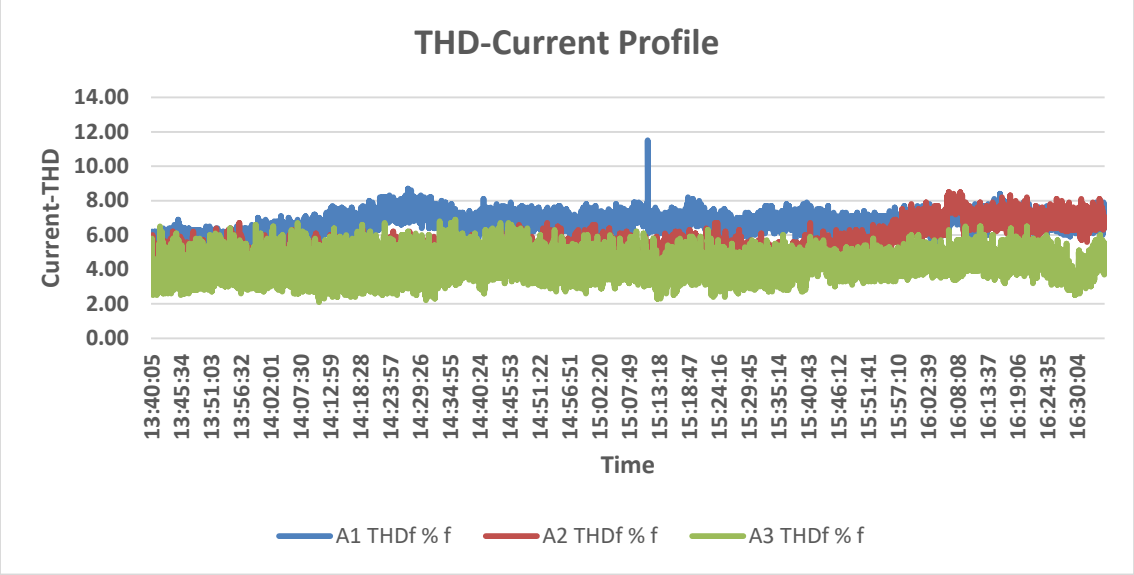

Figure 8: Total Harmonic Distortion (Current) profile of Block A

The figure above shows the profile of Total Harmonic Distortion (Current) of the building during the audit period and it was observed that the current THD during the audit was ranging from 3.93% to 7.30% which under the limit of 15%.

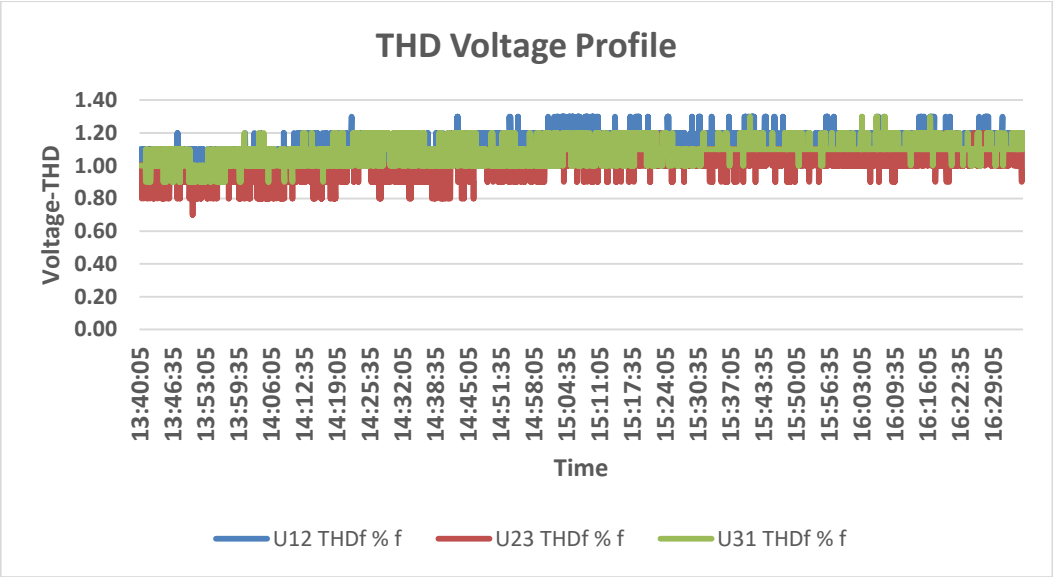

Figure 9: Total Harmonic Distortion (Voltage) profile of Block A

The figure above shows the profile of Total Harmonic Distortion (voltage) of the building during the audit period and it was observed that maximum voltage THD during the audit was ranging from 0.87% to 1.23% which is under the limit of 3%

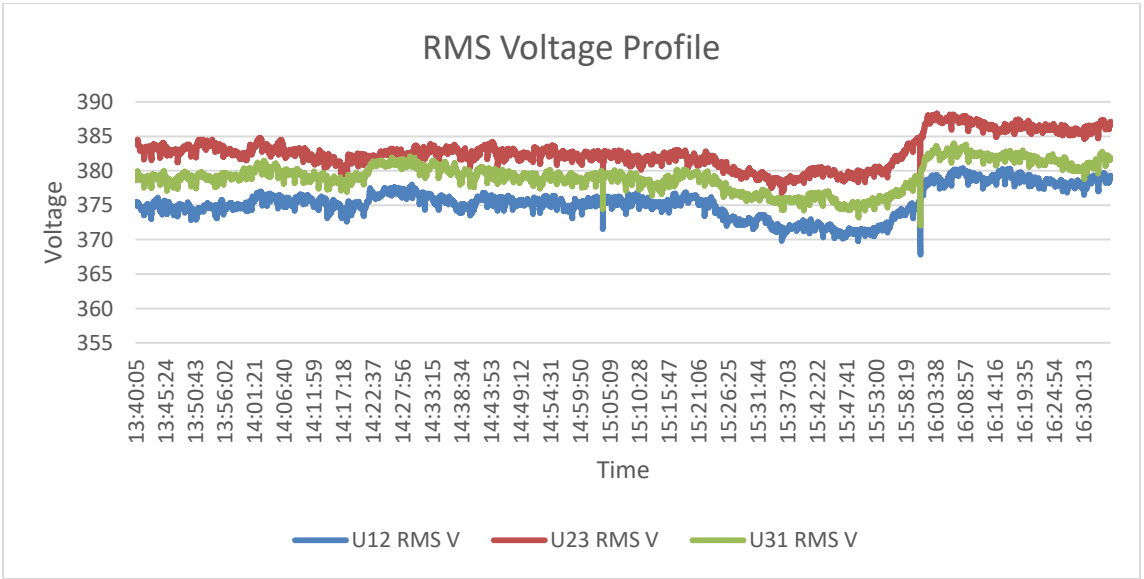

Figure 10: RMS Voltage Profile of Block A

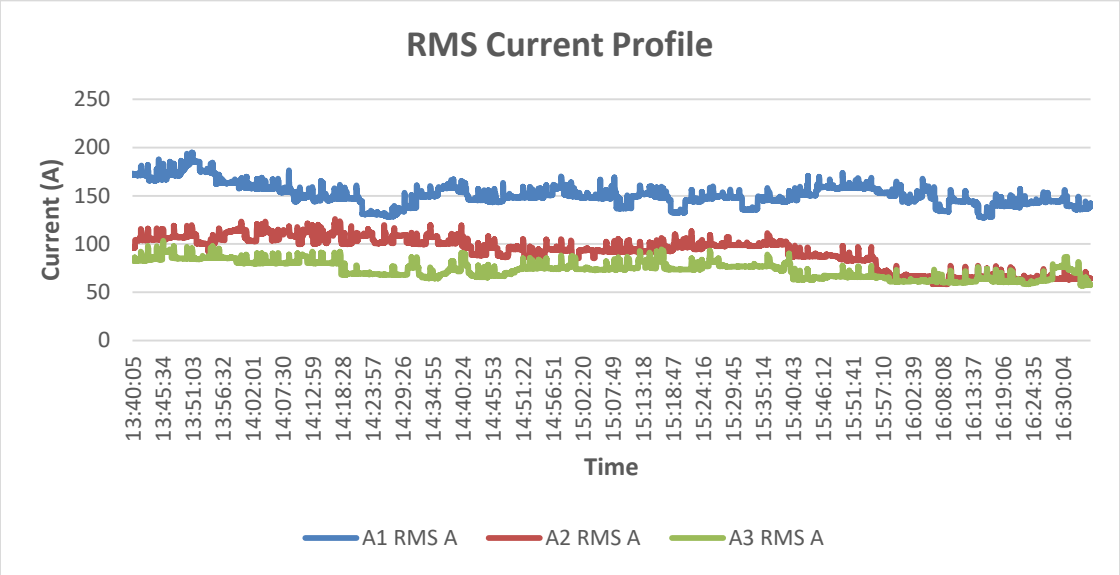

Figure 11: RMS Current Profile of Block A

The figure above shows the profile of voltage variations during the audit period and it was observed that, the voltage varies in the range **372 V to 384 V**. Also the profile of current variations during the audit period was observed in the range **84.20 A to 136.77 A.**

3.2 BLOCK B LOAD PROFILE ANALYSIS

Block B has 4 floors, the connected load in Block A are AC, Fan, Light and other laboratories instruments. Major and continuous running load is of AC, fan and light.

Audit team recorded loading pattern of Block A which are shown in below graphs.

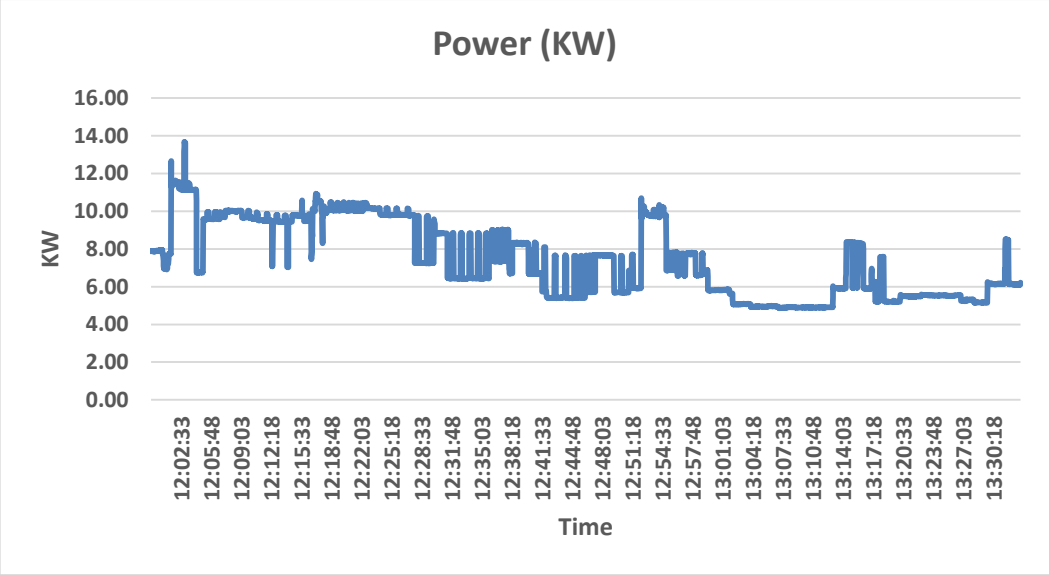

Figure 12: Power profile of Block B

The figure above shows the Power profile of the Block B building during the audit period and it was observed that the maximum load during the audit was 13.68 KW.

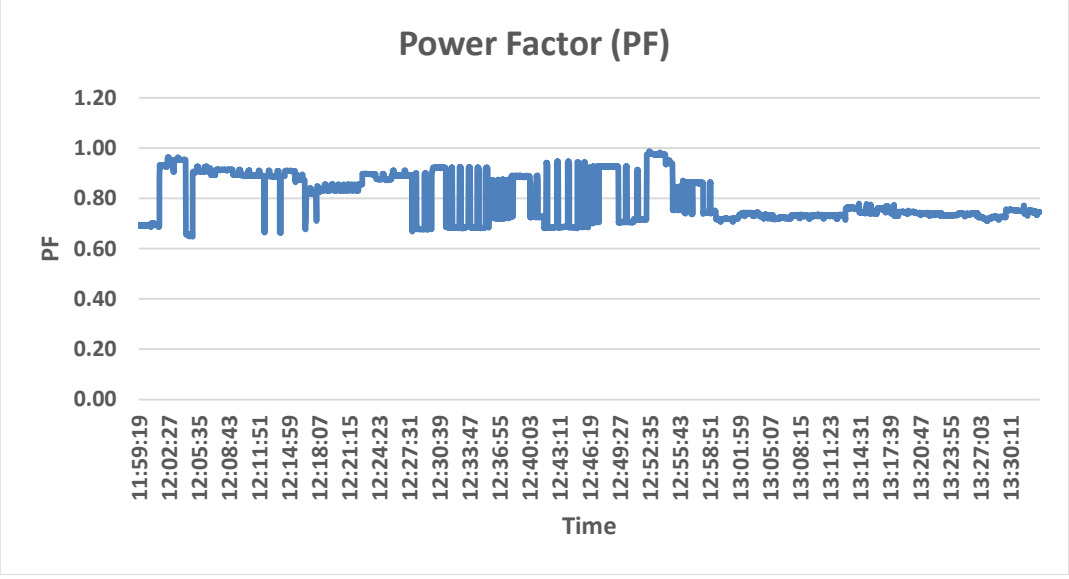

Figure 13: Power Factor profile of Block B

The figure above shows the power factor profile of the Block B building during the audit period and it was observed that the maximum PF during the audit was 0.99 and minimum was 0.65.

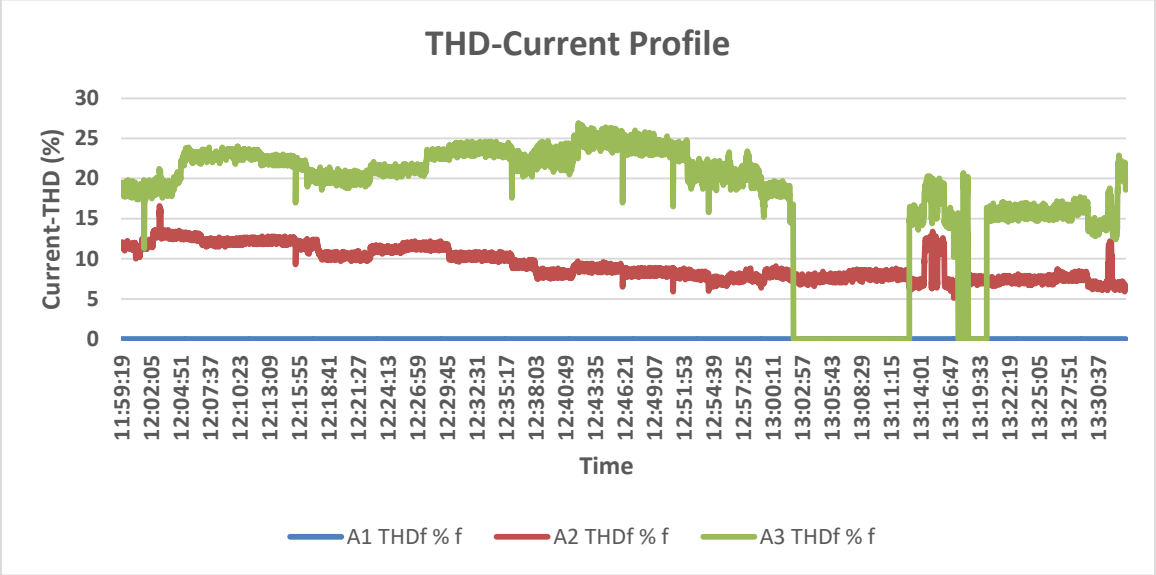

Figure 14: Total Harmonic Distortion (Current) profile of Transformer

The figure above shows the profile of Total Harmonic Distortion (Current) of the building during the audit period and it was observed that the average current THD during the audit was ranging from 3.30% to 12.47% which under the limit of 15%.

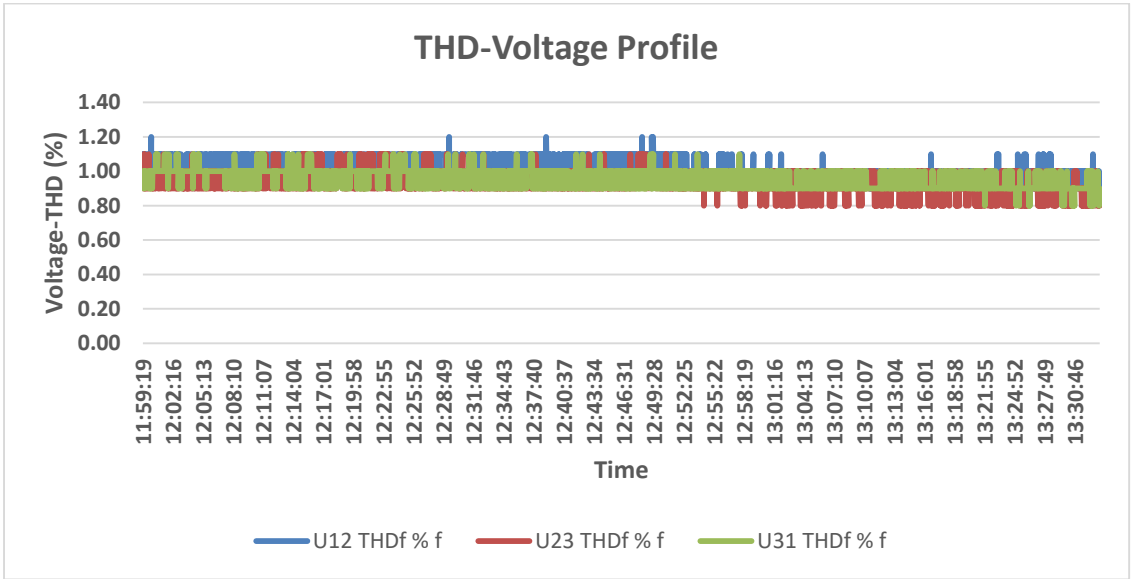

Figure 15: Total Harmonic Distortion (Voltage) profile of Block B

The figure above shows the profile of Total Harmonic Distortion (voltage) of the building

during the audit period and it was observed that average voltage THD during the audit was ranging from 0.83% to 1.10% which is under the limit of 3%.

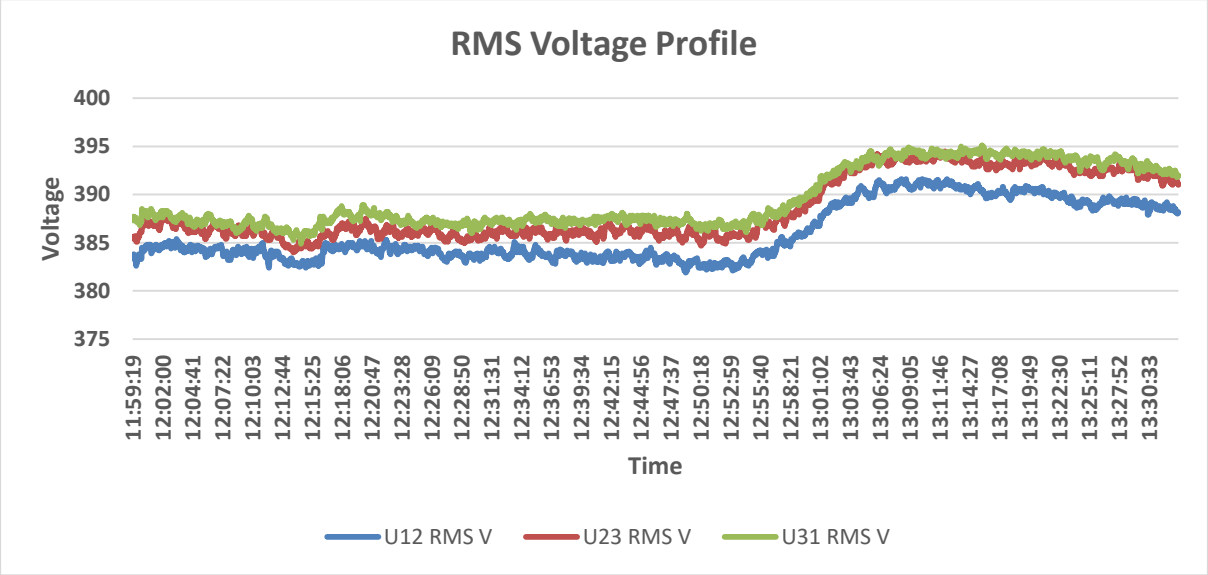

Figure 16: RMS Voltage Profile of Block B

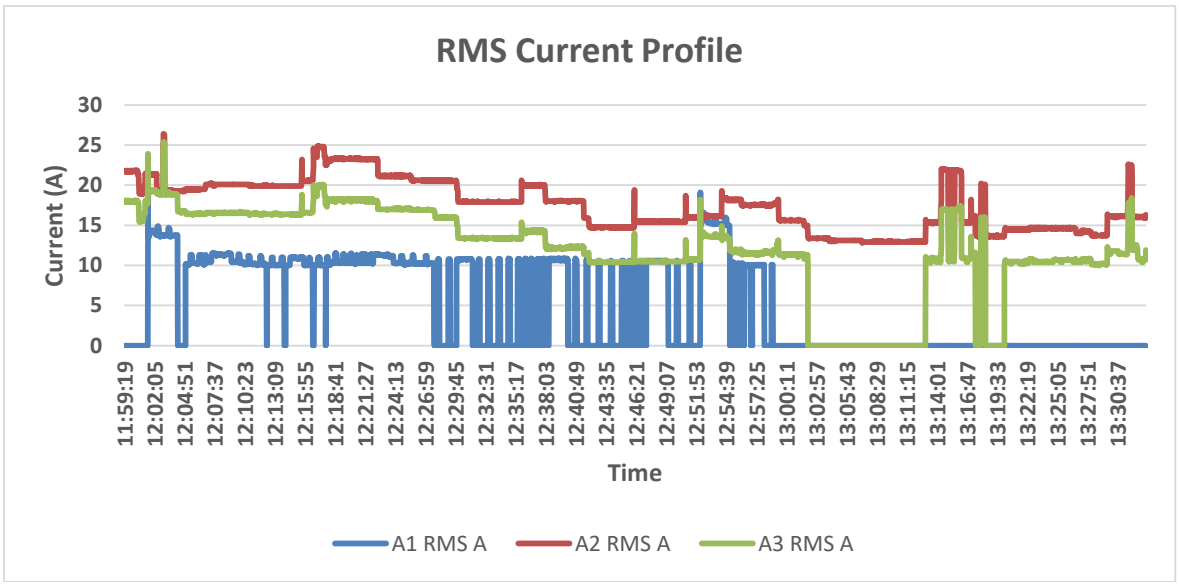

Figure 17: RMS Current Profile of Block B

The figure above shows the profile of voltage variations during the audit period and it was observed that, the voltage varies in the range **384 V to 393 V**. Also the profile of current variations during the audit period was observed in the range **4.27 A to 21.83 A.**

Maximum Voltage Distortion for SEB/Utility as per IEEE Standard 519:

Bus Voltage at PCC	**Individual Voltage Distortion(%)**	**Total Voltage Distortion THD (V) (%)**
69 kV and below	**3.0**	**5.0**
69.001 kV through 161 kV	1.5	2.5
161 kV and above	1.0	1.5
Note: High voltage systems can have up to 2.0% THD where the cause is an HVDC terminalthat will attenuate by the time it is tapped for a user.		

To assess the presence of current harmonic disturbing the power quality of electrical network, we have to calculate the short circuit ratio I_{sc}/I_L, through following formula where I_{SC} is the max short circuit current at the point of coupling "PCC". I_L is the max fundamental frequency load current at PCC. TDD is the Total Demand Distortion (=THD normalized by I_L).

$$I_{SC} \text{ at the secondary of transformer} = \frac{\text{Rated Capacity of Transformer}}{\text{Impedance of Transformer}}$$

Limits of Voltage & Current Harmonics as Per IEEE-519-1993:

For PCC Voltages 69kV & below						
Maximum Harmonic Current Distortion in % of I_L						
Individual Harmonic Order (Odd Harmonics)						
I_{sc}/I_{load}	**<11**	**11≤h<17**	**17≤h<23**	**23≤h<35**	**35≤h**	**TDD**

<20*	4	2	1.5	0.6	0.3	5
20 < 50	7	3.5	2.5	1	0.5	8
50 < 100	10	4.5	4	1.5	0.7	12
100 < 1000	12	5.5	5	2	1	15
> 1000	15	7	6	2.5	1.4	20

Even harmonics are limited to 25% of the odd harmonics limits above.

Current distortions that result in a direct current offset, e.g., half wave converters are not allowed.

*** All power generation equipment is limited to these values of current distortion, regardless ofactual Isc/I_L.**

Where,
I_{sc} = Maximum short circuit current at Pcc. And I_L = Maximum Demand Load Current (fundamentalfrequency component) at PCC; TDD = Total Demand Distortion

The table is for 6 pulse rectifiers. For 12-pulse, 18-pulse, etc. increase characteristic harmonicsby: the value of the square root of q/6, where q = 12, 18, etc. Thus for 12-pulse, increase by 1.414.

CHAPTER: 4 PUMPING SYSTEM

4.1 PUMPING SYSTEM

Pumping Systems account for nearly 20% of the world's electrical energy demand. Furthermore, they range between 25-50% of the energy usage in certain industrial plant operations. The use of pumping systems is widespread. They provide domestic, commercial, and agricultural services. In addition, they provide municipal water and wastewater services, and industrial services for food processing, chemical, petrochemical, pharmaceutical, and mechanical industries.

Pumps have two main purposes:

- Transfer of liquid from one place to another place (e.g., water from an underground aquifer into a water storage tank)
- Circulate liquid around a system (e.g., cooling water or lubricants through machines and equipment)

Since the pump is a dynamic device, it is convenient to consider the pressure in terms of head i.e., meters of liquid column. The pump generates the same head of liquid whatever the density of the liquid being pumped. The actual contours of the hydraulic passages of the impeller and the casing are extremely important in order to attain the highest efficiency possible. The standard convention for centrifugal pump is to draw the pump performance curves showing Flow on the Horizontal Axis and Head generated on the Vertical Axis. Efficiency, Power & NPSH required are conventionally shown on the vertical axis, plotted against Flow, as illustrated in the figure below

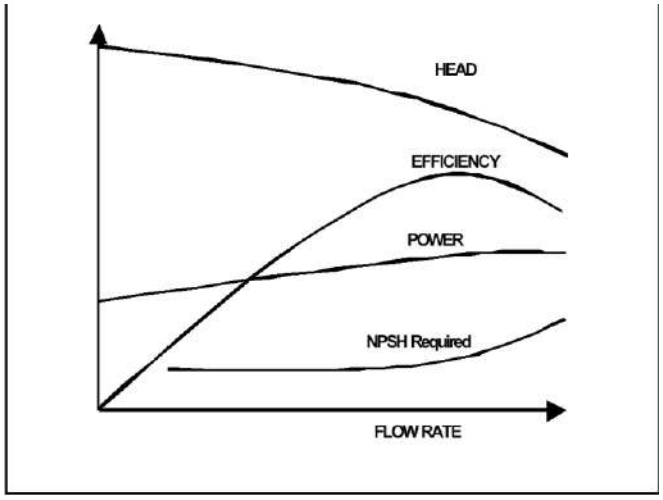

Figure 18: Pump Performance Curve

Given the significant amount of electricity attributed to pumping systems, even small improvements in pumping efficiency could yield very significant savings of electricity. The pump is among the most inefficient of the components that comprise a pumping system, including the motor, transmission drive, piping and valves.

Hydraulic power, pump shaft power and electrical input power:

$$\text{Hydraulic Power (Ph)} = \frac{Q \text{ X } (h_d - h_s) \text{ X } \rho \text{ X } g}{1000}$$

Where, Q: Flow Rate (in m^3/hr.)

h_d: Discharge Head (in metres)

h_s: Suction Head (in metres)

ρ: Density of the Fluid (in kg/m^3)

g: Acceleration due to gravity (m/s^2)

$$\text{Pump Shaft Power } (P_s) = \frac{\text{Hydraulic Power } (P_h)}{\text{Pump Efficiency}}$$

Electrical Input Power = Pump Shaft Power (Ps) X Motor Efficiency (η)

IHE has installed two bore wells for ground water extraction of capacity 3HP each and one supply water transfer pump of 3 HP capacity. Audit team has been conducted the performance assessment of pumps which are shown in below table.

Table 6: Performance Assessment of Source Water Pump

Sr. No.	Description	Unit	Supply Water Transfer Pump	Submersible Pump
1	Input Power of Pump	kW	1.12	0.83
2	Motor Efficiency	%	89	89
3	Shaft Power	kW	0.99	0.74
4	Total Head	m	60.00	45.00
5	Density of Fluid	kg/m^3	1000	1000
6	Water Flow	m^3/hr.	3.9	4.4
7	Hydraulic Power	kW	0.64	0.54
Pump Calculated Efficiency		**%**	**64.17%**	**72.81%**

4.2 OBSERVATIONS AND RECOMMENDATIONS

- Performance Assessment of Supply Water Transfer Pump and Submersible pump has been done and its performance found satisfactory.

CHAPTER: 5 AC's PERFORMANCE

In IHE 32 numbers of AC units are installed on different floor with various capacity and type. Rated capacity of each AC unit along with its location are given in below tables.

Table 7: Installed AC's in Building

S.N	AREA	TYPE	NOS.	RATED TR	Watt	TOTAL WATTAGE
1	Block-A Ground Floor	Window Ac	6	1.50	1758.5	10551
		SPLIT AC	3	2.00	2269.0	6807
			3	1.50	1701.8	5105
2	Block-A First Floor	Window Ac	3	1.50	1758.5	5276
			1	2.00	2344.7	2345
3	Block-A Second Floor	Window Ac	3	1.50	1758.5	5276
			1	1.00	1172.3	1172
		SPLIT AC	2	1.50	1701.8	3404
			1	2.00	2269.0	2269
4	Block-A Third Floor	Window Ac	1	1.50	1758.5	1759
		SPLIT AC	2	2.00	2269.0	4538

S.N	AREA	TYPE	NOS.		Watt	TOTAL WATTAGE
1	Block-A Basement Floor	Window Ac	-	-		
		SPLIT AC	3	2	2269.0	6807.1
2	Block-A Ground Floor	Window Ac	-	-		
		SPLIT AC	1	2	2269.0	2269.0
3	Block-A First Floor	Window Ac	-	-		
		SPLIT AC	1	2	2269.0	2269.0
4	Block-A Secondfloor	Window Ac	-	-		
		SPLIT AC	1	2	2269.0	2269.0
5	Block-A Third Floor	Window Ac	-	-		
		SPLIT AC	-	-		

Performance Assessment of some AC units has been conducted during the audit which results are listed in below table.

Table 8: AC's Performance Assessment

Sr. No.	Location	Nos	Rating	Electrical load				Flow	Area Section	Suction		Discharge		Performance	
				Voltage	PF	Ampere	KW	m/s	m2	DBT	RH	DBT	RH	TR	KW/TR
										°C	%	°C	%		
1	Block-B Room No-1003	**Split**	2	221	0.81	5	0.90	2.9	0.066	16	78	10	66	0.81	1.10
2	Block-B Room No-1105	**Split**	2	220	0.82	4.5	0.81	2.75	0.041	19	78	14.2	58	0.52	1.57
3	Block-B Room No-1204	**Split**	2	220	0.76	4.7	0.79	3	0.041	20	89	17.6	57	0.57	1.37
4	Block-A Admin Room	**Split**	1.5	219	0.80	4.3	0.75	3.2	0.035	17.9	83	14.5	65	0.41	1.85
5	Account Room	**Window**	1.5	217	0.79	4.9	0.84	2.8	0.045	22	80	16	68	0.69	1.22
6	Library	**Split**	2	217	0.85	5.1	0.94	3.8	0.045	18.2	79	15.2	55	0.66	1.43
7	Computer Lab-318	**Split**	2	221	0.88	5.6	1.09	3.4	0.041	23.6	81	21.6	59	0.58	1.88
8	Server Room	**Split**	1.5	222	0.84	5.8	1.08	3.9	0.041	22.8	84	21.6	60	0.59	1.82
9	Director Room	**Split**	1.5	220	0.81	4.9	1.51	4.2	0.046	22.1	79	19.4	52	0.92	1.64

Management has adopted AMC for AC's and regular service of AC support in good performance. So AC performance found satisfactory during audit.

CHAPTER 6 LIGHTING PERFORMANCE

6.1 ENERGY SAVING IN LIGHTING

IHE has already replaced conventional tube light of 40 W capacity with LED tube light of 18 W capacity in some of the area of institution building. Few areas where conventional tube lights installed are identified by audit team and recommended for their replacement with LED tube light.

LED tubelight has several advantage over conventional choke tubelight like:

1) Low Energy Consumption & higher Cost Saving
2) Low Heat Production
3) Higher Life Span of around 20000 Hrs.
4) LED tubelight maintain their brightness levels throughout their lifespan.

Table 9: Cost Benefit Analysis

Sr. No	Particulars	UOM	Values
1	Energy consumption of Conventional Choke Tube Light	KW	0.04
2	Energy Consumption of LED Tube Light	KW	0.02
3	Operating Hours/day	hrs	6
4	Annual Operating Period	days	200
5	Quantity of Luminary	nos	259
6	% of Light Operating at any instant	%	0.6
7	Annual Energy Saving	kWh	4,103
8	Unit Cost of Electricity	Rs./kWh	8.50
9	Annual Monetary Saving	Rs in lakhs	0.35
10	Total Investment	Rs. in lakhs	0.52
11	Payback period	Months	18

6.2 LUX LEVELS OF VARIOUS LIGHTING AREAS

The lux levels at various locations were measured with a lux meter which is detailed below:

Table 10: Lux Details Block A

SN.NO.	AREA/LOCATION	MIN	MAX	AVG.	Remark
Block - A /Ground Floor					
1	Director room	221	225	223	Within Limit
2	Kitchen Area	105	109	107	Within Limit
3	SPA Room	102	110	106	Within Limit
4	Administration	198.5	206	202.25	Within Limit
5	Common Room	194	199	196.5	Within Limit
6	Canten				Within Limit
7	Account	175	184	179.5	Within Limit
8	Room No.-13 (IQAC/NAAC)	201	220	210.5	Within Limit
9	Room No.-9	114	118	116	Within Limit
10	Room No.-11	145	150	147.5	Within Limit
11	Room No.-10	165	161	163	Within Limit
12	Room No.-11A	167	175	171	Within Limit
13	Room No.-8A	125	132	128.5	Within Limit
14	Room No.-8	156	166	161	Within Limit
15	Room No.-8B	161	167	164	Within Limit
16	Room No.-5	157	167	162	Within Limit
17	Room No.-6	166	169	167.5	Within Limit
Block - A /First Floor					
18	Room No.101	165	170	167.5	Within Limit
19	Room No.102 (Medical Room)	213	252	232.5	Within Limit
20	Room No.103	265	284	274.5	Within Limit
21	Room No.103 A	214	225	219.5	Within Limit
22	Room No.104	243	256	249.5	Within Limit

SN.NO.	AREA/LOCATION	MIN	MAX	AVG.	Remark
23	Room No.105	274	298	286	Within Limit
24	Room No.106	199	216	207.5	Within Limit
25	Room No.107	161	165	163	Within Limit
26	Room No.108	175	167	171	Within Limit
27	Room No.109	132	125	128.5	Within Limit
28	Room No.110	166	156	161	Within Limit
29	Room No.111	167	161	164	Within Limit
30	Room No.112	167	157	162	Within Limit
31	Room No.114	169	166	167.5	Within Limit
32	Room No.115	245	266	255.5	Within Limit
33	Room No.116	224	248	236	Within Limit
34	Room No.117	246	278	262	Within Limit
35	Phatocop	226	265	245.5	Within Limit
36	Room No.119 (Staff Room)	285	299	292	Within Limit
37	Room No.120	265	287	276	Within Limit
Block - A / Second Floor					
38	Room No.201	265	289	277	Within Limit
39	Room No.202	298	305	301.5	Within Limit
40	Room No.203	266	301	283.5	Within Limit
41	Room No.204	265	288	276.5	Within Limit
42	Room No.205	267	278	272.5	Within Limit
43	Room No.206	285	297	291	Within Limit
44	Room No.207	249	268	258.5	Within Limit
45	Room No.209	167	161	164	Within Limit
46	Room No.210	206	209	207.5	Within Limit
47	Room No.211	169	166	167.5	Within Limit
48	Room No.211 A	245	266	255.5	Within Limit
49	Room No.212	224	248	236	Within Limit
50	Room No.213	246	278	262	Within Limit
51	Room No.214	249	255	252	Within Limit

SN.NO.	AREA/LOCATION	MIN	MAX	AVG.	Remark
52	Room No.215	201	265	233	Within Limit
53	Room No.216	198	204	201	Within Limit
54	Room No.217 (Server room)	187	209	198	Within Limit
55	Room No.218	221	265	243	Within Limit
56	Room No.221	222	233	227.5	Within Limit
Block - A / Third Floor					
57	Room No.301	267	288	277.5	Within Limit
58	Room No.302	249	277	263	Within Limit
59	Room No.303	169	176	172.5	Within Limit
60	Room No.304	245	266	255.5	Within Limit
61	Room No.306	224	248	236	Within Limit
62	Room No.307	246	278	262	Within Limit
63	Room No.308	213	226	219.5	Within Limit
64	Room No.309	265	298	281.5	Within Limit
65	Room No.310	214	265	239.5	Within Limit
66	Room No.312	243	278	260.5	Within Limit
67	Room No.315	274	295	284.5	Within Limit
68	Room No.316	199	206	202.5	Within Limit
69	Room No.317	161	201	181	Within Limit
70	Room No.318 (Computer lab)	175	199	187	Within Limit
71	Room No.319	285	296	290.5	Within Limit
72	Room No.321 (Computer lab)	282	287.3	284.65	Within Limit
73	Room No.322 (Computer lab)	245	278	261.5	Within Limit
74	Server Room	248	265	256.5	Within Limit
75	Library	301	306	303.5	Within Limit

Table 11: Lux Details Block B

SN.NO.	AREA/LOCATION	MIN	MAX	AVG.	Remark
Block - B /Basement					
1	Pannel Room	167	198	182.5	Within Limit
2	Fitness center	205	211	208	Within Limit
3	Physical Edu(Basement	245	265	255	Within Limit
Block - B /Ground Floor					
4	1001	206	224	215	Within Limit
5	1002	289	306	297.5	Within Limit
6	1003 (Confereaance room)	289	309	299	Within Limit
7	1004	226	269	247.5	Within Limit
8	1005	264	298	281	Within Limit
9	1006	287	294	290.5	Within Limit
Block - B / first Floor					
10	1101	175	184	179.5	Within Limit
11	1102	201	220	210.5	Within Limit
12	1103	114	118	116	Within Limit
13	1104	145	150	147.5	Within Limit
14	1105	165	161	163	Within Limit
15	1106	167	175	171	Within Limit
Block - B / Second Floor					
17	1201	265	288	276.5	Within Limit
18	1202	267	278	272.5	Within Limit
19	1203	285	297	291	Within Limit
20	1204	249	268	258.5	Within Limit
21	1205	167	161	164	Within Limit
22	1206	206	209	207.5	Within Limit
Block - B / Third Floor					
23	1301	265	284	274.5	Within Limit
24	1302	214	225	219.5	Within Limit
25	1303	243	256	249.5	Within Limit
26	1304	274	298	286	Within Limit

SN.NO.	AREA/LOCATION	MIN	MAX	AVG.	Remark
27	1305	199	216	207.5	Within Limit
28	1306	161	165	163	Within Limit

The below table may be referred to decide the minimum LUX level to be maintained at different areas in the office which includes office, production floor and street lighting.

BIS standard (IS 3646-1 (1992): Code of practice for interior illumination)

Activity	LUX
Passage	50-100-150
General Office	300-500-750
Substation	100-150-200

6.3 OBSERVATIONS AND RECOMMENDATIONS

- LED Solar Street lights were already incorporated.
- Few areas where conventional tube lights installed are identified by audit team and recommended for their replacement with LED tube light.

CHAPTER: 7 ENERGY SAVING PERFORMANCE SHEET

Encon 1: Power Factor Correction

Background:

IHE receives electricity supply from BSES Rajdhani Power Limited, New Delhi and from open access with 11 KV as the input voltage that comes under Non Domestic/above 3KVA (supply upto 11kv) Category. The Contract Demand is 295 kVA. It is observed from electricity bills of last year that the average power factor is 0.83.

Recommendation:

Existing power factor can be improved from 0.83 to 0.99 by installing 80 KVAR APFC panel. Therefore, the annual energy saving will be 2275 KVAh which result in annual monetary saving of INR 2.32 Lakh and payback period will be 5 months.

Table 12: Cost Benefit Analysis of Power Factor Correction

Particular	UOM	Value
Present Operating Power Factor		0.83
Non Corrected Load (Avg. Monthly)	KVA	150
Actual Load (Avg. Monthly)	KW	124.5
Desired Power Factor		0.99
Proposed Capacitor Bank	KVAR -- KW*(Tan(Cos-1 (ø1))-Tan(cos-1(ø2)))	80
Energy Consumption (Average/Month)	KVAh	14075
Actual Energy Consumption (Average/Month)	KWh	11682
Energy Consumption at Desired PF (@0.99) (Average/Month)	KVAh	11800
Energy Saving	KVAh	2275
Annual Energy Saving	KVAh	27297
Annual Monetary Saving in Energy	Rs/Year	232024.2
Total Monetary Saving	Rs/Year	232024.24
Investment	Rs	88000
Payback (Months)	Months	5

Encon 2: Energy Saving by Installation of Solar Power Plant of 120 kWp

Background:

The Institute has roof top space where solar PV panels can be installed. It is therefore, recommended to use the roof top of building for this purpose of installation of solar PV plant.

Recommendation:
The indicative analysis has been done on the basis of area available.

Table 13 : Cost Benefit Analysis of Installing Solar Panel

Sr. No	Parameters	UOM	Value
1	Available Area Rooftop	m2	2750
2	Considered Area	m2	1375
3	Size of Solar System	kWp	120
4	Approx. Annual Generation from Solar Power Plant	kWh/year	192000
5	Current Avg. Tariff Electrical Unit Cost from DISCOM	Rs./kWh	8.5
6	Avg. Annual Energy Consumption @ 14075 kWh Monthly	kWh	168900
7	Units Generated Annually (in kWh)	kWh/year	189216
8	Kcals Savings	Kcals	162725760
9	Monetary Savings	Lakh/year	16.08
10	Investment @40,991 rs per KW	lakh	49.19
11	Payback Period	months	37

For example, to generate 10,000 watts from a 12% efficient system, we need a 100 sq MTR of roof area. Solar home lighting systems approved under NSM (National Solar Mission) are required to have a certain level of efficiency. The CFL based solar systems are required to have module efficiency of 14% and above and a LED based solar system is required to have module efficiency of 12% and above.

The units or kWh output of a solar panel will depend on the panel efficiency and availability of sunlight in a location. The factor that defines this output is called CUF (or Capacity Utility Factor). For India, it is typically taken as 19% and the calculation of units goes as:

Units Generated Annually (in kWh) = System Size in Kw * CUF * 365 * 24.

So typically, a 1 kW capacity solar system will generate 1600-1700 kWh of electricity per year. This can provide electricity for 25 years.

Around 120 kw of solar PV based power plant can be installed in the areas as recommended above which cost capital @ 0.41 lac /kw will be required. Thus, the total cost will be around 49.19 lacs. The annual Power generation will be 189216 kWh. The total cost of such power @Rs 8.5 /kWh, INR 16.08 lakh. Accordingly, the payback period is around 3 Years.

This way recommendation if opted will result in reduction in electricity cost of the establishment.

Encon 2: Replacing Conventional Choke Tubelight with LED Tubelight

LED tubelight has several advantage over conventional choke tubelight like:

5) Low Energy Consumption & higher Cost Saving
6) Low Heat Production
7) Higher Life Span of around 20000 Hrs.
8) LED tubelight maintain their brightness levels throughout their lifespan.

IHE has already replaced conventional tube light of 40 W capacity with LED tube light of 18 W capacity in some of the area of institution building. Few areas where conventional tube lights installed are identified by audit team and recommended for their replacement with LED tube light. A cost benefit analysis is given below-

Table 14 : Cost Benefit Analysis of Replacement of Choke Tubelight with LED Tube

Sr. No	Particulars	UOM	Values
1	Energy consumption of Conventional Choke Tube Light	KW	0.04
2	Energy Consumption of LED Tube Light	KW	0.02
3	Operating Hours/day	hrs	6

Sr. No	Particulars	UOM	Values
4	Annual Operating Period	days	200
5	Quantity of Luminary	nos	259
6	% of Light Operating at any instant	%	0.6
7	Annual Energy Saving	kWh	4,103
8	Unit Cost of Electricity	Rs./kWh	8.50
9	Annual Monetary Saving	Rs in lakhs	0.35
10	Total Investment	Rs. in lakhs	0.52
11	Payback period	Months	18

Replacement of conventional tube light with LED tube light will give **4103 Kwh** annual energy saving, **INR 0.35 lakh** monetary saving and payback period will be around **18 months.**

CHAPTER: 8 GENERAL TIPS FOR ENERGY CONSERVATION IN DIFFERENT SYSTEMS

8.1 ELECTRICITY

- Schedule your operations to maintain a high load factor.
- Minimize maximum demand by tripping loads through a demand controller.
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.99 under rated load conditions.
- Set transformer taps to optimum settings.
- Shut off unnecessary computers, printers, and copiers at night.

8.2 MOTORS

- Properly size to the load for optimum efficiency (High efficiency motors offer 4 - 5% higherefficiency than standard motors).
- Check alignment.
- Provide proper ventilation (For every 10°C increase in motor operating temperature overrecommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply (An unbalanced voltage can reduce 3 - 5% in motorinput power).
- Demand efficiency restoration after motor rewinding.

8.3 PUMPS

- Operate pumping near best efficiency point.

- Modify pumping to minimize throttling.
- Adept to wide load variation with variable speed drives or sequenced control of smaller units.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump inthe problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.
- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

8.4 DG SETS

- Optimize loading.
- Use waste heat to generate steam/hot water /power an absorption chiller or preheat processor utility feeds.
- Use jacket and head cooling water for process needs.
- Clean air filters regularly.
- Insulate exhaust pipes to reduce DG set room temperatures.
- Use cheaper heavy fuel oil for capacities more than 1MW.

8.5 HVAC (Heating / Ventilation / Air Conditioning)

- Tune up the HVAC control system.
- Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.
- Balance the system to minimize flows and reduce blower/fan/pump power requirements.

- Eliminate or reduce reheat whenever possible.
- Use appropriate HVAC thermostat setback.
- Use morning pre-cooling in summer and pre-heating in winter (i.e. -- before electrical peak hours).
- Use building thermal lag to minimize HVAC equipment operating time.
- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.
- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- Improve control and utilization of outside air.
- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- Reduce HVAC system operating hours (e.g. -- night, weekend).
- Optimize ventilation.
- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Reduce humidification or dehumidification during unoccupied periods.
- Use atomization rather than steam for humidification where possible.
- Clean HVAC unit coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.
- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
- Isolate air-conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- Install ceiling fans to minimize thermal stratification in high-bay areas.
- Relocate air diffusers to optimum heights in areas with high ceilings.
- Consider reducing ceiling heights.
- Eliminate obstructions in front of radiators, baseboard heaters, etc.
- Check reflectors on infrared heaters for cleanliness and proper beam direction.

- Use professionally-designed industrial ventilation hoods for dust and vapor control.
- Use local infrared heat for personnel rather than heating the entire area.
- Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- Purchase only high-efficiency models for HVAC window units.
- Put HVAC window units on timer control.
- Don't oversize cooling units. (Oversized units will "short cycle" which results in poor humidity control.)
- Install multi-fueling capability and run with the cheapest fuel available at the time.
- Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- Minimize HVAC fan speeds.
- Consider desiccant drying of outside air to reduce cooling requirements in humid climates.
- Consider ground source heat pumps.
- Seal leaky HVAC ductwork.
- Seal all leaks around coils.
- Repair loose or damaged flexible connections (including those under air handling units).
- Eliminate simultaneous heating and cooling during seasonal transition periods.
- Zone HVAC air and water systems to minimize energy use.
- Inspect, clean, lubricate, and adjust damper blades and linkages.
- Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

8.6 MISCELLANEOUS

- Meter any unmetered utilities. Know what normal efficient use is. Track down causes ofdeviations.
- Shut down spare, idling, or unneeded equipment.
- Make sure that all of the utilities to redundant areas are turned off -- including utilities like AC and cooling water.
- Renegotiate utilities contracts to reflect current loads and variations.

- Consider buying utilities from neighbors, particularly to handle peaks.
- Leased space often has low-bid inefficient equipment. Consider upgrades if your lease willcontinue for several more years.

CHAPTER: 9- ANNEXURES

1. Site Photographs

Figure 19: Site Photograph 1 – Energy Recording at Main Incomer

Figure 20: Site Photograph – Awareness Regarding Energy Efficiency

Figure 21: Site Photograph – Solar Street Light

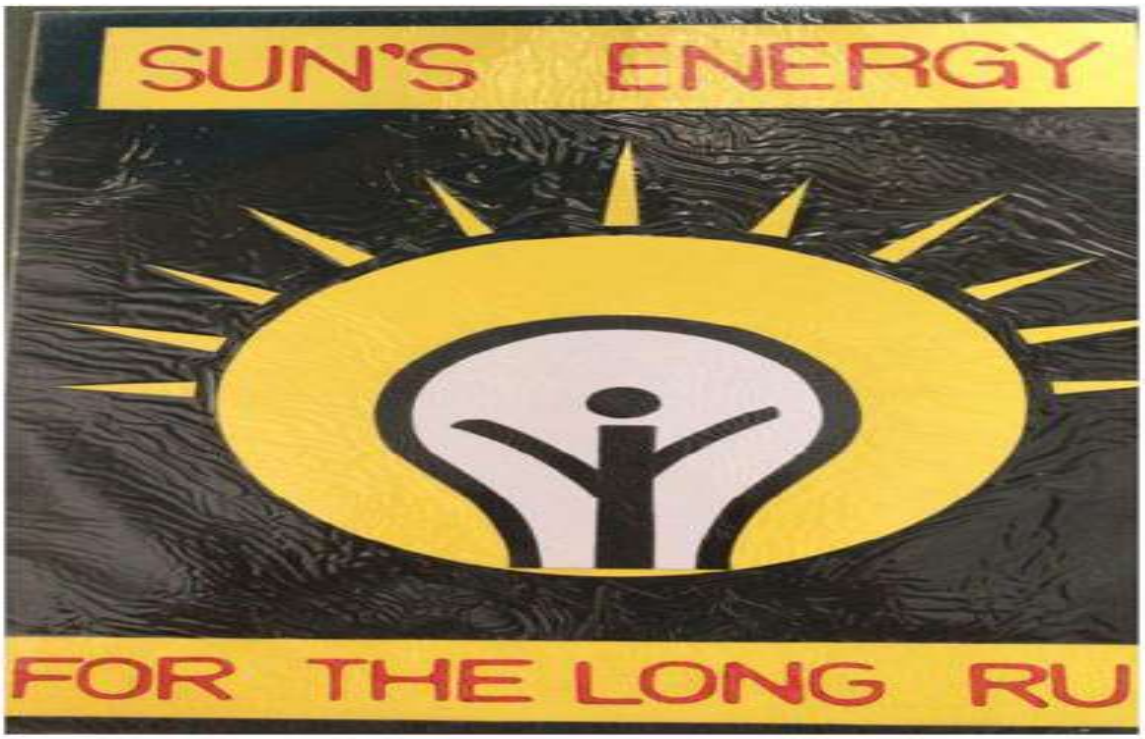

Figure 22: Site Photograph – Awareness Activity

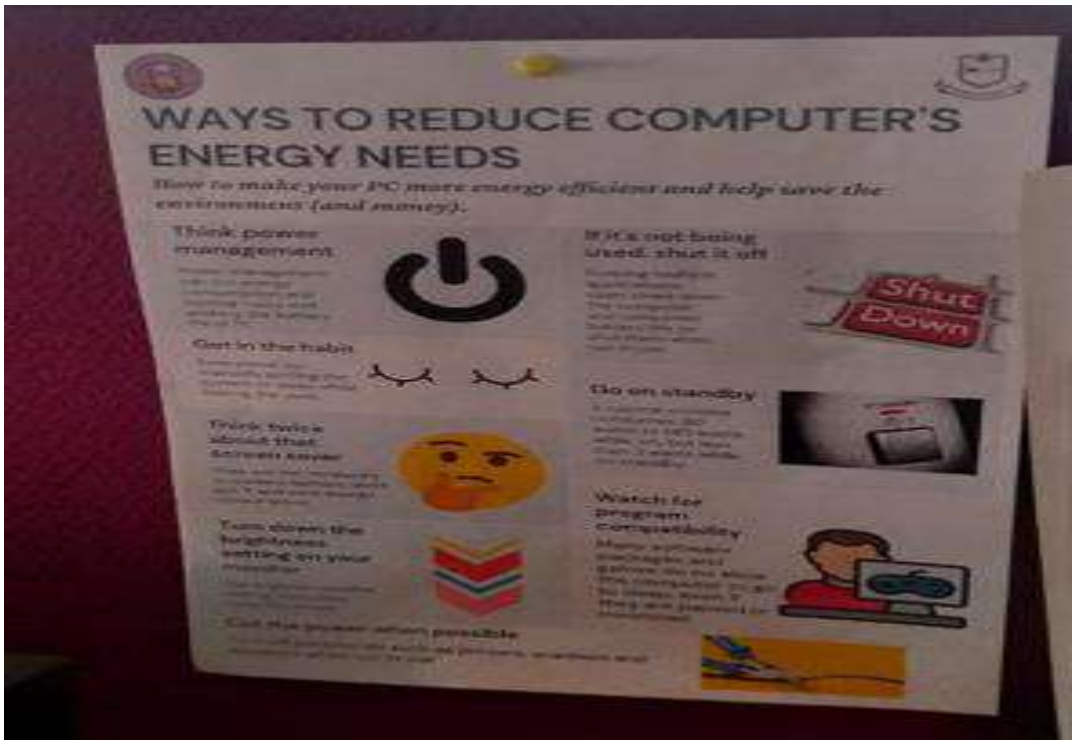

Figure 23: Site Photograph – Awareness Activity

2. A Survey on Energy Management Practices by Institute

ENERGY MANAGEMENT PRACTICES

INSTITUTE OF HOME ECONOMICS

(June 2020 – July 2021)

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Energy Consumption: A Survey Report

Introduction

Energy consumption and economic growth are closely interlinked. India's energy policy focus on increasing energy generation and to reduce energy poverty. In contemporary times the drift has been on developing alternative sources of energy and working towards self-sustainability. In 2017, India attained 63% energy self-sufficiency. The good practice and endeavours of energy generation and reducing energy poverty may further be instilled in behaviour and functioning through HEI. To navigate and understand the consumption, attitudes and readiness for energy saving opportunities, a survey was conducted in the college. The survey elicited 550 responses. The participants were students, faculty and non-teaching staff.

The survey aimed to understand the existing fuel consumption patterns among staff and students. It also was an attempt to increase the awareness regarding the usage of green fuel.

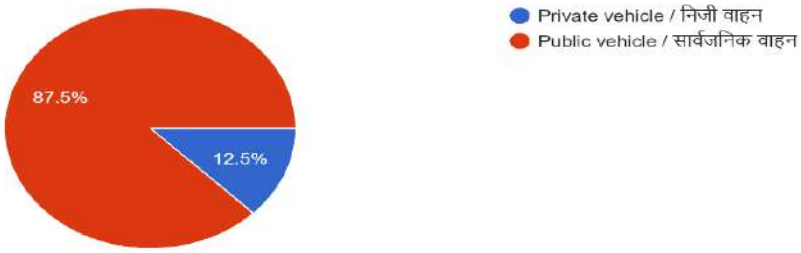
Method

The questionnaire used as the survey instrument consisted of 13 questions items translated both in English and Hindi including questions on background information as well as fuel consumption pattern. A sample of the questionnaire was generated and shared using the link https://forms.gle/L66EstWcEq7PGhrd6. Further the questionnaire was circulated among teaching and non-teaching staff as well as students through the WhatsApp groups. Responses were generated on excel format, frequency tabulation and percentages were auto generated using excel software. Students and faculty both were involved in constructing tools, result analysis and discussion.

Results and Discussions

The survey generated a total of 550 responses. It was found that out of total 82.7% (n = 454) were from students, 10.9% (n = 60) were teachers and 6.4% (n = 35) were non-teaching staff. A gender distribution represented 529 (96.2%) were women and 21 (3.8%) men respondents. Further, the age wise pattern in the survey participation highlighted majority respondents to be in age of 18-25 years, 2.9 % were between 25-35 years, 8.2 % were in 35-50 years and 6 % were above 50 years.

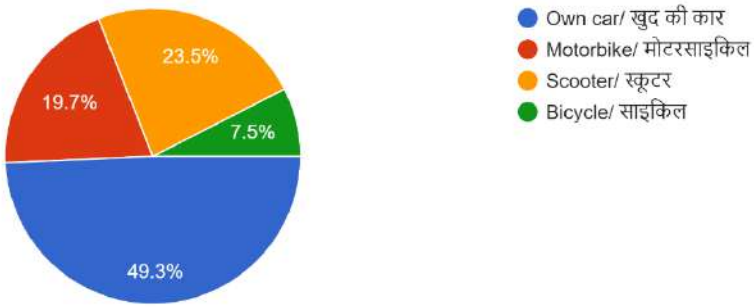
Table 1. Mode of Transport Used



Majority of respondents i.e. 87.5% (n=477) utilized pubic transport for commuting to college in comparison to 12.5% (n= 68) who used private vehicles. Recommendations of working group on Urban Transport (2006) and Ministry of New and Renewable Energy, Government of India have deliberated the changing landscape of cities in favour of planning, practices and support.

Further the use public transport as mode of commuting highlighted commuting by metro (80.3%) followed by bus (13.1%), autorickshaw (3.4%), cab (1.7%), train (0.9%).

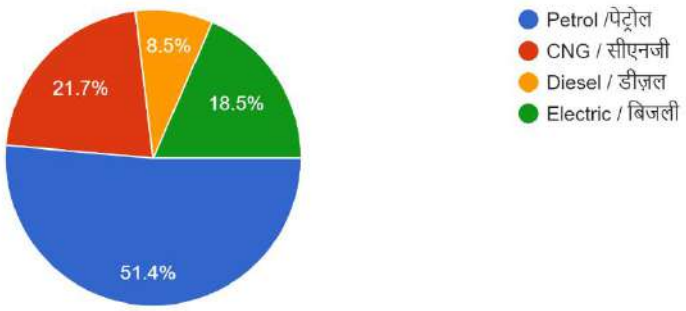
Table 2. Fuel patterns of Private Vehicle Commuters



213 respondents preferred and used private vehicles like cars (49.3%; n= 105), two wheelers (23.5%; n=50) and motorbikes (19.7%; n= 42) while bicycles (7.5%; n=16). The college environment committee has taken a note of it and would work towards channelising renewable fuel sources further.

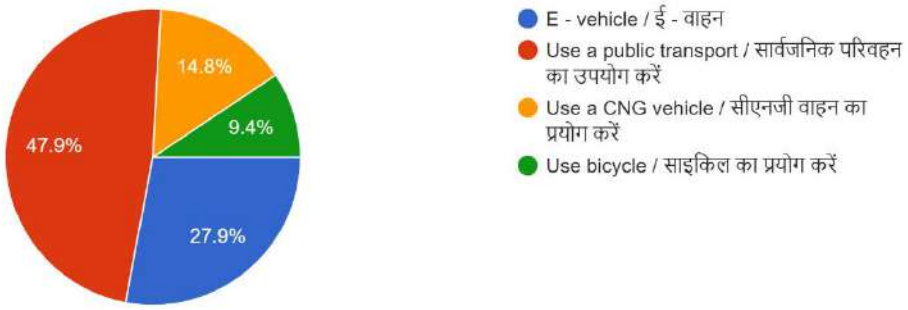
Another finding elaborated on preference towards carpooling. Only 30% (138) respondents reported use carpooling. This may require further attention.

Table 3: Nature of Fuel Consumption at IHE



The college data revealed that almost half of the respondents were conscious fuel consumers working towards renewable and green energy alternatives as the fuel sources. Almost 40.2% staff and students in the college used CNG and electric energy as their vehicle fuel source used were reported as CNG (21.7%), electric (18.5%). The least preferred fuel was diesel which was reported to be used by 8.5% of respondents. Almost all that is 510 respondents (96.1%) of the college consented in favor of green and sustainable energy to be used as an energy alternative source.

Table 4. Preferred Commuting Pattern



Most respondents opted for utilizing public transport (47.9%; n=240) as their preferred option. Other opted for switching over to e-vehicles (27.9%, n= 140), use of CNG vehicle (14.8%, n=74) and use of bicycle (9.4%; n=47).

Table 4. Tackling the AQI crisis in Delhi

The college responded to Delhi's very poor Air Quality Index (AQI), by mostly switching over to public mode of transport (75 %). More than 75% (n= 397) while some (18.8%) continued to use odd and even number vehicles alternatively and only 3.7% reported to initiate carpooling.

Conclusions

- IHE is an energy and fuel conscious college. Most prefer and use public transport to commute to the college.
- The switch over to green energy fuel-based vehicles was a preferred choice for most private vehicle commuters in the college.
- Better community-based programmes and vehicle link apps may facilitate carpooling in the college.
- The college is geared towards renewable energy plan and switch over and is actively working to be fully energy efficient.