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GREEN AUDIT

KL University, Vijayawada

Suggested format for citation

Green Audit of KL University, Vijayawada, 2023-24, New Delhi, The Energy and Resources Institute

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ACKNOWLEDGEMENT

We express our sincere gratitude to the authorities of KL University for entrusting and offering us the opportunity of a green audit assignment. We are very thankful to **Dr. V. Rajesh, Professor & Dean** (Planning and Development) for allowing us to conduct a green audit of the entire campus.

We are very grateful to **Dr. Ch. Hanumantharao, Professor & Dean** (Student Affairs), **Dr. P.Venkata Chalapathi, Professor & Additional Dean** (Faculty & Staff Affairs), **Mr. D. Seshi Reddy, Associate Professor & Associate Dean** (Energy Management), **Mr. K. J. Brahma Chari, Assistant Professor & Associate Dean** (Planning & Development), **Mr. A. V. S. Ram Prasad, Associate Professor & Associate Dean** (Transport Facilities) and **Mrs. T. K. Durga Devi, Inst. Mech., Department of Civil Engineering** for their valuable inputs and support during the entire study. We are grateful for their cooperation during field studies and for providing the necessary data for the study.

We also would like to thank **Mr. K. J. Brahma Chari, Assistant Professor & Associate Dean** (Planning & Development) for coordinating the study and being the point of contact for the work.

We are also thankful to all support staff working with whom we interacted during the field studies for their wholehearted support in undertaking measurements and eagerness to assess the system/equipment performance and saving potential. Also, thanks to all concerned staff that interacted during the conduct of this exercise for completing official documentation. This report is made with sincere efforts, gives details of the relevant data collected during the green audit study, observation, analysis & recommendations made pertaining to different facilities in the campus.

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EXECUTIVE SUMMARY

A "Green Audit" of KL University, Vijayawada was conducted in the academic year 2023-24. Green auditing is the process of identifying and determining whether institutions practices are eco-friendly and sustainable. The main objective to carry out green audit is to check green practices followed by university and to conduct a well formulated audit report to understand where we stand on a scale of environmental soundness.

Survey questionnaires prepared to conduct the green audit were based on the guidelines, rules, acts and formats set by Government of India, Ministry of Environment and Forest, New Delhi and Central Pollution Control Board, New Delhi. Questionnaires were prepared for solid waste, energy, water, health, safety and hygiene and carbon footprint.

1. Energy audit

The average annual electricity tariff paid by the KL university is approximately Rs 10.23/kWh. The total annual energy consumption of the KL University from the grid has been estimated to be approximately 78 lakhs of units in energy quantity and that amounts to approximate Rs 7.96 crores in energy cost annually. The energy performance index (EPI) is the total energy consumed in a building over a year divided by the total built-up area in kWh/sq m/year and is considered the simplest and most relevant indicator for qualifying a building as energy-efficient or not. The existing EPI of the university is approximately 41.36 kWh/sq m/yr.

KL University has an operational solar power generation plant of more than 2.1 MW and a hybrid (solar + wind) plant of 102 kWp. They have saved approx. amount of Rs. 1,81,23,279/- from Nov. 2022 to Oct -2023 by Solar power generation and they save approx. amount of Rs. 1,79,89,387/- every year by the utilization of renewable energy (solar power)

Occupancy sensors have not been provided in the entire building. Daylight and occupancy sensor are recommended for areas where sufficient daylight is available and occupant movement is variable. KL university already uses BEE star labelled AC units on their campus but still they have some old Non-BEE labelled AC units for some places which are in process of replacement. They are using BLDC fans on their entire campus.

They generate 26,07,666 kWh units annually from renewable resources. They contribute around 2138.29 tonne/year reductions in CO_2 emission through reducing energy demand and supply of renewable energy.

2. Water and solid waste audit

A water audit is an on-site survey and assessment to examine the water use pattern & management and lay down recommendations for the site to target and achieve overall self-sufficiency and water positivity based on the scope of water conservation/recharge/reuse aspects on the site.

The water audit of the KL campus was conducted by assessing both the demand and supply side water management. During the analysis, it was found that the site has implemented number of water efficient measures on the site such as using alternative sources of water, rainwater harvesting techniques for groundwater recharge, recycle and reuse of sewage water, water metering coverage for monitoring the water use, vast expanse of green landscape area etc. 40% of the total water demand of the campus is being met by treated water from STP, thus reducing the dependency on the fresh groundwater source. 53% of the the total site area is covered by shrubs, treeas and lawn. Measures such as preservation of trees has been taken by transplantation of trees to the backside of the campus. These trees were proposed to be removed from the main entrance road by the concerned local municipal body due to the widening of the road.

Whereas, a solid waste audit is a process used to quantify the type and amount of waste generated by the facility and how it manages this waste as per applicable regulations.

The solid waste audit focused on volume, type and current management practice of solid waste generated in the KL University. The solid waste collected was paper products, cardboard, wood, metal, media waste such as CD, DVD etc., plastic bottles, glass, garden waste, batteries, waste oil, food waste, electrical & electronic equipment, furniture and construction waste. The total solid waste collected in the campus 46,313 kg/year. Waste bins are placed at every corner of the campus for collecting each category of waste that is produced. No plastic covers or disposable items are allowed to be served in by cafeteria and canteen on campus. Several recycling waste streams have been implemented at KLU diverting much from landfills. All paper products, cardboards, wood, metal, plastic bottles, glass, electronic items are stored and given to authorized vendors for further processing. Biodegradable waste such as food waste, plant left over's, garden waste (dried/wet leaves, small dry flowers) which is generated on the site is converted into compost on the site and is reused.

In order to further strengthen the green measures incorporated on the site w.r.t water and solid waste management, several recommendatons associated with the alternative water sources use, stormwater runoff reduction, operation and maintenance of the water and waste systems been suggested for further improved performance.

3. Health audit

The quality of a building's performance and the comfort and health of its occupants are interrelated. Factors like indoor environment quality (IEQ), visual and acoustical comfort, general health and hygiene, and high-quality infrastructure can help improve this performance.

The health audit at the KL University was conducted by assessing these factors at the infrastructure and the standard operating procedure level. A building health audit questionnaire was shared with the authorities for the collection of primary data and an afterward on-ground site visit was conducted to assess the aforementioned policy protocols. As perceived, the university has defined definite measures for the health, safety, and hygiene of the students and staff members as recommended by several government policies and guidelines. The implementation of the required standards and protocols for various measures like accessibility and barrier-free environment, first-aid and medical facilities, health and mental well-being, fire safety, health and hygiene, and waste management has been showcased by the departments and authorities with strict policies and a responsible attitude. However, several recommendations associated with the operation and maintenance of the implemented health, safety, and hygiene policies and protocols have been suggested for further improved performance with minimized resource consumption.

4. Carbon Footprint

A carbon footprint study of the existing university building was conducted to provide the total carbon footprint and recommendations to reduce it. The various aspects which have been looked at for the carbon footprint study of the campus are:

- Combustion of fuels in stationary sources – diesel used in DG Sets (Scope 1)
- Combustion of fuels in mobile sources – petrol used in vehicles (Scope 1)
- Combustion of fuels in mobile sources – diesel used in vehicles (Scope 1)
- Unintentional GHG release from equipment and system (fugitive emissions from fire suppression system and refrigeration/air conditioning equipment) (Scope 1)
- Electricity purchased from Grid (Scope 2)
- On-site RE generation (Scope 2)
- Water supply (Scope 3)
- Water treatment (Scope 3)
- Students/Employees commuting (Scope 3)
- Food consumption (Scope 3)
- Carbon sequestration through the plantation

The significant findings of the study were that in the financial year 2023-24, the Carbon Footprint of KL University was computed to be 10,100.91 tons of CO_2, equivalent to the identified GHG emission sources. The primary source of emissions came from Scope 3 emissions, i.e., 4486.97 tCO2e followed by Scope 2, which is 4243.64 tCO2e. The minimum contribution is by Scope 1, which was computed as 1370.32 tCO2e. Carbon sequestration through plantation results in reducing 142.61 tCO2e GHG emission sources.

ABOUT GREEN AUDIT

Introduction

NAAC accreditation is mandatory for all the higher learning institutes, particularly state universities. Without NAAC accreditation, universities are not eligible for UGC grants, RUSA grants, financial aid etc. On the other hand, NAAC accreditation determines the quality of the institute in terms of education, infrastructure, research, teaching & learning etc. Institutes with top NAAC grades such as 'A++', 'A+' and 'A' are most sought-after institutes, as they offer high-quality education. On the other, all the recognized institutes of UGC must apply for NBA/ NAAC/ any other accreditation after the completion of the first or second batch of courses.

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.

Green auditing is the process of identifying and determining whether institutions practices are eco-friendly and sustainable. It can be one of the initiatives for such institutes to account their energy, water resource use as well as wastewater, solid waste, health, safety and hygiene and carbon footprint.

Benefits of Green Audit

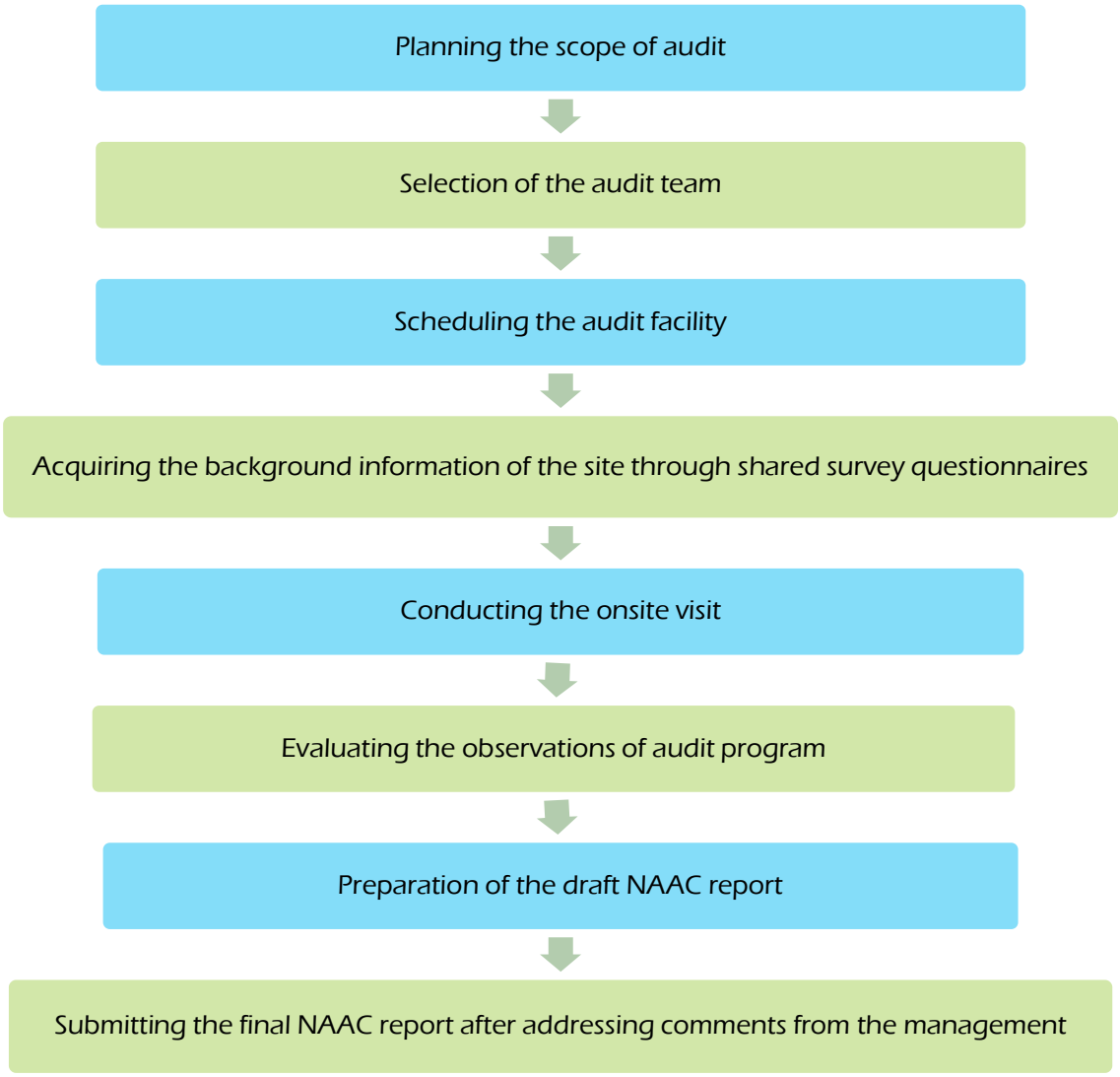
Green Audit offers a number of advantages as listed below:

- Shield the environment
- Recognize the cost saving methods through waste minimizing and managing strategies
- Point out prevailing and forthcoming complications
- Authenticate conformity with the implemented laws and empower the organizations to frame a better environmental performance
- Portrays a good image of an organization which helps building better relationships with the group of stakeholders
- Enhance the alertness for environmental guidelines and duties
- Increases overall consciousness among the people working in institution towards the environment

Methodology

The methodology for conducting the site study consisted of both onsite and offsite activities. The offsite activity involved carrying out literature search and review to develop survey questionnaire specific to the typology of the site prior to site visit and data interpretation and analysis post site visit. The onsite activity intended to do a detailed walkthrough of the site and to observe various systems along with the discussion with facility manager and the operations team. The onsite activity i.e., site visit of KLU was conducted from 5th Nov 2023 to 9th Nov 2023. During the visit, required data in designed questionnaire was collected and verified. The overall methodology is represented in Figure-1.

Stages of Green Audit



Description of the Site

KL University is a higher educational institution deemed to be University, located in Vaddeswaram which is part of Mangalagiri Tadepalle Municipal Corporation nearby Vijayawada, Andhra Pradesh, India. Established in 1980 as a college of engineering, it consists of eight schools, offering academic programs at UG, PG, doctoral, and post-doctoral industry-focused courses.

It is situated in a 100-acre site adjacent to Buckingham Canal, and is about 8 kilometres from Vijayawada in Krishna district and 33 kilometres from Guntur.

Figure 1: KL University

KL University comprises of various functional building blocks as shown below.

Table 1: Details of infrastructure for KL University

Sr. No.	Building Name	RCC Roof	No of Floors	SQ.M.	SQ.FT.
1	MECH, COMPUTER & FED [G+7]	RCC	G+7	51,414	5,53,416
2	RESEARCH BLOCK	RCC	G+6	31,322	3,37,147
3	CIVIL ENGG LABS BLOCK SHED	AC SHEET	G	1,406	15,134
4	LAW BLOCK SHED	AC SHEET	G	1,521	16,372
5	CLASS ROOM BLOCK SHED	AC SHEET	G	448	4,822
6	ARCHITECTURE BLOCK [G+2]	RCC	G+2	6,075	65,391
7	LIBRARY & DISTANCE EDU [G+7]	RCC	G+7	17,399	1,87,281
8	ENTRANCE GATE	RCC	G	48	517
9	SECURITY POST	RCC	G	39	420
10	PARKING SHED	AC SHEET	G	810	8,719
11	GUEST HOUSE [G+2]	RCC	G+2	531	5,716
12	SEMINAR HALL / INDOOR STADIUM [G+1]	RCC	G+1	3,619	38,955
13	CANTEEN SHED	AC SHEET	G	856	9,214
14	INDOOR POWER ROOM	RCC	G+1	72	775
15	ANIMAL HOUSE	AC SHEET	G	310	3,337
16	SKILL DEVELOPMENT CENTRE [C+S+S+G+7]	RCC	G+8	35,386	3,80,892
17	YAGASALA	RELLI GADDI	G	57	614
18	TRANSPORT OFFICE	AC SHEET	G	128	1,378
19	GENERAL TOILETS	AC SHEET	G	191	2,056
20	EAST STP 300KLD	RCC	G	152	1,636
21	WEST STP 300 KLD	RCC	G	951	10,236
22	STP 350 KLD	RCC	G	608	6,544
23	STP 1200 KLD	RCC	G	820	8,826
24	SCRAP YARD	AC	G	521	5,608

Sr. No.	Building Name	RCC Roof	No of Floors	SQ.M.	SQ.FT.
		SHEET			
25	GOSALA	AC SHEET	G	474	5,102
26	STAFF QUARTERS 1	RCC	G+10	6,580	70,827
27	SRI CHAKRA PRAYER HALL	RCC	G	366	3,940
28	MACHANICAL FAB LAB	AC SHEET	G	665	7,158
	TOTAL BUILTUP AREA EXISTING			**1,62,769**	**4,97,831**
29	FACULTY RESIDENCES (under construction)	RCC	C+S+G+9	89,932	9,68,020
30	SWIMMING POOL (under construction)	RCC	G+1	3,491	37,577
31	SPORTS COMPLEX (under construction)	RCC	C+G+6	41,726	4,49,140
32	LOTUS NEW BOYS HOSTEL (under construction)	RCC	C+S+S+11	61,604	6,63,100
	TOTAL BUILTUP AREA UNDER CONSTUCTION			**1,96,753**	**9,68,020**
	GIRLS HOSTELS				
33	KANCHANAGANGA GIRLS HOSTEL (LADIES HOSTEL)	RCC	G+7	30,037	3,23,316
34	ARAVALI BOYS HOSTEL(SQ-A) (GIRLS)	RCC	G+10	8,840	95,153
35	VINDYA BOYS HOSTEL(SQ-B) (GIRLS)	RCC	G+10	8,840	95,153
36	NEELADRI GIRLS HOSTEL(VGH)	RCC	G+1	2,983	32,109
	TOTAL			**50,700**	**5,45,730**
	BOYS HOSTELS				
31	HIMALAYA HOSTEL (HARNIKS INDIA L L P)	RCC	C+G+12	55,162	5,93,759
32	SATPURA BOYS HOSTEL(ARAVINDA 1)	RCC	S+G+4	4,486	48,287
33	SAHYADRI BOYS HOSYEL(ARAVINDA2)	RCC	S+G+5	1,961	21,108
34	VIJAYA LAKSHMI BOYS HOSTEL (VL ENCLAVE)	RCC	G+4	5,838	62,840
35	KUNCHANAPALLI HOSTEL (KUNCHINAPALLI)	RCC	C+G+4	9,164	98,640
36	GUNDIMEDA HOSTEL (GUNDIMEDA)	RCC	G+5	7,030	75,670

Sr. No.	Building Name	RCC Roof	No of Floors	SQ.M.	SQ.FT.
	TOTAL			**83,641**	**8,24,634**
	GRAND TOTAL			**4,93,863**	**28,36,215**
	OTHER BUILDINGS				
36	AO BUILDING	RCC	G+2	1,654	17,803
35	HARNIKS PARK(LOCAL CENTRE)	RCC	G+4	2,814	30,287
36	FOOD COURT	RCC	G+4	2,733	29,418
	TOTAL			**7,201**	**77,508**
	GRAND TOTAL			**5,01,064**	**29,13,723**

Area Statement of the Site

Table 2: *Area statements of KL University*

Area Statements of the site	
Total Site Area	1,76,281 sqm
Ground Coverage (Building Footprint)	33,551 sqm
Total Built Up Area	1,88,170 sqm
Under Construction Area	38,691 sqm
(Sports Complex and Swimmiing Pool)	
Green Lawn Area (pervious)	57,157 sqm
Hard Paved Area (impervious)	34,049 sqm
Occupancy (both fixed and floating)	26000
Occupancy of Girls Hostel	2530
Occupancy of Boys Hostel	2511
Total occupancy of girls and boys hostel	5041
Area statements of the typologies existing within the property	
Office Block-Including all shopfloors	23,231 sqm
Security Block	53 sqm
Utility Block	300 sqm
Cafeteria	1,133 sqm
Parking	58,363 sqm
Training Center + Dispatch Dock	1,141 sqm

ENERGY AUDIT

According to Energy Conservation Act, 2001, Energy Audit is the verification, monitoring, and analysis of the use of energy including the submission of a technical report containing recommendations for improving energy efficiency with cost-benefit analysis and an action plan to reduce energy consumption.

The energy audit aimed to cover the aggregate consumption of electrical energy within the KL University campus including academic, hostels and administrative blocks. Within the campus, no other fossil fuel like coal-fire or firewood, etc. based energy is used.

The annual energy consumption of the KL University campus is **77,82,840 kWh**.

All the buildings of the university are designed and constructed in such a way that during the day time minimal artificial lighting is required. Proper daylight and ventilation facilities are available for every building.

Internal Lighting

There are a total 17,335 number of interior lighting installed on the university campus i.e., 36 W, 28 W FTL, CFL tubes & LED lights of different models.

Table 3: Types of interior lighting installed on the campus

Block Name	36 W F.T. L's (Nos.)	28 W F.T. L's (Nos.)	CFL Lights (Nos.)	Led Lights (All Models) (Nos.)
FED Block	175	240	425	107
CSE Block	78	315	614	936
Mechanical Block	28	136	Nil	390
Old EEE Block	46	212	152	118
Library Block	-	30	-	1702
SK Block	24	22	-	68
Indoor Stadium	30	38	40	238
Main Canteen	9	-	-	24
R & D Block	-	-	-	2289
Temple	-	-	30	-
SDC Block				1745
Total	**390**	**993**	**1261**	**7617**

The 1261 numbers of CFL tubes and 1383 numbers of F.T.L are under the provision to change with the same lux level LED lights.

Table 4: Hostel wise number of lighting installed

Description	Total no. of Lighting
Kanchan Ganga hostel	1,065
Nilgiris hostel	240
Aravalli hostel	445
Vindhya hostel	496
Staff quarters hostel	231
Himalaya hostel	1,850
Aravindha-1	310
Aravindha-2	110
VL Enclave	295
Animal House	22
Tulip Residency	1,750
AO Building	260
Total	**7,074**

Ceiling Fans

At present, a total 9,993 number of fans are installed on the university campus and all the fans are energy-efficient i.e., BLDC & BEE star rating fans.

Table 5: Block wise number of ceiling fans installed

Description	Total no. of fans
FED Block	517
CSE Block	942
Mechanical Block	277
Old EEE Block	164
Library Block	716
SK Block	61
Main Canteen	26
Indoor Stadium	77
R & D Block	875
SDC block	1280
Kanchan Ganga hostel	980
Nilgiris hostel	190
Aravalli hostel	424
Vindhya hostel	424

Description	Total no. of fans
Staff quarters hostel	186
Himalaya hostel	1728
Aravindha-1	250
Aravindha-2	72
VL Enclave	252
Animal House	2
Tulip Residency	1650
AO Building	180
Total	**9993**

HVAC

KL University has a cooling demand of 2,399 TR which is completed by 1158 AC of different capacities. There are four centralized chiller plants- two are water-cooled plant and two are air-cooled plant.

Centralised water-cooled chiller plant

- They are using two water-cooled chillers (1* 200 Tr & 1* 30 TR) for the library block.
- The water chiller plant itself has some advantages like:
  - Longer Lifespan
  - Quiet Operation
  - Energy Efficiency
  - No Open Space Needed
- During the audit, we measured the chiller performance and they were found to be performing very well and their measured ikW/TR was somewhat near their rated ikW/ TR.

Figure 2: Centralised water-cooled chiller plant

Centralised air-cooled chiller plant

- Two air-cooled chillers of the same capacity (216 TR) are used to fulfilling the cooling demand of the R&D block and SDC block
- The air-cooled chiller has its own advantages like:
    - Cheaper
    - Low maintenance
    - Simple installation
    - Do not require a mechanical room
    - Ideal for drought-stricken areas
    - Efficient in humidity
- During the audit, we measure the chiller performance and they are performing very well and their measured ikW/TR is near to-rated ikW/ TR.

Figure 3: Centralised air-cooled chiller plant

The remaining cooling demand of KL University is fulfilled by the AC unit of different BEE stars labelling (2 stars, 3 stars, 5 stars). Approx. 100 AC units are non-BEE star labelled units they are under the process of replacement with the latest BEE 5-star labelled.

Table 6: Block wise number of AC installed

Description	Total no. of AC
FED	18
CSE	121
MECH	24
R&D	13
EEE	21
Indoor stadium	4

Description	Total no. of AC
FM&HM LAB	7
Admin block	49
Library	12
SDC	2
AO Block	44
KANCHAN GANGA (HN)	298
NELAGIRI (HN)	34
ARAVALI	120
VINDHYA	181
STAFF QUARTERS	51
TADEPALLI STAFF QUARTERS	24
SATPURA	33
SAHYADHRI	20
HIMALAYA	82
Total	**1,158**

Figure 4: *AC units installed on site*

Renewable Energy

KL University is taking its initiative to utilize renewable energy and has installed rooftop solar panels of capacity 2133 KWp on the campus to compensate for the necessity of electrical energy within the campus. This has resulted in tremendous curtailment in electricity consumption.

Table 7: Block wise Solar PV installed

Solar Installed	Inverter Capacity (kVA)	Grand Total
Girls Hostel Building	50 kVA (INVERTER - 3)	75,325
	20 kVA (INVERTER - 2)	28,169
	15 kVA (INVERTER - 3)	19,955
Indoor Stadium	30 kVA (INVERTER - 1)	46,380
	30 kVA (INVERTER - 2)	46,232
	20 kVA (INVERTER - 3)	32,501
EEE Block	30 kVA (INVERTER - 1)	47,007
	15 kVA (INVERTER - 2)	22,907
	30 kVA (INVERTER - 3)	46,250
Computer Science Building	50 kVA (INVERTER - 1)	70,538
	50 kVA (INVERTER - 2)	62,344
	50 kVA (INVERTER - 3)	42,338
Mechanical / Computer Science Building	50 kVA (INVERTER - 1)	56,412
	20 kVA (INVERTER - 2)	30,071
	10 kVA (INVERTER - 3)	15,870
Indoor Stadium Building	20 kVA (INVERTER - 1)	30,114
	15 kVA (INVERTER - 2)	20,480
	20 kVA (INVERTER - 3)	29,877
New Library Block	10 kVA (INVERTER - 1)	14,051
New FED Block	10 kVA (INVERTER - 1)	14,604
Research Block	50 kVA (INVERTER - 1)	96,388
	50 kVA (INVERTER - 2)	95,469
	20 kVA (INVERTER - 3)	37,168
SDC Block	110 kVA (INVERTER - 1)	2,36,844
	110 kVA (INVERTER - 2)	2,37,652
	110 kVA (INVERTER - 3)	2,36,895
	50 kVA (INVERTER - 4)	1,12,714

Solar Installed	Inverter Capacity (kVA)	Grand Total
Kanchan Ganga Girls Hostel	125 kVA (INVERTER - 1)	96,472
	125 kVA (INVERTER - 2)	94,936
Himalaya Boys Hostel	125 kVA (INVERTER - 1)	1,23,543
	125 kVA (INVERTER - 2)	1,22,240
	125 kVA (INVERTER - 3)	1,23,440
	125 kVA (INVERTER - 4)	1,24,064
	125 kVA (INVERTER - 5)	1,18,416
Solar power generation, kWh		**26,07,666**
Monetary annual savings, INR		**1,81,23,279**

They have saved approx. amount of Rs. 1,81,23,279/- from Nov. 2022 to Oct -2023 by Solar power generation and they save approx. amount of Rs. 1,79,89,387/- every year by the utilization of renewable energy (solar power).

In Phase 6 (2023-2024) KL University is going to commission a 1500 kWp solar power plant from Dec-2023.

Table 8: Year wise Solar PV Capacity

Description	Year	kWp
Phase 1	2013-2014	250.25
Phase 2	2015-2016	161.72 (Solar) 102 (Wind)
Phase 3	2017-2018	313.11
Phase 4	2021-2022	454
Phase-5	2022-2023	955
Phase -6	2023-2024	1500 (Commissioning from Dec-2023)

By this, they have an operational solar power generation plant of more than 3.6 MW and a wind power plant of 102 kWp.

Figure 5: *Rooftop solar panels installed on site*

Figure 6: *Rooftop solar wind mills installed on site*

Observations

- Power Factor is close to 1.00 Lag.
- VFD's are installed on secondary chilled water pumps.
- 2-Way valve has been used for AHU.
- Heat Recovery Wheel is being used to reduce the HVAC load.
- At most of the BLDC fans are used.
- Most of the conventional lights have been replaced with LED lights.
- Skylight has been provided in the Library block to reduce the artificial lighting load during day time.
- All the street lights are operation on timer system.
- Lifts are installed with regenerative system, which helps in lower the lift energy consumption by approx. 10%.
- Additional 1.5 MW solar PV panel is under commissioning from Dec 2023.
- Pre-paid energy meter for individual AC units are installed to reduce the energy wastage during non-occupied hours.

Recommendations

- Develop an SOP for operating and maintaining the equipment
- Replace old non-BEE star labelled AC units with the latest BEE 5 star labelled AC units.
- Replace all CFL lighting with LED lighting.
- There should be a facility to record energy consumption in every building block.
- Regular campaigns should be done to switch off lights and other electric appliances after use.
- Regular campaigns about optimal AC temperature setting: using all units at specific set points can greatly reduce HVAC energy consumption. It was observed that the set-point for AC was generally at

WATER AND SOLID WASTE AUDIT

Overutilization of water resources and contamination of river systems along with lack of water treatment facilities has aggravated the already existing water crisis in India. The future of India consists of rapid urbanization and an increasing population which will excessively multiply the water demand across sectors energy, industry, domestic, irrigation etc. In the context of extreme neglect, overutilization of water resources and contamination of river systems throughout the world, this 'ubiquitous resource' today has become a 'precious' one, as water is a unique resource without any substitutes or alternatives. This coupled with climate change is going to make the water stress more severe in coming years.

As population continues to boom along with rapid urbanization and concentrate in tier II and tier III cities such as Kanpur, Patna, Madurai, Nashik, Vijayawada etc., this has led to an accelerated economic growth with a number of manufacturing industries, business parks and educational institutions thronging up in and around the cities. The availability of water resource is one major area of concern considering the increase in the water demand by educational institutions. Therefore, it has become important for them to use and manage water sustainably. Today many large corporates/industries/institutes are themselves embarking on the road to sustainability. Educational institutes such as KL University are gradually incorporating SDGs into their responsible business actions such as achieving water self-sufficiency being one of the key action themes.

In addition, solid waste management has become a significant problem in our country. Due to an increase in urbanisation and scarcity of land, it has become necessary to manage waste at the source of generation itself. With the rapid urbanization, the problem of waste management has compounded and India is awakening to the magnitude of the problem. A major environmental concern is gas release by decomposing garbage. Therefore, we need to focus on the solid waste generated from the buildings.

Management of solid waste reduces or eliminates adverse impacts on the environment and human health and supports economic development and improved quality of life. Waste treatment techniques seek to transform the waste into a form that is more manageable, reduce the volume or reduce the toxicity of the waste thus making the waste easier to dispose of.

With above background, it was envisioned to examine the existing water use pattern & solid waste management of KL University, Vijayawada as a part of the green audit.

Water Audit

Reduced dependency on fresh water source

The main source of fresh water supply to the site is groundwater along with treated water from STP. Groundwater is used to meet the domestic, flushing, irrigation, HVAC, RO plant requirements and for filter backwash. Treated water from STP is also used to meet the flushing, irrigation and filter backwash requirement. There are 14 bores designed on the site from where water is extracted.

Figure 7: Bore located near the FED block with water meter installed for taking the readings for groundwater extraction

Table 9: Readings of monthly water supply from various sources by installed water meter on site for year from Nov 2022 to Oct 2023

Month	Groundwater Water Supply (KL)	Treated water from STP (KL)
November	11,76,260	6,20,124
December	11,99,131	6,10,568
January	12,22,902	6,34,293
February	12,12,838	6,32,125
March	12,35,122	6,45,864
April	12,61,932	6,54,525
May	12,61768	6,65,898
June	12,78,830	6,67,854
July	13,25,256	7,21,450
August	13,64,000	7,32,140
September	13,70,297	7,24,560
October	13,70,836	NA
Total annual water supply to site	**1,52,79,172**	**73,09,391**

Approx. 40% of the total water demand of the campus is being met by treated water from STP, thus reducing the dependency on the fresh groundwater source.

RO water plants for providing drinking water

For meeting the drinking water requirement of the site 19 RO water plants have been installed on the site as shown below. There are 62 water coolers of 120 litres (44 nos.), 150 litres (1 nos.) and 380 litres (17 nos.)

Table 10: List of RO plants installed on the campus

S.No.	Name of the Block	Capacity of R.O. PLANT (Liters)	Total Number of R.O. Plant	Capacity of The R.O. TANK	Type of Tank
1	C–Block	2,000	1	2,000	Sintex
2	F.E.D.–Block	500	1	1,000	Sintex
3	Library Block	500	1	1,000	Sintex
4	Old E.E.E.– Block	500	1	1,000	S.S Tank
5	R & D Block	2,000	1	2,000	S.S Tank
6	S.D.C. Block	1,000	1	1,000	Sintex
7	Indoor Stadium	1,000	1	1,000	Sintex
8	Poly House	1,000	1	1,000	Sintex
9	Kanchana Ganga Girls Hostel	2,000	1	5,000	Sintex
10	Kanchana Ganga Mess	2,000	1	4,000	Sintex
11	Aaravali & Vindhya Girls' Hostels	1,000	1	2,000	Sintex
12	Himalaya Boys Hostel	2,000	1	2,000	S.S Tank
13	Old Staff Quarters (Mrs. Usha Sri)	500	1	500	S.S Tank
14	Tulip Residency	2,000	1	2,000	S.S Tank
15	Nilagiri Girls Hostel	1,000	1	1,000	Sintex
16	Aravinda-1 Girls Hostel	500	1	1,000	Sintex
17	Aravinda-2 Boys Hostel	250	1	500	Sintex
18	Tadepalli Staff Quarters	500	1	1,000	Sintex
19	Gundemeda Panchayati	1,000	1	2,000	Sintex
	Total RO Plants		**19**		

A total of 62 water coolers have been installed in the site as shown below.

Table 11: List of water coolers installed on the campus and hostels

Block & Floor	Capacity	Qty
R&D 6 Th & Ground	380 Ltrs	02 Nos
Old Library	150 Ltrs	01 Nos
Indoor Stadium	120 Ltrs	01 No
EEE 1 St Floor& 2 Floor	120 Ltrs	02 Nos
New Library	380 Ltrs	01 No
Mechanical	1st Floor-380 Ltrs,2nd Floor-120 Ltrs	02 Nos
CSE & Mechanical Link	3rd & 5th Floor-380 Ltrs	02 Nos
CSE	Ground & 1 St & 4th&6 Th-120 Ltrs-3rd Floor -380 Ltrs	05 Nos
Old Fed	Ground & 1 St & 2nd Floor -120 Ltrs	03 Nos
New Fed	03 & 07 Th Floor -120 Ltrs	02 Nos
Main Canteen	380 Ltrs	01 No
SDC Block	380 Ltrs	01 No
Kanchana Ganga Girls Hostel	380 Liters & 120 Liters.	15 Nos
Aravalli & Vindhya Girls Hostels	380 Liters & 120 Liters.	15 Nos
New Boys Hostel	380 Liters	04 Nos
Old Staff Quarters	120 Liters	01 No
Tulip Residency	380 Liters	04 Nos
	Total	**62 Nos**

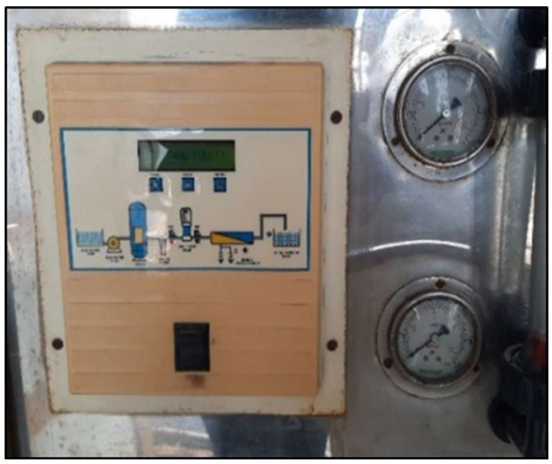


Figure 8: RO plant installed on the terrace of one of the blocks and a water cooler on the ground floor for drinking water

Water balance of the site

Water extracted from bores is stored in overhead water tanks of each block and used in kitchens, toilets, chiller plants, RO plants, flush tanks, gardening and in fire tanks. The waste water generated from the blocks is treated in the onsite sewage treatment plants. The treated effluent is further used in meeting the flushing and gardening water requirements of the site. The site also has arrangements for storing the rainwanter which is used in fire tanks and for groundwater recharge. The water balance diagram with inflow, outflow, sources and applications of the site has been shown below.

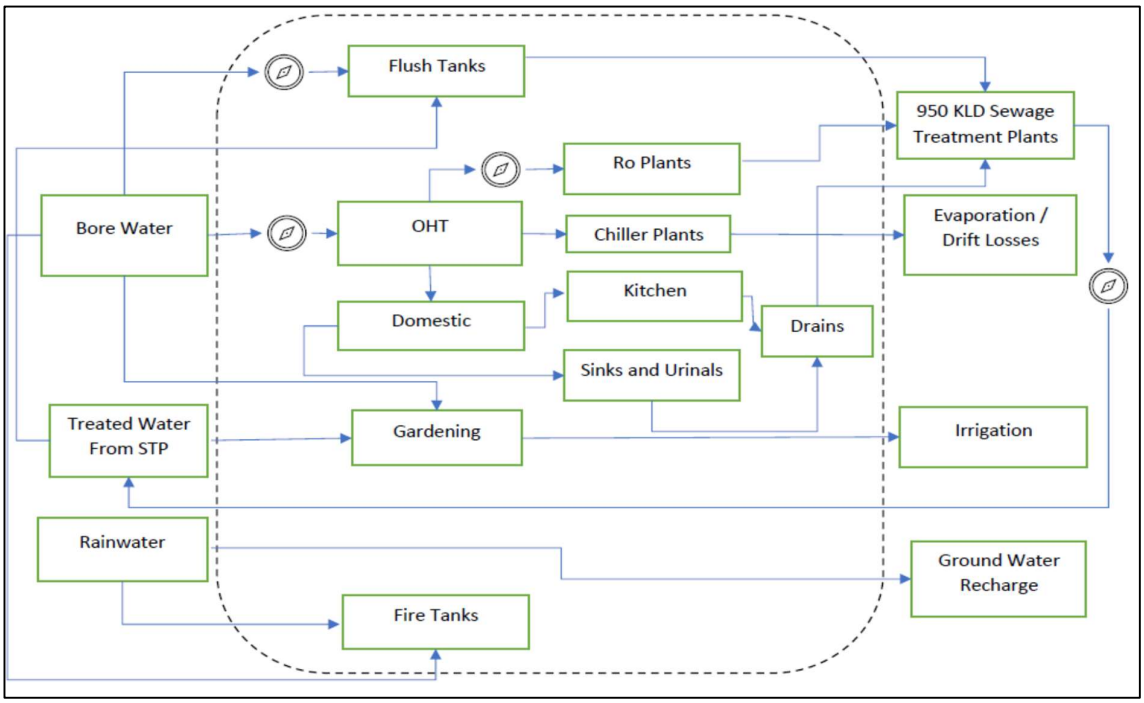


Figure 9: Existing water balance of the campus

Water tank infrastructure

The extracted groundwater is stored in overhead tanks of the respective blocks which is used for both domestic and non-domestic (flushing and irrigation) applications. Treated water from STP is also used for meeting flushing and gardening water requirement.


Figure 10: Overhead domestic and fire water tank located on the terrace of one the blocks

Table 12: List of water storage tank on site

Block	No. Of Tanks
New FED	1
Old FED	1
FED-CSE LINK	1
C Block	2
CSE & MECH LINK	1
Mech	1
R&D	2
EEE	1
New library	1
SDC	2
Old guest house	1
Kanchana ganga	13
Aravalli Hostel	6
Vindhya hostel	6
Staff quarters	2
Indoor stadium	2
Nilagiri hostel	3
Satpura hostel	1

Block	No. Of Tanks
Sahyadri hostel	1
Tadepalli hostel	1
Gundimeda	7
Himalaya hostel	4
Tulip residency	6
TOTAL	**Total tanks: 66**

Table 13: List of fire water storage tank on site

S.no	Fire water Tank Name	No of Tanks	Capacity (Liter)
1	New FED	1	1X20000
2	Old FED	1	1X20000
3	FED-CSE LINK	1	1X20000
4	C	2	2X10000
5	CSE/MECH LINK	1	1X10000
6	Mech	1	1X10000
7	R&D	1	1X20000
8	EEE	1	1X10000
9	New library	2	2X20000
10	SDC	1	1X24000
11	Kanchana ganga	2	2X20000
12	Aravalli Hostel	1	1X20000
13	Vindhya hostel	1	1X20000
14	Staff quarters	1	1X20000
15	Indoor stadium	1	1X5000
16	Satpura	1	1X10000
17	Himalaya boys' hostel	1	1X25000
Total Fire water Tanks		**20**	

Waste water treatment and reuse

There are three onsite sewage treatment plants on the site for treating the waste water generated from the various blocks. One more STP is being constructed near second boys hostel and TULIP staff quarters to cater the need of rising demand by addition of these two new blocks.

Figure 11: View of on-site STP 1, 2 and 3

Table 14: List of STP's on the campus

S.No	STP and its location	Capacity (in KLD)	Year of installation	Technology	Blocks of which waste water is getting treated	Use of treated effluent	Working Efficiency
1	STP 1 located near main canteen	300	2015	MBBR	All blocks except Kanchenjunga and SDC block	Irrigation and Flushing in R & D block	89%
2	STP 2 located near main entrance gate	300	2019	MBBR	SDC, Staff and Kanchenjunga block	Irrigation and flushing in SDC block	90%
3	STP 3 located near boys hostel	350	2022	ARBiT	Boys hostel	Agriculture and discharged into nearby canal currently. In future, it will be used for flushing needs in the boys hostel	95% - 100%
4	STP 4 Located near second boys hostel and TULIP staff quarters	1.2 MLD	2023	ARBiT	Second Boys hostel and Tulip staff quarters	Irrigation and Flushing	95% - 100%

A 500 kg balloon filled with biogas, derived from a combination of wastewater and kitchen food waste, has been established for cooking purposes.

Rainwater harvesting

Site has the facility of both storing the rainwater and for ground water recharge.

The rainwater collected from the rooftops is collected in a rainwater tank of capacity 1,20,000 litres which is used in fire water tank. It has a pre tank silt filter for weeding out the dirt/debris collected along the rainwater. The maintenance protocol for filter media is to remove and replace the top 2-5 inches of media every 3 to 5 years. The maintenance protocol for the storage tank being followed on the site comprises of the following steps-

Step 1: Inspect your gutters

Step 2: Check all gaps and openings are sealed.

Step 3: Check outlets and access points.

Step 4: Inspect and assess the sediment level.

Step 5: Set a reminder.

In addition to this, site has 31 rainwater harvesting recharge pits with a total volume of 22.7 sqm. Dimensions of recharge pits are 3m (height) * 0.9m (diameter) and dimensions of the desiltation chamber are 1.2m (length) * 0.6m (breadth) * 0.6m (height).

Figure 12: Rainwater recharge pit with desilting chamber

Table 15: Location of rainwater harvesting recharge pits in the campus

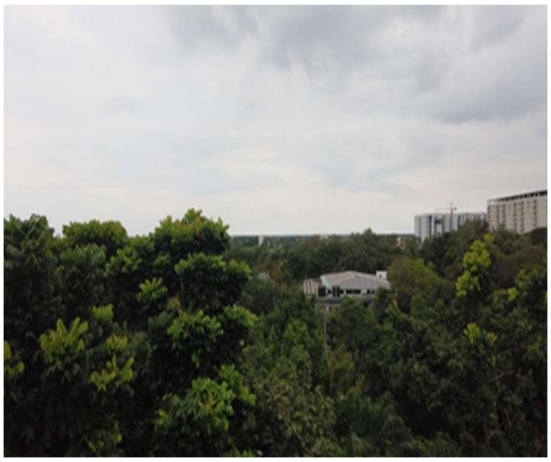
DESCRIPTION	LOCATION OF RWH PIT
RWH PIT-1	C-Block entrance Northeast
RWH PIT-2	FED block West North
RWH PIT-3	FED block West North
RWH PIT-4	FED block Northeast
RWH PIT-5	FED Block Front Garden (parking area) east side Middle
RWH PIT-6	FED Block Front Garden (parking area) Northeast
RWH PIT-7	SBI Bank Front side
RWH PIT-8	SBI Bike parking area
RWH PIT-9	Hotel management Frontside East
RWH PIT-10	KGH lawn area
RWH PIT-11	KGH & SDC middle road
RWH PIT-12	KGH Entrance
RWH PIT-13	Left Side of Satish Canteen
RWH PIT-14	Near tennis court

DESCRIPTION	LOCATION OF RWH PIT
RWH PIT-15	Beside indoor stadium
RWH PIT-16	Indoor stadium Northeast
RWH PIT-17	Indoor stadium Entrance Northeast
RWH PIT-18	New library Northeast
RWH PIT-19	M007 Northeast
RWH PIT-20	Mechanical block Near M007 Front east
RWH PIT-21	Mechanical block Front Eastside
RWH PIT-22	R&D block beside boys washroom
RWH PIT-23	R & D BLOCK THEATRE NORTHEAST
RWH PIT-24	R & D block Nort Eastside
RWH PIT-25	Open-air theatre Northeast
RWH PIT-26	EEE block Southeast side (near server room)
RWH PIT-27	Near old STP
RWH PIT-28	EEE BLOCK

Flora Diversity

KLU campus has a rich and vast expanse of green landscaped area which comprises of lush green trees, shrubs and lawn. Designated spaces for landscape and building blocks have been integrated in a grid iron pattern across the campus with tall trees which provides natural shade to the walkways/road used by the pedestrians.

In a total site area of 1,76,281 sqm, approx. 53% (94,096 sqm) is covered by the green landscape.



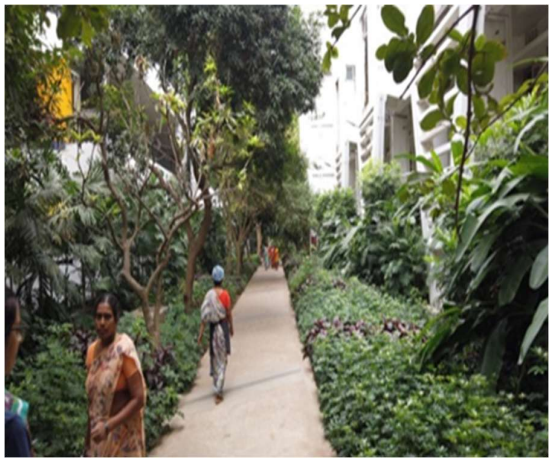


Figure 13: Green landscape area on the campus

Table 16: List of plant/tree species on the campus

S.No.	Plant name	Scientific name	Quantity
1	Mango tree	Mangifera indica	180
2	Subabul	Leucaena luecocephala	20
3	Ashoka	Sarca asoka	5
4	Rain tree	Samanea saman	66
5	Neredu	Syzygium cumini	58
6	Techoma	Techoma stans	30
7	Hibiscus	Hibiscus rosa sinensis	102
8	Banyan tree	Ficus bengalensis	29
9	Cherry fruit	Disambiguation	10
10	Kadamba	Neolomarckia kadamba	35
11	Mahagani	Swetenia mahagoni	34
12	Ravi tree	Ficus religiosa	8
13	Jack fruit	Artocarpus heterophyllus	48
14	Kanaka champa	pterospermum acerifolium	54
15	Bottle brush tree	Melaleuca quinquenervia	6
16	Coconut	Cocos nucifera	220
17	Portia tree	Thespetia populenea	3
18	Areca palms	Dypsis lutescens	1802
19	Devil tree	Alstonia scholaris	49
20	Legistromia	Legestromia speciosa	22
21	Cannon boll tree	couroupita guianensis	16
22	Star fruit	Averrhoa carambola	5
23	Royal palm	Roystonea regia	255

S.No.	Plant name	Scientific name	Quantity
24	Akasha malli	Millingtonia hortensis	102
25	veitchia merrilli plant	Adonidia merrilli	25
26	Triangular palm	Dypsis decaryi	19
27	Neem	Azadirecta indica	69
28	Champa	Mangnolia champaca	52
29	Tabubia	Tabubia rosea	205
30	Jakaranda	Jacaranda mimisifolia	25
31	Guava	Psidium gajava	56
32	Erytrina (Vajyapu tree)	Erythrina variegata	9
33	Temple tree	plumeria indica	66
34	Sapota	Achras sapota	36
35	Pogada	Stypholobium japonicum	28
36	Custard apple	Annona squamosa	37
37	Drumstick	Moringa olefera	19
38	Ashoka	Sarca asoka	55
39	Golden shower	Cassia fistula	150
40	Ramaphal	Annona reticulata	22
41	Tamarind	Tamarindus indica	13
42	Ficus panda	Weeping fig	108
43	Kentia palms	Howea forstriana	59
44	Areca palms	Areca catechu	55
45	Pichodia grandis	Ruffled fan palm	22
46	Raphis	Raphis excelsa	3200
47	Fishtail palms	Caryota mittis	119
48	Casuarina	Casuarina equisetifolia	16
49	Indian gooseberry	Phyllanthus emblica	15
50	Tasmania blue gum	Eucalyptus globulus	45
51	Bauhunia	Bauhunia blackeana	265
52	Araucaria	Araucaria columnaris	18
53	Cycad	Cycas	20
54	Arjuna tree	Terminalia arjuna	25
55	Tade palm	Borassus flabellifer	130
56	Silver date palm	Phoenix sylvestris	80
57	Pongam	Pongamia glabra	39

S.No.	Plant name	Scientific name	Quantity
58	Conocarpus	Conocarpus eractus	450
59	Ixora	Ixora cocinea	39
60	TaLe palm	Livistonia rotundifilia	29
61	cluster fig	Ficus recemosa	26
62	Rubber plant	Ficus elastica	29
63	Orange	Citrus Z sinensis	5
64	Adavi badam	Sterculia foetida	34
65	Water apple	Syzygium samarangenes	22
66	Elaich	Elettaria Cardamomum	5
67	Regu	Ziziphus martiana	16
68	Spathodia	Spathodia campanulata	35
69	Red sandlewood	Pterocarpus satalinus	52
70	Jammi	Propsis cineraria	16
71	Vakkaya	Carissa carandus	10
72	Gulmohar	Delonix regia	80
73	Peltophorum	Peltophorum pterocarpum	18
74	Bambusoideae	Bambusoideae	44
75	Soap berris	Sapindus	10
76	Indian bael	Aegle marmelos	30
77	Rudraksha	Elaeocarpus gantirus	12
78	Betel	Piper betel	34
79	Magnoleophyta	Acacia arabica	8
80	Date palm	Phoenix dactylifera	125
81	Oil palm	Elaeis	45
82	Madras thorn	Pitecellobium dulce	15
83	Bread fruit	Artocarpus altilis	15
84	Ippa	Madhuca logifolia	18
85	Mangosteen	Garcina mangostana	16
86	Fox tail palm	Wodyetia bufurcata	39
87	fern tree	Filicium decipens	14
88	Parijatham	Nyctanthes arbortristis	22
89	Teak	Tectona grandis	85
90	Badam	Prunus dulcis	25
91	Henna	lawsonia inermis	116

S.No.	Plant name	Scientific name	Quantity
92	Ponna (Calophyllum inophyllum)	Calophyllum inophyllum	92
93	Silver Oak Southern silky oak	Grevillea robusta	93
94	Adavi Patti	Hibiscus vitifolius	94
95	Moduga (Sacred Tree)	Butea monosperma	95
96	Cardia Virigin	Cordia sebestena	96
97	Velvet Apple	Diospyros blancoi	97
98	Saraka Indica	Saraca asoca	98
99	Bismarkia Palm	Dypsis decaryi	99
	Total plants		**10564**

Various native plant species and efficient irrigation equipment such as drip irrigation for shrubs, sprinklers for lawn has also been installed on the site for reducing the water requirement for landscaping.

Figure 14: Sprinklers have been widely used on the site to irrigate the lawn

Site has also taken a number of measures such as preservation of trees. Due to the widening of the road in front of the main entrance gate, the trees on the roadside had to be uprooted. KLU decided to transplant these trees to the backside of the campus.

Water metering coverage

Sub metering has been done on the site for monitoring water usage and extraction at various levels. This helps the site team to control the water usage as required.

Figure 15: Water meters for recording water use- treated effluent use in STP 1, 3 and 2 and groundwater in one of the overhead water tanks of the block

Table 17: List of water meters installed on the campus

Sl. No	Block	No Of Meters	Size of Meters	Location	Digital/ Analog
1	CSE	2	2"- 1 No's 1"- 1 No's	Ro Tank- 2 NO	Analog
2	EEE	2	2"- 1 No's, 1"- 1 No's	Bore-1 NO, Ro Tank-1 NO	Analog
3	L	2	2"- 2 NO	Ro Tank- 2 NO	Analog
4	New FED	3	1" -2 NO, 2"-1 NO	Ro Tank- 2 NO, Bore-1 NO	Analog
5	Old FED	1	2"- 1 NO	Bore-1 NO	Analog
6	R&D	2	2" – 2No's	Ro Tank-1 NO, Softner-1 NO	Analog
7	Mechanical	1	2" – No's	Bore-1 NO,	Analog
8	Indoor stadium	3	2" – No's	Bore-1 NO,	Analog

Sl. No	Block	No Of Meters	Size of Meters	Location	Digital/ Analog
			1" – No's	Ro Tank-2 NO	
9	SDC	4	1"- 1 no, 2"- 3 NO	Bore"- 2"- 3 NO, Ro Tank- 1 NO	Analog
10	Civil Block Toilets	1	1"-1 NO	CV Raman Hall Toilets -1 NO	Analog
11	Himalaya Boys Hostel	2	2"-1 NO, 1"-1 NO	Ro Tank-1 NO, Washing Machine-1 NO	Analog
12	Tulip Residency	1	2"-1 NO	Ro Tank- 2 NO	Analog
13	Kgh Mess	1	1"-1 NO	Mess 1 st Floor-1 NO	Analog
14	Kgh Girls Hostel	3	2"- 3 NO	Ro Tank-1 NO, Washing Machine-2 NO	Analog
15	Old Staff Quarters	1	1"-1 NO	Ro Tank- 1 NO	Analog
16	Aravali	2	1"-2 NO	Ro Tank- 1 NO, Washing Machine-1 NO	Analog
17	Vindya	2	1"-2 NO	Ro Tank- 1 NO, Washing Machine-1 NO	Analog
18	Campus Stp	1	2"-1 NO	Sand & Carbon Filters Outlet line-1 NO	Analog
19	Kgh Stp	1	2"-1 NO	Sand & Carbon Filters Outlet line-1 NO	Analog
20	Himalaya Stp	2	2"-2 NO	Sand & Carbon Filters Outlet line-1 NO, Himalaya DUAL plumbing line-1 NO	Analog
	Total	**37**			
21	Himalaya Hostel	574		Smart water Meter	
22	KGH Hostel	59		Smart water Meter	
	Total	**633**			

Water efficient fixtures

Restrooms and kitchen/canteen are water intensive areas. Water efficient faucets are fitted in washrooms of the SDC and library block. Dual flushing systems are provided in some washrooms.

Figure 16: Water faucets installed in SDC and library block

Solid Waste Audit

The types of waste generated on site are paper products, cardboard, wood, metal, media waste such as CD, DVD etc., plastic bottles, glass, garden waste, batteries, waste oil, food waste, electrical & electronic equipment, furniture and construction waste.

Figure 17: *Various types of solid waste generated on site*

Table 18: Quantity of wet and dry waste generated from March 2023 to Oct 2023

S.No.	Area of source of waste	MARCH 2023		APRIL 2023		MAY 2023		JUNE 2023		JULY 2023		AUGUST 2023		SEPTEMBER 2023		OCTOBER 2023	
		Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)	Wet (in kgs)	Dry (in kgs)
1	FED Block	295	260	290	320	120	100	207	355	205	410	183.9	265	292	250	205	325
2	Computer Block	492.5	350	673	650	150	120	567.5	650	625	650	522.5	580	533.5	300	605	655
3	Mechanical Block	108.6	67	98.6	57	98	57	108.6	67	400	89	60.6	34	410	85	98	57
4	Research Block	49.1	33	87.1	305	145	225	49.1	33	443	310	142.1	330	169.5	32	145	225
5	Architecture and Fine arts block	30.6	35	33.1	35	30	40	33.1	35	430	130	33.1	35	118	56	30	40
6	Law Block	32.2	13	32.2	13	37	15	31.2	13	50	20	32.2	13	61	33	37	15
7	Library Block	35.5	46	35.5	85	48.9	95	35.5	46	93	320	35.5	46	96.5	160	48.9	95
8	Civil Engineering Labs Block	22	0	22	0	22	0	22	0	0	0	22	0	22	0	22	0
9	SDC Block	30	150	80	210	20	50	65	255	60	350	65	255	65	200	75	220
10	Indoor Stadium	19	29	19	29	19	29	19	29	13	23	19	29	19	29	19	29
11	Canteen	775	550	798	550	93	120	880	625	1035	1050	670	550	450	990	798	550
12	Guest house	18.6	50	59	55	44	55	34.6	57	305	265	29.6	57	102	57	44	55
13	Main mess	6022.5	45	4995	50	1577	85	6232.2	160	610.5	155	6165	210	6575.9	100	6477	85

S.No.	Area of	MARCH 2023		APRIL 2023		MAY 2023		JUNE 2023		JULY 2023		AUGUST 2023		SEPTEMBER 2023		OCTOBER 2023	
14	Girl's Hostel	155.6	1100	431.6	2550	180.6	450	121.6	1670	313	1880	139.6	1330	955	2290	180.6	1880
15	Girl's Hostel New	145	1000	77	2150	146	500	163	1660	190	1990	106	1950	850	2000	146	2150
16	Boy's Hostel	85.9	880	190.9	1660	225.9	500	264.9	2150	1176	2200	87.5	1680	651	1550	225.9	1880
17	Staff quarters	47.2	45	47.2	45	87	55	37.2	50	82.5	105	76.5	85	75.9	100	87	55
Total		**8364.3**	**4653**	**6787.4**	**7397**	**3043.4**	**2496**	**8871.5**	**7855**	**6031**	**9947**	**8390.1**	**7449**	**11446.3**	**8232**	**9243.4**	**8316**

Implementation of the Waste Policy on the Campus

The site is complying with the designated waste management rules i.e. Solid Waste Management Rules (SWM) 2016, Plastic Waste Management Rules, 2016, E-waste (Management) Rules, 2016, Bio-Medical Waste Management Rules, 2016 and Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016 as laid by the Union Ministry of Environment, Forests and Climate Change (MoEF&CC).

- **Waste Hierarchy**

The strategy on site uses the principle of the waste hierarchy:

REDUCE – the best approach to waste is to reduce it at source.

REUSE – if you cannot reduce it, then try to re-use it.

RECYCLE – if you cannot reuse it, then try to recycle it.

- **Implementation**

Several recycling waste streams have been implemented at KLU diverting much from landfills. The key to successful recycling and reduction in landfills is to collect at the source and segregate. A number of contracts with waste management and recycling vendors have been established in order to provide the means to implement the waste policy.

The following items are currently recycled:

- All paper products (excluding blue roll)
- Cardboard
- Wood
- Metal
- Media waste – CD's, DVD's, floppy discs, videos and audio cassettes
- Plastic bottles, packaging, cups, food containers and all metal cans
- Glass
- Garden waste
- Batteries
- Waste Oil
- Food
- Waste electrical & electronic equipment
- Furniture

- Segregation of waste in all the blocks of the campus

- Collection of leaves by tricycle

- Sanitary pads incineration at scrapyard

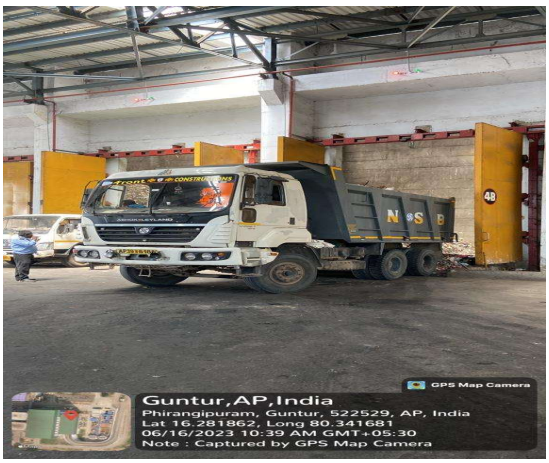
- Collection of dry and wet waste by auto

- Feeding wet waste into new Organic Waste Composter (OWC) machine

- Cardboard waste being taken by vendors

- Iron waste taken by vendors

- Mixed waste being sent to Jindal waste management plant



- Sanitary waste taking by the Safenviron company

- E-waste taking by the vendors

- Paper waste taking by the vendor

The procedure in which the above mentioned waste type is generated on the campus is either recycled or disposed as summarized below:

Table 19: List of waste type generated on site

S.No.	TYPES OF WASTE	DISPOSAL METHOD
1.	PLASTIC	Handover to Certified Vendors for further recycling.
2.	PAPER	Handover to Certified Vendors for further recycling
3.	ALUMINIUM TINS	Handover to Certified Vendors for further recycling
4.	WET WASTE (VEGETABLES, FOOD WASTE)	In-house composting facility (OWC MACHINE, COMPOSTING PITS)
5.	CARDBOARD WASTE	Handover to Certified Vendors for further recycling

S.No.	TYPES OF WASTE	DISPOSAL METHOD
6.	E-WASTE	Handover to Certified Vendors for further recycling
7.	MIXED WASTE	JINDAL WASTE MANAGEMENT PLANT
8.	SANITARY WASTE	In-house recycling facility and Handover to Certified Vendors for further recycling
9.	IRON	Handover to Certified Vendors for further recycling

Waste Collection

Waste bins are placed at every corner of the campus for each category of waste that is produced. Waste bins are provided on each floor, in staff rooms, laboratories, washrooms, kitchen and in campus area. The normal code of dustbins is as follows:

- Green- Recyclable
- Red – Metal
- Blue – Paper
- Yellow – General
- Steel- Dry waste

Figure 18: Multi coloured waste bins provided on the campus

Table 20: Details of waste bins in the campus

S NO	BLOCK	CLASSROOMS	LABS	ADMINISTRATIVE ROOMS	TOTAL
1	R&D BLOCK	43	36	14	93
2	MECHANICAL BLOCK	29	12	15	56
3	C -BLOCK	59	16	62	137
4	FED BLOCK	23	17	32	72
5	NEW LIBRARY	9	17	50	76
6	EEE BLOCK	8	16	43	67

S NO	BLOCK	CLASSROOMS	LABS	ADMINISTRATIVE ROOMS	TOTAL
7	SDC BLOCK	63	20	20	103
8	BHM BLOCK	4	4	5	13
	TOTAL COUNT	**238**	**138**	**241**	**617**

Waste Transfer and Transport (within the site)

Both wet and dry waste is separated at the source level itself by block supervisors and is handed over to the rickshaw trollies. There are dedicated separate trollies for segregated waste and their schedule is as follows. Rickshaw schedule for picking up the waste is as follows-

- **Rickshaw-1 (Wet Waste)**

- Morning 8:00 To 9:00 Road side leaves collection

- 9:15 to 10:30 Dry waste collection

- 10:45 to 12:30 Dry waste collection

- 12:30 to 1:30 Lunch break

- 1:30 to 3:00 Roadside dust bins collection

- 3:30 to 4:00 Vegetable waste collection from hostel mess

- 4:30 to 5:30 Scrap yard work

- **Rickshaw-2 (Wet Waste)**

- Morning 8:00 to 9:00 Roadside leaves clearance

- 10:45 to 12:30 Dry waste collection

- 12:30 to 1:30 Lunch break

- 3:30 to 4:00 Vegetable waste collection from hostel mess

- 4:30 to 5:30 Scrapyard work

- **Rickshaw-3 (Wet and Dry in Segregated Manner)**

- 9:15 to 10:30 Wet waste from campus

- 1:30 to 3:00 Wet waste collection from cafés


Figure 19: Rickshaw trollies collecting waste from bins and cleaning of landscape areas

Waste management space on site for its separation, processing and transformation

A waste segregation area is established at back corner of the site (away for habitable space) to segregate collected waste from trash bins by rickshaw trollies and is then further supplied to the respective vendors and processing units both within and outside the campus for recycling/disposal etc.

Table 21: Type of waste generated on site along with its disposal method

S.No.	Type of waste	Quantity generated (kg/day)	Method of disposal
1	Plastic waste	66	Local recycling vendors
2	Dry food waste	80	Eluru fish farming vendors
3	Wet food waste	800	Eluru fish farming vendors
4	Paper waste	133	Local recycling vendors
5	Rubber materials	3	Local recycling vendors
6	Garden waste	600	Waste dumping yard
7	Additional waste Materials	500	Waste dumping yard
8	Used oils	8	Disposed in boilers
9	Oil filters	2	Local recycling vendors
10	RO filters	6	Waste dumping yard
11	Bio medical waste	-	Incinerator
12	E waste	-	Donations to nearby needy/local vendor

- Organic waste management

Organic waste converter (OWC) is an easy to use decentralized waste management system to turn large amounts of organic waste such as food waste, fruits, fruit peels, plate left over's, vegetables, vegetable peels, fish, fish bones, chicken bones, bread, curries, garden waste (dried/wet leaves, small dry flowers) etc. into compost.

Figure 20: Collection and disposing off of organic waste in OWC

A biogas plant is being established with a capacity of 2 tons of capacity to recycle food waste from the kitchen, canteen and cafeteria. No plastic covers or disposable items are allowed to be served in by cafeteria and canteen on campus. Everything is served either in metal utensils or in a degradable item.


Figure 21: Some of the waste management strategies implemented in the KLU campus

Recommendations

- Implement water-saving technologies such as water-free urinals (also known as zero flush urinals or air-based flushing systems) and utilize low-flow or flow control water equipment.
- Conduct regular maintenance of aerators in all water faucets and fixtures, including manual flow rate testing to ensure optimal water flow and implement corrective measures as needed.
- Schedule general maintenance of desilting chambers and filter media before the monsoon season to prevent clogging.
- Provide periodic staff training on efficient water usage, with a focus on kitchen staff.
- Display signage promoting water conservation, waste reduction and segregation, and reduction of food and water waste in washrooms, kitchens, dining areas, and near drinking water facilities to raise awareness among staff and students.
- Encourage digitalization to minimize paper usage.
- Maximize reuse and recycling of solid waste.
- Promote the use of biodegradable materials as alternatives.
- Expand the coverage of drip irrigation systems for watering shrubs and plants to reduce irrigation water consumption.
- Reduce water usage for washroom cleaning by emphasizing dry and wet mopping instead of solely wet mopping.
- Replace existing Multi Jet Dry Dial Water Meters with Smart Automated Water Reading (AMR) Meters to automate utility consumption data collection, eliminating the need for manual meter reads.
- AMR technology offers quick and accurate consumption data that can be remotely accessed, providing detailed monitoring and analysis.
- Expand the provision of dual plumbing systems to all blocks to utilize rooftop rainwater and treated water from sewage treatment plants (STPs) for domestic and non-domestic purposes, further reducing groundwater dependency.
- Establishment of a comprehensive maintenance program for efficient on-site water management is crucial. The longevity of treatment plants, pumps, pipelines, and other water and wastewater system structures is influenced by various factors such as construction materials, design specifications, and location-related variables. However, the primary determinant of their

A robust maintenance program not only prolongs equipment longevity but also minimizes breakdowns. Moreover, it yields several additional benefits that enhance overall operational efficiency. While these secondary outcomes may not be directly linked to maintenance, they play a significant role in improving operational efficacy.

A well-structured program ensures:

Regular equipment inspections

- Periodic calibration and adjustments
- Development of long-term overhaul and outage schedules
- Improved personnel scheduling and utilization

Reduction in overtime for emergency repairs

- Enhanced coordination between departments, particularly in cases of shared equipment
- Increased knowledge and comprehension of equipment functionality
- Streamlined organization of equipment maintenance procedures
- Efficient utilization of lubricants
- Optimized procurement of spare parts
- Enhanced organization of maintenance department operations

HEALTH AUDIT

The quality performance of a building is linked with the occupant's health and comfort. Aspects like indoor environment quality (IEQ), visual and acoustic comfort, general health and hygiene and quality infrastructure enhance the occupant's comfort and wellbeing in buildings. The government of India has several guidelines to implement and enhance the social, environmental and building infrastructure of colleges and universities. Further, it includes several protocols associated with the mental and physical health and safety of the students.

The health audit at the KL University is conducted in two steps; one at the infrastructure level and the second at the policy level. A building health audit questionnaire was shared with the authorities for the collection of primary data and an afterwards on-ground site visit was conducted to assess the aforementioned policy protocols.

Following observations were made during the health audit of the KL University campus:

Health and Safety

Accessibility and Barrier-Free Environment

- As per the All India Council for Technical Education guidelines; the Institution has provided appropriate facilities to take care of the physically challenged students and elderly persons comprising of Teaching/ Non-Teaching/ Others including parents of the students visiting the Institution.
- Barrier-Free built environment for disabled/ elderly persons is available in the campus buildings, including the availability of specially designed toilets for ladies and gents.
- The provision of a golf cart facility at the campus is available for transportation.
- The campus encourages Non-motorised transportation in the campus and has provided appropriate pathways and landscaping for outdoor walking.
- Separate provision for on-ground 2-wheeler and 4-wheeler parking is available at the entrance along with a multi-level car parking (MLCP).

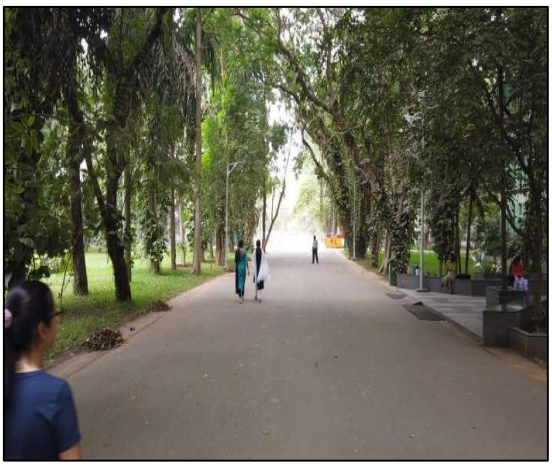


Figure 22: Outdoor pathways/roads with street lighting and landscaping

Figure 23: Provision of ramps and lifts for vertical circulation in the buildings

Figure 24: Multi-level Car Parking

Figure 25: On-ground Parking at the Entrance

Figure 26: Golf Cart Facility at the campus

Figure 27: Provision of Clean PwD Washrooms

First-Aid, Medical Facilities and Safety

- On-campus medical facilities are available to students and at least one ambulance is kept in ready mode for attending to emergencies and crises as per UGC guidelines on the safety of students on and off campuses of higher educational institutions.
- A first aid kit is available on each floor of each block in case of emergencies.
- Separate medical facilities are available in the hostel blocks.
- Regular health check-ups and awareness programs are conducted at the campus.
- Self-defence training for women studying and working on campus through tie-ups with training institutions / NGOs is actively conducted.

Figure 28: Medical Room at the Indoor Sports Complex

Figure 29: Doctor's cabin at the Indoor Sports Complex Medical Room

Figure 30: Beds at the Indoor Sports Complex Medical Room

Figure 31: Medical Room at the Girls Hostel

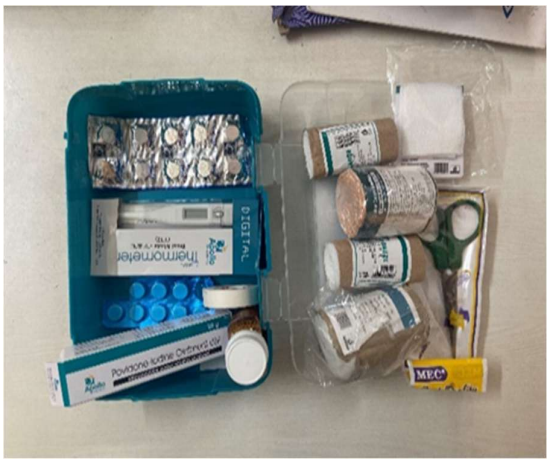


Figure 32: First Aid kit in each building block and floor

Figure 33: Ambulance and Bus Service at the campus

Health and Mental Well-being

i. A standard operating procedure is in place for an anti-ragging committee to prevent any misconduct with the students inside the campus. (As per All India Council for Technical Education notified Regulation for prevention and prohibition of ragging in AICTE approved Technical Institutions vide No. 37-3/ Legal/ AICTE/ 2009 dated 01.07.2009)

ii. An Internal Complaint Committee (ICC) is also in place as per Section 4 of All India Council for Technical Education (Gender Sensitization, Prevention and Prohibition of Sexual Harassment of Women Employees and Students and Redressal of Grievances in Technical Institutions) Regulations, 2016 vide no. F. AICTE/ WH/ 2016/ 01 dated 10th June 2016.

iii. Anonymous Complaint boxes are present in each building to address any personal or departmental issues. Counselling arrangements for the affected individuals are also available.

iv. Several events on mental health and well-being, awareness programs on health and safety, and anti-discrimination are conducted throughout the year. (Refer to Table-18)

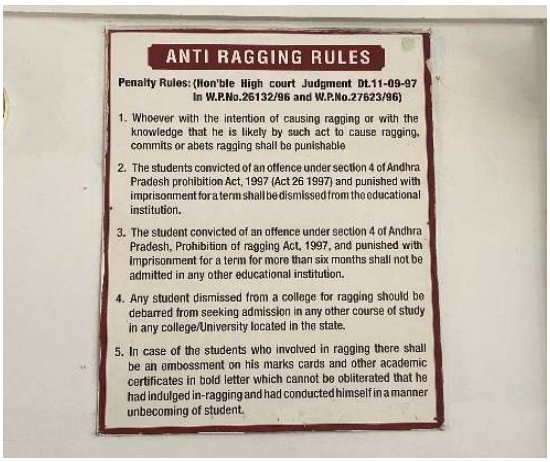


Figure 34: Anti-ragging rules posters on campus

Figure 35: Complaint Box

Fire Safety and Mock drills

i. A fire safety system under which mechanisms for the detection of a fire, the warning resulting from a fire and standard operating procedures for the control of fire are present at the campus.

ii. Sprinkler systems and other fire extinguishing systems, fire detection devices, stand-alone smoke alarms, and smoke control and reduction mechanisms (fire hose reels) are present in all the buildings and at the campus.

iii. Students and staff is trained regularly in the effective operation of firefighting devices. Mock drills for fire situation is undertaken at least once in two months.

iv. Appropriate safety signage and exit boards are present at the campus for evacuation purposes in case of a hazardous situation.

v. Several other events are conducted at the campus besides the mock drills. The links to the detailed report of an individual event are mentioned in Table-2.

Figure 36: Fire Mock Drill

Figure 37: Fire Mock Drill

Figure 38: Fire extinguisher, hose reels, sand buckets and exit Signage at the campus

Figure 39: Fire Exit Signage at the staircase

Table 22: Abstract List Of Fire Fighting Equipment

S.No	Location	Fire Stands	Fire Buckets	Hose Reel Box with Hose Reels	Hose Reel Drum with Tube	Fire Alarm	MCP	Type of Extinguishers			Yard Hydrants Water Tank Hydrants Motor with Control	Zonal Panel	SM/D	Sprinklers
								A TYPE	BC TYPE	ABC TYPE				
1	STAFF QUARTERS II-A	10	40	12	10	20	20	22	11	12	3	1	1	
2	STAFF QUARTERS II-B	10	43	12	10	20	20	20	9	6	3	1	1	
3	STAFF QUARTERS 1	10	40	13	10	10	10	20	10	10	4	1	1	
4	NEW FED	9	36	5	8	8	8	14	4	9	1	1	1	29	
5	OLD FED	5	22	3	4	12	12	21	10	9	1	1		54	
6	COMPUTER BLOCK	37	148	29	29	30	38	98	50	45	3	3	1	265	
7	MECH & CIVIL	15	60	10	10	10	9	19	11	15	3	1	1	116	
8	LIBRARY	24	96	38	32	36	36	35	28	34	6	2	9	364	309
9	INDOOR STADIUM	4	16	8	4	6	6	8	4	4	4	1	1	29	
10	EEE BLOCK	7	30	7	6	6	6	20	9	7	3	1	1	122	
11	R&D BLOCK	1	4	42	35	20	20	17	22	284	8	1			
12	ALL LABS	1	4					3	3	7					
13	ARAVINDA 1&2	8	32	8	7	7	7	9	2	8	2	1	1		
14	GIRLS HOSTEL	29	116	35	32	31	29	136	62	68	7	4	2	333	
	TOTAL	**170**	**687**	**222**	**197**	**216**	**221**	**442**	**235**	**518**	**48**	**19**	**20**	**1312**	**309**

Health and Hygiene

Implementation of Housekeeping Policies at the Campus

To maintain the health and hygiene at the campus the housekeeping services have been assigned to CLR Facility Services Pvt. Ltd., Pune which is an ISO 9001:2015; ISO 41001:2018 & OHSAS 18001-2007 Facility Management, Contract Staffing, and HR Solutions Company. It was observed that a dedicated staff of housekeeping professionals is maintaining the cleanliness of the campus.

Following observations are made:

Figure 40: Equipment used for housekeeping

Figure 41: Provision of Clean Washrooms

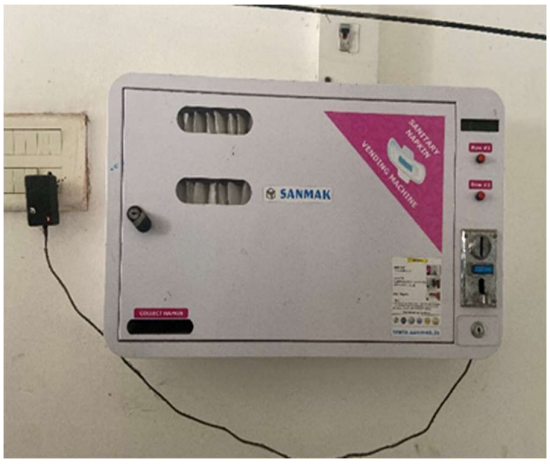


Figure 42: Provision of Sanitary Napkin Vending Machine

Figure 43: Provision of hand sanitisers and liquid soap

Figure 44: Provision of Multi-coloured dustbins all over the campus

Figure 45: Regular cleaning of campus roads and maintenance of landscape area

Figure 46: Provision of laundry services at the hostel

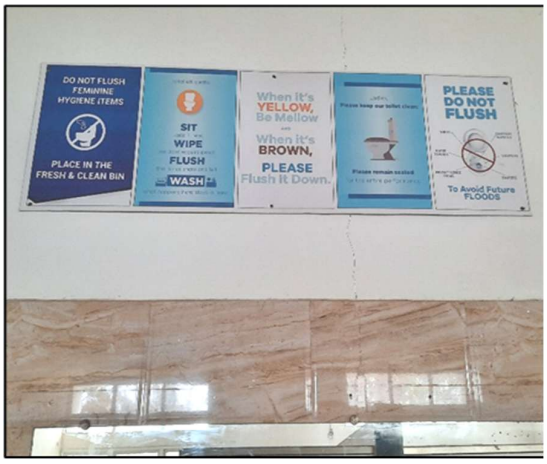


Figure 47: Posters inside washrooms

Note: The assigned policy protocol adopted by the University and the list of equipment and chemicals for the daily and weekly housekeeping of the campus is mentioned in the Annexure-1

Implementation of policies for food and portable water quality checks

- It is ensured that standards of quality and hygiene are strictly observed in the food outlets, canteens and messes and the food on offer is certified through a hygiene test report by an expert doctor for foods, water and cleaning.
- The university has a standard operating procedure in place for regular inspection of the food quality and hygiene. It includes routine inspection of preparation counters, food hygiene, personal hygiene, transportation and handling of food, storage, special requirements of high-risk food and inspection of documentation and records with suggestions for improvements. (Refer to Annexure-2 for detailed report)

- The Food Safety and Standards Authority of India (FSSAI) has been established under Food Safety and Standards, 2006 which consolidates various acts & orders that have hitherto handled food-related issues in various Ministries and Departments. The campus has partnered with the food business operator that is registered under FSS Act, 2006.
- The campus has a zero plastic use policy and has prohibited the supply and purchase of plastic water bottles. Only canned drinks are sold at the campus.

Figure 48: Registration of food business operator

Figure 49: Food preparation unit for the mess

Figure 50: Canteen inside the building blocks

Figure 51: Canteen Counters

Figure 52: Food preparation area in small canteens

Figure 53: Washing area in the main canteen

Figure 54: Bakery at the hotel management block

Figure 55: Vegetable storage at the main mess

Figure 56: Girls hostel mess area

Figure 57: Main Canteen

Recommendations

- The campus has the provision for lifts and ramps. However, it was noticed that some blocks do not have the provision of a ramp at the entrance. It is recommended to provide ramps and appropriate handrails in all the public and institutional spaces.
- The requisite number and size of various exits are provided, based on the occupants in each room and floor based on the occupant load, the capacity of exits, travel distance and height of buildings as per provisions of Building Bye-Laws 4.8. I. However, implementation and display of fire evacuation plans, radium stickers and signage at an appropriate height of visibility on each floor and staircases shall be provided for further improvements.
- The assembly points are used for gathering during any hazardous situation. Provision of designated assembly points in case of any hazardous situation should be provided as per each building block's capacity and size with proper signage.
- Regular maintenance and testing of the fire equipment including re-filling of fire extinguishers and sand buckets shall be done.
- Proper storage of raw materials, vegetables and cold products shall be done in a covered, clean and hygienic storehouse. The same shall be cleaned and quality checked at regular intervals to prevent insects and bacterial breeding.
- Proper storage/janitor cupboards shall be provided for housekeeping equipment.
- Proper washing of utensils using low-flow water fixtures with eco-friendly cleaning soaps and detergents shall be done. It must be ensured that the water from the washing area should be channelized through proper drains and shall not be spilt over the floor to avoid wastage of water and any injury through water spillage.
- The washrooms are cleaned at regular intervals. However, it is advised to use minimum water for cleaning purposes. The floors and WCs should be dry for the next person to use.
- Sanitary Napkin Vending machines are available on campus at each block.

CARBON FOOTPRINT AUDIT

In the last few decades, global warming has emerged as one of the most pressing concerns confronting the international community on a local, national, and global scale. The most immediate and visible effect of global warming is increasing global temperature. One of the critical drivers of global warming is greenhouse gas emissions. Quantifying GHG emissions from various human activities is a viable first step toward emission reduction and a better understanding of disaster risk.

As a climate indicator, Carbon Footprint (CF) assists in identifying key GHG emission sources and potential areas for improvement. It was introduced as a tool to direct applicable emission cuts and verifications, making it easier to understand the risk of global warming at the outset. **"Carbon Footprint is defined as a measurement of the total GHG emissions caused directly and indirectly by an individual, an organization, an event, or a product, and is expressed as a carbon dioxide equivalent (CO_2e),"** according to Carbon Trust (2007). The GHG emissions from all activities across the organization, including energy consumed in buildings, industrial processes, fugitive emissions, and the organization's cars, are measured in an organizational carbon footprint. A CF analysis will give the organization a thorough GHG inventory, allowing it to identify and target reductions from its significant emissions sources and estimate its total GHG impact.

The study is a first step toward reducing the college's emissions and developing an environmental policy framework. It will provide an overview of the campus's CO_2 emissions and help identify key emission sources and areas for improvement.

Carbon footprint calculations

Three "scopes" (scope 1, scope 2, and scope 3) are defined for GHG accounting and reporting purposes to assist differentiate direct and indirect emission sources, promote transparency, and provide utility for different sorts of companies and different types of climate policies and business goals. Scope 1, Scope 2, and Scope 3 emissions are taken into account when determining the university's carbon footprint. Scope 1 and Scope 2 are the largest contributors to overall emissions since day scholars utilize college-provided transportation and hostellers stay on campus.

Scope 1: Direct GHG Emissions

Direct GHG emissions and removals occur from GHG sources or sink inside organizational boundaries and are owned or controlled by the organization. Those sources can be stationary or mobile. Direct emissions from stationary combustion are the consequence of the combustion of any fuel (fossil or biomass) burnt in stationary (fixed) equipment such as

heaters, gas turbines, and boilers. This could be done to generate heat, mechanical work and steam. Direct emissions from mobile combustion result from the fuel burnt in transport equipment, such as motor vehicles, trucks, ships, aircraft, locomotives forklift trucks.

Sources of Scope 1 emissions in KL University:

- Combustion of fuels in stationary sources – diesel used in DG Sets
- Combustion of fuels in mobile sources – petrol used in vehicles
- Combustion of fuels in mobile sources – diesel used in vehicles
- Unintentional GHG release from equipment and system (fugitive emissions from fire suppression system and refrigeration/air conditioning equipment)
- LPG used for canteen

Table 23: Scope 1 – Direct GHG Emissions

Scope 1: Direct GHG Emissions						
Type	**Fuel**	**Unit**	**Factor**	**Amount**	**kg CO_2e**	**t CO_2e**
Direct emissions arising from owned or controlled stationary sources that use fossil fuels and/or emit fugitive emissions						
Liquid fuels	Diesel	litres	2.7	3,88,086	10,49,980.35	1,049.98
Liquid fuels	Petrol	litres	2.3	1,685.73	3,944.09	3.94
Refrigerants	HFC-32	kg	675.0	2.6	1,741.50	1.741
Refrigerants	HFC-134a	kg	1430.0	32	45,760.00	45.76
Refrigerants	R410A	kg	2088.0	38	79,344.00	79.344
Refrigerants	HCFC-22/R22	kg	1810.0	104.7	1,89,543.20	189.54
Direct emissions from owned or controlled mobile sources						
Battery EV	Battery EV	km	0.0	48,642	-	-
		Total				**1,370.31**

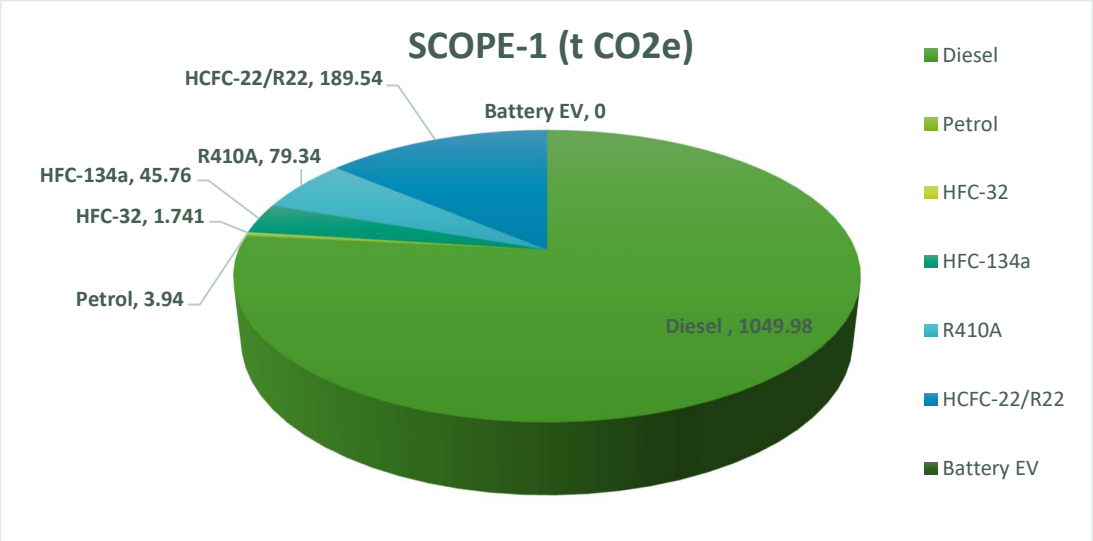


Figure 58: Scope 1 – Direct GHG Emissions

Scope 2: Electricity Indirect GHG Emissions

Scope 2 includes only GHG emissions due to the fuel combustion with the production of final energy and utilities, such as electricity, heat, steam, cooling, and compressed air. It excludes all upstream emissions associated with fuel, emissions due to the construction of the power plant, and emissions allocated to transport and distribution losses. Indirect emissions from imported electricity, including GHG emissions related to the production and consumption of electricity imported by the organization.

Sources of Scope 2 emissions in KL University:

- Electricity purchased from Grid
- On-site RE generation

Electricity purchased from Grid: 77, 82,840 kWh

Renewable energy generated and used: 26,07,666 kWh

Table 24: Scope 2 – Indirect GHG Emissions

Scope 2: Indirect GHG Emissions					
Activity	**Unit**	**Factors**	**Amount**	**kg CO2e**	**Total Emission t CO2e**
Electricity From Grid	kWh	0.82	77,82,840	63,81,928	6,381.92
RE Generation	kWh	0.82	26,07,666	21,38,286	2,138.29
Net Electricity	**kWh**	**0.82**	**51,75,174**	**42,43,642**	**4,243.64**

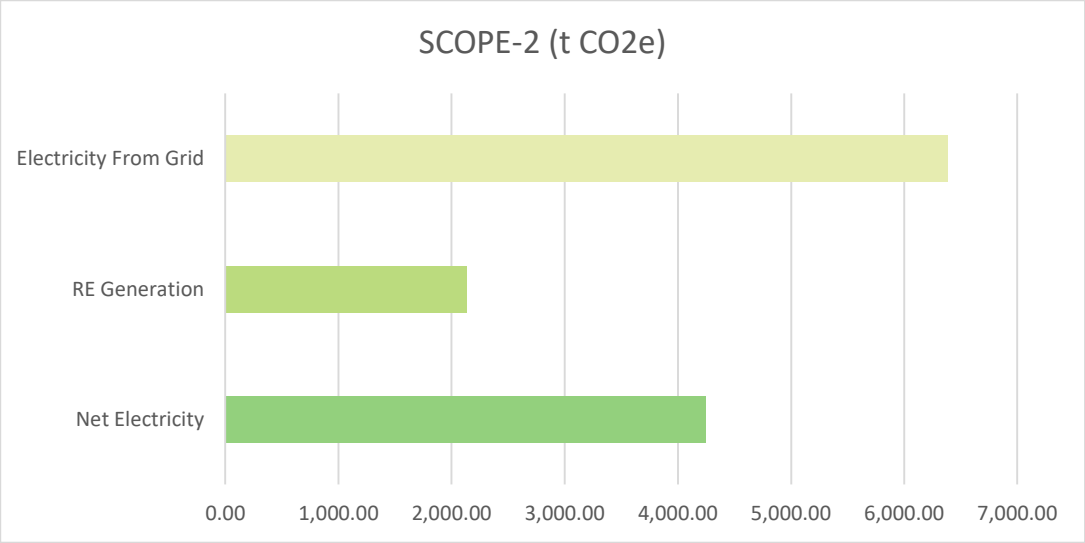


Figure 59: Scope 2 – Indirect GHG Emissions

Scope 3: Other indirect GHG emissions

GHG emissions occur from sources located outside or from outsourced activities, i.e. from the activities of members of the organization but occurred at sources owned/controlled by another organization.

- Water supply
- Water treatment
- Students/Employees commuting
- Food Consumption

Table 25: Scope 3 – Other Indirect GHG Emissions

Scope 3: Other Indirect GHG Emissions					
Type	Unit	Factor	Amount	kg CO_2e	Total Emission t CO_2e
Water Treatment					
Water Supply	cum	0.149	1,52,79,172	22,76,596	2,276.596
Water Treatment	cum	0.272	73,09,391	19,88,154	1,988.15
Students/Employees commuting					
Van -Class-II (Diesel)	km	0.63	1,12,167	70,575	70.58

Scope 3: Other Indirect GHG Emissions					
Bus	passenger.km	0.10	11,85,500	1,18,550	118.55
Food Consumption					
1 standard breakfast	breakfast	0.84	2,494	2,095	2.09
1 average meal	meal	4.70	4,988	23,443	23.44
1 hot snack (burger + fries)	hot snack	2.77	1,870	5,181	5.18
1 sandwich	sandwich	1.27	1,870	2,375	2.38
					4,486.97

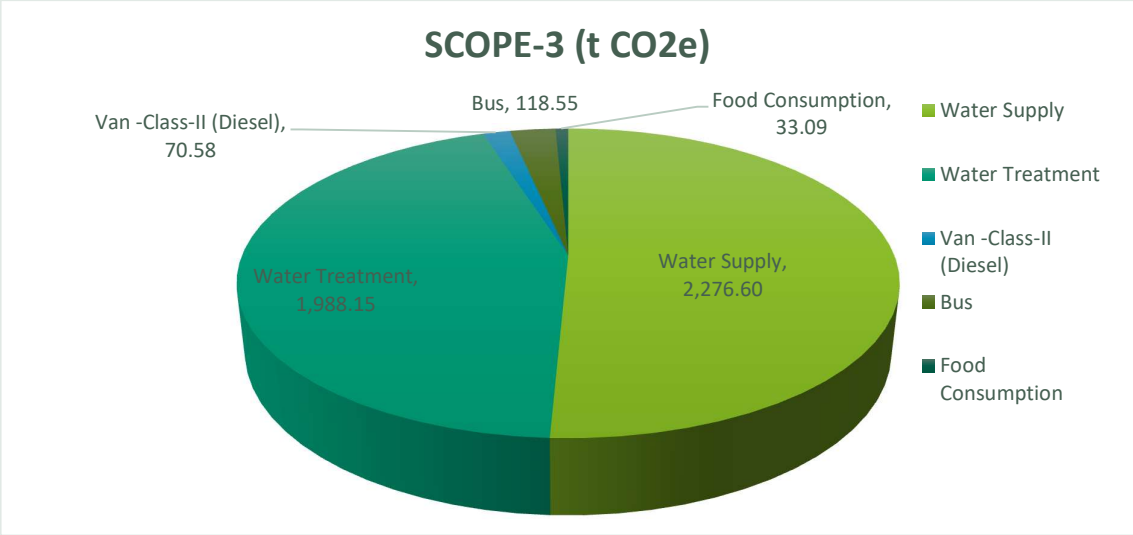


Figure 60: Scope 3 – Other Indirect GHG Emissions

Carbon sequestration through plantation

Carbon sequestration is soil and plants' natural removal of carbon from the atmosphere. It has also been described as any of the several processes for removing excess carbon dioxide (CO2) from the atmosphere to mitigate global warming. Carbon sequestration can be termed as the capture and long-term storage of carbon dioxide before it is emitted into the atmosphere. In the carbon footprint calculation of KL University, carbon sequestration through plantation is considered;10,564 is the total number of trees planted in the campus. For the analysis of the carbon footprint, 75% of the total planted tree is considered, i.e., 7923.

Table 26: Carbon sequestration through a plantation

Carbon sequestration through plantation			
No. of trees considered for carbon footprint calculation	CO_2 absorbed by a tree in one year, KG	Total CO_2 sequestrated, KG of CO_2 / year	Total CO_2 sequestrated, t CO_2e
7,923	18	1,42,614	142.61

KL University Carbon Footprint for year 2023-24

In the financial Year 2023-24, Carbon Footprint of KL University was computed to be 10,100.93 tons of CO2 equivalent to the identified GHG emission sources. The primary source of emissions came from Scope 3 emissions, i.e., 4486.97 tCO2e followed by Scope 2, which is 4243.64 tCO2e. The minimum contribution is by Scope 1, which was computed as 1370.32 tCO2e. Carbon sequestration through plantation results in reducing 142.61 tCO2e GHG emission sources.

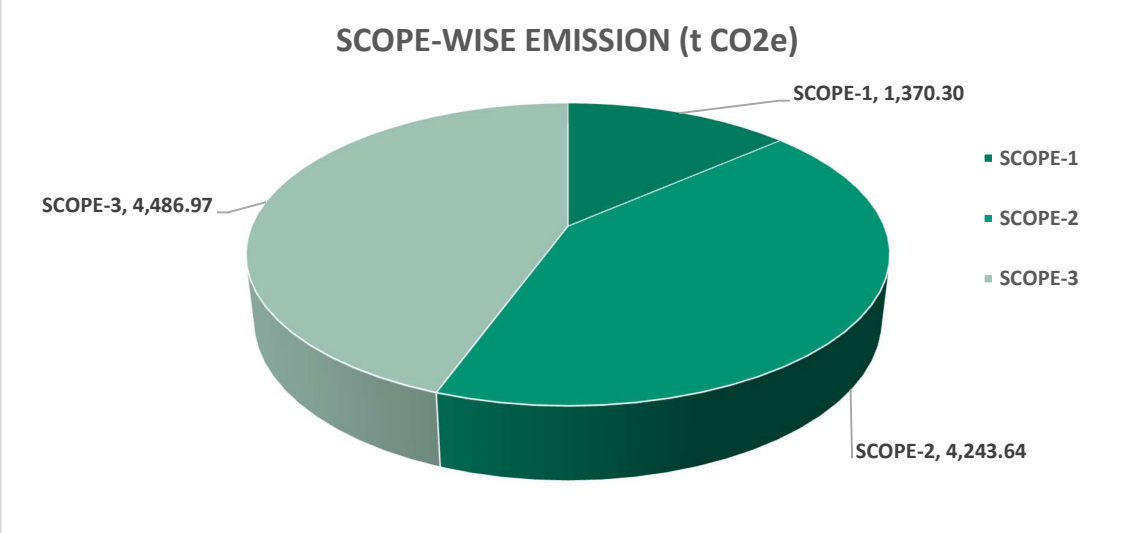


Figure 61: Scope-wise emission

Table 27: Carbon Footprint of KL University

Carbon Footprint of KL University	
Total Emission, t CO_2e	10,100.93
Carbon sequestration through plantation, t CO_2e	142.61
Carbon Footprint, t CO_2e	**9,958.32**

Recommendations

- The green procurement procedure is recommended to extend to energy-saving utilities.
- During the study, it was found that the campus has a potential of approximately 1.2 MW of solar; installing more solar panels on available open space shall reduce the campus's carbon footprint.
- Periodical cleaning of solar panels.
- Setting up an intelligent monitoring system to monitor real-time energy consumption is recommended.
- Carbon Road Map: It is recommended that KL University engage different stakeholders to develop its short, medium and long-term reduction targets based on a review of internal capacity and current performance.

ANNEXURE 1

ANNEXURE - II

DESCRIPTION OF SERVICES:

DAILY CLEANING

A. Sweep Clean - Sweep clean all floor areas including

- Damp Moping of Tiles, Vitrified floors, staircases, elevators floor, sidewalls and entrance areas.
- Floors shall be free of dirt, mud, sand, footprints, liquid spills, and other debris.
- Chairs, trash receptacles, and easily movable items shall be moved to clean underneath.
- During inclement weather, the frequency may be higher than once per day.
- After sweeping all vitrified floors, areas would be machine scrubbed and cleaned.

B. Vacuuming

- Vacuum cleaner would be used to ensure adequate cleaning of carpets in operations support building. When completed, the area shall be free of all litter, lint, loose soil and debris.
- Any chairs, trash receptacles, and easily moveable items, shall be moved to vacuum underneath, and then replaced in the original position.

C. Washroom Cleaning

- Thorough cleaning and sanitization of toilets, bathrooms, wash basins and shower facilities, using suitable non- abrasive cleaners and disinfectants.
- All surfaces shall be free of grime, soap mud and smudges.
- Cleaning of mirrors, glass doors, glass windows, etc.
- Replacement of paper towels, toilet paper, and soap dispenser in all bathrooms shall be performed.

D. Trash Removal

- Emptying all waste paper baskets, ashtrays (if applicable) from all floor areas, and washing or wiping them clean with damp cloth, replacing plastic wastepaper basket linings and returning items where they were located.
- All waste from waste paper baskets will be collected and deposited in the building's waste containers.
- Dry & wet garbage would be segregated and dumped into designated area within the premises.

E Glass Surface Cleaning

- All glass at entrance doors of the premises would be cleaned using damp and dry method.
- Glass tabletops, cabin doors, cabin partitions and glass accessories would also be cleaned.
- Removal of grease marks or fingerprints glass counters and partitions. This cleaning is done using approved all-purpose cleaner and lint free cloth or paper towels.

F. Damp & Dry Cleaning

- Wipe clean all White boards of meeting rooms, Conference rooms, workstations, cabins etc.
- Wipe clean all table tops of workstations, cubicles, office cabins and other furniture and fixtures.

WEEKLY CLEANING

A. Deep Cleaning

- Stairways Terraces, generator rooms, AHU Rooms, Shop Floor, Workstation etc.
- Ceilings, Walls, Partitions, etc.
- Toilets and Washrooms.

B. Window Glass Cleaning

- Interior cleaning of the glasses till height of 3 Meters
- Dusting window- sills and blinds.

C. Sanitizing

- Office area, paper bins would be cleaned and sanitized
- All washroom dustbins would be thoroughly cleaned and sanitized.
- All telephone instruments would be sanitized using disinfectants.
- Waste Bins from Pantry and cafeteria areas would also be thoroughly cleaned and sanitized with disinfectants.
- Thorough washing of all walls and doors of all toilets with appropriate detergent and disinfect.

FACILITY SERVICES PVT. LTD. PUNE-21.

REGISTRAR
Koneru Lakshmaiah Education Foundation,
(Deemed to be University)
Green Fields, VADDESWARAM-522 502.
Guntur District, Andhra Pradesh.

HOUSEKEEPING EQUIPMENT					
S. No.	Equipment	Image	S. No.	Equipment	Image
1	Ride-On Sweeper		2	Manual Walk Behind Sweeper	
3	Debris Dustpan - Jumbo (for removal of leaves etc. from the road)		4	Auto Scrubber	
5	Wet & Dry Vacuum Cleaner		6	Dry Mop Set	
7	Single Disk		8	Wringer Trolleys	
9	Glass Cleaning Kit		10	Signage Boards	
11	Telescopic Pole				

ANNEXURE 2

Checklist for Routine Inspection

√ In order X Not in order NA not applicable

Date of Inspection:

(1) Good Manufacturing Practices For Whole Premise

Requirements	√/ X
a) Food Preparation Areas	
I. Cooking and frying is done under chimney having appropriate suction capacity.	X
b) Hand washing facilities and toilets	
II. Adequate number of wash-hand basin fitted with taps for running hot and cold water.	✓
c) Changing facilities	
III. Facilities for staff to change their cloths; wherever necessary.	✓

(2) Good Food Hygiene Practices

a) Cleaning	
I. Working area and equipments/ utensils are properly cleaned.	✓
b) Water Supply	
II. Adequate supply of portable water.	✓
III. The water is examined chemically and bacteriologically by a NABL Accredited laboratory.	✓
IV. Ice and steam wherever in use during processing is made from portable water.	✓
c) Raw Materials	
I. Preparation of Fruits/ Vegetables	
1. Uncooked, ready-to-eat fruits & vegetables are treated before peeling in 50ppm chlorinated water.	✓
2. The equipment used for peeling/ cutting etc. of fruits & vegetables is clean and of non absorbent food grade materials.	✓
II. Preparation of Non-Veg. Product	
1. Raw meat and processed meat is kept separate from other food items.	NA
2. Used surface is cleaned properly with anti-bacterial agents.	✓
d) Cooking	
I. The preparation/ processing/ cooking are adequate to eliminate and reduce hazards to an acceptable level.	✓
II. Cooking oil is not repeatedly used for frying.	✓
e) Chilling	
I. Fridge and display units are in good working condition and maintained at temperature 5 C.	✓
f) Cross-contamination	
I. Raw food/ meat/ poultry and ready-to-eat foods are kept	✓

separate.	
II. Staff is trained enough to avoid cross-contamination.	✓

(3) Personal Hygiene

a) Food production personnel are appropriately attired in clean protective clothing, hair covering, footwear, gloves, facial mask etc.	✓
b) Food production personnel should use disinfection and hand washing facilities whenever they enter or re-enter food processing areas and hand washing facilities to be equipped with non hand operated taps, liquid soaps, disposable paper towels and covered waste bins.	✓
c) Restriction to unhygienic practices such as eating, smoking, spitting, etc., within the food processing premises are adhered to and strictly enforced.	✓

(4) Transportation and Handling of Food

a) Food vehicles are internally lined with appropriate material and provided with suitable facilities.	NA
b) Chilled/ frozen food products are transported at appropriate regulated temperatures.	NA
c) Vehicles are clean, free from pest infestation and other contamination.	NA
d) Separate food vehicle should be used for raw and finished products.	NA

5) Storage

a) Adequate, well designed storage rooms/ areas with appropriate storage facilities are available and which are impervious to moisture, clean, free from pest infestation and well maintained.	✓
b) Chemicals, detergents and other cleaning materials are stored in designated areas away from food items	✓
c) Ingredients, intermediate and finished products are stored and maintained at appropriate temperature.	✓
d) Ingredients, intermediate and finished products are handled and stored n a manner to prevent damage, contamination and spoilage.	✓
e) Proper stock rotation (First-In-First-out) is practiced to prevent deterioration and spoilage of raw materials and finished products.	✓
f) Returned, defective or suspect products are clearly identified and isolated in designated area or containers.	✓

6) **Special Requirements for High-Risk Foods**

a) Cut fruits/ salads, fresh juices and beverages	NA
I. Juice dispensing machine are cleaned and free from contaminants.	NA
b) Confectionary products	
I. Confectionary products properly refrigerated with labels indicating date of expiry.	✓
c) Meat, poultry and fish products	
I. Non-veg. products are washed with potable water.	NA
II. Processing area is clean and properly disinfected.	✓

d)	**Water based chutneys, sauces etc.**	
I.	Cleaned and disinfected chopping boards are used.	✓
II.	Permitted food additives are used as per recommended quantities; wherever necessary.	✓
III.	Sauces and chutneys are stored in glass/ food grade plastic container with proper lid.	✓
e)	**Fried foods**	
I.	Good quality/ branded oil/ fats are used for preparation, frying etc.	✓
II.	Packaged oil is used.	✓
III.	Oil is not repeatedly used for deep frying.	✓

7) Documentation and Records

a. Test report from own or NABL accredited/ FSSAI notified labs regarding microbiological contaminants in food items are available.	✓
b. Records of daily production, raw material utilized and sales are available.	✓
c. A periodic audit of the whole system according to the Standard Operating Procedure conducted regarding Good Manufacturing Practices/ Good Hygienic Practices (GMP/ GHP) system.	✓
d. Appropriate records of food processing/ preparation, food quality, laboratory test results, pest control etc. for a period of 1 year or the shelf-life of the product; whichever is more.	✓
e. Records of sale and purchase that the food product sold to registered/ licensed vendor and raw material purchased from registered/ licensed supplier.	✓

Suggestions for Improvement (if any)

1. More flies are at serving area and dinning table

Time limit prescribed for compliance of suggestions

one week

Recommendations

NIL

Place: 23/12/2021
Date: KLEF

KRS released 23/12/21

Dean (Student Affairs)
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522502,
Guntur Dist, Andhra Pradesh.

(Signature of Inspecting Employee with Seal)

Associate Dean (Student Affairs)
Koneru Lakshmaiah Education Foundation
(Deemed to be University)
Green Fields, VADDESWARAM-522502,
Guntur Dist, Andhra Pradesh.

TERI has a Sustainable Buildings (SB) Division that has vast experience in the buildings sector for providing green design assistance to design teams at conceptual stage of projects. The Division offers services for enhancing the design of buildings and selection of climate responsive building materials. These interventions optimize the building systems through resource efficiency and reduced operational costs, ultimately improving the environmental footprint of the building. The Division also conducts building energy audits and recommends retrofit measures for improvement of energy efficiency in existing buildings. TERI has also helped develop an indigenous rating for green buildings called GRIHA, (Green Rating for Integrated Habitat Assessment), which has been adopted by the Ministry of New and Renewable Energy, and supported as a national rating system for India. This rating covers new constructions, large developments and existing buildings. Over the years, SB has contributed to formulation of enabling policies, norms and standards, and has provided technical support for implementation of various codes and standards at the national and sub national levels. Presently, TERI is supporting a number of State governments in the implementation of Energy Conservation Building Code (ECBC) through handholding and amendments in their building bye laws.

Apart from consultancy, SB also conducts regular training programmes for green buildings, energy conservation & energy efficiency, and sustainable habitat.

SB has a dedicated team of professionals from varied backgrounds such as architecture, electrical and mechanical engineering, environmental & energy.

It has pan India presence with established offices at Delhi, Mumbai and Bengaluru.

The Energy and Resources Institute
www. teriin.org