INSPIRED BY LIFE
MANIPAL UNIVERSITY

Integrative Design Solutions

Environmental Audit and Carbon Footprint calculations

- Manipal University, Jaipur

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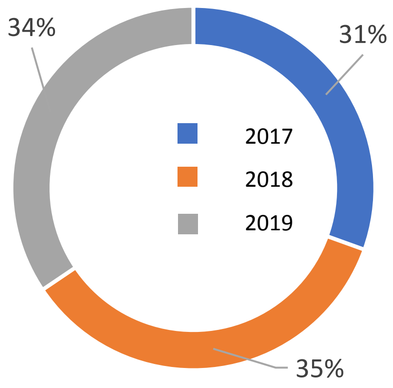
Energy

Annual Energy Consumption 2017/18/19



Key Performance Indicator (KPI)

Energy Performance Index (EPI) per year of MUJ is

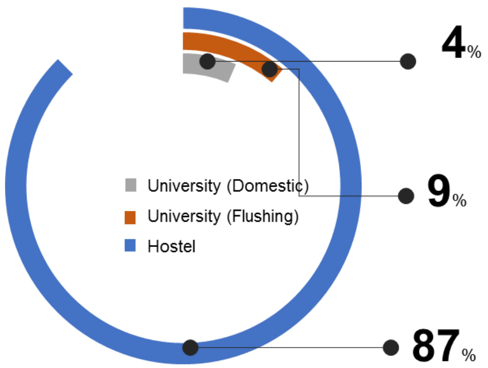
Energy performance Index (2019)
***77.3** kWh/m2.year*

Energy performance per student (Academic + Hostel)
***1,291** kWh/ person. year*

Energy use per student (Hostel)
***2,156** kWh/ person. year*

Water

Water Consumption



Key Performance Indicator (KPI)

Water Consumption per student per year of MUJ is

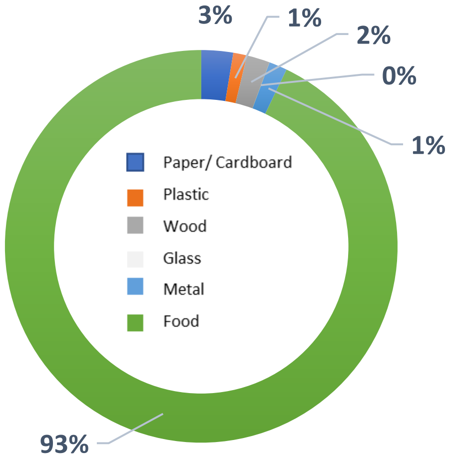
Campus Level:
***56.1** kL/Student. Year*

University Level:
***2.83** kL/Student. Year*

Hostel Level:
***88.4** kL/Student. Year*

Waste

Waste Generation



Key Performance Indicator (KPI)

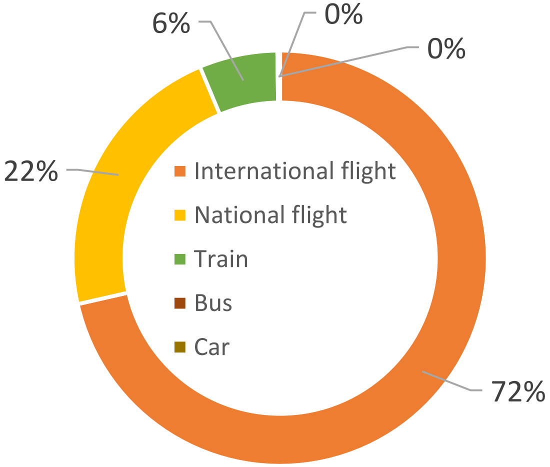
Annual Waste Generation per student per year of MUJ is

Dry Waste:
***2.94** kg/student.year*

Food waste :
***7.9** kg/student.year*

Mobility

TCO2 Equivalent (Commute)



Key Performance Indicator (KPI)

Total MUJ CO2 emission in 2019:

Total CO2 emission from daily commute-
***15,179 TCO2** per student*

Total CO2 emission from out station travel-
***16 TCO2** per student*

Total MUJ CO2 emission in 2019-
***15,195 TCO2** per student*

Dashboard - (Executive Summary)

In this Audit we have mapped the performance of the Students and Staff in the University in four different sectors; Energy Waste, Water and Mobility.

The report will define the ***Key Performance Indicators (KPIs)*** at individual and campus levels. This will further help the university in benchmarking their performance and monitor the KPIs periodically.

Manipal University Jaipur (MUJ)

Manipal University Jaipur (MUJ) was launched in 2011, as a self-financed State University. The campus is of 140 Acres including academic and residential area. The multi-disciplinary university offers career-oriented courses at all levels, i.e., UG, PG and doctoral and across diverse streams, including Engineering, Architecture, Planning, Fashion Design, Interior Design, Fine Arts, Hospitality, Humanities, Journalism and Mass Communication, Basic Sciences, Law, Commerce, Computer Applications, Management, etc. The university intents to conduct an Energy Audit and Carbon Footprint Calculation for Manipal University Jaipur campus.

The main objective of this project is to develop and propose recommendations for low carbon transition roadmap for the entire campus of Manipal University, based on the understanding of direct and indirect GHG emissions through energy use in the campus, energy monitoring, benchmarking of embodied energy for existing buildings, aligning the campus strategies with Sustainable Development Goals (SDGs), Energy Efficiency, renewable energy, and environmental performance.

Project Description

- Project name – Manipal University Jaipur
- Typology – Institutional Building
- Type building blocks – Academic, Administrative, Hostel
- Climate zone – Hot and dry
- Location – Jaipur, Rajansthan-303007
- Site area – 5,63,697 m^2
- Built up area – 1,14,389 m^2
- No of students - 9143
- No. of Student (Hostel) - 4978
- No of staff - 1000
- Approximate numbers of day of operation – 210 days

Integrative Design Solution (IDSPL) has been appointed by MUJ to conduct **the Green Audit** for the campus covering the ***Energy and Environmental assessments along with calculation of Carbon Footprint*** of the University.

Abbreviations

AHU	Air Handling Unit
APFC	Automatic Power Factor Control
BEE	Bureau Of Energy Efficiency
CFM	Cubic Feet Per Minute
CPCB	Central Pollution Control Board
DCS	District Cooling System
ECBC	Energy Conservation Building Code
EPI	Energy Performance Index
HVAC	Heating, Ventilation, And Air Conditioning
KL	Kilo Litre
KLD	Kilo Litres /Day
kVA	Kilovolt-Ampere
kVAr	Kilovolt-Ampere Reactive
KW	Kilowatt
kWH	Kilowatt Hour
kWP	Kilowatt Peak
LPM	Litre Per Minute
MEP	Mechanical, Electrical & Plumbing
MVA	Megavolt Ampere
MW	Megawatt
NBC	National Building Code
SOP	Standard Operating Protocol
STP	Sewage Treatment Plant
TR	Ton Of Refrigeration
VFD	Variable Frequency Drive

Green audit (Energy & Environmental Audit) serve to identify opportunities to sustainable development practices, enhance environmental quality, improve health, hygiene and safety, reduce liabilities and save money. Energy & Environmental audits can be a highly valuable tool for college in a wide range of ways to improve their environmental and economic performance and reputation; while reducing wastages and operating costs. Once a baseline data is prepared after the auditing process, the data can serve as a point of departure for further action in campus greening. It will also help the college to benchmark its programs and activities with other peer institutions, identify areas for improvement and prioritize the implementation of future projects.
The data will also provide a basis for calculating the economic benefits of resource conservation projects by establishing the current rates of resource use and their associated costs.

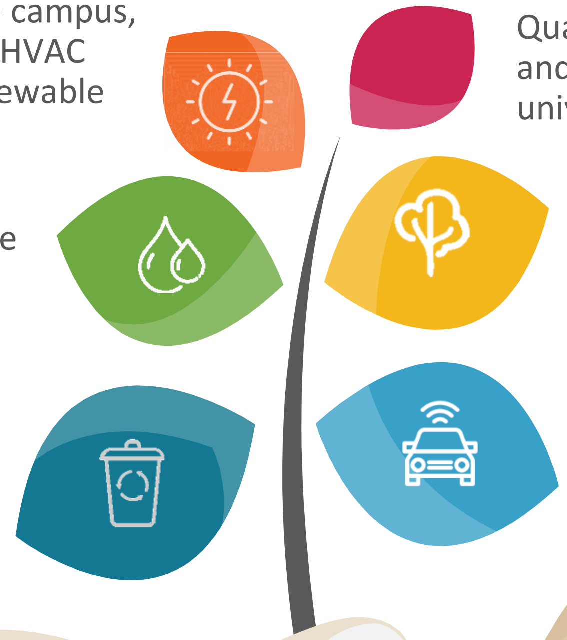
- The Green Audit is a requirement under **the Criteria 7 of NAAC, National Assessment and Accreditation Council.**
- The basic objective of green audit is to **continually improve**
- Benchmarking and analyzing of **the performance of** environment conditions in and around the institutes and colleges

Outcome:

- Formalized Management System for Energy and Environmental concerns
- Increased awareness towards energy and environment concerns
- Reduce Energy Consumption
- Reduced carbon footprint
- Reduced water footprint
- Improved Illumination, Noise level, Ventilation and Indoor Air quality
- Overall Sustainable Development

What is Green Audit (Energy & Environment) and what can be achieved from it?

Criteria for conducting the Audit



1. Energy:
The energy criteria covers the Energy use of the campus, lighting systems, HVAC systems, and renewable integration

2. Water:
The criteria includes the water consumption in the campus, water balancing, reusing and recycling of water.

3. Waste:
This criteria covers the solid waste management and food waste generation and its disposal

4. Mobility:
This criteria covers the CO_2 emissions calculation for the campus for the daily commute, national and international trips and analyze the carbon footprint for the transportation.

5. Landscape:
It calculates the CO_2 sequestration, Oxygen secretion through plants and the water requirements for the plant species.

6. Wellness:
This covers the Indoor Air Quality (IAQ), water quality and daylight quality in the university campus.

Structure of the Audit Report

1. Defining the objective of the criteria for evaluation
2. Collecting the available data
3. Analysis of the information
4. Deriving the Key Performance Indicators (KPIs) for University and at Individuals based on the performance.
5. Recommendations to improve the performance under each criterion

In the second phase of the audit, a roadmap will be developed based on the evaluated scenarios. University's benchmarking of the performance can be monitored against the set KPIs. This will help the MUJ to plan informed improvements of infrastructure and services leading to reduced carbon footprint of the campus

MUJ Site Zoning

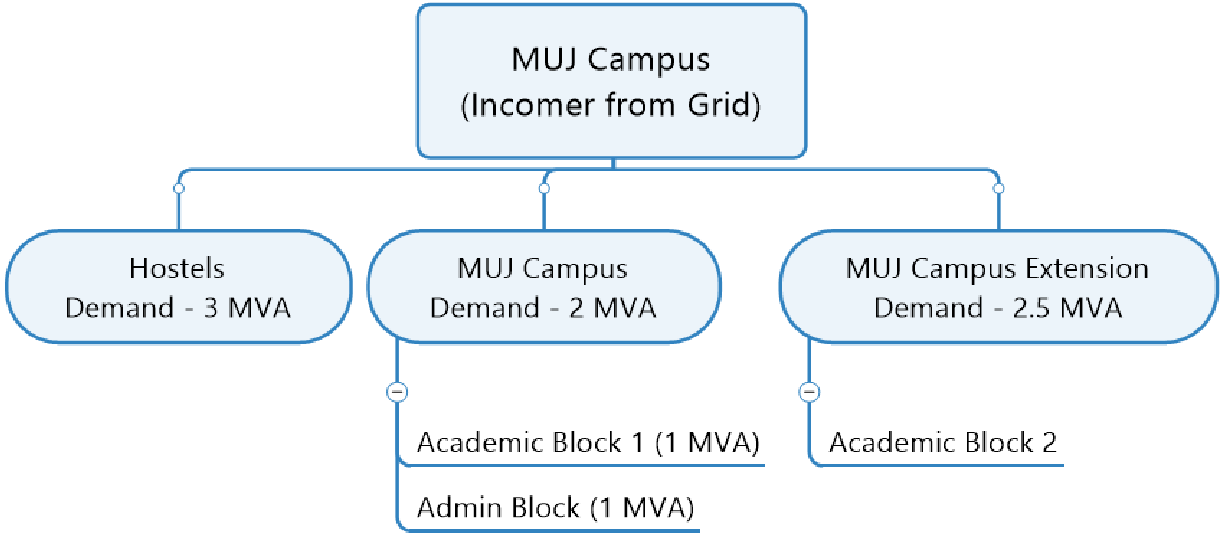
Legends

1	Administrative Block
2	Academic Block
3	Hostel block (Students Residential Area)
4	Staff Residential Area
5	STP & Water harvesting pond
6	Future Expansion
7	Recreational ground

Criteria - Energy

Energy Demand (As of 2019)

MUJ Campus including hostels and staff quarters has an electrical connected load of **7.07 MW** and contract demand of 4,000 kVA which caters to HVAC load, indoor and outdoor lighting, building services like lifts, water pumping, power backup, etc.



Transformer capacities of each area in the campus

MUJ purchases grid electricity from **Jaipur Vidyut Vitaran Nigam Ltd from 2010** and also uses electricity generated from the on-site Solar PV power plants installed in the campus.

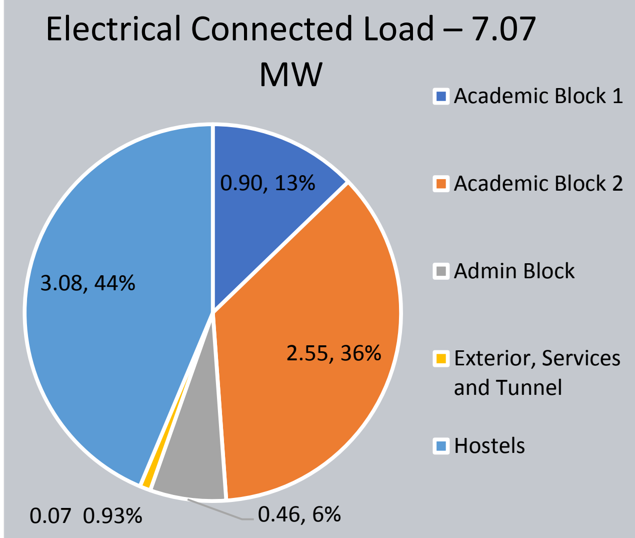
Average Grid Electricity Price – INR 11.84 per kWh during 2020-21

Average Renewable Electricity Price – INR 5.26 per kWh during 2020-21

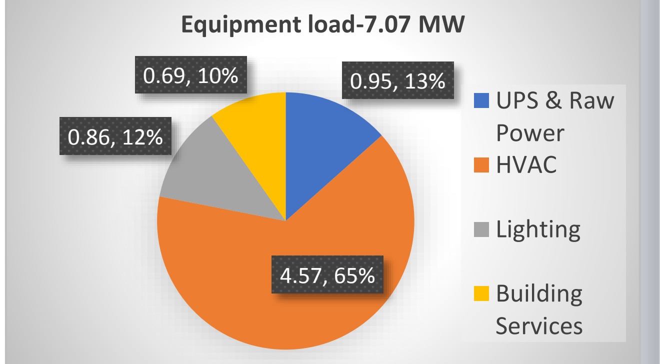
Source: MUJ Asset List dashboard, Electricity Bills, Handover documents (Hostel, Academic & Admin Area

Observations:

Energy Demand Share:



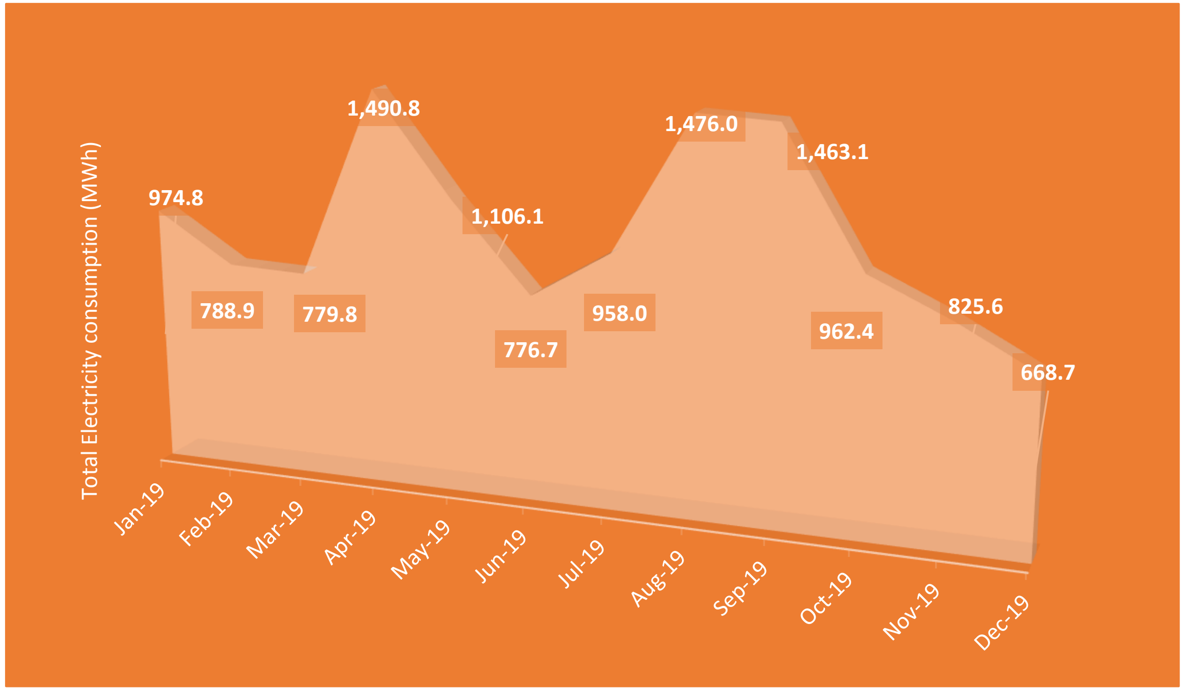
Energy End-use Equipment Demand Break-up



Criteria - Energy

Energy Consumption: Academic and Hostel Area (Jan 2019 - Dec 2019) – Grid + Renewable energy

S/N	Month	Total Electricity Consumption (KWh)
1	January	974,808.30
2	February	788,946.10
3	March	779,796.80
4	April	1,490,753.10
5	May	1,111,942.90
6	June	776,685.60
7	July	957,999.30
8	August	1,481,003.60
9	September	1,483,796.40
10	October	972,188.60
11	November	806,394.20
12	December	650,528.40
Total		**12,274,843.30**



Electricity consumption in the campus is the highest during the month of April, followed by August and September. This is due to higher demand for air conditioning and ventilation during the summer and monsoon periods. June and December months' electricity consumption is low due to the holidays for the students.

Source: Electricity Bills and Solar PV Power generation data from MUJ team

Key Performance Indicator (KPI):

Energy performance Index (2019)

77.3 kWh/m².year

33% better performance compared to BEE benchmark for schools and University Buildings.

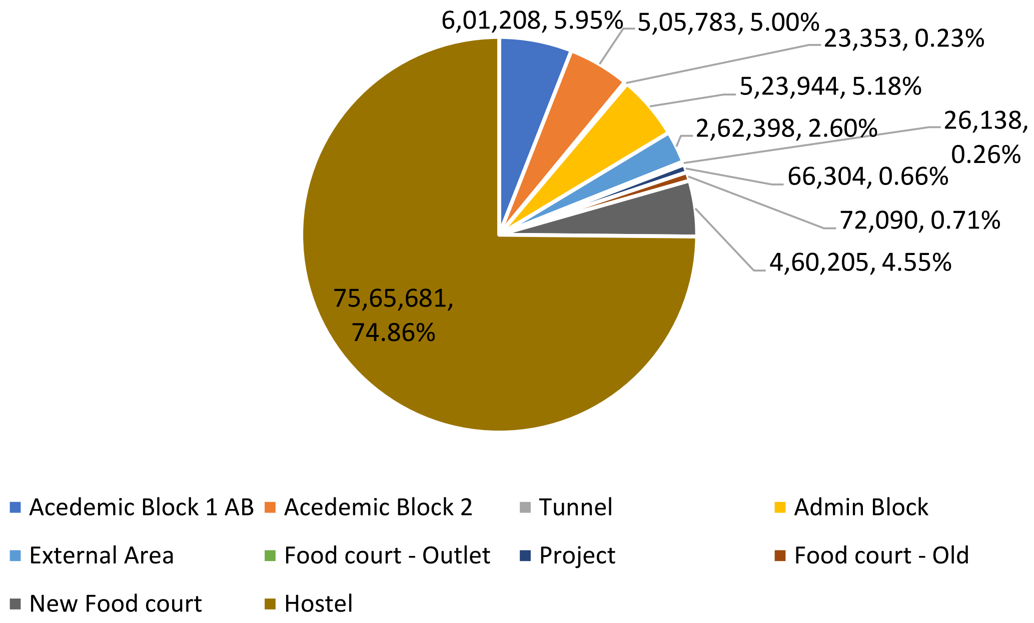
Energy performance per student (Academic + Hostel)

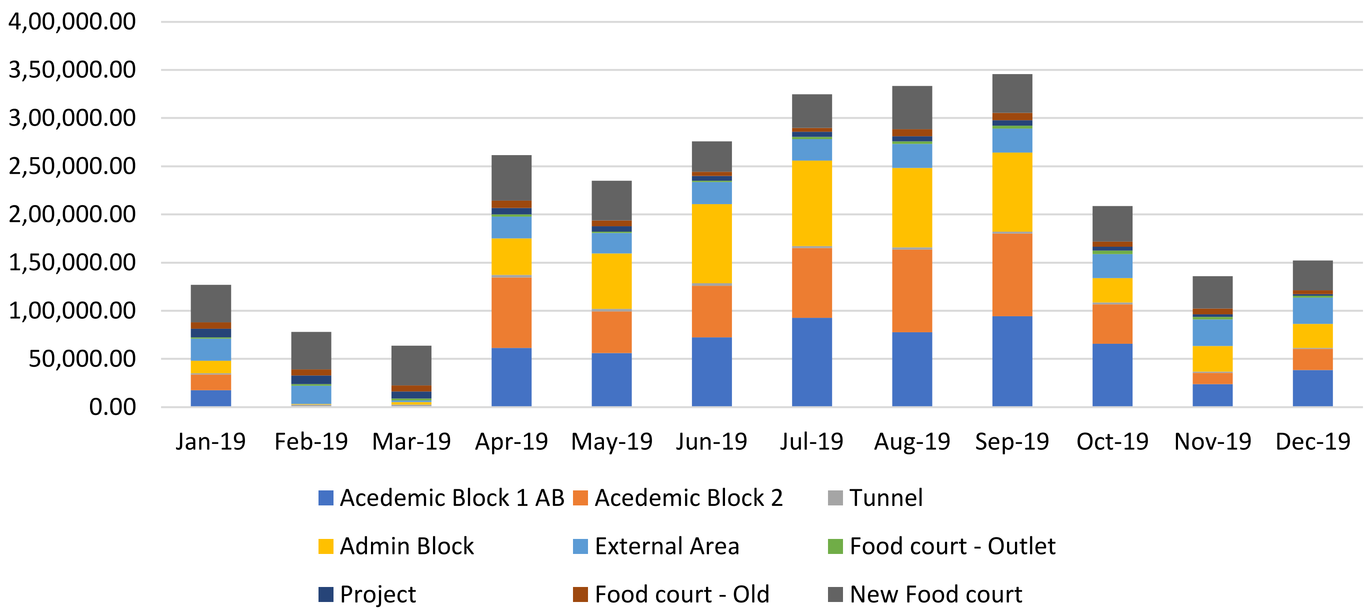
1,291 kWh/ person. year

Energy use per student (Hostel)

2,156 kWh/ person. year

Energy Consumption: Spatial Break-up of Grid Energy Consumption (Jan 2019- Dec 2019)

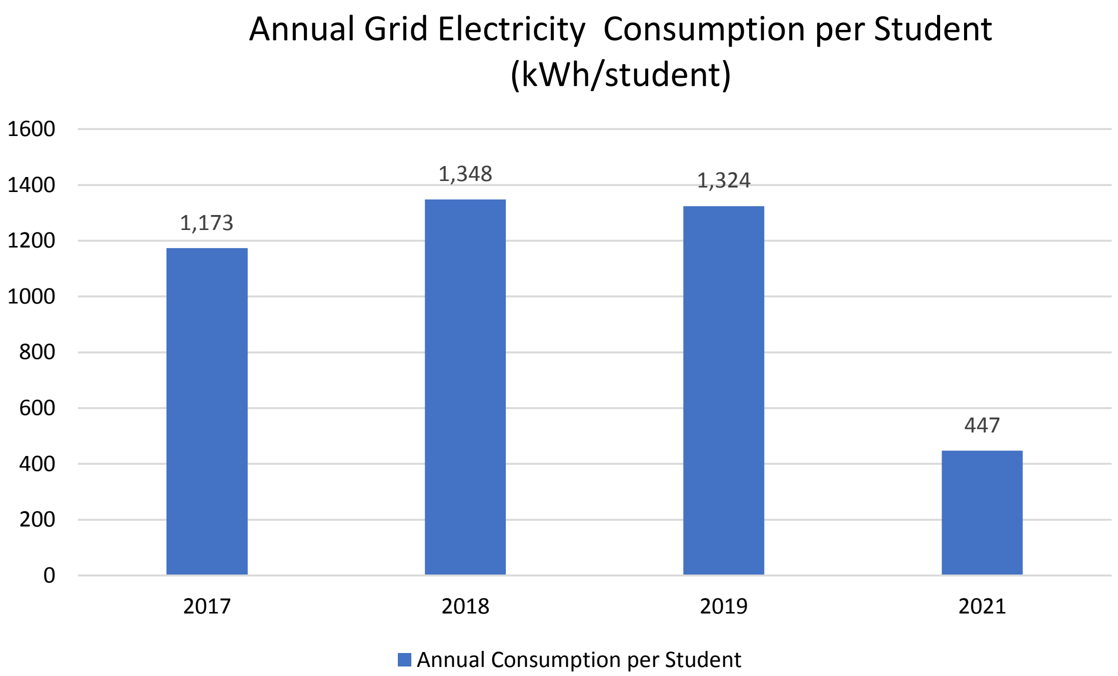


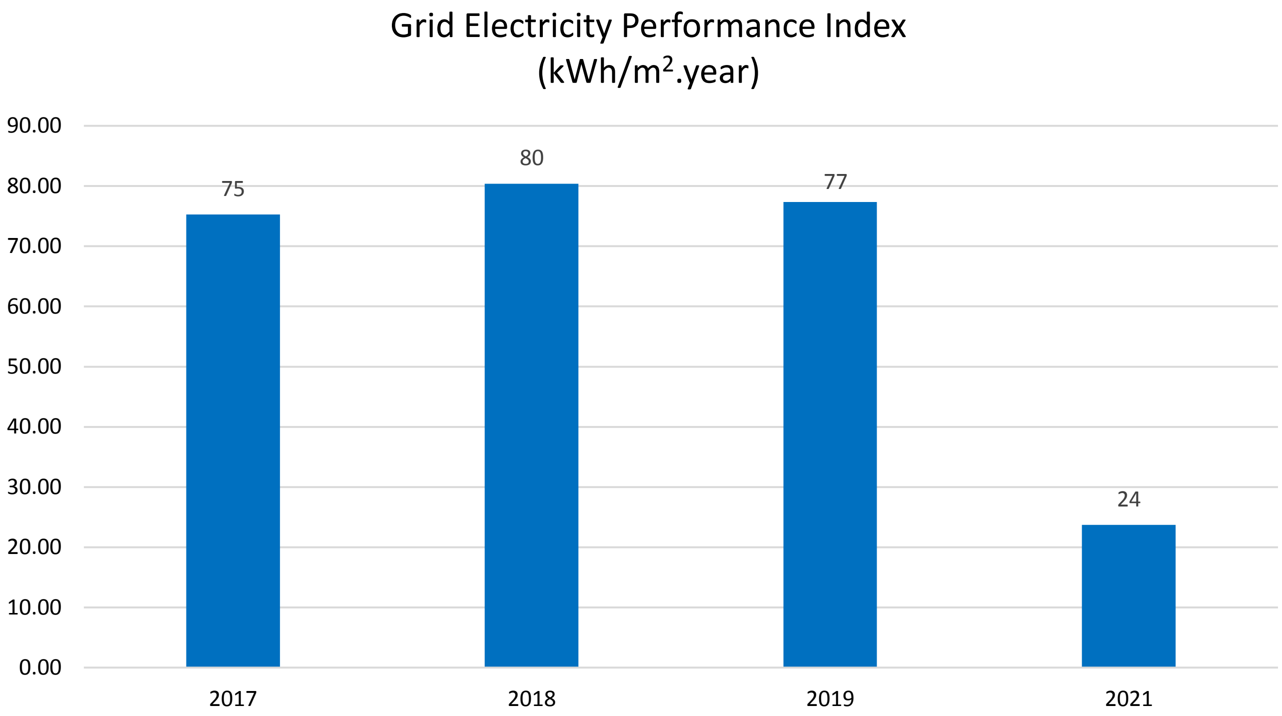


Hostels (consisting of tunnel, food court & residentials) with 75% of the total electricity is the highest consumer in the campus, followed by Academic Block 1, Admin Block and Academic Block 2. Energy consumption in hostels can be attributed to higher share of electrical loads for HVAC, Water Heating and Plug loads. The evidence documents on energy consumption in hostels is not available during the audit.

In the academic area of the campus, **Academic Block 1 and 2** constitutes 44% of the grid electricity consumption, whereas **Food courts (New and Old) and Admin block** uses 22% and 21% of the grid electricity respectively. These are the major **energy cost centres** in the campus.

Energy Key Performing Matrix





Annual energy consumption per capita has increased from 1,173 kWh/student in 2017 to 1,348 kWh/student in 2018 and to 1,324 kWh/student in 2019.

Note: This Calculation consider the no. of students as 9143 for all the three years as data for no. of student for different year was not provided by MUJ team.

Energy Performance Index (EPI) has increased from 75 kWh/m^2.year in 2017 to 80 kWh/ m^2.year in 2018 and to 77 kWh/m^2.year in 2019. Integration of the staff quarters with the campus has led to the increase in energy consumption of the campus.

Note: Area considered is 1,58,710 m^2.

Lighting Systems: Overview of lighting system

- The MUJ campus uses LED light fixtures for lighting in both the hostels and the academic area, as shown in the picture 1 below. Total lighting load in the building is 860 kW.
- The lighting fixtures data of the campus was not available during the audit, but the total lighting loads are found from the interview with the estate management team and “Project Handover” documents for hostel area.
- The campus has ample daylighting in the circulation areas like corridors and courtyards, as seen in the picture 2 in this slide.
- The quality of lighting was assessed by conducting measurements of illuminance levels across different locations of the campus at the workspace levels (0.8 m) and ground levels (for street lightings). This lighting measurements were compared against lighting levels requirements provided in National Building code 2016 (NBC).

Image 1: LED Lighting Fixtures

Image 2: Daylighting in the corridor area

Lighting Systems: Actual lighting levels inside occupied zones

S.No.	Type	Locations	Lux Level measured	Lux requirements as per NBC standards	Observations
1	Conference room	Admin block ,first floor , Board room	240-275	300-500-750	Lighting levels sufficient but not meeting the NBC standards
2	Classroom	Academic Block- Level 0, Wing B Classroom 18	238-320	200-300-500	Sufficient
3	Office	Level 0, Wing A, Director SAMM 006	176-265	300-500-750	Lighting levels sufficient but not meeting the NBC standards
4	Faculty sitting	Faculty centre AB1	204	300-500-750	1. Few rooms/location have very low visibility. 2. Windows curtains are kept closed during the day.
5	Circulation Area (Below Dome)	Centre of Dome	323	100-150-200	Sufficient
6	Corridor	Faculty centre AB1	14-276	100-150-200	Sufficient
7	Streetlights	Outside Guest house and staff quarters	2-39	6-30	Low Lux levels and light failures
8	Board Room	Academic Block	316-473	300-500-750	

Observations:

Some of the zones in the campus like Faculty offices and Corridor area (First Floor) in Academic Block 1 are poorly lit and the lux levels do not meet the requirements as per NBC 2016.

Also, some of the streetlights in the campus does not meet the lighting requirements, measured at the floor levels, in addition to the lights not working on fewer places.

Lighting design in Academic Block 1 needs to be rectified for uniform distribution of light throughout the spaces. The images in the next slide show the imbalance in lighting distribution in the campus

Lighting Systems: Site survey photographs

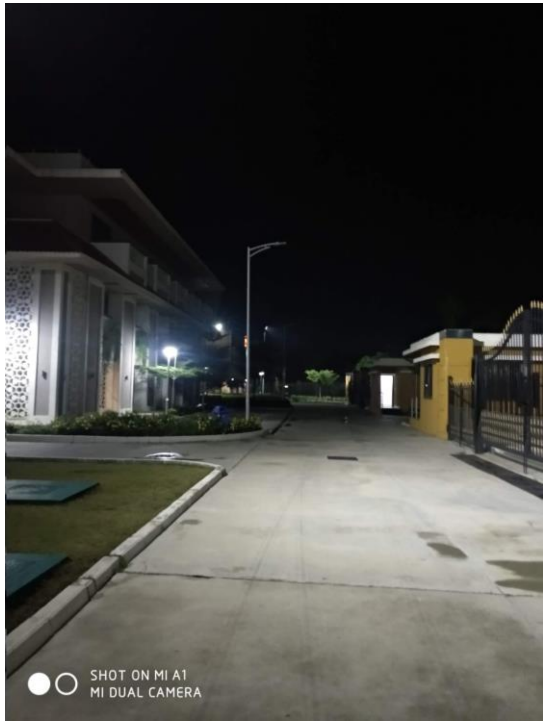


Image 3: Low street lux level

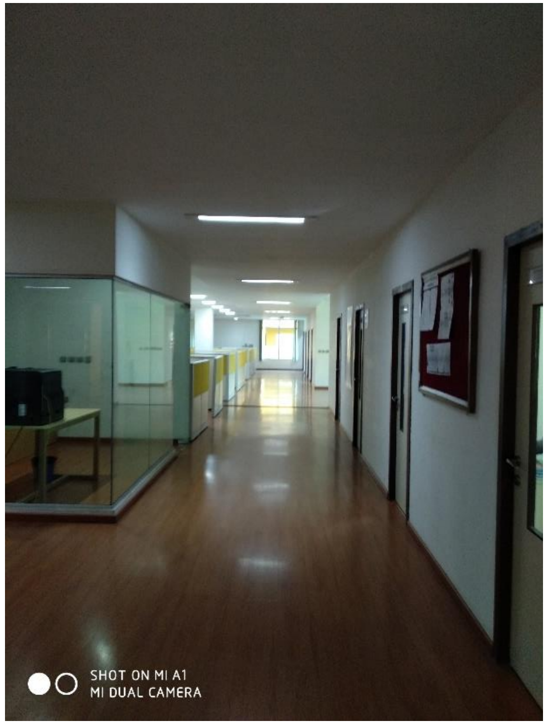


Image 4: Low corridor and faculty cabin lux level

Image 5: No use of day lighting as drapes are shut during the daytime.

Criteria - Energy

HVAC Systems: Total capacity of centralised HVAC system installed in the campus is 3,960 TR

Academic Area - Total HVAC System Size is 1,530 TR Centralized HVAC system in each building with air-cooled chiller system (constant flow system) and air distribution (Constant air volume system) through Air-Handling Units (AHUs) and Ceiling Suspended Units (CSUs).

Academic Block 1 – 480 TR	COP – 2.72
Academic Block 2 – 810 TR	COP – 3.3
Admin Block – 240 TR	COP – 2.72

Hostel Area - Total HVAC System Size is 2,430 TR Centralized HVAC system in each building with air-cooled chiller system and air distribution through AHUs, Cassette type units and Fan Coil Units.

Phase I,II & III – 810 TR each	Chiller Average COP – 2.8
High Wall Units of 1.5 to 2 TR Capacity – 60 units FCU – 1,234 units	DX Unit Average COP – 2.9

The HVAC system is operated manually by the facility management team (Daily operations and maintenance). The setpoint for chilled water temperature are fixed, and the pumps flow are maintained at constant flow rate. Only the AHUs are fitted with VFDs, which is not connected to any two-way control valve or automation system. None of the datapoints of the HVAC operation are recorded.

Observations:

The HVAC systems in the academic block 1 and Admin Block are of an ***average age of 11 years*** *(Operated from 2010 onwards)*. The efficiency of the systems with respect to current benchmark design efficiencies are very low. ECBC 2017 mandates the Cooling system shall have a COP of 3.1 (For air cooled chillers). Also, ECBC recommends the use of Water-Cooled Chiller system for buildings with more than 12,500 m2 air-conditioned area), which shall have chiller COP of at least 5.

As, provided in the MEP handover document for Hostel Block, a **load diversity factor of 50%** is considered for the **Hostel HVAC** system. This is a potential reason for the higher energy consumption in hostels, as the chillers having low design efficiency and are operated with constant flow.

Criteria - Energy

HVAC Systems: Chillers

Academic Area

Air Cooled Chillers

- 40 TR * 17 units
- 135 TR * 2 units
- 270 TR * 2 units

Chilled Water (CHW) Primary Pumps:

- 6 units in Academic Block 1
- Rest blocks fitted with internal CHW Pumps in Chillers
- No VFD used in operation

Hostel Area

Air Cooled Chillers

- 270 TR * 9 units

Chilled Water (CHW) Primary Pumps:

- 12 units in total for all hostel blocks
- No VFD used in operation

Source: Interview with Facility Management Team and Project Handover documents for Hostel MEP services

Observations:

The chillers are nearing their end-of-life (12th year in operation for Academic and Admin Blocks, which generally have average life cycle of 15 years, and there are visible water leakages in the chiller hydronic system and in the AHU rooms. (Refer to the Site Survey Images 6 and 7).

The design COP of the systems are low and needs enhancement at least up to the ECBC levels, which can save **up *to 25% direct energy savings***. (COP improvement from 2.7 to 5)

The loading of hostel block HVAC system needs to be studied in detail for designing a SOP with full load efficiency operation of the chillers.

Academic Block 1 and Admin block Chiller Units have lower design efficiencies compared to Academic block-2, thereby increasing the share of energy consumption in the campus. As the part of the Admin Block HVAC are operated 24*7 (Chiller and AHU serving board room), the lower efficiency is a potential reason for higher energy consumption from the Admin Block (5.2% Admin Block vs. 5% Academic Block 2).

Criteria - Energy

HVAC Systems: Air Distribution Systems

System Type	Location	Quantity	Capacities
AHU	Academic Area and Admin Block	12	2000 CFM * 9 6000 CFM * 2 7000 CFM * 1
FCUs		617	1 TR * 120 1.5 TR * 124 2 TR * 373
High Wall Units		14	1 TR each
TFAs		133	800 CFM * 122 600 CFM * 11
FCUs	Hostel Area	4827	4800 * 1.5 TR 27 * 2.5 TR

Observations:

The AHUs are fitted with VFDs for efficient operation of fans. The operational schedule is maintained manually by the estate management team.

The classrooms constitute most of the rooms with cassette units, whereas the laboratories are served by supply air grills from the AHUs.

AHU rooms requires periodic maintenance to address water leakages and condensation issues in the AHU and ductwork.
(Refer to the photographs in next slide)

Criteria - Energy

HVAC Systems: Site survey photographs

Image 6: Leakages in chiller supply and return water lines

Image 7: Leakages in AHU rooms

Observations:

Leakages of chilled water supply and return lines were seen during the audit visit;

These leakages can lead to loss of pressure and cooling and hence reduce the performance of the HVAC operation.

These leaks need to be investigated. This may occur due to the exposure to high temperatures/wear tear/corrosion of exposed pipes in the terrace.

Similarly, leakages from the AHUs are also observable in the Academic Block-1, which hampers the efficiency of the system.

Criteria - Energy

HVAC Systems: Site survey photographs

Image 8

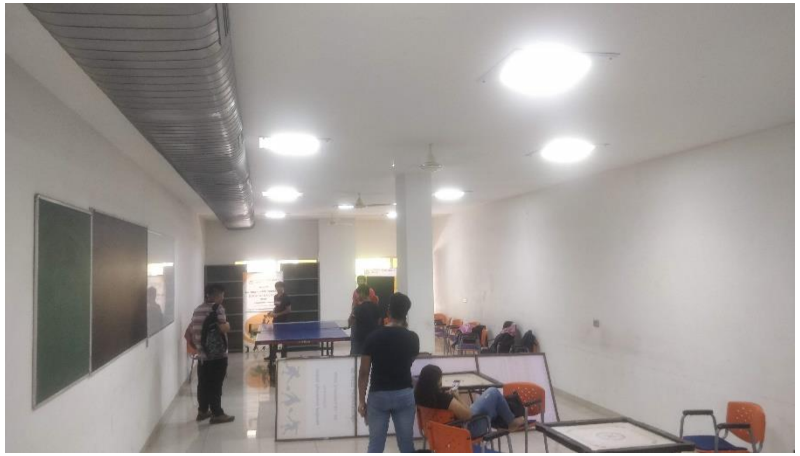
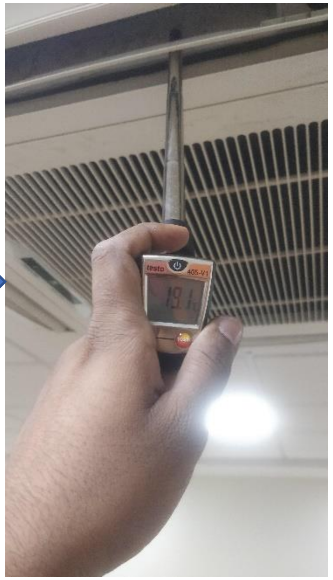


Image 9

Image 10

Image 11: Admin Block – Admission Area – Cassette unit (supplied with chilled water)- Indoor air delivery temperature at FCU is 19.1^{0}C. Relates to low performance of the HVAC.



Observations:

Figure 1, 2 & 3 show the civil engineering labs, biochemical lab and indoor game rooms, which are connected to the same AHU.

As the laboratories disperse particulate matter and volatile chemical components into the air, it may pose an indoor air quality issue and also, a higher load on the AHU filters.

Branching the air flow from the AHU into multiple AHUs for the zones with different air contamination and fresh air requirements can lead to both energy savings and better indoor environmental quality.

Criteria - Energy

HVAC Systems: Monitoring and Automation

Monitoring System	Current Availability	Need for the monitoring
HVAC System Monitoring With Water Flow and Temperature Monitoring	Not available; Only chiller level panels are available, without connectivity to any common monitoring system	Helps the operator and manager in regulating operational leakages and improve performance; Temperature, Pressure and Flow measurements needed for better operational decision making
Electrical Monitoring	Some of the HVAC components are fitted with energy meters but not monitored regularly	Regular energy monitoring can help benchmark the performance and to identify the impact of HVAC on peak demand and energy bills
Thermal Comfort Monitoring	Not available	Helps in understanding HVAC demand side requirements and in improving indoor environmental quality; IAQ and Temperature monitoring is needed.

Observations:

- A central monitoring and automation dashboard is needed to monitor the HVAC operational parameters and operating energy parameters.
- Chilled Water Temperature, Flow Rate and Pressure needs to be monitored for deriving the insights on system performance during varying loads and help sequence the chillers efficiently
- Including outdoor weather station can help derive the operational settings for chilled water flow and temperatures in the system.
- Combinational automation products can help reduce the energy consumption of the HVAC operation

Recommendations – Energy Efficiency in HVAC System

- As HVAC constitutes the major electricity demand and consumption, efficiency improvements need to be implemented in the campus.

- Conduct periodic audits (monthly internal audits) of the chilled water hydronics and air distribution systems to identify visible leakages and address it.
- Modification of the Standard Operating Protocol (SOP) of HVAC Plant operation with control measures on:
  - Seasonal chilled water and indoor temperature set-point variation
  - Recording of pressure and temperature data from the chillers in hourly intervals by the operators and prepare revised operational logics
  - Record energy data from the existing smart energy meters in hourly intervals for chillers and prepare analysis of the collected chilled water properties and energy consumption; Based on the analysis, modify monthly set-points and operational logics.
  - Based on recorded data, develop sequencing of chillers and scheduling of daily operation

High-cost measures | Low-cost measures | No-cost measures

Observations:

- A central monitoring and automation dashboard will support in monitoring the HVAC operational parameters and operating energy parameters.
- Chilled Water Temperature, Flow Rate and Pressure needs to be monitored for deriving the insights on system performance during varying loads and help sequence the chillers efficiently
- Including outdoor weather station can help derive the operational settings for chilled water flow and temperatures in the system.
- Combinational automation products can help reduce the energy consumption of the HVAC operation

Recommendations – Energy Efficiency - HVAC

- Construct shading structures for DX units in the terraces
- Integrate all the individual DX systems (In admin block) into efficient Packaged Unit or VRF systems
- Establish HVAC and energy data monitoring and control system as mentioned in the right column

Retrofitting of existing air-cooled chillers with water-cooled chillers, where water can be availed from stored rainwater or the treated water from the STP.
(or)
Implement the District Cooling System (DCS) in the campus to serve both academic area and hostel areas, as the campus has diverse loads across the day (Academic area with most loads in the day and hostel and staff quarters with most loads during night). (A brief of DCS is shown in the slides below).

High-cost measures | Low-cost measures | No-cost measures

Monitoring System Recommendations:

- A central monitoring and automation dashboard is needed to monitor the HVAC operational parameters and operating energy parameters.
- Chilled Water Temperature, Flow Rate and Pressure needs to be monitored for deriving the insights on system performance during varying loads and help sequence the chillers efficiently
- Including outdoor weather station can help derive the operational settings for chilled water flow and temperatures in the system.
- Combinational automation products can help reduce the energy consumption of the HVAC operation

Recommendations – Energy Efficiency- Electrical Distribution

- As the campus has larger number of reactive loads, combined with electronic measurement and control devices installed in individual circuits, the harmonic variations needs to be measured at the incomer level using Smart Energy Meter with THD measurement capabilities.
- Periodical audit of transformer performance (Input and output variation measurement) shall be conducted by operations team

- Installation of harmonic filters at the distribution boards closer to harmonic loads (Circuits with AHUs connected to VFDs)
- Increasing the capacitor bank and APFC system capacity by 25-30% as more reactive loads (For equipment with total loads of 2,450 kW) are operated during the peak demand, compared to the available capacitor bank capacity (520 kVAr)

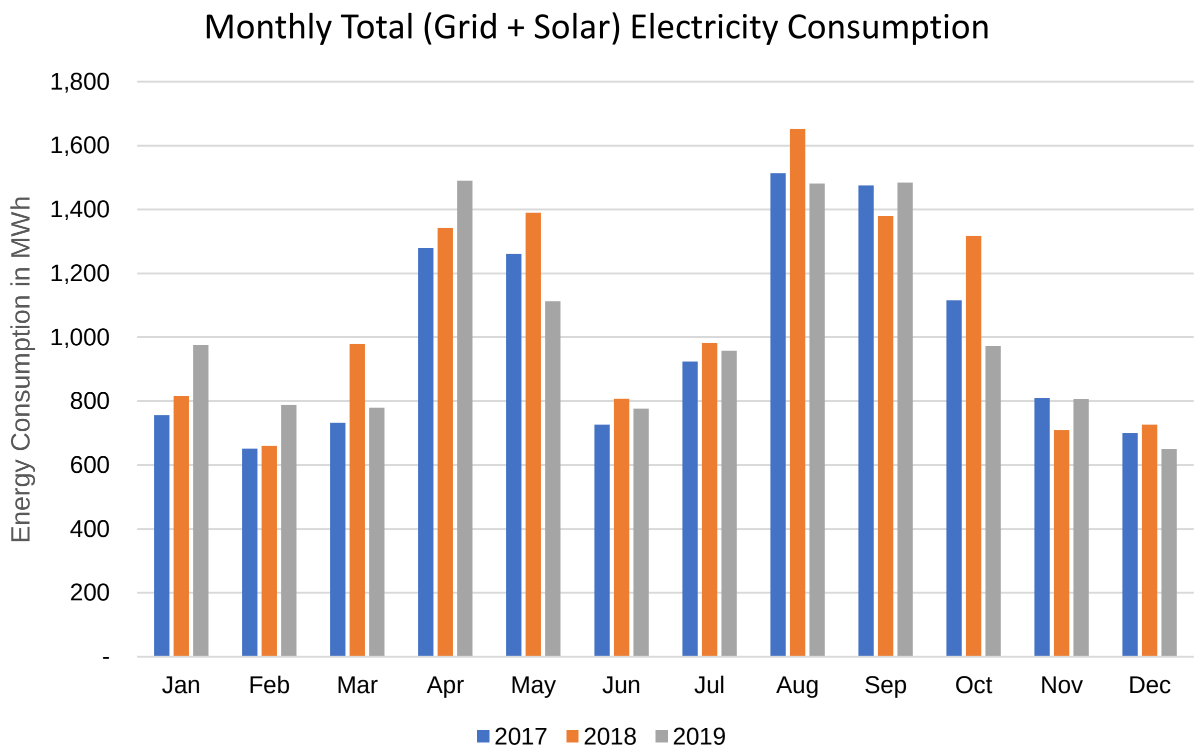
High-cost measures

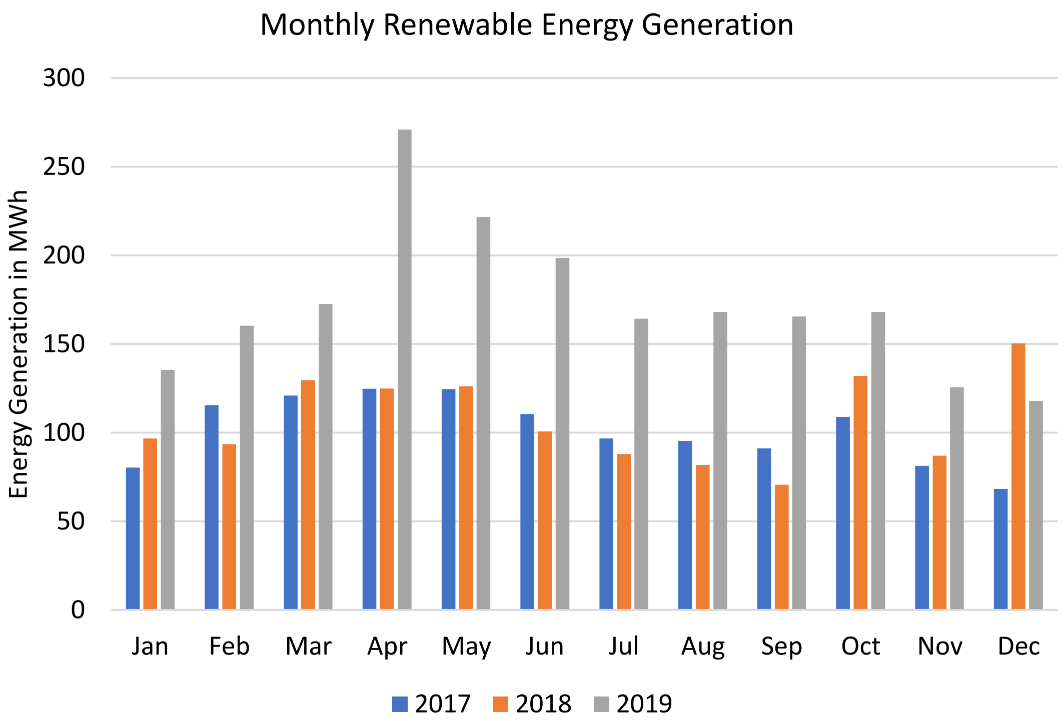
Low-cost measures

No-cost measures

Observations:

- A central monitoring and automation dashboard is needed to monitor the HVAC operational parameters and operating energy parameters.
- Chilled Water Temperature, Flow Rate and Pressure needs to be monitored for deriving the insights on system performance during varying loads and help sequence the chillers efficiently
- Including outdoor weather station can help derive the operational settings for chilled water flow and temperatures in the system.
- Combinational automation products can help reduce the energy consumption of the HVAC operation

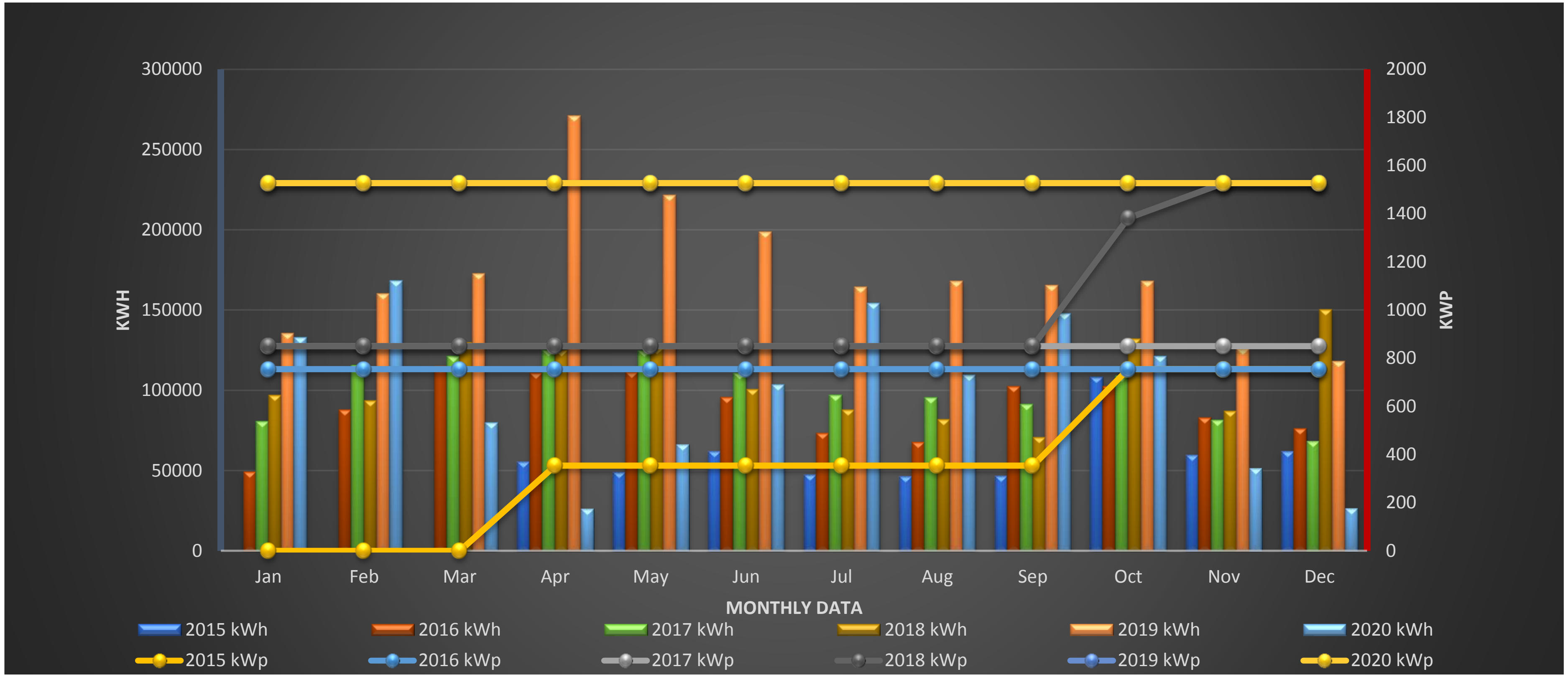




Increase in electricity consumption over past 3 years is visible in the months of April, August, November and January. Average growth of 5% of total electricity consumption is observed in the campus, which can be related to additional electricity requirements from the new buildings like staff quarters, and potentially due to higher temperatures faced during the summer season, causing higher needs for air conditioning and ventilation.

By 2019, the campus has integrated 1.5 MWp of Solar PV Power plants into the local electricity mix of the campus. Increase in the solar PV capacity has reduced the peak grid electricity consumption in the months of July, August, and October.
Solar PV generates the highest amounts of electricity in the months of April, May, June and July , whereas energy consumption during June is very less.

Renewable Energy Systems: Capacity and Generation



By 2015, MUJ campus integrated the Solar PV plant of 754 kWp with its internal grid. The capacity increased to 850 kWp in 2017, and to the final capacity of 1527 kWp by 2019. The Solar PV systems are connected to the local distribution systems located in the Academic Blocks 1 & 2 and the Administrative Block.
The capacity additions have led to the increase in electricity generation from 537,624 kWh in 2015 to 2,069,212 kWh in 2019. This has led to cost savings of 97.89 Lakhs INR per year in 2019, in comparison with electricity purchase from the electricity grid (Average grid electricity price of 9.8 INR/kWh and RESCO electricity price of 5.07 INR/kWh).

Observations:

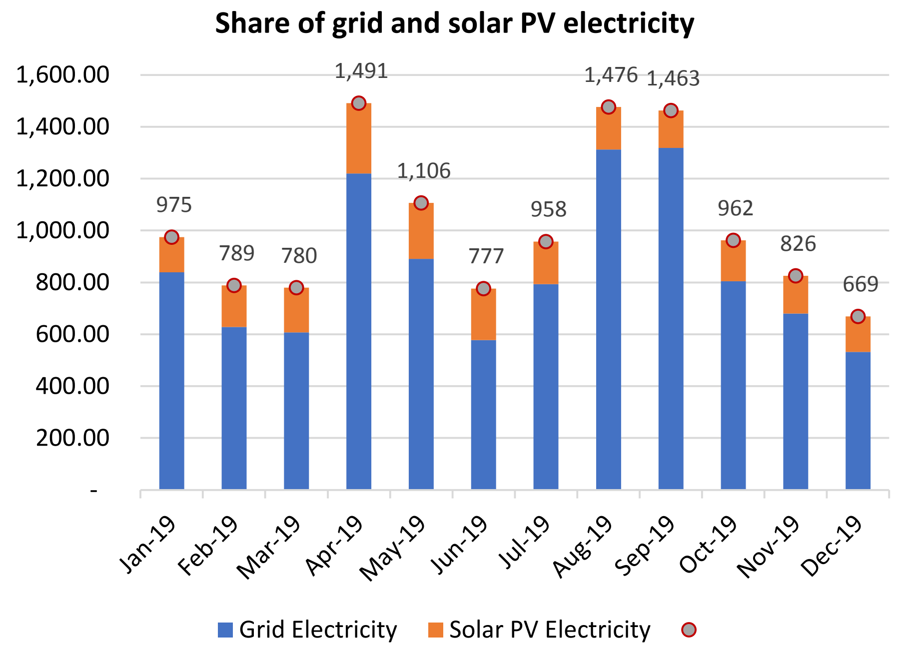
By 2019, the campus has in operation ***1.527 MW*** of Solar PV power plant, with annual generation of more than 2 GWh electricity. This electricity generated is directly fed into the campus electricity feeders for localized use.

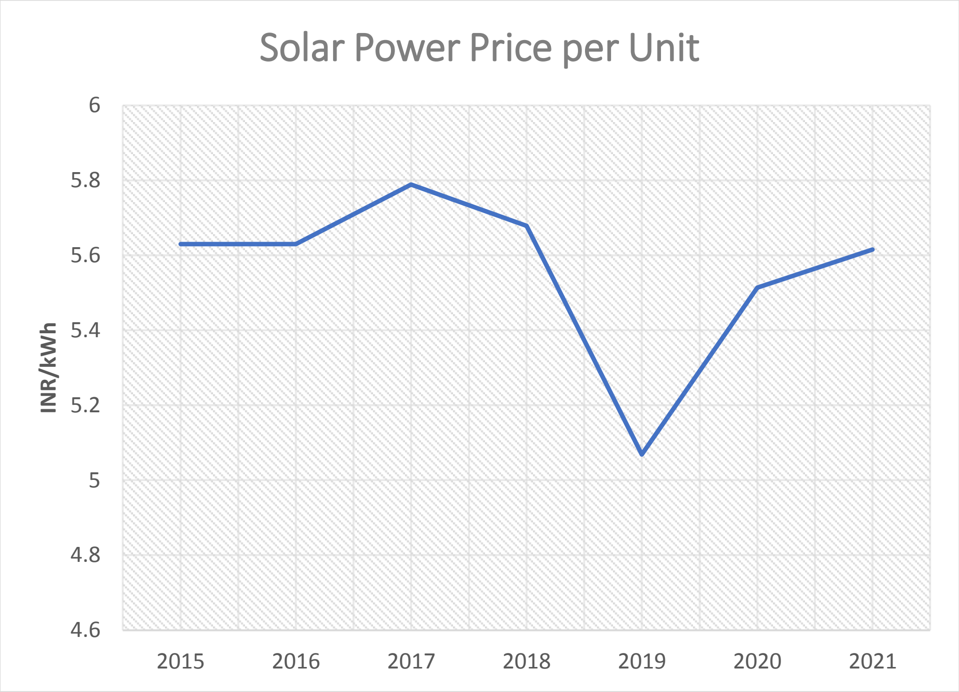
The system is implemented in RESCO mode with power purchase agreements with Cleanmax for 850 kWp and Renewpower for 677 kWp.

The available potential in Jaipur is of ***1,642 kWh/kWp.year.*** This is not achieved in the MUJ campus SPV installation. The campus SPV generates 2.05 Million Units, whereas the potential for the installed system is 2.65 Million Units. (23% deviation from maximum performance, leading to cost implications of INR 30,60,000 per year).

The cause of this inefficiency in the generation needs to be reviewed by the Estate Management Team in discussion with the Solar PV service providers.

Renewable Energy Systems: Capacity and Generation





The installed solar PV plants has led to reduction in grid electricity use by up to 33% of total electricity consumption.
As seen from the graph, months of March, June, April, May and February produce higher renewable electricity.

The price of solar power was the lowest (INR 5.06 per kWh) in 2019. This can be set as the benchmark cost for the future power purchase agreements.

Observations:

By 2019, the campus has in operation ***1.516 MW*** of Solar PV power plant, with annual generation of 2 GWh electricity.

The system is implemented in RESCO mode with power purchase agreements with 2 vendors.

The available potential of ***1,642 kWh/kWp.year*** is not achieved in the campus, as the campus generates 2.05 Million Units whereas the available potential for the installed system is 2.65 Million Units. (23% deviation from maximum performance)

Recommendations – Renewable Energy

- Any new Solar PV Plant to be installed needs to be designed with maximum efficiency panels for generating maximum from the available roof space. The conditions related to the efficiency of the panels and the associated generation guarantee shall be included into the PPA with the vendors.

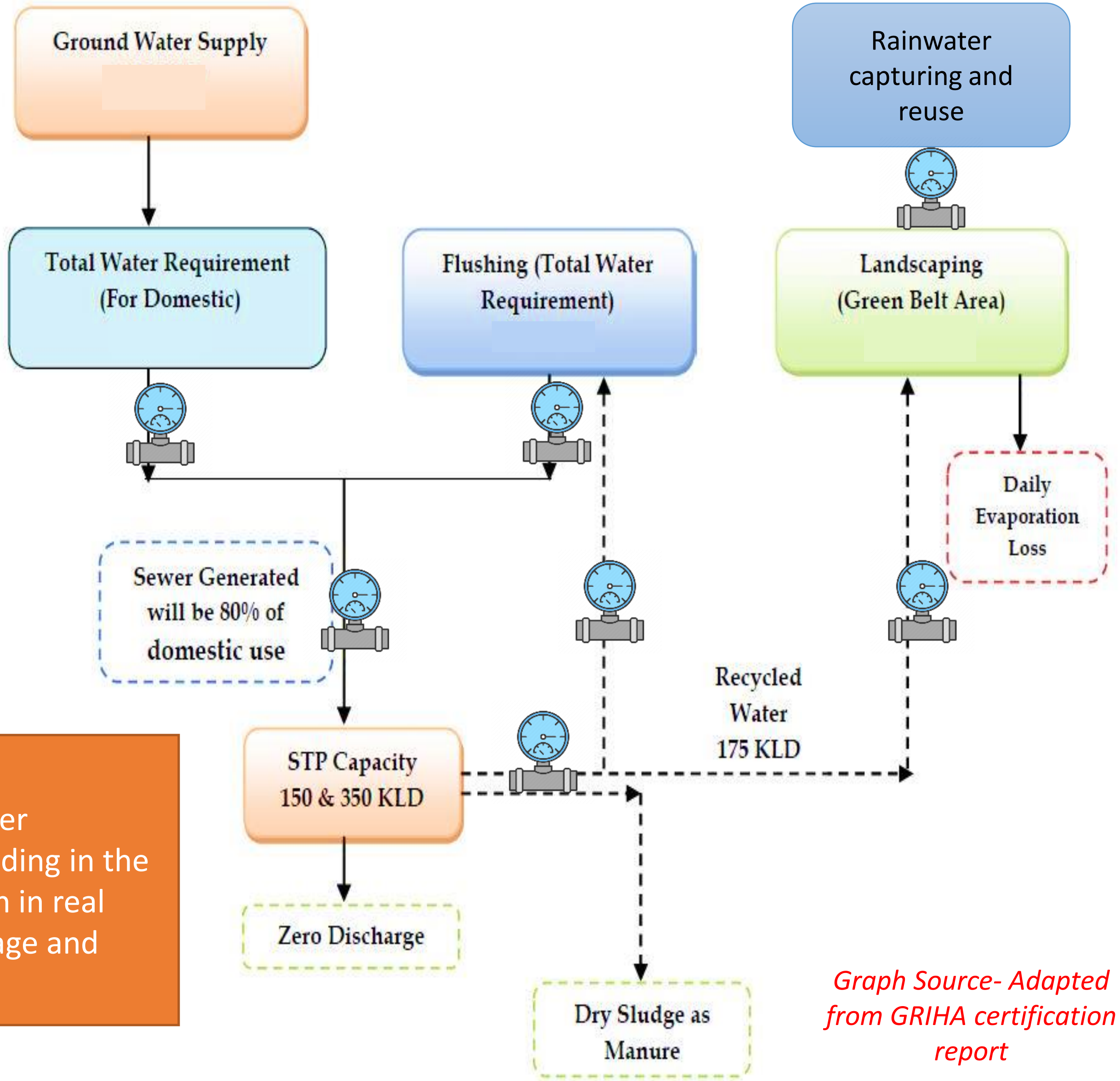
- Performance stability can be improved by installation of automatic cleaning systems for the solar PV panels.
- Net metering facility, if provided by the DISCOM, has to be enabled in order to utilize the maximum cost benefits from the generated electricity.

High-cost measures | Low-cost measures | No-cost measures

Water Source and Distribution in MUJ Campus

Manipal university has an Integrated Water management strategies that are designed & implemented for the campus mainly focusing on triple bottom line benefits i.e., social, economic and environmental benefits. This created a flexible, resilient water infrastructure which helped MUJ progress towards water neutrality.

RECOMMENDATIONS -
Water meters to be installed at all water sources/distribution lines at every building in the campus to monitor water consumption in real time basis to understand excessive usage and leaks



Graph Source- Adapted from GRIHA certification report

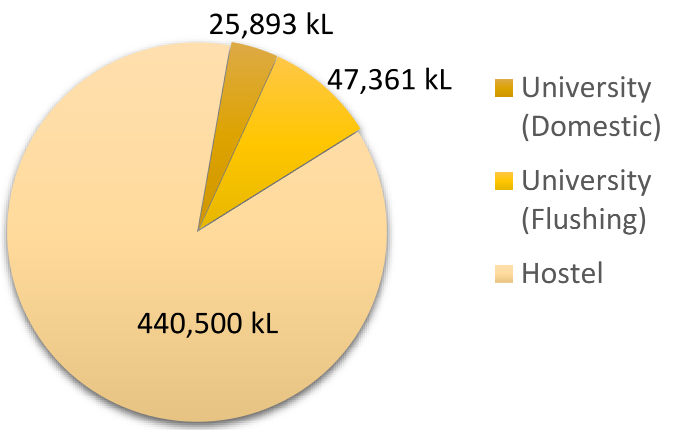
Observations:

The ground water supply water requirement as per the design guidelines for the MUJ university campus is 220 LKD. The Total water requirement is segregated under domestic use, flushing requirement and landscaping irrigation purposes.
The domestic purpose requirements gets fulfilled through ground water supply. For flushing and landscaping requirements MUJ uses the treated water from the Sewage Treatment Plant (STP). For landscaping requirements MUJ also use the rainwater from the RWH tanks. The dry sludge from the STP is further converted into manure used for on-site landscaping purpose.

Water Consumption

- MUJ consumes **25,893 kL/year** of water annually for the university blocks & **440,500 kL/year** for hostel blocks
- Total water consumption is **513,754 kL/year**
- 100% wastewater is treated on site and used for flushing and landscape purposes within the campus.

Water consumption for 2019



University (Administrative +Academic Blocks) data for domestic and flushing comes is shared by MUJ. Data for Sept 2019-Dec. 2019 was not available, so the respective month data of 2018 was used for the analysis

Hostel (Student accommodation + staff accommodation + Guest House) is available from GRIHA report

- To reduce the water usage, all the building toilets in MUJ are equipped with automatic, low flow fixtures and low flush fixtures. These fixtures when compared with conventional fixtures can save significant amount of water.

FIXTURE TYPE	CONVENTIONAL FLOW/ FLUSH FIXTURE FLOW RATE LPF/LPM	FIXTURE FLOW RATES INSTALLED IN MUJ LPF/LPM	Estimated Water Savings (%)
WC Flush	≤ 6 LPF	3 & ≤6 LPF	**50%**
Sensor Urinals	≤ 3.8 LPF	≤ 0.5 LPF	**86%**
Restroom Faucets	≤ 9.4 LPM	≤ 2.75 LPM	**70%**
Pillar cock	≤ 9.4 LPM	≤ 2.75 LPM	**70%**
Health faucet	≤ 9.4 LPM	≤ 6.4 LPM	**32%**
Kitchen Faucet	≤ 9.4 LPM	≤ 7.5 LPM	**20%**

RECOMMENDATIONS-
Regular monitoring of water use at the building level and regular maintenance checks for leaks will ensure additional water savings

Observations:

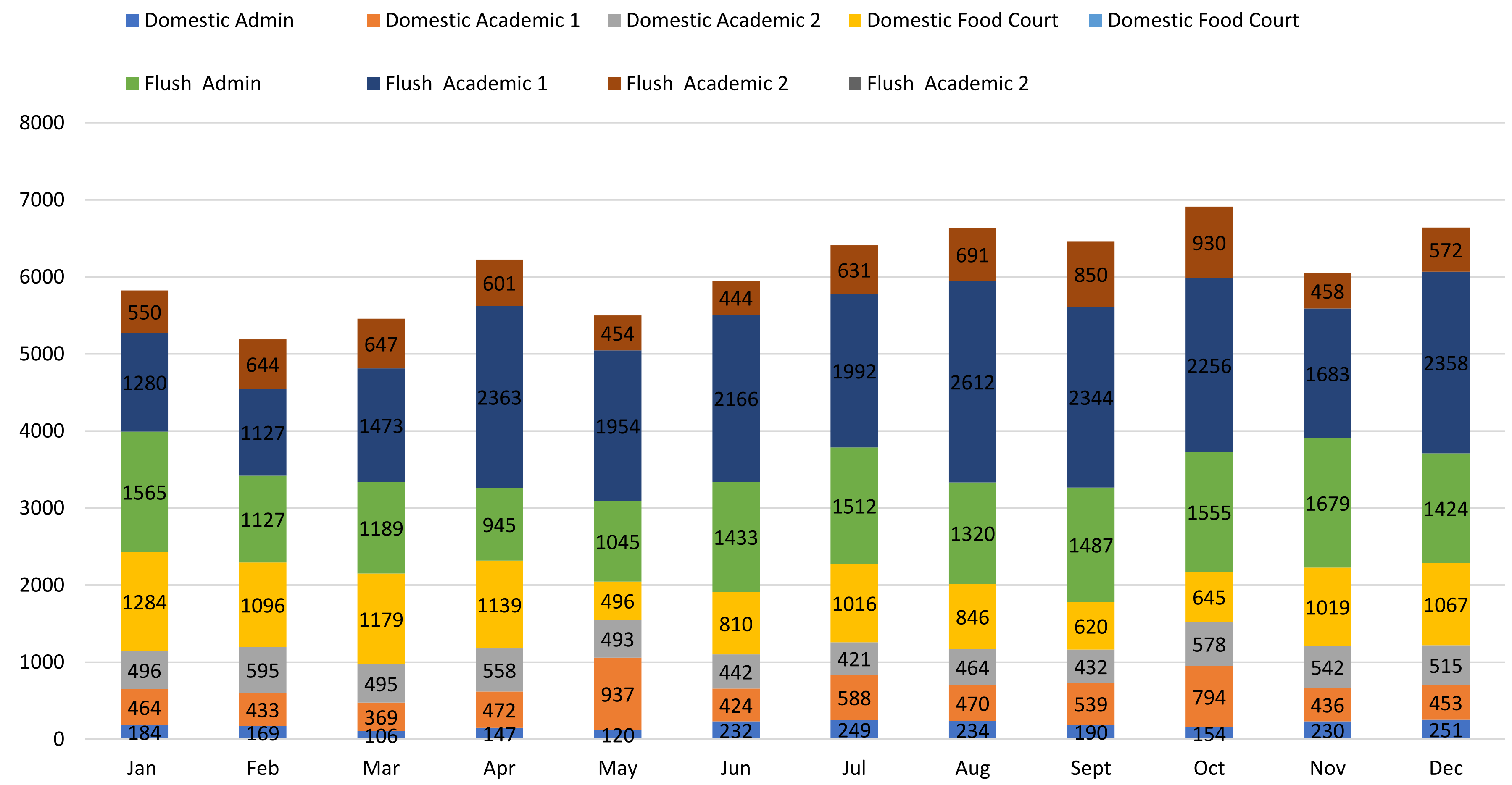
The total water consumption in the campus is segregated for domestic and flushing purposes. 80% of waste-water from domestic and flushing purpose is treated and this recycled water is used for landscape irrigation and the dry sludge generated in the sewage treatment plant is used as manure for landscape.

Criteria - Water

Monthly Water Consumption: Admin, AB-1 and AB-2, Hostels

January 2019 to December 2019

Monthly Water Consumption in KL



Key Performance Indicator (KPI):

"Water Consumption per student per year" of MUJ is

Campus Level:
56.1 kL/Student. Year

University Level:
2.83 kL/Student. Year

Hostel Level:
88.4 kL/Student. Year

NOTE- From September to December, all the water consumption data is from 2018 as 2019 data was not provided

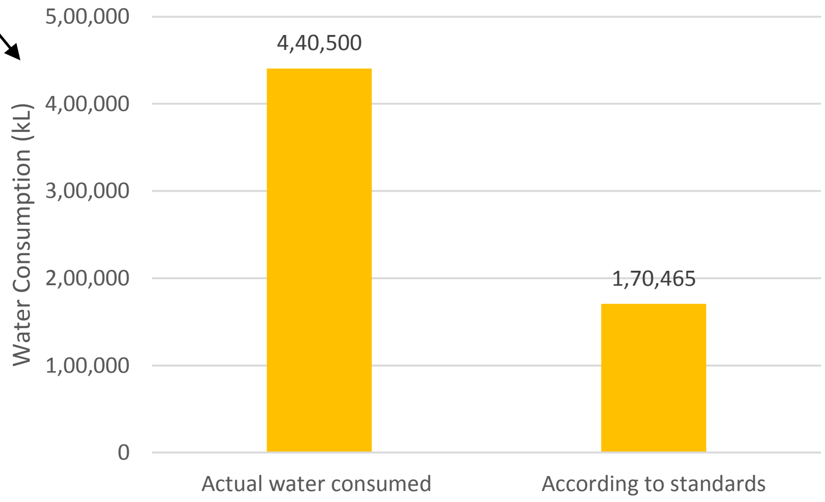
Monthly water consumption data of Hostel was not available

Criteria - Water

Water Consumption

For university	Total consumption domestic- 25,893 Kl/year
For hostel (domestic)	**Total consumption- 440,500 Kl/year**
Total consumption excluding flushing- 4,60,912 Kl/year	
(all the flushing water requirement is catered by STP treated water)	Total consumption flushing- 47,361 Kl/year

Total no of students in hostel in 2019 - 4140
According to NBC,
Water required for domestic purpose is 135 liters per person per day
Estimated water consumption for 305 days of operation is 170,465 kL/year



COST IMPLICATIONS:
Regular monitoring of water use in the buildings can save – 2,70,036 kL
1 litre of water cost – INR 60/kL
Calculated cost savings – 1,62,02,160 INR

HYPOTHESIS -
As the water savings can be upto 61%, there is a merit of investigating further the water consumption in the hostel area. This can be done by active remote monitoring of water consumption at the building level

Key Performance Indicator (KPI):

"Water Consumption per student per year" of MUJ is

Campus Level:
56.1 kL/Student. Year

University Level:
2.83 kL/Student. Year

Hostel Level:
88.4 kL/Student. Year

Sewage Treatment plant

Manipal University Jaipur has zero discharge waste-water policy. Hence 100% of the wastewater generated on site is treated to tertiary standards and reused within the campus for various purposes like Flushing, cooling tower makeup, Horticulture etc.

MUJ has two Sewage treatment plants with **150kLd** and **350 kLd** respectively. Membrane Bioreactor (MBR) type Sewage Treatment plant with total capacity of **500 kLd** is commissioned at MUJ university campus considering the future developments & excess wastewater from hostels.

A standalone 350 kLd Sewage Treatment plant is commissioned to serve only the Hostel blocks, excess wastewater is sent to University STP.

Wastewater treated on site will have projected water quality standards meeting Central Pollution Control Board (CPCB) norms.

Observations:

- Annually ***1,14,609 kl/year*** of treated water is available for flushing and landscape uses in MUJ Academic side
- ***30,726 kl/year*** i.e. ***26.7%*** of total available treated wastewater is used for non potable uses in all the buildings.
- ***83,883 kl/ year*** i.e. ***73.3%*** of total available treated wastewater is used for landscape requirement in university campus.

HYPOTHESIS-
If the treated water used for landscape can be reduced by 10-15% then this water can be used for flushing purpose as the 2019 water consumption was flushing is not 100% catered by treated water.

Annual Rainwater Potential

Annual rainfall is the sum of daily rainfall, that is collected from building roof area. With this calculation we understand the potential usage of this collected water that can be used for irrigation and flushing purpose.
The table explains the effective harvesting possibilities.

NAME	ROOF AREA (sqm) - X	RUNOFF COeF. - Y	ANNUAL RAINFALL (m) -Z	Effective Harvesting Potential (m^3)-(X*Y*Z)
Admin block	6860	0.95	0.536	3,493
Mess block	5185	0.95	0.536	26,402
AB_1 block	7814	0.95	0.536	3,978
Garden Lawn	3571	0.2	0.536	382
AB_2 block	8565	0.95	0.536	4,361
Garden	3517	0.2	0.536	377
Road	15567	0.95	0.536	7,926
			Total (in kL)	**23,160**

536 mm is the annual rainfall. The driest month is December. There is 3 mm | 0.1 inch of precipitation in December. Most of the precipitation here falls in July, averaging 178 mm | 7.0 inch.

The peak rainfall months (July & August) harvesting potential is **7700 kL** (i.e. 256kLd).

Observations:

- Rainwater holding capacity at MUJ **Hostel blocks 670 kL** & **University blocks is 490 kL**
- Rainwater from roofs is collected on site in the rainwater harvesting tanks and used for irrigation purposes in the MUJ campus.
- Rainwater from different areas on site is conveyed to RWH tanks through channels.

Hypothesis & Recommendations:
The RWH tanks currently used for harvesting the rain water are **not sufficient** to hold the peak demand of rainfall, which is around **7700 kL** for peak rainfall month (i.e. **256 kL/day**). It is important to **increase the harvesting capacity of RWH** tanks to catch the surplus rainwater and utilize it for domestic/ potable purposes in the university campus.

**Source:
Surface areas – Provided by MUJ
Rainwater tank sizes – GRIHA report
Rainfall data - https://en.climate-data.org/asia/india/rajasthan/jaipur-3888/#climate-graph

Criteria - Water

Storm Water Harvesting Potential

Storm water harvesting is the sum of daily rainfall, that is collected from the ground area. With this calculation we understand the potential usage of this collected water that can be used for irrigation and flushing purpose or ground water recharge.
The table explains the effective harvesting possibilities.

536 mm** annual rainfall

**Source: https://en.climate-data.org/asia/india/rajasthan/jaipur-3888/#climate-graph

Surfaces	GROUND AREA (sqm) - X	RUNOFF COEFFICIENT - Y	ANNUAL RAINFALL (m) -Z	Effective Harvesting Potential (m3- (X*Y*Z)
Granite Flooring	2,381	0.95	0.536	1,212
Road Median	568	0.25	0.536	76
Lawn	14,818	0.2	0.536	1,588
Football ground	10,392	0.35	0.536	1,949
Cricket Ground	16,286	0.35	0.536	3,055
Open Area (batching plant)	15,544	0.5	0.536	4,165
Open area Thadi	16,912	0.5	0.536	4,532
Open area behind basketball ground	17,445	0.25	0.536	2,337
Lawn area near admin block	4,663	0.2	0.536	499
Area under dense tree plantation (No. of trees- 126	23,233	0.25	0.536	3,113
Pathway Area	3,658	0.95	0.536	1,862
			Total (in KL)	**24,393**

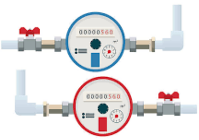
Observations:

Storm water from the site is collected in swales. Part of this water is diverted to a collection tank that also works as a sedimentation pit. The rest of the stormwater is diverted to 3 recharge pits located in the lowest part of the site. The collection tank is in turn connected to the WTP. The swales reduce the rate of flow during conveyance and allow stormwater to percolate into the ground as it reaches the recharge pits.

HYPOTHESIS-
There is good scope to collect water and store. Currently, MUJ is collecting water from 35% of its surfaces (roof top and open areas). Considering that Jaipur faces water scarcity due its climate, investing in water harvesting measures will be beneficial lead to cost savings of ~ INR 14,63,580 annually.

Recommendations:

Following recommendations are suggested to manage water in a sustainable manner:

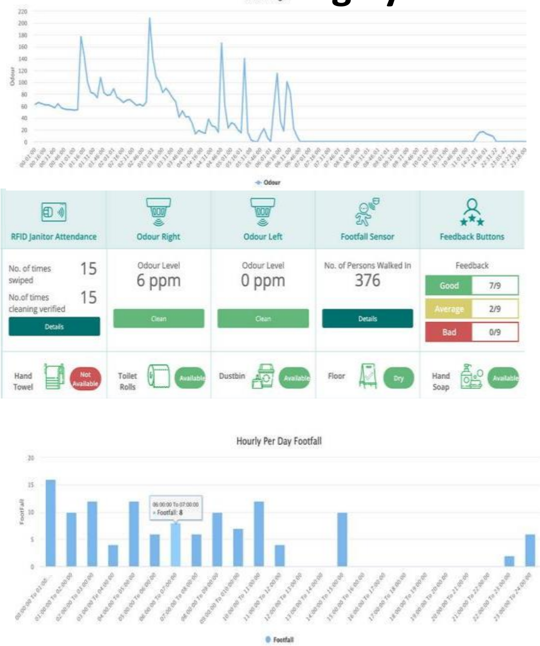


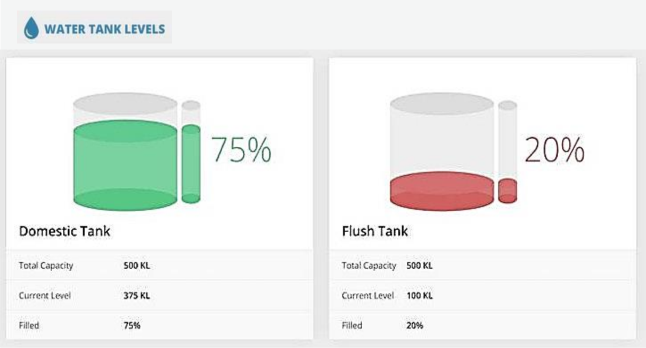
Consider carrying out meter readings on a regular basis (e.g. bi-monthly) or through remote monitoring system in order to monitor water usage. Not only will this make checking water bills much easier but will also allow a baseline to be set from which further reductions can be measured, as well as identifying the possibility to any leaks.

Investigate the feasibility of sub-metering different areas of the buildings and blocks, in order to give a more accurate picture of water use.

It would be useful to digitalise the tank level in the rainwater harvesting tanks to optimally use the captured rain-water.

Water Monitoring Systems:





Consider installing spray taps or water-saving cartridges in sinks that are still to be refurbished.

Criteria - Waste

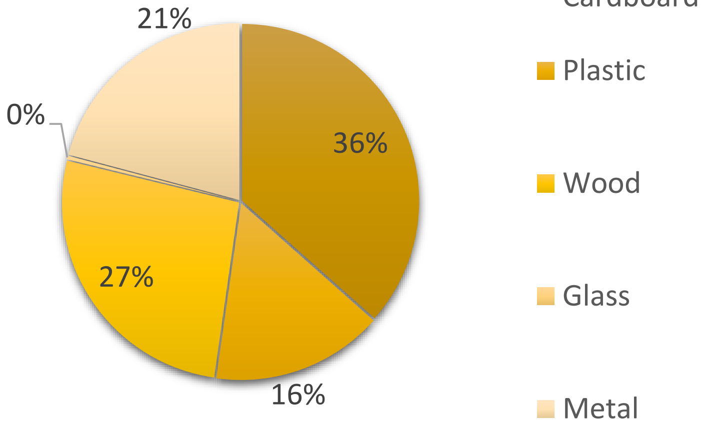
Solid Waste Management:

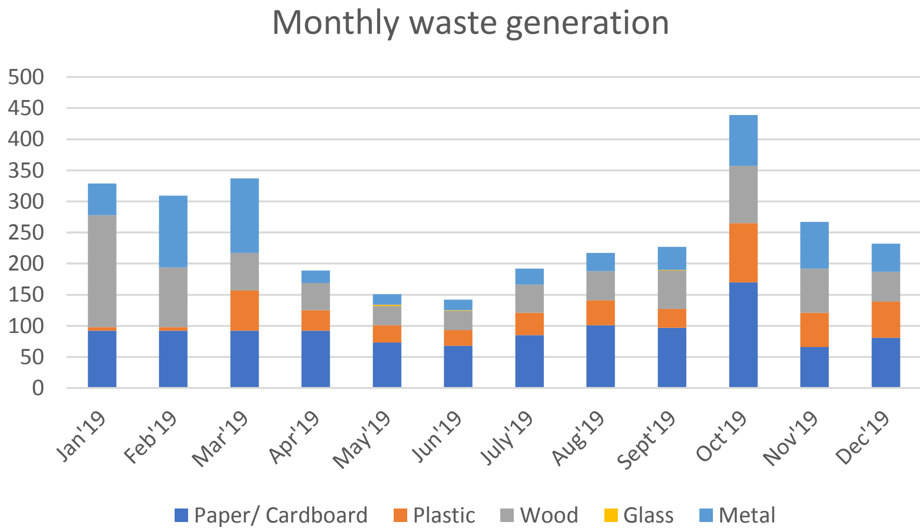
Solid Waste Generated – January 2019 to December 2019

Month	MUJ Academic Blocks					Total (kg)
	Paper/ Cardboard	Plastic	Wood	Glass	Metal	
Jan'19	9206 (92)	6	180	0	51	329
Feb'19	8156 (92)	6	96		115	309
Mar'19	6790 (92)	65	60		120	337
Apr'19	92	33	44	0	20	189
May'19	73	28	31	2	17	151
Jun'19	68	25	31	1	17	142
July'19	85	36	45	0	26	192
Aug'19	101	40	47	0	29	217
Sept'19	97	30	62	1	37	227
Oct'19	170	95	92	0	82	439
Nov'19	66	55	71	0	75	267
Dec'19	81	58	48	0	45	232
Annual waste generation	**1110**	**477**	**807**	**4**	**634**	**3031**

Dry Waste generated –
3031 kg/ year , i,.e **7.2% of total solid waste**

Waste generation in 2019: 26,907 kg





Observations:

It seems the first three months (i.e. January, February and March) the paper and cardboard waste generation is comparatively quite high than the rest of the months.

If we consider the average waste generation based on the 9 months of data, the paper waste is the highest waste generated in solid waste (i.e. **1110.6 kgs**). Based on the observations average values for paper waste is considered to understand the waste generation for the first three months (i.e. 92 kgs)
This paper and cardboard waste can be recycled through collaboration with 3rd party vendors.

Key Performance Indicator (KPI):

Solid waste KPI- Annual waste generation/ total number of students
= 26,907/9143
= **2.94 kg/student.year**

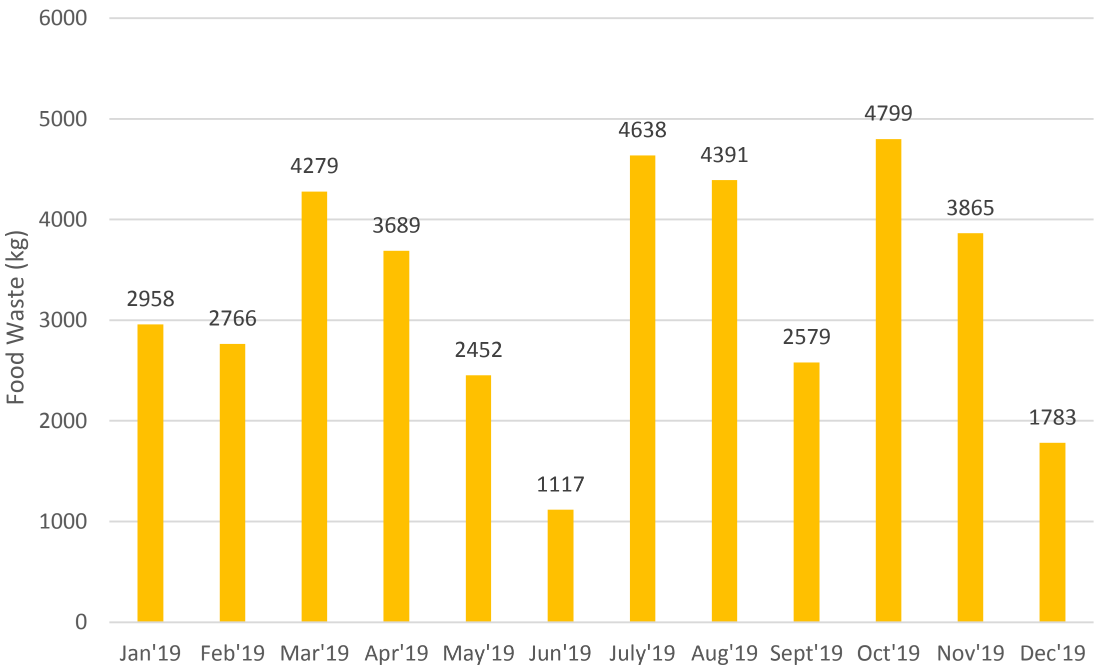
Criteria - Waste

Solid Waste Management:

Food Waste Generated – January 2019 to December 2019

Food Waste at Hostel Blocks	
Month	**Total (kg)**
Jan'19	2958
Feb'19	2766
Mar'19	4279
Apr'19	3689
May'19	2452
Jun'19	1117
July'19	4638
Aug'19	4391
Sept'19	2579
Oct'19	4799
Nov'19	3865
Dec'19	1783
Annual waste generation	**39,316**

Food waste generated in 2019:



Food Waste generated –
39,316 kg/year, i.e. **92.8%** of total solid waste

Observations:

Food waste is the major waste generated in the University. It is important to understand the reason of such high waste generation and also measures to reduce it. MUJ can look for food circularity as suggested in detail in the recommendation section.

Food waste generated in the hostel block can be composed and the dry sludge can be used as manure for landscape purposes.

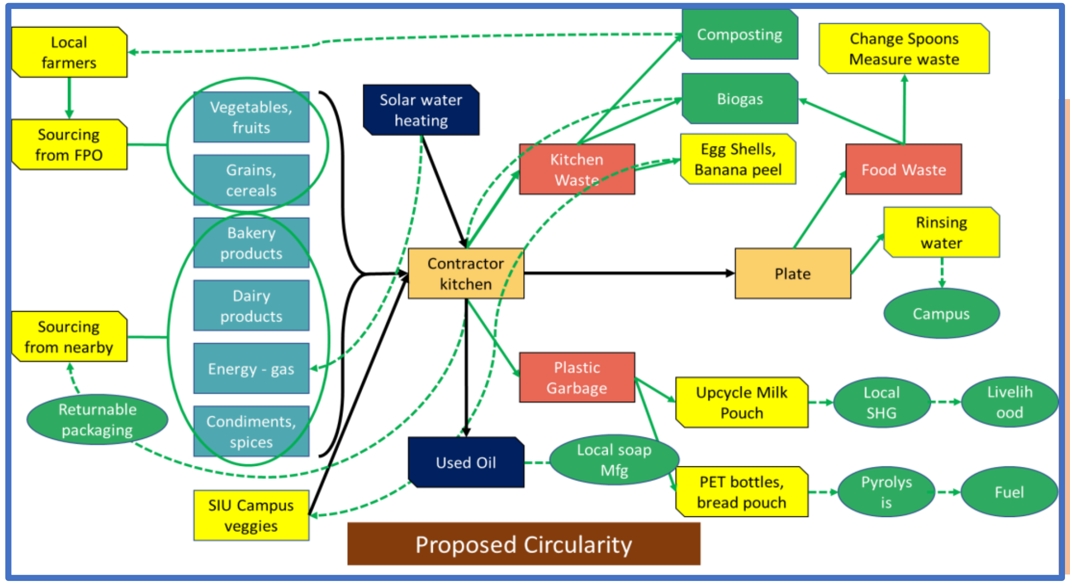
Key Performance Indicator (KPI):

Food waste KPI- Annual waste generation/ total number of students
= 39,361/4978
= **7.9 kg/student.year**

Consider reducing the number of general waste bins in offices to one or two in order to encourage people to think more carefully about the waste they're producing

Ensure that it's clear as to which bin collects which waste stream.

- Considering the 92.8% of kitchen waste generated, a mechanical organic waste converter is recommended over an anaerobic digestion which would not be technically but financially feasible.
- Also, it is recommended that MUJ should incorporate some management changes, like reducing the plate and spoon sizes and allow servings, so as to reduce the food waste.
- The proposed mechanical organic waste converter shall provide organic manure for the garden



Circular Food Economy

A circular economy for food mimics natural systems of regeneration so that waste does not exist, but is instead feedstock for another cycle.

In a circular economy, organic resources such as those from food by-products, are free from contaminants and can safely be returned to the soil in the form of organic fertiliser. Some of these by-products can provide additional value before this happens by creating new food products, fabrics for the fashion industry, or as sources of bioenergy. These cycles regenerate living systems, such as soil, which provide renewable resources, and support biodiversity.

For paper waste, existing practice of segregation, shredding and disposal is best suitable that should be continued as for such limited quantity of paper waste, paper recycling plant would not be a feasible solution to implement on-site

Mobility Analysis : Introduction

This category includes emissions from the transportation of employees & students between their homes and their campus. Apart from daily commute to the campus, this analysis also includes transportation of employees for business-related activities which includes both national and international trips in vehicles owned or operated by third parties, such as airlines, trains, buses, and passenger cars.

Methodology

Approach

1. Baseline
2. Near and future scenarios

Base case

- What is the current mobility situation in MUJ?
- Mapping of the current situation: number of trips, mode of transport, fuel consumed etc

Scope of impact

- Kind of trips they are affected largely (definition of the current trips that have severe impact)

Impact assessment

- How these kind of trips are affected (Assessment of the potential impact- quantitative assessment, uncertainties etc)
- Short distance travel and long distance travel

Research questions

1. Amount of travel
2. Trip quantities
3. Trip patterns
4. Type of fuel used

Data source-

1. National trips survey
2. International trips survey
3. Questionnaire and survey results
4. Focus group

Methodology:

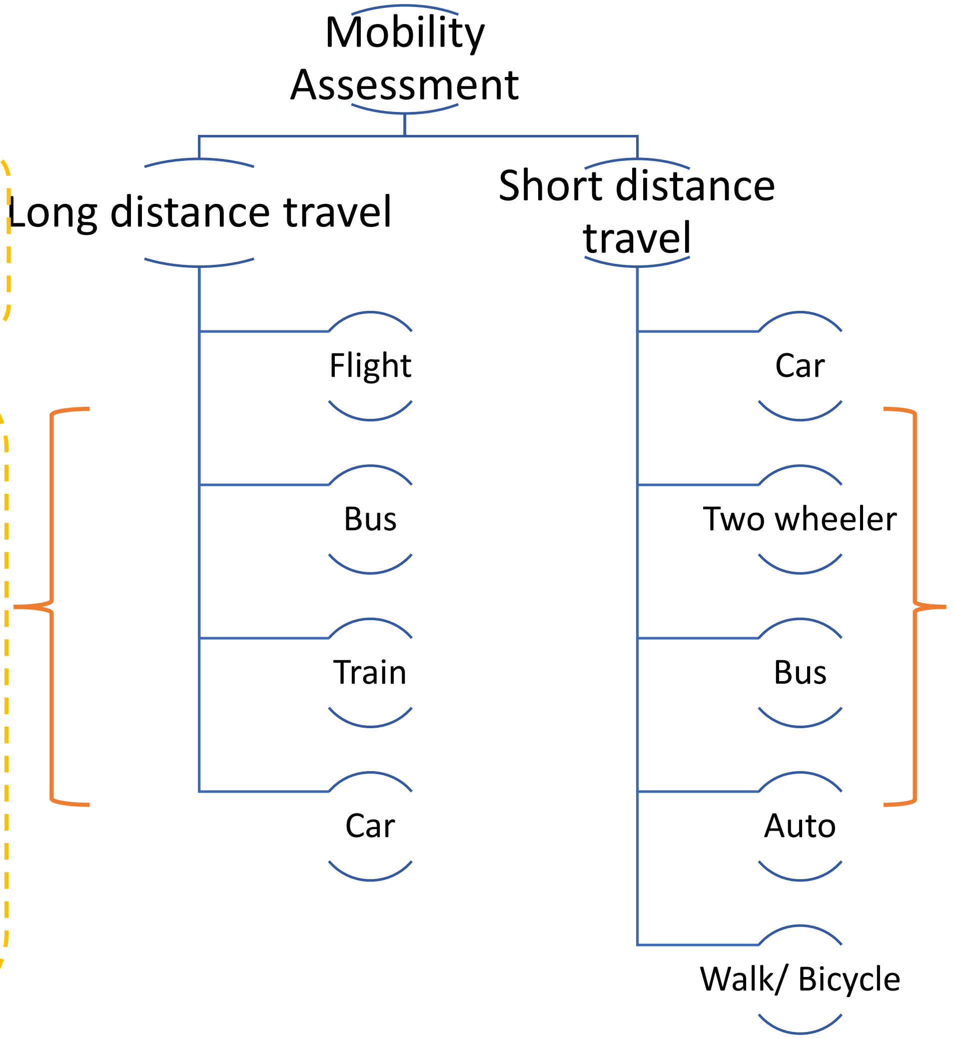
A mobility survey has been conducted for both staff and students (day scholars and residents) where we understood their daily mode of transport, distance traveled, type of fuel and fuel consumed.
From this data received, an emission factor was considered to understand the total carbon emission from each fuel and vehicle type. After finding out the total carbon emission, Tonnes of carbon dioxide (TCO2) equivalent per capita is generated.

Criteria - Mobility

Mobility Analysis : Methodology

Out station travel is intra city, national and international trips

Analysis-
All the data related to national and international trips held in 2019 was provided by MUJ. This includes the distance travelled, mode of transport and city visited.



Daily commute travel is within campus and city travel

Analysis-
A survey was conducted to understand daily commute to and from the campus which includes, mode of transportation, vehicle fuel, distance travelled and no of trips

Key Performance Indicator (KPI):

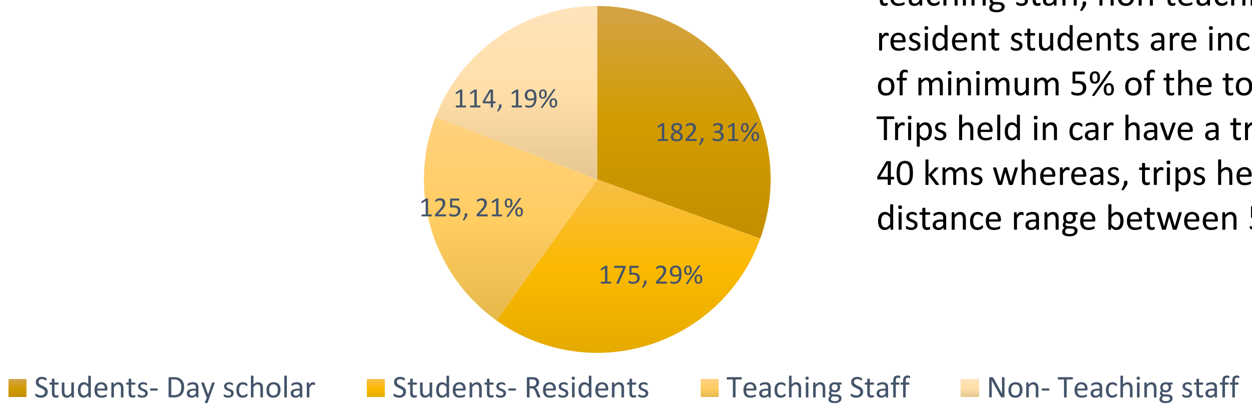
Total CO2 emission from daily commute- **15,179 TCO2** per student

Total CO2 emission from out station travel- **16 TCO2** per student

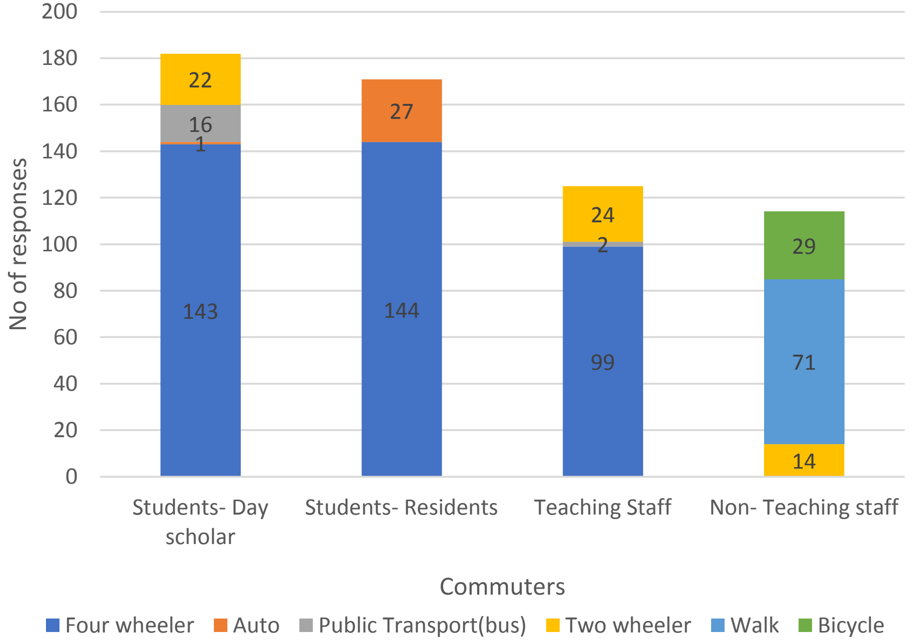
Total MUJ CO2 emission in 2019- **15,195 TCO2** per student

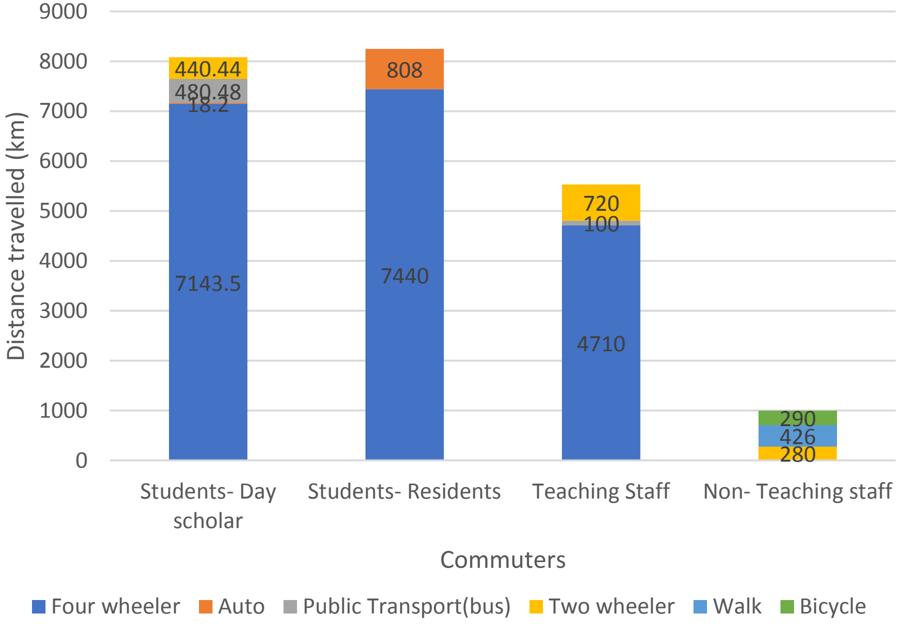
Mobility Analysis : Short distance travel

No. of responses received- 596



From the daily commute held to and from MUJ, all the teaching staff, non teaching staff, day scholar students and resident students are included in the survey. A sample size of minimum 5% of the total strength is considered.
Trips held in car have a travel distance range between 20 to 40 kms whereas, trips held in two wheeler have a travel distance range between 5 to 15 kms and trips held



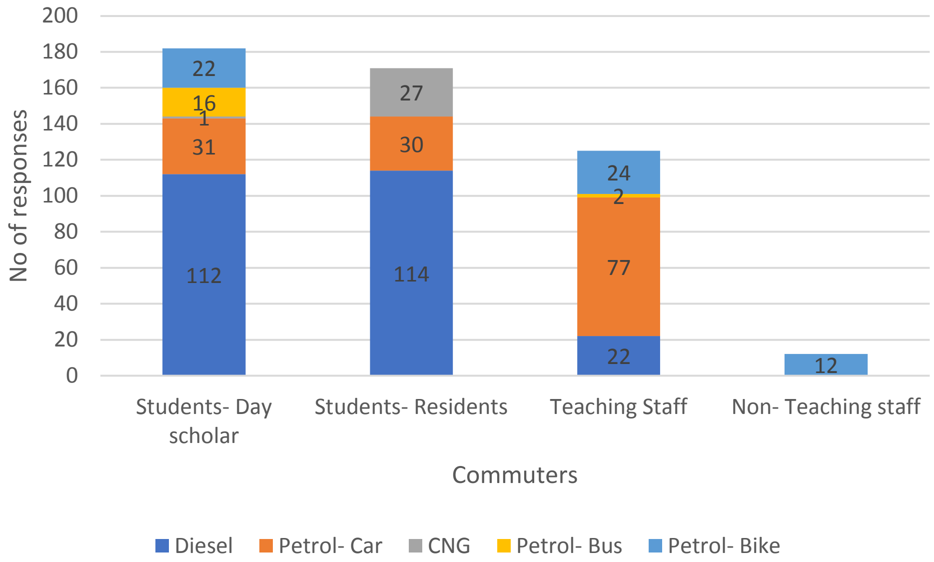


Calculations:

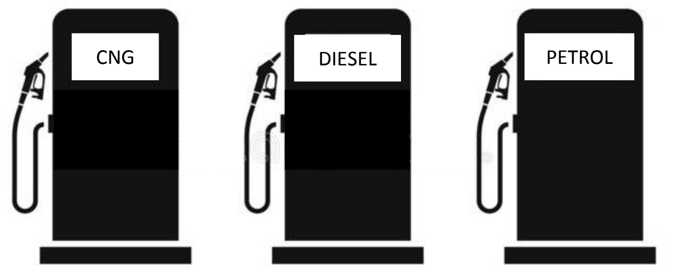
- From the online mobility survey conducted, we have received 596 responses which includes day scholar students, resident students, teaching staff and non teaching staff where we have segregated and filtered the data wrt different mode of transport i.e., four wheeler, auto, public transport, two heeler, walk, bicycle.
- After deriving number of students and staff and their travelling mode, total distance travelled under each mode of transport was evaluated.
- Total no of students under four wheeler * average distance travelled* to and fro trips = total distance four wheeler travelled

Criteria - Mobility

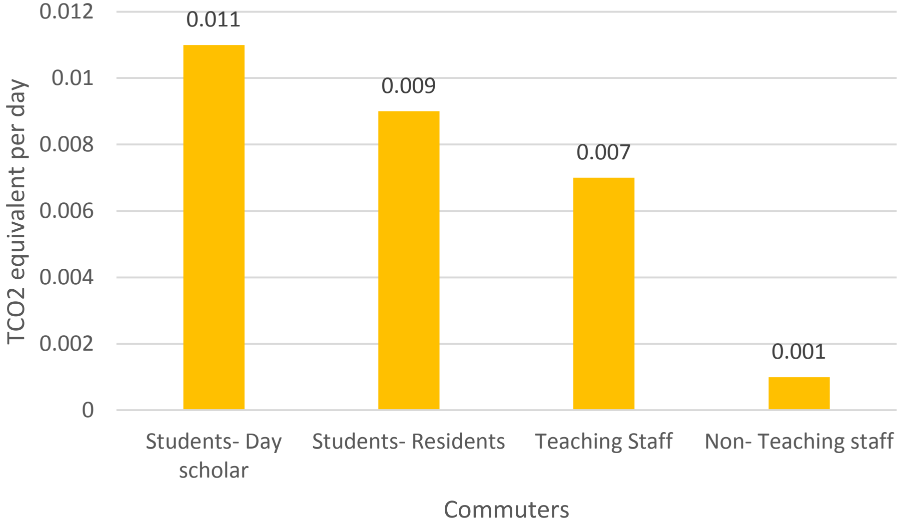
Mobility Analysis : Short distance travel

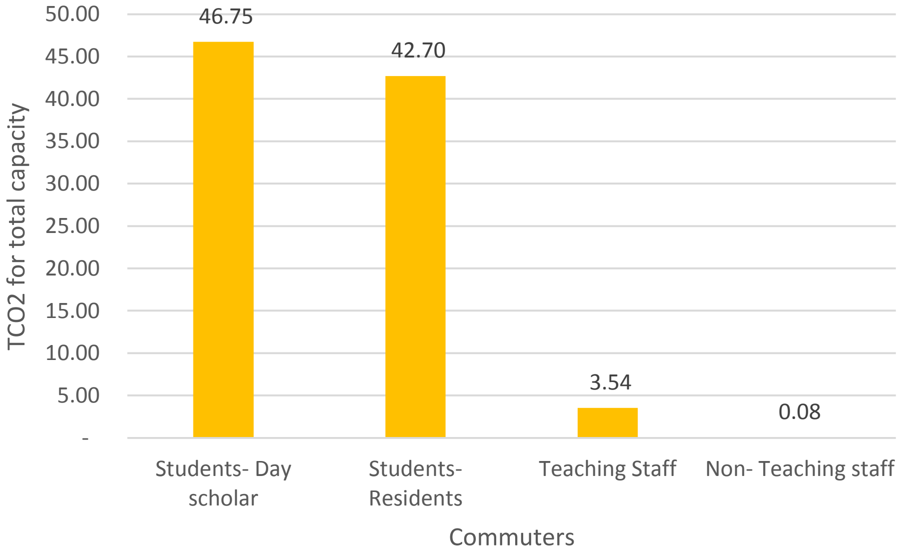


Emission factor for different fuel types



CNG	DIESEL	PETROL
0.48	2.62	2.21



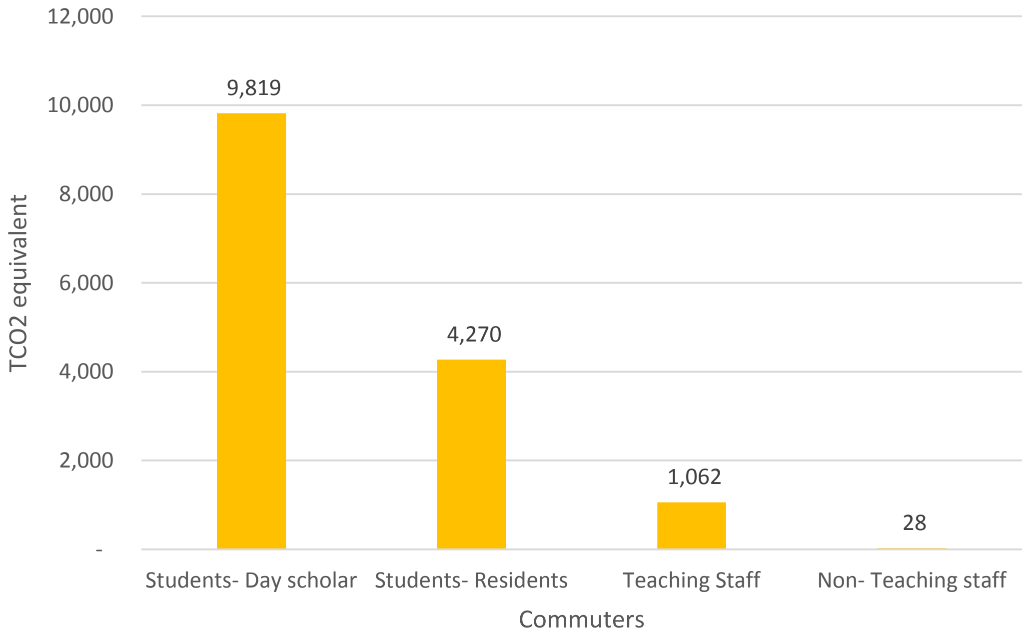


Calculations:

- Once the total distance travelled was calculated, the vehicle fuel type data was segregated wrt to commuters.
- As many commuters use different type of fuel such as diesel, petrol or CNG and each of these fuel have different associated emission factor.
- With these emission factors per day total tonne of CO_2 was calculated for individual commuter category.
- Total CO_2 emission per day from different mode of transport/ total no of responses received= TCO_2 equivalent per capita per day
- This TCO_2 equivalent per capita per day is then multiplied with total strength of each commuters category.

Mobility Analysis : Short distance travel

No of working days for Students day scholar - 210 days
No of working days for students residents - 100 days
No of working days for teaching staff - 300 days
No of working days for non- teaching staff - 365 days



Recommendations-
All majority of day scholar students travel using cab service, this can be replaced with college bus transport.
All the petrol and diesel fuel consumption can be replaced with CNG as the emission factor is comparatively less.
As the distance travelled cannot be reduced opting for car pooling or college bus is the next best option

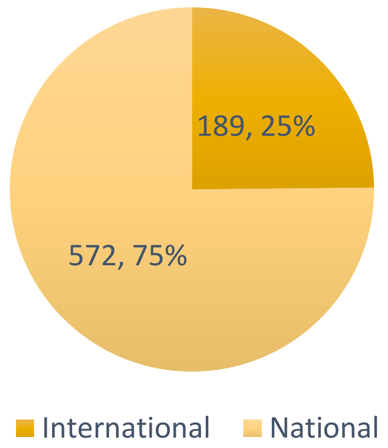
Calculations:

- After under standing the cumulative TCO2 emission for one day which includes both 2 way trip we need to understand the annual carbon emission causing due to mobility.
- TCO2 equivalent per capita per day X individual commuters working day = Total tonne of CO2 emission from mobility for MUJ

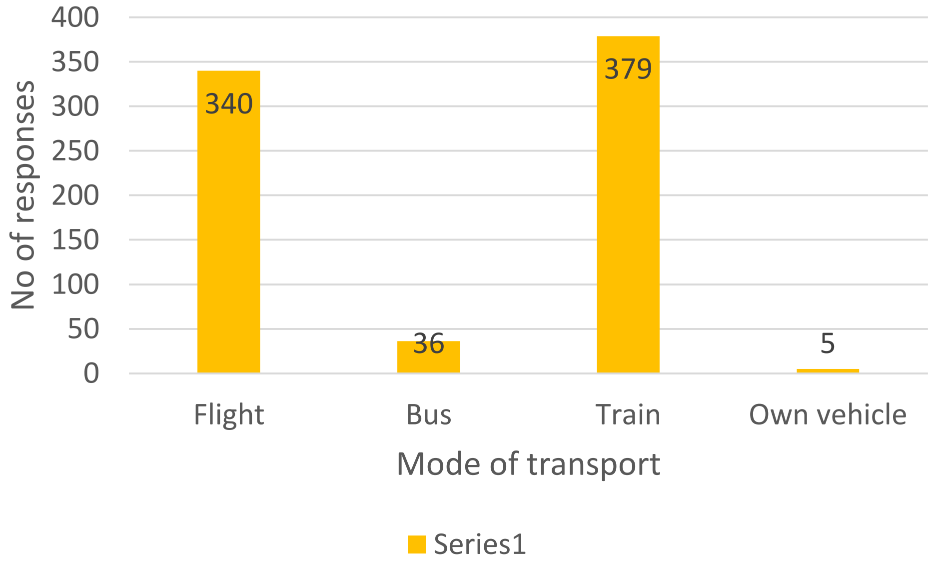
Criteria - Mobility

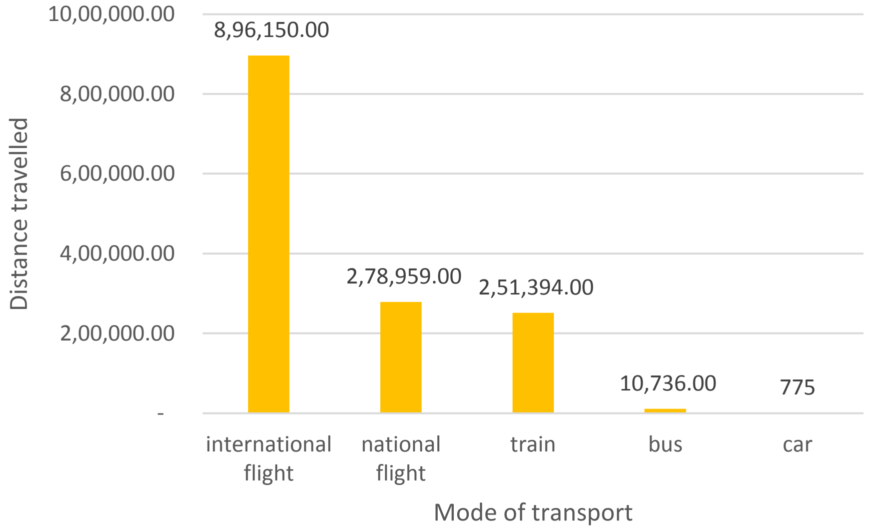
Mobility Analysis : Out station travel

National and International Trips-761



From the national and international trips held by MUJ staff and faculty members, majority of mode of transport is by flight and train.
Trips held in flight have a travel distance range between 800 to 12,000 kms whereas, trips held in train have a travel distance range between 400 to 700 kms. Trips held in bus and own vehicle are below 400 kms.



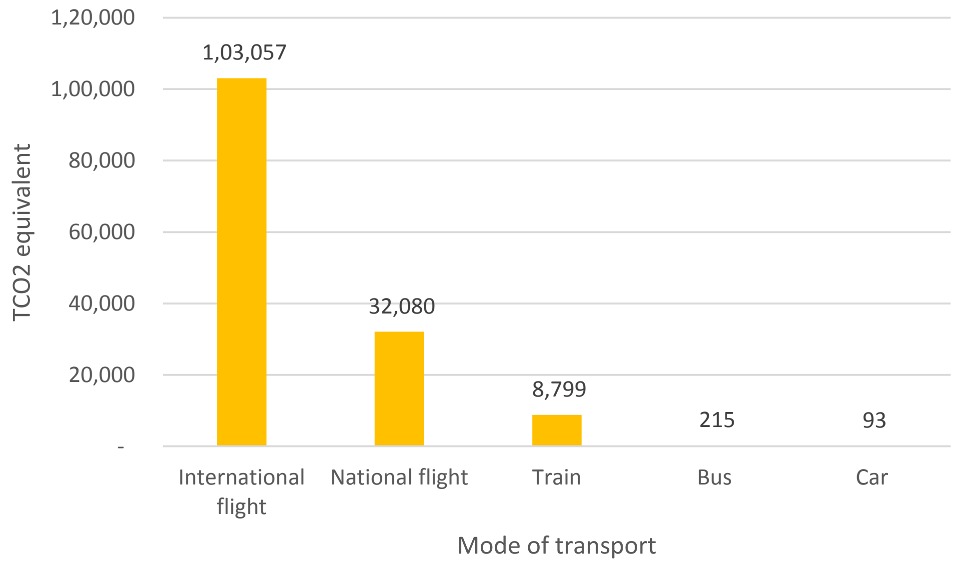


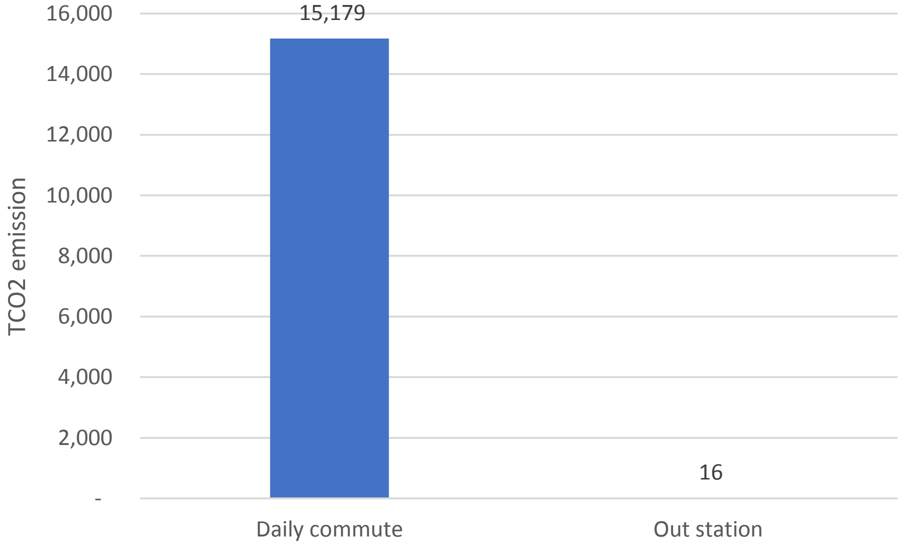
Observations:

- From the data received for both national and international trips includes different mode of transport and distance travelled.
- From the details provided, travel within 500 kms- bus and train, travel within 1200 kms- train and travel above 1200 kms- flight for national trips.
- From the data provided by MUJ, all the national and international trips are segregated.
- No of responses for each mode of travel is diverted. From this individual distance travelled is accumulated.

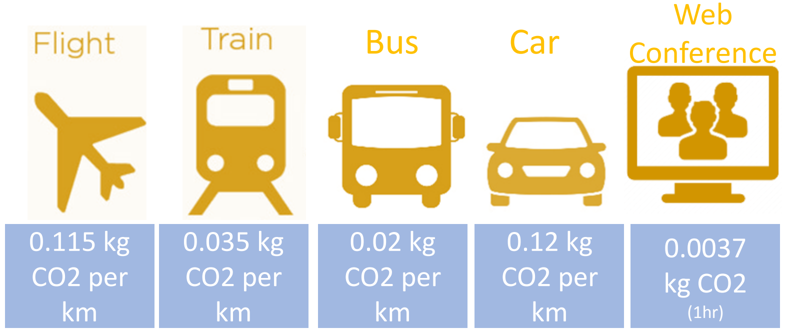
Criteria - Mobility

Mobility Analysis : Out station travel





Emission factor for different mode of travel



Inference-
Daily commute has a predominantly high value because it involves everyday commute for 4165 students and 4978 occasional travel and 1000 staff everyday travel.

Total MUJ CO_2 emission in 2019- **15,195 TCO2 per student**

Inference & Calculations

Even thought the number of international trips are comparatively less to national trips but CO_2 emission from international trips are very high.
To reduce this excess emission in near future, majority of the trips can be converted to web based meeting or conference.
As far as possible all the national trips can be by shifted from flights to trains.

Calculations:
total TCO2 equivalent for all the different mode of transport/ total no of student= Tonne of CO_2 emission per student

Recommendations:

Following are the recommendations are suggested to manage waste in a sustainable manner:

- Identifying the major pockets students and staff are commuting from and initiate the university bus facilities.
- Introducing paid parking policies for 4-wheelers
- Consider the use of tele- or video-conferencing for meetings where feasible.
- Development of a roadmap to shift for using e-vehicles for the entire campus users

Shared mobility
- RIDE SHARE
- Carpooling
- Bus provision
- Taxi or auto

Shared mobility
- RIDE HALL OR RIDE SOURCE
- Taxi aggregator
- Auto aggregator
- Motorcycle

Shared mobility
- VEHICLE SHARE
- Car share
- Bicycle share
- Motorcycle share

College bus facility

Alternate engine and fuels

Multiple trips of college buses or government buses

Drinking WATER TEST REPORT

5473

AQUACHEK
THE WATER TESTING FACILITY
FROM EUREKA FORBES LTD.

TEST REPORT – G1

Report No. : WL/Jan/2014
Sample Code No : 1082
Sample Source : *Drinking Water (Eng. Dept. 3rd Floor) – G1
Date of Report : 23.01.2014
Collected on : 18.01.2014

Customer's Name : M/S Sikkim Manipal University
Address : Dahmi kalan, Near GVK Toll Plaza, Ajmer Express Highway, Jaipur
Mob No. : 7727006789

S.NO.	PARAMETER TESTED		RESULT	IS: 10500,2012-DRINKING WATER SPECIFICATION (Second Revision)	
				Requirement (Acceptable limit)	Maximum Permissible limit
	Physico-chemical Analysis				
1.	Odour		Agreeable	Agreeable	-
2.	Taste		Agreeable	Agreeable	-
3.	Turbidity,	NTU	0.4	1	5
4.	pH value		8.01	6.5-8.50	No relaxation
5.	Total Dissolved Solids,	mg/l	267	500	2000
6.	Total alkalinity as CaCO3,	mg/l	197	200	600
7.	Total Hardness as CaCO3,	mg/l	162	200	600
8.	Calcium as Ca^{++}	mg/l	25	75	200
9.	Magnesium as Mg^{++}	mg/l	23.8	30	100
10.	Chloride as Cl^-	mg/l	42	250	1000
11.	Sulphate as SO4	mg/l	7.3	200	400
12.	Nitrate as $NO3^-$	mg/l	4.1	45	No relaxation
13.	Total Iron as Fe,	mg/l	0.1	0.3	No relaxation
14.	Residual Free Chlorine	mg/l	Nil	0.2	1
15.	Fluoride as F^-	mg/l	Nil	1.0	1.5
	Bacteriological Analysis				
16.	Total Coli forms /100ml		Zero	Zero	No relaxation
17.	Faecal Coli forms /100ml		Zero	Zero	No relaxation
18.	E.coli presence/ absence in 100ml		Absent	Absent	No relaxation

* The above sample Collected by Lab.
Remarks: The above sample conforms to IS: 10500-2012 – Drinking Water specification (Second Revision) with respect to test conducted

Lab Address :
51/1, Ground Floor
Shipra Path, Mansarovar, Jaipur
Tel. 0141- 5130002

Authorised Signatory
AQUACHEK THE WATER TESTING FACILITY EUREKA FORBES LTD. JAIPUR

Corporation Office: Bhupesh Gupta Bhavan 1st Floor, 85, Sayani Road Prabhadevi, Mumbai 400 025 (INDIA) | Phone: 91-22-430 1725 (8 Lines) | Telefax: 91-22-422 2703 | E-Mail: eflpbo@bom2.vsnl.net.in | Cable: "Aquaguard" Fort, Mumbai | Mailing Address: 143-C/4. Bommasandra Indl. Area Off. Hosur Rd., Bangalore 562 158. | Regd. Office: 7, Chakraberia Road (South) Kolkata 700 025.

STP treated Water Test reports

1405

AQUACHEK
THE WATER TESTING FACILITY
FROM EUREKA FORBES LTD.

TEST REPORT

Report No. : WL/Jan/2014
Sample Code No : 1108
Sample Source : * Treated Water (STP) MIS
Date of Report : 04.02.2014
Collected on : 22.01.2014

Customer's Name : M/S Sikkim Manipal University
Address : Dahmi kalan, Near GVK Toll Plaza, Ajmer Express Highway, Jaipur
Mob No. : 7727006789

S.NO.	PARAMETER TESTED		RESULT	Method of Testing IS:3025
				Requirement (Acceptable limit)
	Physico-chemical Analysis			
1.	pH Value		7.25	5.5-9.0
2.	Total Suspended Solids	mg/l	14.76	100 mg/l
3.	Biological Oxygen Demand	mg/l	21.43	30 mg/l
4.	Chemical Oxygen Demand	mg/l	81.59	250 mg/l
5.	Oil & Grease	mg/l	0.761	10 mg/l

* The above sample Collected by Lab.
Remarks: The above sample conform to Indian Standard: 3025

Lab Address :
51/1, Ground Floor
Shipra Path, Mansarovar, Jaipur
Tel. 0141- 5130002

Authorised Signatory
AQUACHEK THE WATER TESTING FACILITY EUREKA FORBES LTD. JAIPUR

Corporation Office: Bhupesh Gupta Bhavan 1st Floor, 85, Sayani Road Prabhadevi, Mumbai 400 025 (INDIA) | Phone: 91-22-430 1725 (8 Lines) | Telefax: 91-22-422 2703 | E-Mail: eflpbo@bom2.vsnl.net.in | Cable: "Aquaguard" Fort, Mumbai | Mailing Address: 143-C/4. Bommasandra Indl. Area Off. Hosur Rd., Bangalore 562 158. | Regd. Office: 7, Chakraberia Road (South) Kolkata 700 025.

Observations:

From the **Drinking Water test report**, we can understand all the physico-chemical analysis are in between the required acceptable limit. All the drinking water (RO water) available in the campus is perfectly safe for students and staff members to consume.

From the **STP water test report**, we can understand all the physico-chemical analysis are in between the required acceptable limit. This water can be later reused for landscape or flushing purpose.
Currently, MUJ is reusing this treated water for landscape and flushing purpose. All the buildings have dual plumbing system to cater to this measure. Because of this method, MUJ is consuming less potable water and ground water.

Action Plan:

Way Forward to Develop the Roadmap

Priority	Timeline	Actions
Immediate	4-6 Months	Add list of actions
Short term goal	2-5 years	Add list of actions
Mid term goal	6-10 years	Add list of actions
Long term goal	10- 15 years	Add list of actions