INDIAN INSTITUTE OF TECHNOLOGY GANDHINAGAR

ENERGY AUDIT REPORT

BUILDING AND WORKS DEPARTMENT

YEAR 2022

Annual Energy Audit Report
(From Jan 2022 to Dec 2022)

Introduction

The annual Energy audit report for the year 2022 has been prepared by compiling the quarterly reports.

The customized benchmark EPI for Academic Buildings including Air conditioning, Hostel without AC and entire campus has been worked out on the basis of GRIHA standard of latest EPI Bench mark.

Benchmark for EPI

The EPI Bench marks has been revised by GRIHA authorities for institutional and residential buildings applicable to large area development (LD), which is relevant to IITGN Campus. As the buildings in IITGN campus do not exactly fall in below mentioned two categories, customized EPI Benchmarks of the buildings have been worked out based on GRIHA standard as mentioned in the table below.

Table for Bench Mark in (kWh/Sq. Meter/year)			
	As per Criterion- 7, GRIHA Version 2019. IITGN Academic area		**IITGN Campus**
Climate Classification	**Day time Occupancy**	24 Hr. Occupancy	Customized Benchmark based on GRIHA Parameters
	5 Days a week	**7 Days a week Annexure-02**	**As per Annexure-02**
Composite/ Warm and Humid / Hot and Dry	**90**	**225**	**111**

EPI of IITGN Campus

In order to work out the Energy Performance Index (EPI) of the campus, data of energy utilization of individual building and utilities of the campus building have been complied quarterly and mean value worked out for the year of 2022 as mentioned above.

The supply data are based on the meter reading of HT incomer from Torrent Power Ltd to Main infra substation and solar power generation. The main supply at 11KV is received from Torrent and step-down to 415 V through IITGN Transformers at various sub- stations for supply to building/ utilities. Total installed capacity of the distribution transformer is 11.63 MVA against connected load of campus is 12MW (Approx.). The transformer capacity has been provided considering load diversity in peak demand including stand by transformers as per standard practice.

The consumption data have been compiled by taking reading of energy meter of individual panel provided in various buildings and utilities.

Housing complex receives power supply directly from Torrent Power through individual LT connection, the energy consumption of housing has not been considered to derive the EPI of the campus.

Central air conditioning facilities have been provided to Hostel buildings since April 2019. EPI of AC for hostel has been shown separately in this report.

Research park, New Hostels and dining, Sports complex were completed and occupied during 2020 & 2021 have been included in this report.

While accounting for total energy consumption of the campus the same in respect of utilities like WTP, STP etc. of Housing has been deducted on approximate prorate basis based on built up area of buildings.

Energy Audit Report 2022							
Quarterly Energy Audit Comparison Report							
Energy performance Index (EPI) comparison with benchmark (kWh/Sq. Meter/year)							
Year-2022		1st quarter	2nd quarter	3rd quarter	4th quarter	Annual	
Building type	**Bench mark value**	**Jan-22 to Mar-22**	**April-22 to Jun-22**	**July-22 to Sep-22**	**Oct-22 to Dec-22**	**Jan-22 to Dec-22**	**Remarks for benchmark**
Academic buildings	225	70	112	112	106	100	Customized Bench mark Value based on GRIHA Standard. EPI increased from April to Sept. due to HVAC load. HVAC service reduced in 1st and 4th quarter EPI dropped.
Research Park	90	12	29	32	27	25	Research park is not fully occupied
Hostels	70	33	34	35	33	34	Customized Bench mark Value based on GRIHA Standard.
Hostels HVAC		4	24	21	3	13	EPI drop in 1st & 4th quarters is due to non-operation of AC plant during Winter.
Guest House	275	30	23	27	30	28	
Utilities	-	4	4	3	4	4	Customized Bench mark Value based on GRIHA Standard. EPI in 3rd quarter reduced due to partial operation of Sewage Pump set in monsoon.
Institute	111	55	82	83	68	72	Customized Bench mark Value based on GRIHA Standard. EPI reduced in 1st and 4th quarter as HVAC service were reduced.

EPI Comparison of year 2021 and 2022				
Energy performance Index (EPI) comparison with benchmark (kWh/Sq. meter/year)				
Climate Zone	Hot and Dry			
Building type	**Bench mark**	**Jan-2021 to Dec- 2021**	**Jan-2022 to Dec-**	**Remarks for benchmark**
Academic buildings	225	92	100	Customized Bench mark Value based on GRIHA Standard. Central arcade, Sports complex, Research park, is not fully occupied so far.
Hostels	70	30	34	GRIHA 1 No Kitchen block was not in use.
Hostels HVAC	-	14	13	
Guest House	275	-	28	
Research Park	90	-	25	Research Park was not fully occupied
Utilities	-	5	4	New Areas added which are not fully occupied.
Institute	111	63	72	Customized Bench mark Value based on GRIHA Standard.

1st Quarter 2022				
Quarterly Energy Audit Comparison Report				
Energy performance Index (EPI) comparison with benchmark (kWh/Sq. meter/year)				
Climate Zone	**Building type**	**Bench mark value**	**Jan 22 to Mar 22**	**Remarks for benchmark**
Hot and Dry	Academic buildings	225	70	Customized Bench mark Value based on GRIHA Standard
Hot and Dry	Hostels	70	33	GRIHA
Hot and Dry	Hostels HVAC	-	2	
Hot and Dry	Research Park	90	12	
Hot and Dry	Guest House	275	30	
Hot and Dry	Utilities	-	4	
Hot and Dry	Institute	111	55	Customized Bench mark Value based on GRIHA Standard

Annexure-01			
Energy consumption of Chillier plant bifurcation of Hostel and Academic			
Month	**Chiller Plant 2022**	**Consumption of Chiller Plant for Hostels 40% Approx.**	**Remarks**
	A	B=40% of A	
Jan	0	0	Ratio of 40% considered with total HVAC consumption.
Feb	0	0	
March	201,611	40322.2	Chilled water supply for hostel has been started on 19-03-22 Consumption of Chiller Plant for Hostels 20% Approx.
TOTAL	201,611	**40322**	

EPI of Academic Buildings, Central Arcade & Sports complex (kWh/Sq. Meter/Year)

Jan-22 to Mar-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Academic Building 01 to 09, Central Arcade & Sports complex =(A)	kWh / Year	762,183	3,048,732	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	369,758	1,479,032	Table-01
3	Less Hostel Consumption for AC (C)	kWh / Year	80,644	322,576	Annexure-01
4	**Total (D) = (A+B-C)**	**kWh / Year**	**1,051,297**	**4,205,188**	
5	Built-up Area (E)	Sq. Meter	59,828	59,828	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**17.57**	**70.29**	**70.29**

EPI of Research park (kWh/Sq. Meter/Year)

Jan-22 to Mar-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Research park =(A)	kWh / Year	58,858	235,432	Table-01
5	Built-up Area (E)	Sq. Meter	19,070	19,070	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**3.09**	**12.35**	**12.35**

EPI of Hostel (kWh/Sq. Meter/Year)

Jan-22 to Mar-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	624,420	2,497,680	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	-	-	-
	Total C= (A+B)		**624,420**	**2,497,680**	
3	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel- 1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**8.27**	**33.06**	**33.06**

EPI Guest House Buildings (kWh/Sq. Meter/Year)

SL No	Combinations	Unit	Value	Yearly	Remarks
1	Power consumption inside Buildings =(A)	kWh / Year	72,880	291,520	Table-01
	Total		**72,880**	**291,520**	
3	Built-up Area (B)	Sq. Meter	9,805	9,805	Built-up Area
4	**EPI (E= A/B)**	**(kWh/Sq. Meter/Year)**	**7.43**	**29.73**	**29.73**

EPI of Hostel HVAC (kWh/Sq. Meter/Year)

Jan-22 to Mar-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	-	-	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	40322	161288	Annexure-01
3	**Total C= (A+B)**		**40322**	**161288**	
4	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel- 1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
5	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**0.53**	**2.13**	**2.13**

EPI of Utilities (kWh/Sq. Meter/Year)

Jan-22 to Mar-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption of treatment plant =(A)	kWh / Year	117,851	471,404	Table-01
2	Power consumption for Street lights =(B)	kWh / Year	65,669	262,676	Table-01
3	**Total (C= A+B)**	**kWh / Year**	**183,520**	**734,080**	
4	Deduct energy consumed by bulk services in Housing Pro rata Basis (D)	**kWh / Year**	**25,364**	101,456	(59878 /209859) x Energy consumed for bulk service
5	**Total (E= C-D)**	**kWh / Year**	**158,156**	**632,624**	
6	Built-up Area (F)	Sq. Meter	169,051	169,051	Excluding Housing areas
7	**EPI (G= E/F)**	**(kWh/Sq. Meter/Year)**	**0.94**	**3.74**	**3.74**

Jan-22 to Mar-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Total Power consumption Buildings =(A)	kWh / Year	2,117,320	8,469,280	Table-01
	Deductions				
2	Deduct energy consumed by bulk services in Housing Pro rata Basis (B)	kWh / Year	25,364	101,456	(59878 /209859) x Energy consumed for bulk service
3	Power consumed by Shops (C)	kWh / Year	29,991	119,964	Table-01
4	Power consumed by Temporary connections (D)	kWh / Year	7,490	29,960	Table-01
5	**Total Deductions (E= B+C+D)**	kWh / Year	62,845	251,380	
6	**Total (F= A-E)**	**kWh / Year**	**2,054,475**	**8,217,900**	
7	Built-up Area (G)	Sq. Meter	149,981	149,981	Includes New Hostels (1,2,3,4,5,6, OAT & Mess), Guest House, Director's residence, Central Arcade, Sports complex & Amphitheatre.
8	**EPI (H= F/G)**	**(kWh/Sq. Meter/Year)**	**13.70**	**54.79**	**54.79**

TABLE -01

Summary Sheet of Power Supply and Consumption.

	Supply			Consumption										
Month	Torrent Power	Solar Power	Total	Hostels	Guest house	Academic Area	Chiller Plant	Street light	Treat Plant (WTP STP WSC SPS CWPS)	Bank, Shops & Mobile tower	Temporary Connections to Construction agencies	Sports Complex	Research park	Total
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Jan-22	588,770	57,827	646,597	228,101	25,312	218,749	79,338	25,404	39,405	9014	2,088	15,613	11012.00	654,036
Feb-22	599,590	85,689	685,279	188,374	20,556	221,297	88,809	19,436	35,057	9491	2,249	16,830	12149.00	614,248
Mar-22	776,650	67,652	844,302	207,945	27,012	262,350	201,611	20,829	43,389	11486	3,153	27,344	35697.00	840,816
Total	1,965,010	211,168	2,176,178	624,420	72,880	702,396	369,758	65,669	117,851	29,991	7,490	59,787	58,858	2,109,100
	Transmission loss													3.08%

2nd Quarter 2022					
Quarterly Energy Audit Comparison Report					
Energy performance Index (EPI) comparison with benchmark (kWh/Sq. meter/year)					
Climate Zone	**Building type**	**Bench mark value**	**Jan 22 to Mar 22**	**April 22 to June 22**	**Remarks for benchmark**
Hot and Dry	Academic buildings, Central arcade and sports complex	225	70	112	Customized Bench mark Value based on GRIHA Standard. EPI Increased due to HVAC load.
Hot and Dry	Hostels	70	33	34	GRIHA. EPI decreased as old mess was not use and less energy consumed due to Vacation of students.
Hot and Dry	Hostels HVAC	-	4	24	Increased due to HVAC load of Summer.
Hot and Dry	Research Park	90	12	29	
Hot and Dry	Guest House	275	30	23	
Hot and Dry	Utilities	-	4	4	
Hot and Dry	Institute	111	55	82	Customized Bench mark Value based on GRIHA Standard. HVAC and Sports complex load increased the EPI.

EPI of Academic Buildings, Central Arcade & Sports complex (kWh/Sq. Meter/Year)

April-**22 to** Jun-**22**					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Academic Building 01 to 09, Central Arcade & Sports complex =(A)	kWh / Year	1,004,808	4,019,232	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	1,120,199	4,480,796	Table-01
3	Less Hostel Consumption for AC (C)	kWh / Year	448,080	1,792,320	Annexure-01
4	**Total (D) = (A+B-C)**	**kWh / Year**	**1,676,927**	**6,707,708**	
5	Built-up Area (E)	Sq. Meter	59,828	59,828	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**28.03**	**112.12**	**112.12**

EPI of Research park (kWh/Sq. Meter/Year)

April-22 to Jun-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Research park =(A)	kWh / Year	137,577	550,308	Table-01
5	Built-up Area (E)	Sq. Meter	19,070	19,070	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**7.21**	**28.86**	**28.86**

EPI of Hostel (kWh/Sq. Meter/Year)

April-22 to Jun-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	640,277	2,561,108	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	-	-	-
	Total C= (A+B)		**640,277**	**2,561,108**	
3	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel-1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**8.48**	**33.90**	**33.90**

EPI of Hostel HVAC (kWh/Sq. Meter/Year)

April-22 to Jun-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	-	-	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	448,080	1,792,320	Annexure-01
3	**Total C= (A+B)**		**448,080**	**1,792,320**	
4	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel-1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
5	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**5.93**	**23.73**	**23.73**

EPI Guest House Buildings (kWh/Sq. Meter/Year)

April-22 to Jun-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	56,639	226,556	Table-01
	Total B		**56,639**	**226,556**	
3	Built-up Area (C)	Sq. Meter	9,805	9,805	Built-up area
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**5.78**	**23.11**	**23.11**

EPI of Utilities (kWh/Sq. Meter/Year)

April-22 to Jun-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Power consumption of treatment plant =(A)	kWh / Year	147,369	589,476	Table-01
2	Power consumption for Street lights =(B)	kWh / Year	61,460	245,840	Table-01
3	**Total (C= A+B)**	**kWh / Year**	**208,829**	**835,316**	
4	Deduct energy consumed by bulk services in Housing Pro rata Basis (D)	**kWh / Year**	**38,545**	154,180	(59878 /208929) x Energy consumed for bulk service
5	**Total (E= C-D)**	**kWh / Year**	**170,284**	**681,136**	
6	Built-up Area (F)	Sq. Meter	169,051	169,051	Excluding Housing areas
7	**EPI (G= E/F)**	**(kWh/Sq. Meter/Year)**	**1.01**	**4.03**	**4.03**

EPI of Whole Campus (kWh/Sq. Meter/Year)

April-22 to Jun-22					
SL No	**Combinations**	**Unit**	**Value**	**Yearly**	**Remarks**
1	Total Power consumption Buildings =(A)	kWh / Year	3,170,600	12,682,400	Table-01
	Deductions				
2	Deduct energy consumed by bulk services in Housing (B)	kWh / Year	38,545	154,180	(59878 /208929) x Energy consumed for bulk service
3	Power consumed by Shops (C)	kWh / Year	36,435	145,740	Table-01
4	Power consumed by Temporary connections (D)	kWh / Year	13,352	53,408	Table-01
5	**Total Deductions (E= B+C+D)**	kWh / Year	88,332	353,328	
6	**Total (F= A-E)**	**kWh / Year**	**3,082,268**	**12,329,072**	
7	Built-up Area (G)	Sq. Meter	149,981	149,981	Includes New Hostels (1,2,3,4,5,6, OAT & Mess), Guest House, Director residence, Central Arcade, Sports complex & Amphitheatre.
8	**EPI (H= F/G)**	**(kWh/Sq. Meter/Year)**	**20.55**	**82.20**	**82.20**

TABLE -01

Summary Sheet of Power Supply and Consumption.

	Supply			Consumption										
Month	Torrent Power	Solar Power	Total	Hostels	Guest house	Academic Area	Chiller Plant	Street light	Treat Plant (WTP STP WSC SPS CWPS)	Bank, Shops & Mobile tower	Temporary Connections to Construction agencies	Sports Complex	Research park	Total
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Apr-22	1,074,660	51,715	1,126,375	242,955	21,895	318,069	342,692	23,854	49,327	12795	5,159	35,963	43507.00	1,096,216
May-22	1,012,585	51,965	1,064,550	194,550	13,986	270,475	372,540	18,165	47,116	11637	4,063	37,672	45293.00	1,015,497
Jun-22	1,059,300	57,952	1,117,252	202,772	20,758	295,695	404,967	19,441	50,926	12003	4,130	46,934	48777.00	1,106,403
Total	3,146,545	161,632	3,308,177	640,277	56,639	884,239	1,120,199	61,460	147,369	36,435	13,352	120,569	137,577	3,218,116
	Transmission loss													2.72%

Annexure-01			
Energy consumption of Chillier plant bifurcation of Hostel and Academic			
Month	**Chiller Plant 2022**	**Consumption of Chiller Plant for Hostels 40% Approx.**	**Remarks**
	A	B=40% of A	
April	342,692	137076.8	Ratio of 40% considered with total HVAC consumption.
May	372,540	149016	
June	404,967	161986.8	
TOTAL	1,120,199	**448080**	

3rd Quarter 2022						
Quarterly Energy Audit Comparison Report						
Energy performance Index (EPI) comparison with benchmark (kWh/Sq. meter/year)						
Climate Zone	**Building type**	**Bench Mark**	**Jan 22 to Mar 22**	**April 22 to June 22**	**July 22 to Sep 22**	**Remarks for**
Hot and Dry	Academic buildings, Central Arcade & Sports complex	225	70	112	112	Customized Bench mark Value based on GRIHA Standard. Sports complex, Research park are
Hot and Dry	Hostels	70	33	34	35	GRIHA Old kitchen block was not in use.
Hot and Dry	Hostels HVAC	-	4	24	21	Customized bench mark.
Hot and Dry	Research Park	90	12	29	32	
Hot and Dry	Guest House	275	30	23	27	
Hot and Dry	Utilities	-	4	4	3	STP pump operation was not required. Hence energy consumption reduced
Hot and Dry	Institute	111	55	82	83	Customized Bench mark Value based on GRIHA

EPI of Academic Buildings, Central Arcade & Sports complex (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Academic Building 01 to 09, Central Arcade & Sports complex =(A)	kWh / Year	1,070,867	4,283,468	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	1,003,645	4,014,580	Table-01
3	Less Hostel Consumption for AC (C)	kWh / Year	401,458	1,605,832	Annexure-01
4	**Total (D) = (A+B-C)**	**kWh / Year**	**1,673,054**	**6,692,216**	
5	Built-up Area (E)	Sq. Meter	59,828	59,828	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**27.96**	**111.86**	**111.86**

EPI of Research park (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Research park =(A)	kWh / Year	152,473	609,892	Table-01
5	Built-up Area (E)	Sq. Meter	19,070	19,070	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**8.00**	**31.98**	**31.98**

EPI of Hostel Buildings (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	664,009	2,656,036	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	-	-	-
	Total C= (A+B)		**664,009**	**2,656,036**	
3	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel- 1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**8.79**	**35.16**	**35.16**

EPI of Hostel HVAC (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	-	-	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	401,458	1,605,832	Annexure-01
3	**Total C= (A+B)**		**401,458**	**1,605,832**	
4	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel- 1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
5	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**5.31**	**21.26**	**21.26**

EPI of Guest House Buildings (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	67,234	268,936	Table-01
	Total C= (A+B)		**67,234**	**268,936**	
3	Built-up Area (D)	Sq. Meter	9,805	9,805	Built-up area
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**6.86**	**27.43**	**27.43**

EPI of Utilities (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of treatment plant =(A)	kWh / Year	113,139	452,556	Table-01
2	Power consumption for Street lights =(B)	kWh / Year	63,790	255,160	Table-01
3	**Total (C= A+B)**	**kWh / Year**	**176,929**	**707,716**	
4	Deduct energy consumed by bulk services in Housing	**kWh / Year**	**29,592**	118,368	(59878 /228929) x Energy consumed for bulk service

	Pro rata Basis (D)				
5	**Total (E= C-D)**	**kWh / Year**	**147,337**	**589,348**	
6	Built-up Area (F)	Sq. Meter	169,051	169,051	Excluding Housing areas
7	**EPI (G= E/F)**	**(kWh/Sq.eter/Year)**	**0.87**	**3.49**	**3.49**

EPI of Whole Campus (kWh/Sq. Meter/Year)

July-22 to Sep-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Total Power consumption Buildings =(A)	kWh / Year	3,202,601	12,810,404	Table-01
	Deductions				
2	Deduct energy consumed by bulk services in Housing (B)	kWh / Year	29,592	118,368	(59878 /228929) x Energy consumed for bulk service
3	Power consumed by Shops (C)	kWh / Year	39,513	158,052	Table-01
4	Power consumed by Temporary connections (D)	kWh / Year	5,855	23,422	Table-01
5	**Total Deductions (E= B+C+D)**	kWh / Year	74,960	299,842	
6	**Total (F= A-E)**	**kWh / Year**	**3,127,641**	**12,510,562**	
7	Built-up Area (G)	Sq. Meter	149,981	149,981	Includes New Hostels (1,2,3,4,5,6, OAT & Mess), Guest House, Director's residence, Central Arcade, Sports complex & Amphitheatre.
8	**EPI (H= F/G)**	**(kWh/Sq. Meter/Year)**	**20.85**	**83.41**	**83.41**

TABLE -01
Summary Sheet of Power Supply and Consumption.

	Supply			Consumption										
Month	Torrent Power	Solar Power	Total	Hostels	Guest house	Academic Area	Chiller Plant	Street light	Treat Plant (WTP STP WSC SPS CWPS)	Bank, Shops & Mobile tower	Temporary Connections to Construction agencies	Sports Complex	Research park	Total
	kWh	kWh	kWh	kWh		kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Jul-22	951,575	42,758	994,333	179,571	20,441	280,106	319,790	19,261	34,793	12069	2,226	42,436	47885.00	958,578
Aug-22	1,120,125	43,645	1,163,770	234,362	21,529	321,176	310,868	20,981	35,390	13061	2,094	46,177	47623.00	1,053,261
Sep-22	1,143,525	53,446	1,196,971	250,076	25,264	318,043	372,987	23,548	42,956	14383	1,535	62,929	56965.00	1,168,686
Total	3,215,225	139,849	3,355,074	664,009	67,234	919,325	1,003,645	63,790	113,139	39,513	5,855	151,542	152,473	3,180,525
	Transmission loss													5.20%

Annexure-01			
Energy consumption of Chillier plant bifurcation of Hostel and Academic			
Month	**Chiller Plant 2022**	**Consumption of Chiller Plant for Hostels 40% Approx.**	**Remarks**
	A	B=40% of A	
July	319,790	127916	Ratio of 40% considered with total HVAC consumption.
Aug	310,868	124347.2	
Sep	372,987	149194.8	
TOTAL	1,003,645	**401458**	

4th Quarter 2022							
Quarterly Energy Audit Comparison Report							
Energy performance Index (EPI) comparison with benchmark (kWh/Sq. meter/year)							
Climate Zone	**Building type**	**Bench mark value**	**Jan 22 to Mar 22**	**April 22 to June 22**	**July 22 to Sep 22**	**Oct-22 to Dec-22**	**Remarks for benchmark**
Hot and Dry	Academic buildings, Central Arcade & Sports complex	225	70	112	112	106	Customized Bench mark Value based on GRIHA Standard. Sports complex, Research park, is partially occupied during 2nd and 3rd quarters. EPI increased due to HVAC load and increase in occupation of hostel so far.
Hot and Dry	Hostels	70	33	34	35	27	GRIHA (All Hostels are not in use decrease in 2nd quarter due to students' vacation in 4th quarters HVAC indoor unit's load reduced)
Hot and Dry	Hostels HVAC	-	4	24	21	3	In 1st and 4th quarters Value of EPI is low as HVAC load for a small period only.
Hot and Dry	Research Park	90	12	29	32	27	
Hot and Dry	Guest House	275	30	23	27	30	
Hot and Dry	Utilities	-	4	4	3	4	New Areas added which is not fully occupied
Hot and Dry	Institute	111	55	82	83	68	Customized Bench mark Value based on GRIHA Standard EPI decreased in 1st and 4th quarters is due to reduction in HVAC load.

EPI of Academic Buildings, Central Arcade & Sports complex (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Academic Building 01 to 09, Central Arcade & Sports complex =(A)	kWh / Year	1,147,375	4,589,500	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	539,656	2,158,624	Table-01
3	Less Hostel Consumption for AC (C)	kWh / Year	103,463	413,852	Annexure-01
4	**Total (D) = (A+B-C)**	**kWh / Year**	**1,583,568**	**6,334,272**	
5	Built-up Area (E)	Sq. Meter	59,828	59,828	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**26.47**	**105.87**	**105.87**

EPI of Research park (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of Research park =(A)	kWh / Year	130,819	523,276	Table-01
5	Built-up Area (E)	Sq. Meter	19,070	19,070	
6	**EPI (F= D/E)**	**(kWh/Sq. Meter/Year)**	**6.86**	**27.44**	**27.44**

EPI of Hostel & Guest House Buildings (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	628,734	2,514,936	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	-	-	-
	Total C= (A+B)		**628,734**	**2,514,936**	
3	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel-1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**8.32**	**33.29**	**33.29**

EPI of Hostel HVAC (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	-	-	Table-01
2	Power consumption of HVAC Plant (B)	kWh / Year	51,732	206,928	Annexure-01
3	**Total C= (A+B)**		**51,732**	**206,928**	
4	Built-up Area (D)	Sq. Meter	75,542	75,542	New Hostel- 1,2,3,4,5 &6 + Old hostels Total= 39599+35943= 75542 SQM
5	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**0.68**	**2.74**	**2.74**

EPI of Guest House Buildings (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption inside Buildings =(A)	kWh / Year	73,880	295,520	Table-01
	Total C= (A+B)		**73,880**	**295,520**	
3	Built-up Area (D)	Sq. Meter	9,805	9,805	Built-up area
4	**EPI (E= C/D)**	**(kWh/Sq. Meter/Year)**	**7.53**	**30.14**	**30.14**

EPI of Utilities (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Power consumption of treatment plant =(A)	kWh / Year	121,075	484,300	Table-01
2	Power consumption for Street lights =(B)	kWh / Year	71,516	286,064	Table-01
3	**Total (C= A+B)**	**kWh / Year**	**192,591**	**770,364**	
4	Deduct energy consumed by bulk services in Housing Pro rata Basis (D)	**kWh / Year**	**31,668**	126,672	(59878 /228929) x Energy consumed for bulk service
5	**Total (E= C-D)**	**kWh / Year**	**160,923**	**643,692**	

6	Built-up Area (F)	Sq. Meter	169,051	169,051	Excluding Housing areas
7	**EPI (G= E/F)**	**(kWh/Sq. Meter/Year)**	**0.95**	**3.81**	**3.81**

EPI of Whole Campus (kWh/Sq. Meter/Year)

Oct-22 to Dec-22					
SL No	**Combinations**	**Unit**	**Quarterly**	**Yearly**	**Remarks**
1	Total Power consumption Buildings =(A)	kWh / Year	2,643,723	10,574,892	Table-01
	Deductions				
2	Deduct energy consumed by bulk services in Housing (B)	kWh / Year	31,668	126,672	(59878 /228929) x Energy consumed for bulk service
3	Power consumed by Shops (C)	kWh / Year	42,905	171,620	Table-01
4	Power consumed by Temporary connections (D)	kWh / Year	3,702	14,807	Table-01
5	**Total Deductions (E= B+C+D)**	kWh / Year	78,275	313,099	
6	**Total (F= A-E)**	**kWh / Year**	**2,565,448**	**10,261,793**	
7	Built-up Area (G)	Sq. Meter	149,981	149,981	Includes New Hostels (1,2,3,4,5,6, OAT & Mess), Guest House, Director resident, Central Arcade, Sports complex & Amphitheatre.
8	**EPI (H= F/G)**	**(kWh/Sq. Meter/Year)**	**17.11**	**68.42**	**68.42**

Annexure-01			
Energy consumption of Chillier plant bifurcation of Hostel and Academic			
Month	**Chiller Plant 2022**	**Consumption of Chiller Plant for Hostels 40% Approx.**	**Remarks**
	A	B=40% of A	
Oct	258,658	51731.6	Ratio of 20% considered with total HVAC consumption.
Nov	0	0	
Dec	0	0	
TOTAL	258,658	**51732**	

TABLE -01
Summary Sheet of Power Supply and Consumption.

	Supply			Consumption										
Month	Torrent Power	Solar Power	Total	Hostels	Guest house	Academic Area	Chiller Plant	Street light	Treat Plant (WTP STP WSC SPS CWPS)	Bank, Shops & Mobile tower	Temporary Connections to Construction agencies	Sports Complex	Research park	Total
	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh	kWh
Oct-22	995,150	58,693	1,053,843	226,713	25,172	363,276	258,658	23,518	40,819	18276.2	2,260	66,000	48325.00	1,073,017
Nov-22	834,550	53,070	887,620	206,863	22,687	303,884	144,830	22,150	42,008	12092.3	713	55,756	45981.00	856,964
Dec-22	777,275	55,804	833,079	195,158	26,021	312,639	136,168	25,848	38,248	12536.5	729	45,820	36513.00	829,681
Total	2,606,975	167,567	2,774,542	628,734	73,880	979,799	539,656	71,516	121,075	42,905	3,702	167,576	130,819	2,759,662
	Transmission loss													0.54%

Conclusion:

1. The energy consumption in 2022 has increased from 85,84,427 Kwh in 2021 to 1,12,67,403 Kwh. This increase is 23.81%. This is due to additional load of 300Kw for super computer installation and occupation of new buildings like New Hostels, Guest house, research park and sport complex.
2. The EPI of the entire campus works out to 72 kWh/Sq.m/year which is 14.28% more compared to that 2021 of 63 kWh/Sq.m/year. The increase is due to full occupation of the building compared to partial occupancy in 2021 due to COVID-19.
3. Average transmission losses are 2.88% which is within permissible limit.
4. Total solar generation in Year 2022 is 6% of the total energy against 7% in 2021 consumed from Torrent Power Ltd. This is due to increase in consumption on account of new buildings but no additional solar power system provided in 2022.

Recommendation:

1. Initially five Substation having 11 transformers having following capacities: (3 Nos – 1000 KVA, 6 Nos – 630 KVA, 2 Nos – 315 KVA) These were installed in phase 1 A construction.

2. 2 Nos substations have been added in Phase 1B (3 Nos – 1000 KVA and 2 Nos-800 KVA) and augmentation of two substation of phase 1 A (2 Nos-750 KVA in Hostel and 2 Nos – 1000 KVA in academic substation number No-1).

Sr. No	Substation	No of Transformer
1	Substation-1	5
2	Substation-2	2
3	Hostel	4
4	WTP	2
5	Infra	2
6	Sports complex	3
7	Research park	2
Total		**20**

Thus, at present – 7 Nos substation having 20 Transformer are in operation.
It is recommended to carry out Network analysis of the distribution system for effective relay setting for minimizing tripping occurrence.

3. The HVAC system in class rooms be integrated with IBMS and synchronized by schedule of occupancy of class room for auto shut off during no occupancy period.

Annexure-02			
Calculation of Customized EPI for IIT Gandhinagar			
Sr. No	**For** Academic buildings, Central arcade and sports complex	**EPI in kWh/Sq. Meter/year**	**Remarks**
1	GRIHA Bench mark for Daytime occupancy @24 Hrs./day 7 Days in a week, i.e. 168 Hrs. in a week)	225	kWh/Sq. Meter/year This Institute on average remains operational for 6 days and 14 hours per day. (GRIHA Version 2019 page-54)
2	**For IIT Gandhinagar Campus**	**Built-up Area in Sq. Mtr**	
3	Hostels	75542	
4	Academic Buildings		
i	Academic Buildings having laboratory	16599	
ii	Academic Buildings other than laboratory	28602	
5	Sports complex	8785	
6	Central arcade	5843	
7	Research park	19070	
8	Amphitheatre	4023	
9	Guest house	9805	
10	Director's residence	783	
11	Total Built-up area	**169052**	
12	Bench Mark for Hostel/Residential as per GRIHA	70	kWh/Sq. Meter/year
13	Actual increase due to Air conditioning	13	kWh/Sq. Meter/year
14	Benchmark for Institutional 5 Days a Week	90	kWh/Sq. Meter/year
14	Benchmark for Hospitality / Guest house	275	kWh/Sq. Meter/year
15	Derived Bench Mark for Hostels including HVAC	83	kWh/Sq. Meter/year
16	Derived EPI for Campus ((82*75542)+(225*16599)+(90*(28602+8785+5843+19070+4023))+(275*9805)+(70*783))/(169052)	((83*75542) +(225*16599) +(90*(28602+8785 +5843+19070+4023)) +(275*9805) +(70*783))/ (169052)	kWh/Sq. Meter/year
17	Derived Benchmark	111.27	kWh/Sq. Meter/year
	Say	**111**	kWh/Sq. Meter/year