

Energy Audit Report 2021-22



University of North Bengal



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The Energy Audit Team

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Certificate

This is to certify that the energy audit in the electrical utilities of the University of North Bengal has been carried out by our team in order to identify the energy consumption patterns and identify opportunities to improve the energy efficiency on the University campus.



Signature

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Summary

The energy audit takes a constructive approach that aims for constant improvement in energy usage. It offers the required data foundation for the overall energy conservation strategy, primarily covering the study of energy utilization and assessment of energy-saving solutions while maintaining or improving human comfort, health, and safety.

The present report accounts for the energy consumption patterns of the university campus and provides a detailed analysis of the data. Our team carried out the analysis with the help of staff members from the Engineering Branch of the university. In order to compare the consumption for the summer and winter seasons for the years 2021–22, a thorough audit of the energy consumption at various sectors on the university campus has been prepared. For clear understanding of the progress after implementing some of the recommendations of the previous energy audit, the data for two previous years are also analyzed.

The report includes a list of possible recommendations to conserve and efficiently access the available resources. Some daily practices relating to the use of common electrical appliances have also been suggested, which are expected to reduce energy consumption without affecting normal daily activities.

Introduction: The University of North Bengal has three campuses. The main campus is located alongside the Asian High Way 2 in the Darjeeling district of West Bengal, near Siliguri. It spreads across an area of about 331 acres. The second campus has developed over an area of 36.14 acres in Jalpaiguri. The other campus is in Salt Lake, Kolkata. The layout of the main campus of the university has been designed with academic, administrative, sports/recreational, residential, and other requirements in mind.

The departments, research Centres and various administrative branches of the university are hosted at various buildings across the campus. The main campus has three hostels for girls and two hostels for boys. Besides these, the infrastructure facilities, such as Health Centre, Gymnasium, Sports Grounds, Guest houses, auditoriums, canteens, faculty club, bank, post office, and library, are present on the main campus. The main campus is a residential one. The university provides residential facilities for teachers, officers, and non-teaching employees on the campus.

The amount of energy consumption at the campuses of university of North Bengal is huge; the cost of the university's energy use is just about two crore rupees per year. Both environmental and economic concerns demand for various efforts towards reducing energy consumption in the campus without compromising people's safety, health, and comfort.

The main goal of this energy audit is to make NBU campus energy efficient. As we know an energy audit is a systematic process of assessing and analysing energy usage and identifying opportunities for energy efficiency improvements in a building, facility, or industrial process. It involves evaluating energy consumption patterns, identifying areas of energy wastage, and recommending strategies to reduce energy consumption and improve overall energy performance.

The need for an energy audit stems from the desire to reduce costs, improve energy efficiency, comply with regulations, mitigate environmental impact, optimize equipment performance, manage risks, and create healthier and more comfortable environments. By conducting an energy audit, individuals and organizations can gain valuable insights into their energy consumption patterns and take steps toward a more sustainable and efficient energy future. Energy audits in educational institutions will help to better understand how energy and fuel are used in each characteristic, and help identify where vehicle waste occurs and where there is room for improvement.

If one is concerned with cost control or savings in any of the above, energy will always appear at the top of the list, so energy management is an important area for cost reduction. Energy monitoring will provide better guidance for energy cost reduction, preventive maintenance and quarterly activities that are important for production and operations. Such a research process will help to maintain focus on the various changes that occur in electricity costs, the availability and reliability of electricity, to decide on the energy mix in the near future, to determine the potential of energy conservation technologies, upgrading energy-saving equipment, etc.

Existing practices for saving energy consumption in the university:

1. Replacement of incandescent bulbs and fluorescent tube lights by energy efficient light-emitting diode (LED) bulbs/tubes.
2. Replacement of old fans or other equipment with new energy efficient fans or equipment.

ENERGY MANAGEMENT

Main Campus of NBU:

Contract Demand with WBSEDCL	1000 KVA		
Transformer Capacity	1065 KVA		
Diesel Generator Set Capacity in campus	900 KVA		
Electricity Consumption per year	2019-2020	2020-2021	2021-2022
Electricity Consumption per year in Kwh	2083176 Kwh	1422188 Kwh	1663850 Kwh
Electricity Cost per year in Rs.	Rs. 1,91,23,559	Rs. 1,46,44,442	Rs. 1,60,02502
Diesel Consumption per year	1680.5 Ltrs	1950 Ltrs	1400 Ltrs

Jalpaiguri Campus of NBU:

Contract Demand with WBSEDCL	400 KVA
Transformer Capacity	250 KVA
Diesel Generator set Capacity in campus	At present no DG service at the campus

Data Analyzation and visualization

Details of the approximate load distribution at NBU main Campus												
YEAR 2019-2020												
Sl.No.	Department	No. of Tubes	No. of A/C	No. of Fans	No. of Projectors	No. of Photo-copiers	Computer s + Printers	Water Purifiers	LED tubes + Bulbs	Geysers	Sodium vapor	LED Street light
1	Arts Department	1335	16	632	32	33	297	27	75	NA	—	—
2	Science Department	1549	76	819	15	22	365	28	230	NA	—	—
3	Centres	137	6	100	2	4	35	3	28	NA	—	—
4	Service & maintenance Departments	16	1	27	0	4	15	2	38	NA	—	—
5	Library & Library Science	431	5	257	1	6	82	4	0	NA	—	—
6	Administrative building	0	26	259	3	29	141	5	444	1	—	—
7	Guest House	563	14	209	NA	NA	1	11	0	18	—	—
8	PG Hostels	1421	NA	907	NA	NA	NA	31	0	6	—	—
9	RS Hostel	251	NA	79	NA	NA	NA	6	0	2	—	—
10	Faculty Club & Mancho	313	NA	140	NA	NA	NA	1	74	NA	—	—
11	Museum	204	NA	40	NA	1	3	1	0	NA	—	—
12	Residence for Teachers,	1225	5	625	0	0	140	110	560	50	—	—
13	Street Light	—	—	—	—	—	—	—	—	—	104	340
Total		7445	149	4094	53	99	1079	229	1449	77	104	340
Total Consumption in Watt		268020	298000	307050	3710	64350	215800	6870	26082	154000	20800	23800
Per day Consumption in Watt-hr (8 Hrs/ day). <i>(Projectors arenot use for 8 hrs per day we assume that may be used 5 hrs per day)</i>		2144160	2384000	2456400	29680	514800	1726400	54960	208656	1232000	166400	190400
Per day Consumption in Kwh		2144.16	2384	2456.4	29.68	514.8	1726.4	54.96	208.656	1232	166.4	190.4
Per month Consumption in Kwh (Avg. 22 working day for departments and 30 days for street light). <i>Projectors arenot use for daily basis we assume projector may be used 10days/month)</i>		47171.52	52448	54040.8	148.4	11325.6	37980.8	1209.12	4590.43	27104	4992	5712
Per month Consumption at Summer Season in Kwh (April to October Total days of summer = 214 days we assume that total working days in summer season 120 days. For street lights total 214 days)		257299.2	286080	294768	—	61776	207168	6595.2	25038.7	—	35609.6	40745.6
Per month Consumption at Winter Season in Kwh (November to March Total days of Winter = 151 days we assume that total working days in summer seation 120 days. For street lights total 151 days)		257299.2	—	—	—	61776	207168	6595.2	25038.7	147840	25126.4	28750.4
Per year Consumption in Kwh (240 working days for light,water purifier,computer, 160 day for fan & AC, 120 days for geyser, 200 days for projector and 365 days for street lights)		514598.4	286080	294768	5936	123552	414336	13190.4	50077.4	147840	60736	69496

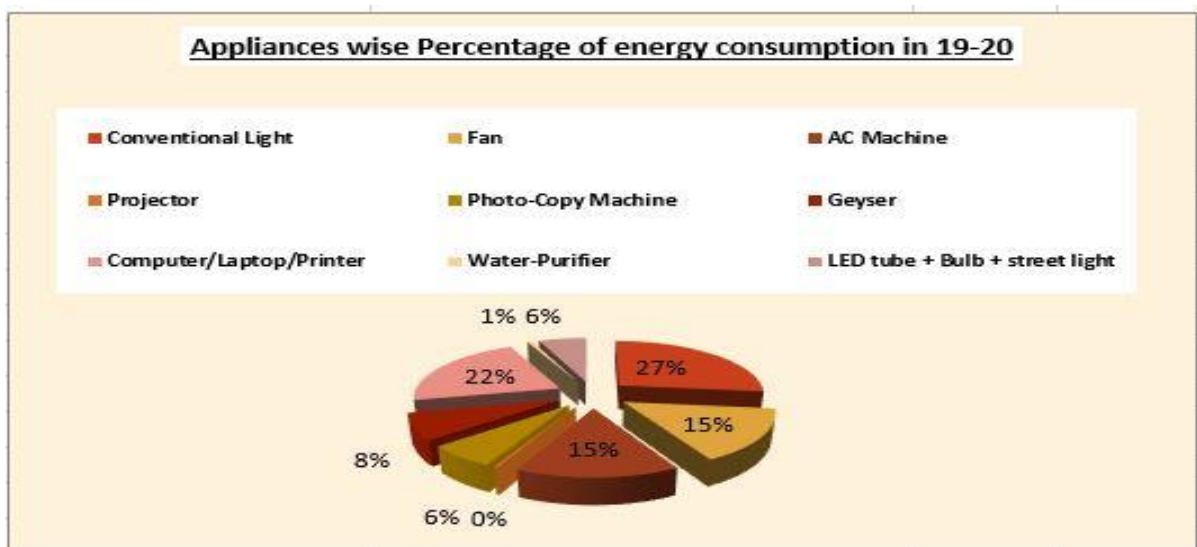
Load calculation of year 2019-2020	Unit in Kwh	Total Cost in Rs.
Total load consumption (Kwh) in summer season	1215080.32	13487391.55
Total load consumption (Kwh) in Winter season	759593.92	8271977.789
Total load consumption (Kwh) of 1 year	1974674.24	21759369.34

The above tabular sheet showed the total equipment of the various departments in the year 2019–20. Those may be in operation for an average of 8 hours per day. The tabular sheet also showed the approximate calculation of consumption and cost per year. As per WBSEDCL the HT tariff rates

vary in different seasons (i.e., summer, monsoon, and winter). We try to present the percentage of uses of various equipment year-wise in a pie chart, which is given below.

Percentage of present Energy Consumption by various Electrical Appliances wise in the Year of 2019-2020 (Approx.)

Equipment	Energy Consumption in Kwh/year (19-20)
Conventional Light	514598
Fan	294768
AC Machine	286080
Projector	5936
Photo-Copy Machine	123552
Geyser	147840
Computer/Laptop/Printer	414336
Water-Purifier	13190.4
LED tube + Bulb + street light	119573



It is found from the above pie chart that in the year 2019–2020 the energy consumed by the conventional light is 27% of the total energy usage whereas the LED light consumes only 6% of the total utilized energy.

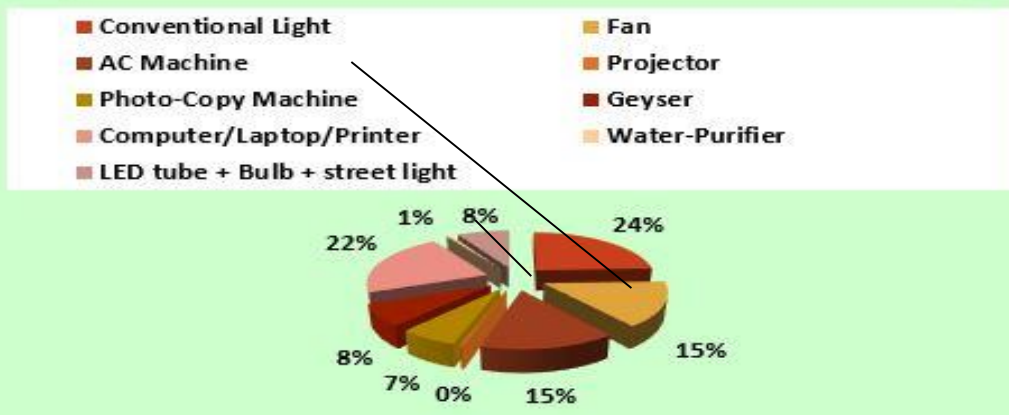
Details of the approximate load distribution at NBU main Campus												
YEAR 2020-2021												
Sl.No.	Department	No. of Tubes	No. of A/C	No. of Fans	No. of Projectors	No. of Photocopiers	Computers + Printers	Water Purifiers	LED tube + bulbs	Geysers	Sodium vapor	LED Street light
1	Arts Department	952	16	632	32	33	297	27	454	NA	—	—
2	Science Department	1369	76	819	15	22	365	28	410	NA	—	—
3	Centres	129	6	100	2	4	35	3	36	NA	—	—
4	Service & maintenance Departments	13	1	27	0	4	15	2	41	NA	—	—
5	Library & Library Science	431	5	257	1	6	82	4	0	NA	—	—
6	Administrative	0	26	259	3	29	141	5	444	1	—	—
7	Guest House	563	14	209	NA	NA	1	11	37	18	—	—
8	PG Hostels	1421	NA	907	NA	NA	NA	31	0	0	—	—
9	RS Hostel	251	NA	79	NA	NA	NA	6	0	0	—	—
10	Faculty Club & Mancho	313	NA	140	NA	NA	NA	1	74	NA	—	—
11	Museum	204	NA	40	NA	1	3	1	0	NA	—	—
12	Residence for Teachers, Officers & Staffs	1025	5	532	0	0	145	120	760	55	—	—
13	Street Light	—	—	—	—	—	—	—	—	—	54	390
Total		6671	149	4001	53	99	1084	239	2256	74	54	390
Total Consumption in Watt		240156	298000	300075	3710	64350	216800	7170	40608	148000	10800	27300
Per day Consumption in Watt-hr (8 Hrs/ day). <i>(Projectors are not use for 8 hrs per day we assume that may be used 5 hrs per day)</i>		1921248	2384000	2400600	29680	514800	1734400	57360	324864	1184000	86400	218400
Per day Consumption in Kwh		1921.248	2384	2400.6	29.68	514.8	1734.4	57.36	324.864	1184	86.4	218.4
Per month Consumption in Kwh <i>(Avg. 22 working day for departments and 30 days for street light). Projectors are not use for daily basis we assume projector may be used 10days/month)</i>		42267.456	52448	52813.2	296.8	11325.6	38156.8	1261.92	7147.008	26048	2160	5460
Per month Consumption at Summer Season in Kwh <i>(April to October Total days of summer = 214 days we assume that total avg working days in summer season 120 days. For street lights total 214 days)</i>		230549.76	286080	288072	—	61776	208128	6883.2	38983.68	—	18489.6	46737.6
Per month Consumption at Winter Season in Kwh <i>(November to March Total days of Winter = 151 days we assume that total avg working days in winter season 120 days. For street lights total 151 days)</i>		230549.76	—	—	—	61776	208128	6883.2	38983.68	142080	13046.4	32978.4
Per year Consumption in Kwh <i>(240 working days for light, water purifier, computer, 160 day for fan & AC, 120 days for geyser, 200 days for projector and 365 days for street lights)</i>		461099.52	286080	288072	5936	123552	416256	13766.4	77967.36	142080	31536	79716

Load calculation of year 2020-2021	Unit in Kwh	Total Cost in Rs.
Total load consumption (Kwh) in summer season	1185699.84	13161268.22
Total load consumption (Kwh) in Winter season	701447.04	7638758.266
Total load consumption (Kwh) of 1 year	1887146.88	20800026.49

Percentage of present Energy Consumption by various Electrical Appliances wise in the Year of 2020-2021 (Approx.)

Equipment	Energy Consumption in Kwh/year (20-21)
Conventional Light	461099.5
Fan	288072
AC Machine	286080
Projector	5936
Photo-Copy Machine	123552
Geyser	142080
Computer/Laptop/Printer	416256
Water-Purifier	13766
LED tube + Bulb + street light	157683

Appliances wise Percentage of energy consumption in 20-21



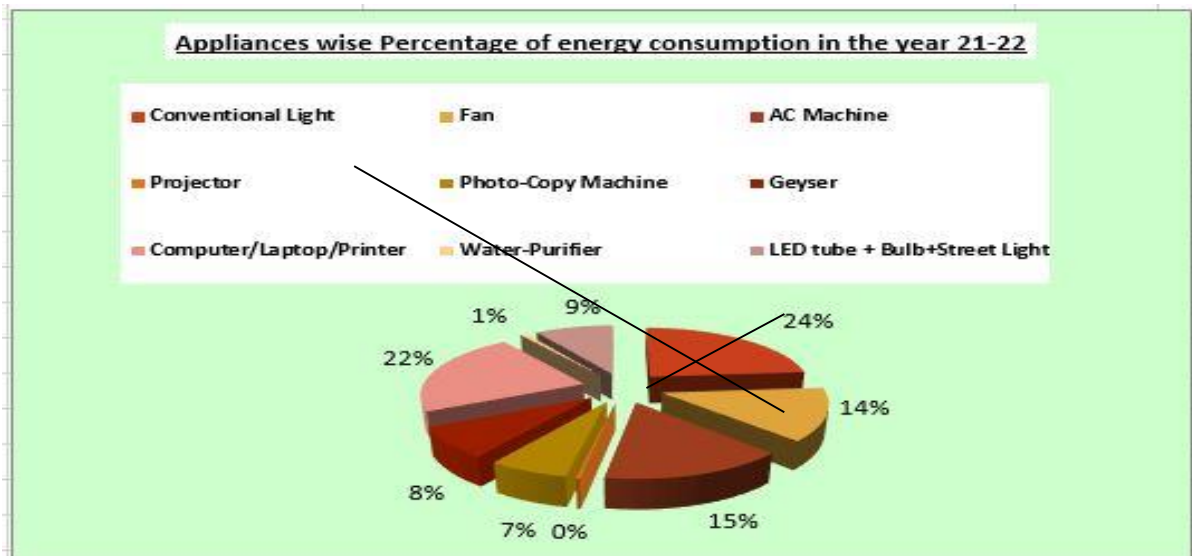
One may notice from this pie chart that the number of LED light is increased from the previous year (2019-2020).

Details of the approximate load distribution at NBU main Campus												
YEAR 2021-2022												
Sl.No.	Department	No. of Tubes	No. of A/C	No. of Fans	No. of Projectors	No. of Photo-copiers	Computers + Printers	Water Purifiers	LED tube+bulb	Geysers	Sodium vapor	LED Street light
1	Arts Department	942	16	632	32	33	297	27	464	NA	-	-
2	Science Department	1285	76	819	15	22	365	28	583	NA	-	-
3	Centres	127	6	100	2	4	35	3	38	NA	-	-
4	Service & maintenance Departments	8	1	27	0	4	15	2	47	NA	-	-
5	Library & Library Science	370	5	257	1	6	82	4	61	NA	-	-
6	Administrative building	0	26	259	3	29	141	5	444	1	-	-
7	Guest House	549	14	209	NA	NA	1	11	51	18	-	-
8	PG Hostels	1421	NA	907	NA	NA	NA	31	0	0	-	-
9	RS Hostel	251	NA	79	NA	NA	NA	6	0	0	-	-
10	Faculty Club & Mancho	313	NA	140	NA	NA	NA	1	74	NA	-	-
11	Museum	204	NA	40	NA	1	3	1	0	NA	-	-
12	Residence for Teachers, Officers & Staffs	930	5	480	0	0	145	120	760	60	-	-
13	Street Light	-	-	-	-	-	-	-	-	-	24	420
Total		6400	149	3949	53	99	1084	239	2522	79	24	420
Total Consumption in Watt		230400	298000	268532	3710	64350	216800	7170	45396	158000	4800	29400
Per day Consumption in watt/hr (8 Hrs / day) (Projectors)		1843200	2384000	2148256	29680	514800	1734400	57360	363168	1264000	38400	235200
Per day Consumption in Kwh		1843.2	2384	2148.256	29.68	514.8	1734.4	57.36	363.168	1264	38.4	235.2
Per month Consumption in		40550.4	52448	47261.63	296.8	11325.6	38156.8	1261.92	7989.7	27808	960	5880
Per month Consumption at Summer Season in Kwh (April to October Total days of		221184	286080	257790.7	-	61776	208128	6883.2	43580.2	-	8217.6	50332.8
Per month Consumption at Winter Season in Kwh (November to March Total days of Winter = 151 days we assume that total avg working days in summer seation 120 days . For street lights total 151 days)		221184	-	-	-	61776	208128	6883.2	43580.2	151680	5798.4	35515.2
Per year Consumption in Kwh (240 working days for light,water purifier,computer, 160 day		442368	286080	257790.7	5936	123552	416256	13766.4	87160.3	151680	14016	85848

Load calculation of year 2019-	Unit in Kwh	Total Cost in Rs.
Total load consumption	1143972.48	12698094.53
(Kwh) in Winter season	734544.96	7999194.614
(Kwh) of 1 year	1878517.44	20697289.14

Percentage of present Energy Consumption by various Electrical Appliances wise in the Year of 2021-2022 (Approx.)

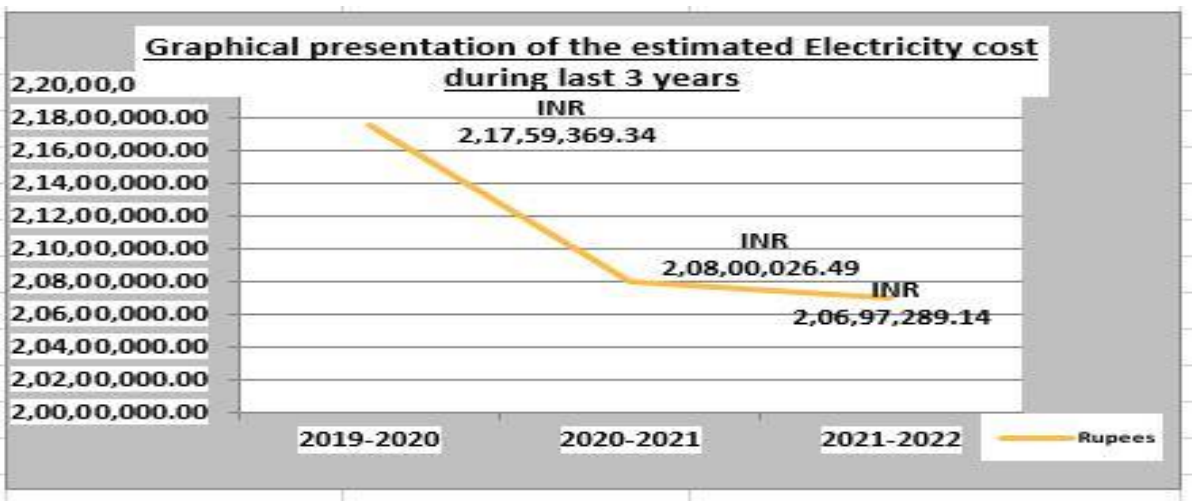
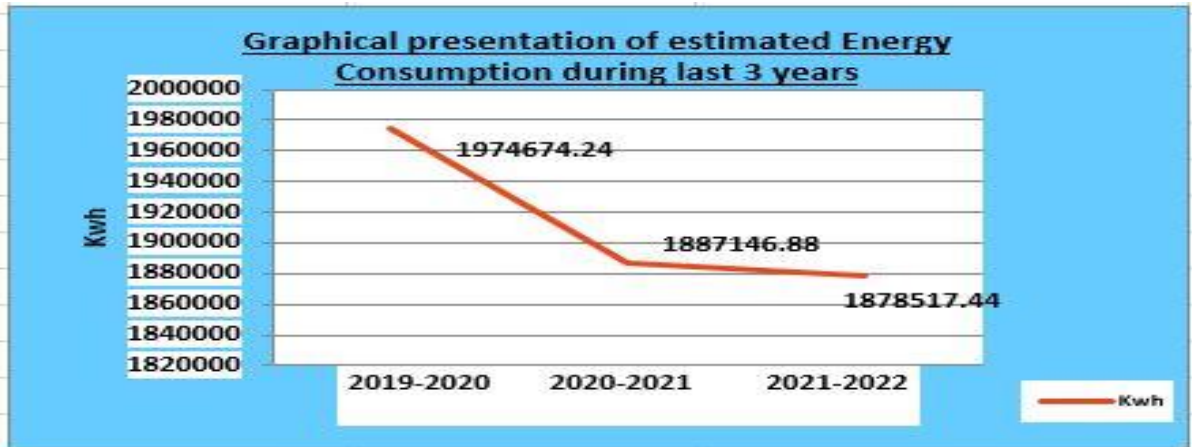
Equipment	Energy Consumption in Kwh/year (20-21)
Conventional Light	442368
Fan	257791
AC Machine	286080
Projector	5936
Photo-Copy Machine	123552
Geyser	151680
Computer/Laptop/Printer	416252
Water-Purifier	13766
LED tube + Bulb+Street Light	173008



The number of LED bulbs at various departments in the university increase during the last two years. The above chart together with the similar charts for last two years reflect the fact that the use/installation of conventional light has decreased gradually.

Estimated Energy of Consumption and Electricity Cost (Approx.) during the last 3 years (2019-2022)

YEAR	Kwh Per Year	Electricity Cost in Rs. Per year
2019-2020	1974674.24	2,17,59,369.34
2020-2021	1887146.88	2,08,00,026.49
2021-2022	1878517.44	2,06,97,289.14



The above figure shows that the estimated approximate consumption and energy cost for the equipment list given above. It can be seen from the above figure that the consumption and annual energy cost is decreasing with time.

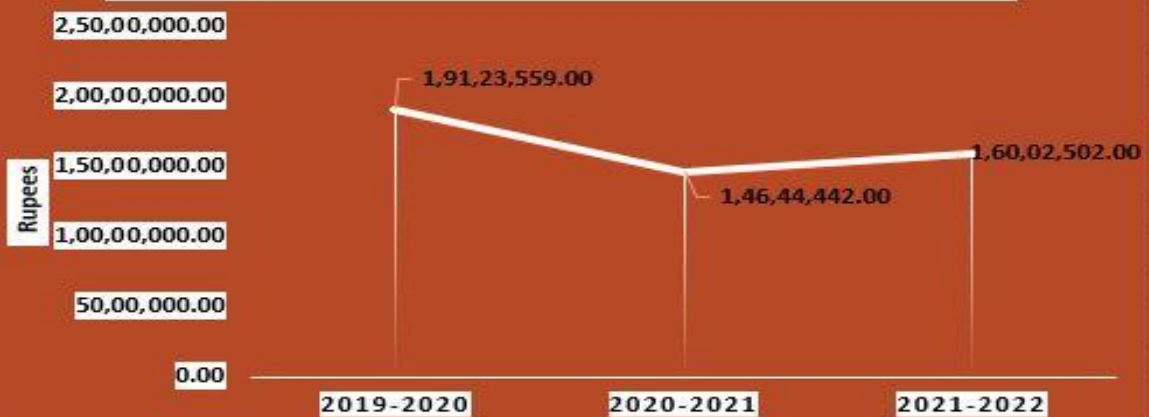
Actual Energy Consumption and Electricity Cost during the last 3 years

YEAR	Kwh Per Year	Electricity Cost in Rs. Per year
2019-2020	2083176	1,91,23,559.00
2020-2021	1422188	1,46,44,442.00
2021-2022	1663850	1,60,02,502.00

ACTUAL ENERGY CONSUMPTION DURING THE LAST 3 YEARS



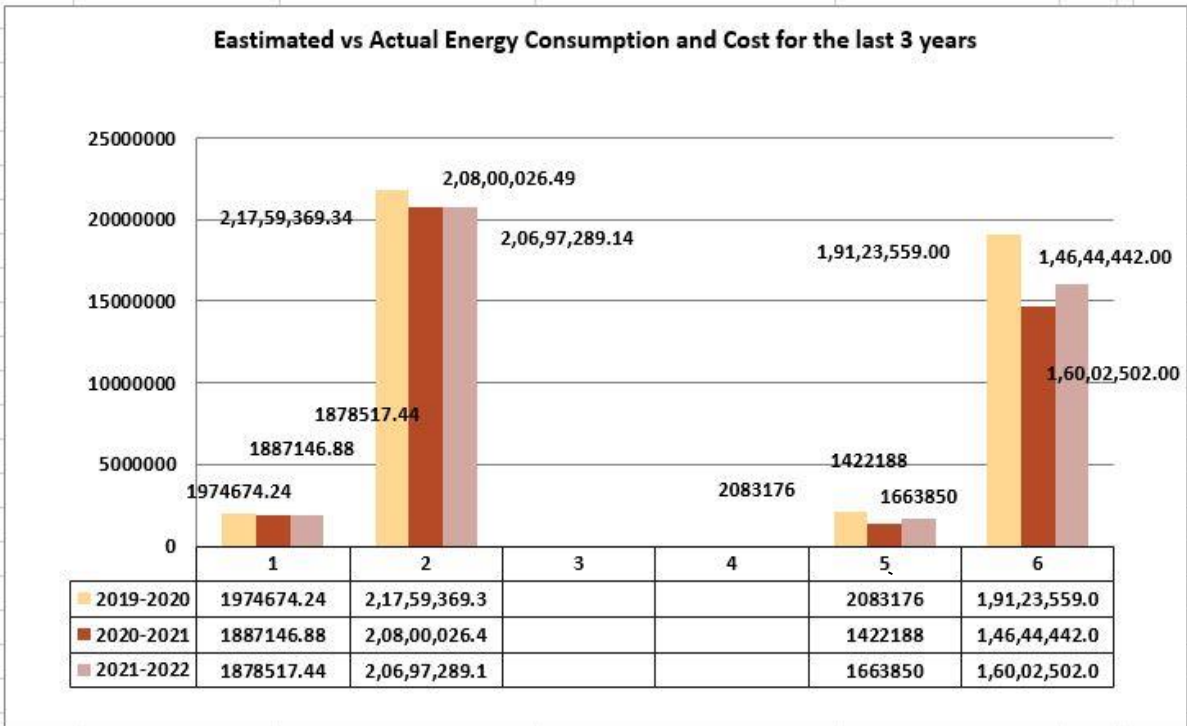
ACTUAL ENERGY COST DURING THE LAST 3 YEARS



In the above figure, we show the actual consumption and energy bills of the University during last three years. It can be seen that the consumption and the energy cost for the year 2020-2021 were substantially lower, which is due to Covid-19 pandemic (the offline academic activities were suspended for a few months).

Graphical chart of estimated vs Actual Energy Consumption and Cost for the last 3 years

YEAR	2019-2020	2020-2021	2021-2022
Kwh Per Year	1974674.24	1887146.88	1878517.44
Electricity Cost in Rs. Per year (Approx)	2,17,59,369.34	2,08,00,026.49	2,06,97,289.14
Kwh Per Year	2083176	1422188	1663850
Electricity Cost in Rs. Per year (Actual bill)	1,91,23,559.00	1,46,44,442.00	1,60,02,502.00



The estimated and the actual consumption of electric energy during the last three years. The column 1 and 2 describe the estimated energy consumption and cost respectively, whereas the column 5 and 6 show the actual energy consumption and cost.

Recommendations:

1. The prevailing policy of replacing incandescent bulbs and fluorescent tube lights by energy efficient light-emitting diode (LED) bulbs in phase wise manner to be continued.
2. The existing practice of replacing old fans by new energy efficient fans in phase wise manner to be continued.
3. Master switch may be installed outside each of the classrooms/office rooms.
4. Regular arrangement of awareness program on saving energy. "Energy club" may be formed in the university.
5. A few energy-efficient brushless direct current motor (BLDC) fan may be installed for testing the performance.
6. Motion-sensor light may be used in corridors etc. at some places for testing the performance.
7. Judicious use of air conditioners. Curtains to be used in AC rooms.
8. Turn off electrical equipment when not in use.
9. Maintain appliances and replace old appliances.
10. Installation of solar water heaters at university guest houses, hostels and residential quarters.
11. A 1000 KW grid connected Solar Power Plant at the roof top of various buildings of this University has been installed but it is not yet functioning. The WBSEDCL and NBDD may be approached for early commissioning and operation of the plant.

A special note:

The university has a total of 149 ACs of different types, including split, tower, and window types, which make up a very large part of the total energy consumption of the campus. But, at many places, it was found that ACs are not used with the best recommended energy-saving practices, such as insulation. Also, at certain places, AC is found to be used without curtains. These poor practices account for the increase in AC load and, thus, consumption.

Proper maintenance and cleaning of ACs are required regularly to make them work at their highest efficiency. Any dirt in the filter may reduce efficiency of ACs very significantly. Also, if the ampere of an AC is found more than 12A, then the AC machine requires to be replaced immediately.

The ACs should be switched on 15 minutes before actual use and should be switched off before leaving the room.

Saving calculation on replacement of LED lights

Luminous efficacy is the measure of the number of lumens a bulb produces per watt i.e., how much visible light is produced compared to the power consumed. If we compare Crompton LED Battens against traditional tube lights, we get the following results:

- 40W tube light churns out approx. 1900 lumens for 36 watts.
- 18W Crompton LED Batten easily produces over 1800 to 2000 lumens for 18 watts. An LED Batten consumes less than half the power to match the light produced by a conventional tube light.