Energy audit 2023

MAY 16

KHALSA COLLEGE AMRITSAR
Authored by: NAVJYOT SINGH

ENERGY MANAGEMENT

The fundamental goal of energy management is to produce goods & provide services with the least cost & least environmental effects. Energy is one of the major inputs for the economic development of any country. The fundamental goal of energy management is to produce goods & provide services with the least cost & least environmental effects.

"The strategy of adjusting & optimizing energy, using systems & procedures so as to reduce energy requirements per unit of output while holding constant or reducing total cost of producing the output from these systems"

The objective of energy management is to achieve & maintain optimum energy procurement & utilization, throughout the organization and:

To minimize energy cost / waste without affecting production & quality.

To minimize environmental effects.

ELECTRICAL ENERGY

Energy resources utilized by all the departments, support services & the administrative buildings of *"KHALSA COLLEGE AMRITSAR"* including electricity, solar energy & liquid fuels as Diesel. Major use of energy is at office, canteen, hostel & laboratories, for electricity, cooking & workshop instruments. Electricity is supplied to the college by Punjab Electricity Board & the tariff rate is 6.63 / kwh. The communication process for awareness in relation to energy conservation is found to be inadequate.

- Regular monitoring of equipment and immediate rectification of any problems.
- Conduct more save energy awareness programs for students & staff.
- Observe a power saving day every year.
- Automatic power switch off system should be introduced.
- Use of APFC panel for 3-Phase pumps.

ABOUT THE LOCATION

FACILITY INFORMATION	
FACALITY TYPE	*COMMERCIAL / INSTITUTIONAL*
TYPE	*EDUCATION*
PREPARED FOR	*KHALSA COLLEGE AMRITSAR*
PREPARED BY	*ECO PARYAVARAN*
FACILITY NAME	*KHALSA COLLEGE*
CITY	*AMRITSAR*
STATE	*PUNJAB*

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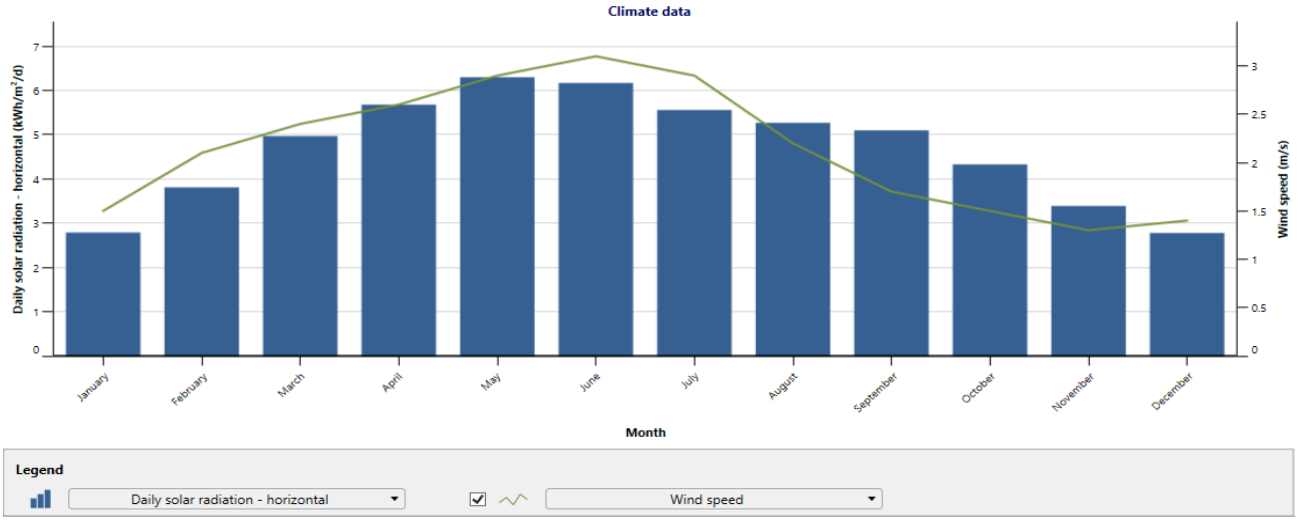
CLIMATE DATA ACCORDING TO LOCTION

			Unit	Climate data location		Facility location		Source	
Latitude				31.5		31.6			
Longitude				74.4		74.8			
Climate zone				1B-Very hot-D				Ground+NASA Ground - Map	
Elevation			m	217		232			
Heating design temperature			*c	5				Ground	
Cooling design temperature			*c	41.8				Ground	
Earth temperature amplitude			*c	25.1				NASA	
Month	Air temperature	Relative humidity	Precipitation	Daily solar radiation horizontal	Atmospheric presure	Wind speed	Earth temperature	Heating degree-days 18*C	Cooing degree-days 10*C
	*C	%	mm	kWh/m2/d	kPa	m/s	oc	*C-d	*C-d
January	12.8	70.90%	17.98	2.79	99.2	1.5	11.3	161	87
February	15.4	64.10%	32.2	3.81	99.0	2.1	14.7	73	151
March	20.5	58.40%	27.28	4.97	98,7	2.4	21.4	0	326
Apri	26.8	45.20%	17.1	5.68	98.2	2.5	28.9	0	504
May	31.2	39.50%	16.12	6.30	97.8	2.9	36.2	0	657
June	33.9	50.50%	55.20	6.17	97.3	3.1	39.4	0	717
Juy	31.5	72.60%	152.21	5.56	97.4	2.9	36.6	0	667
August	30.7	74.70%	141.67	5.27	97.6	2.2	33.4	0	642
September	29.7	70.50%	61.2	5.1	98.0	1.7	30.9	0	591
October	25.6	61.20%	13.02	4.33	98.6	1.5	24.9	0	484
November	19.5	62.30%	5.4	3.39	99.1	1.3	18.4	0	285
December	14.2	67.90%	12.4	2.78	99.3	1.4	13.1	118	130
Annual	**24.4**	**61.60%**	**551.78**	**4.68**	**98.4**	**2.1**	**258**	**352**	**5,240**
Source	Ground	Ground	NASA	Ground	Ground	Ground	NASA	Ground	Ground
Measured at					m	10	0		



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Graphical Representation of Solar Radiation & Wind Speed Month Wise

BENCHMARK- COMMERCIAL / INSTITUTIONAL- EDUCATION

FACALITY SIZE	1,200,000 m^2

ENERGY USE INTENSITY

BENCHMARK	13 Kwh/m^2
Minimum (Typical)	11 Kwh/m^2
Maximum (Typical)	12
Base case	13
Reference year	2022
SET TARGET	
Year	2023
Target	-10%
Proposed case	11.7 Kwh/m^2
Facility – plan	Annual
Energy consumption	kwh
Base case	1560000
Proposed case	1404000
Energy saved	156000 kwh

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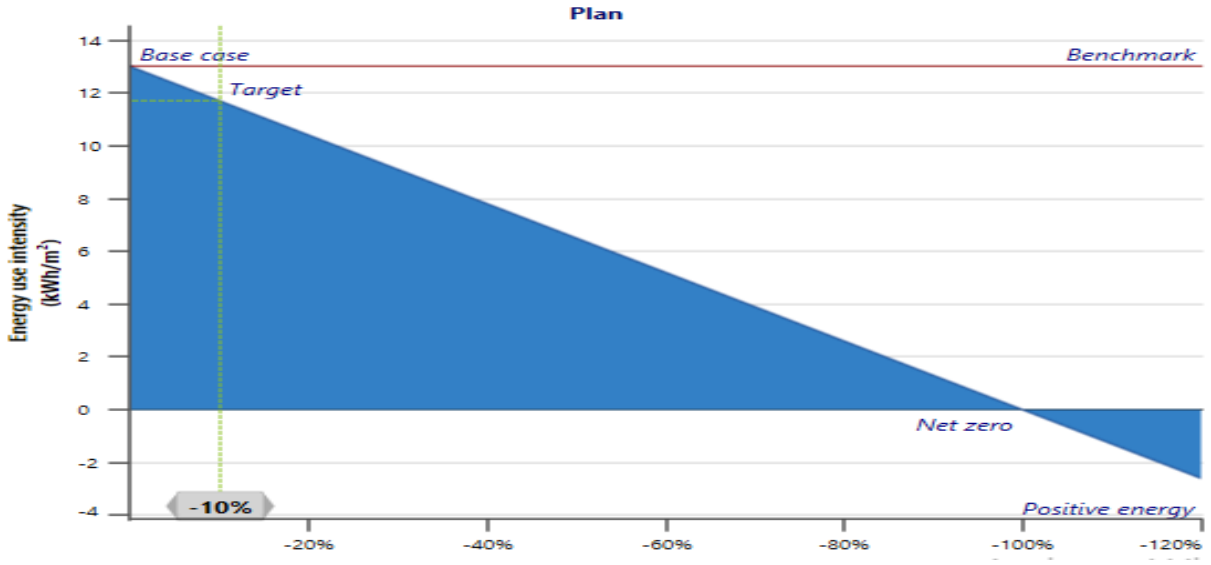

SOLAR WATER HEATING SYSTEM

Solar water heaters -- sometimes called solar domestic hot water systems -- can be a cost-effective way to generate hot water. They can be used in any climate, and the fuel they use -- sunshine -- is free. There are solar water boilers in the facility. Following is the comparison of solar heater with electricity.

Calculations for electrical water heating system

Hot water - Method 1

		Base case	Proposed case	Energy saved
☑ **Load type - calculator**		Other		
Hot water use	L/d	2,000	2,000	
Temperature	°C	70	70	
Supply temperature method		Formula		
Water temperature - minimum	°C	20.3		
Water temperature - maximum	°C	27.7		
Operating hours	h/d	7	7	
Heat recovery efficiency	%			
☑ **Percent of month used**				
January		100%	100%	
February		100%	100%	
March		70%	70%	
April		50%	50%	
May		5%	5%	
June		2%	2%	
July		2%	2%	
August		5%	5%	
September		30%	30%	
October		35%	35%	
November		45%	45%	
December		85%	85%	
Incremental O&M savings	INR			
Heating system		Water heater	Water heater	
Heating	kWh	5,167	5,167	0
				0%

From the above data we observe that 2000 L of hot water is used, which is different every month. According to the usage 5,167 Kw/h of electricity is used every month. The current tariff rate is Rs. 6.63, so the approximate cost would be RS.34257/ month.

Calculations for solar water heating system

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Solar water heater

Load characteristics

Hot water		Hot water
Temperature	°C	
Heating	kWh	

Resource assessment

Solar tracking mode		Fixed
Slope	°	25
Azimuth	°	0

Show data

Solar water heater

Type		Glazed
Manufacturer		
Model		
Gross area per solar collector	m^2	3.5
Aperture area per solar collector	m^2	3.5
Fr (tau alpha) coefficient		0.72
Fr UL coefficient	$(W/m^2)/°C$	0.02
Temperature coefficient for Fr UL	$(W/m^2)/°C^2$	
Number of collectors - suggested		
Number of collectors		4
Solar collector area	m^2	14
Capacity	kW	9.8
Miscellaneous losses	%	

Balance of system & miscellaneous

Storage	yes/no	Yes
Storage capacity / solar collector area	L/m^2	85.76
Storage capacity	L	1,201
Heat exchanger	yes/no	No
Miscellaneous losses	%	1%
Pump power / solar collector area	W/m^2	0
Electricity rate	INR/kWh	6.63
Initial costs	INR	2,00,000
O&M costs (savings)	INR	

Summary

From the above data we absorb that there is no solar water boiler is installed in the facility. And as per our recommendations 60% of water boilers (each having the capacity of 300 LPD) should be replaced with solar boilers.

Solar boiler details are as follows

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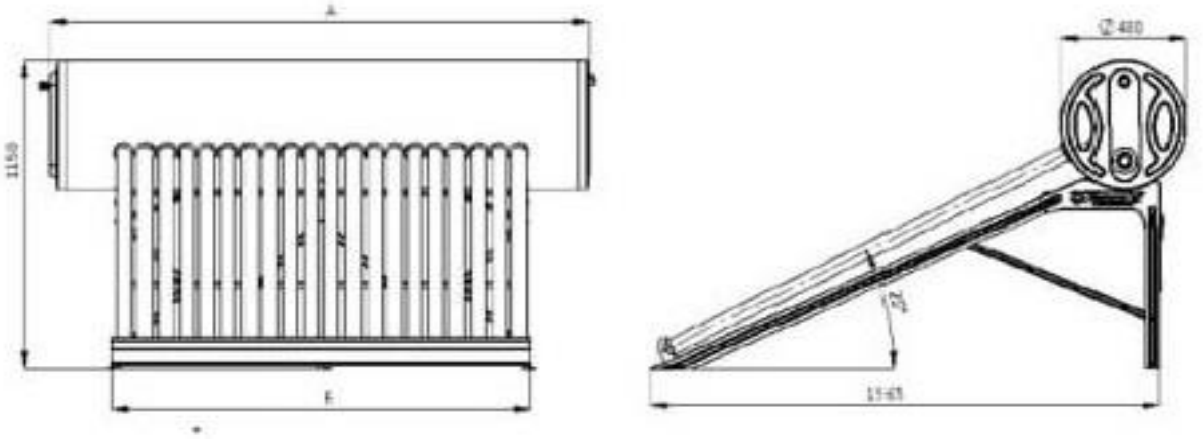
Technical specification of 300L solar water boiler

TECHNICAL SPECIFICATION OF ALPHA PRO						
Parameter		VTC 100 L	VTC 150 L	VTC 200 L	VTC 250 L	VTC 300 L
Angle of Stand	°	25				
Heating Element		Optional				
Anode provision (Ø21.3x 165mm)	No	1	1	1	1	1
Corrosion Protection		Mg Anode, Dia.21 x 165mm				
Inlet with 3/4"	nos	1	1	1	1	1
Vent Pipe (Bottom)	nos	1	1	1	1	1
Outlet (Bottom Opening D47)	nos	3/4"	3/4"	3/4"	3/4"	3/4"
Base Length (L)	mm	1965	1965	1965	1965	1965
Base Width (B)	mm	812	1212	1612	2012	2412
Height (H)	mm	1150	1150	1150	1150	1150
Tank Length (A)	mm	1197	1597	2097	2647	3047



Total number of solar panels	=	4
Capacity of individual panel	=	300 LPD
Cost of installation	=	Rs. 2,00,000 (approx.)
Electrical units used per month	=	5167
Total cost per month	=	34360
Recommended solar boilers	=	60%
Reduction of electrical units	=	2066.8
Total saving	=	20616
Payback time	=	Less than 10 months

STREET LIGHTS

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Streets lights are important part of energy management. It is observed that the institution has adopted the solar street lights

The wattage of solar light	=	30 W.
Total lights are	=	68,
so total wattage	=	2040 W or 2.04 KW
One unit of electricity	=	1000 W/h
Operating hours	=	12hr
Units consumed in one day	=	32
Units consumed in one month	=	960
Electrical charges of one month	=	Rs.6345

As the institution is using the solar streets lights so this amount is saved.

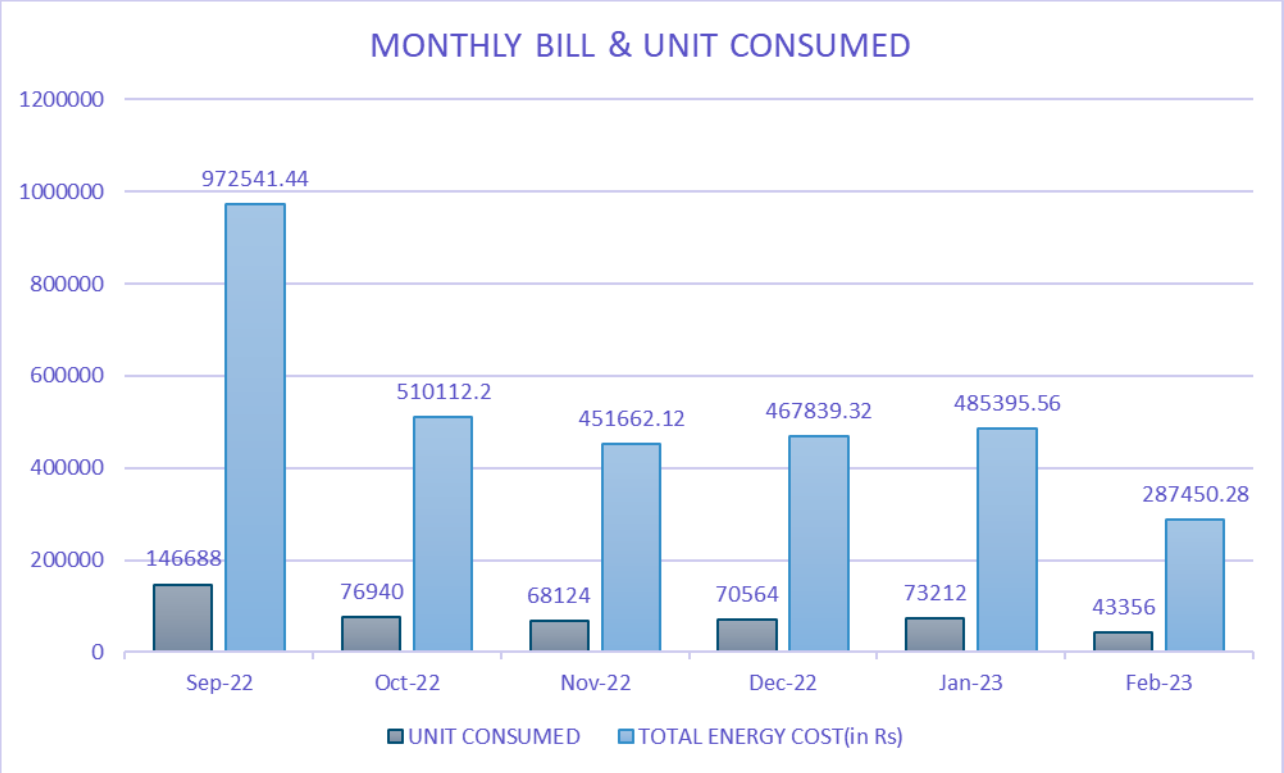
ENERGY CONSUMPTION IN COLLEGE

There are two sources of electricity in the facility

1. Main electricity with tariff rate of Rs. 6.63 Kw/h
2. Electricity from solar with tariff rate of Rs. 4 Kw/h.

The six-month Energy consumption of the college is shown in below table

S. No	Bill month	Unit consumed	Rate/kwh	Total energy cost(in rs)	Bill no
1	Sep-22	146688	6.63	972541.44	1004317798
2	Oct-22	76940	6.63	510112.2	1001932434
3	Nov-22	68124	6.63	451662.12	1005036457
4	Dec-22	70564	6.63	467839.32	1006747792
5	Jan-23	73212	6.63	485395.56	1005240050
6	Feb-23	43356	6.63	287450.28	1006306609



GRAPHICAL REPRESENTATION

SOLAR ENERGY IN COLLEGE

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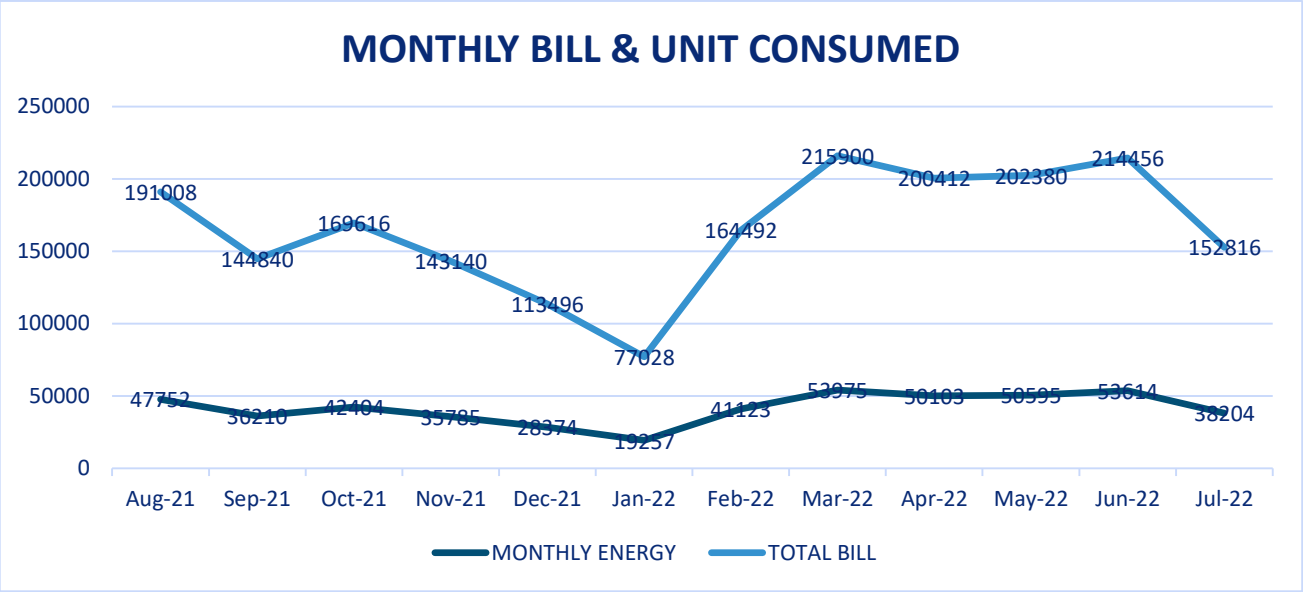
The campus has installed solar plant of capacity nearly about 599.7 Kw on the monthly tariff of Rs. 4 per unit. Which can be seen in the picture below.

The one-year Solar Energy consumption of the college is shown in below table

SI.NO.	MONTH	MONTHLY ENERGY	RATE /KWH	TOTAL BILL
1	AUGUST-21	47752	4	191008
2	SEPTEMBER-21	36210	4	144840
3	OCTOBER-21	42404	4	169616
4	NOVEMBER-21	35785	4	143140
5	DECEMBER-21	28374	4	113496
6	JANUARY-22	19257	4	77028
7	FEBRUARY-22	41123	4	164492
8	MARCH-22	53975	4	215900
9	APRIL-22	50103	4	200412
10	MAY-22	50595	4	202380
11	JUNE-22	53614	4	214456
12	JULY-22	38204	4	152816
TOTAL		497396		



GRAPHICAL REPRESENTATION

The above tables show the graphical representation of consumption of electrical energy and solar energy of six months & twelve months respectively. It is observed that the college installed the solar panels and the capacities are shown below:

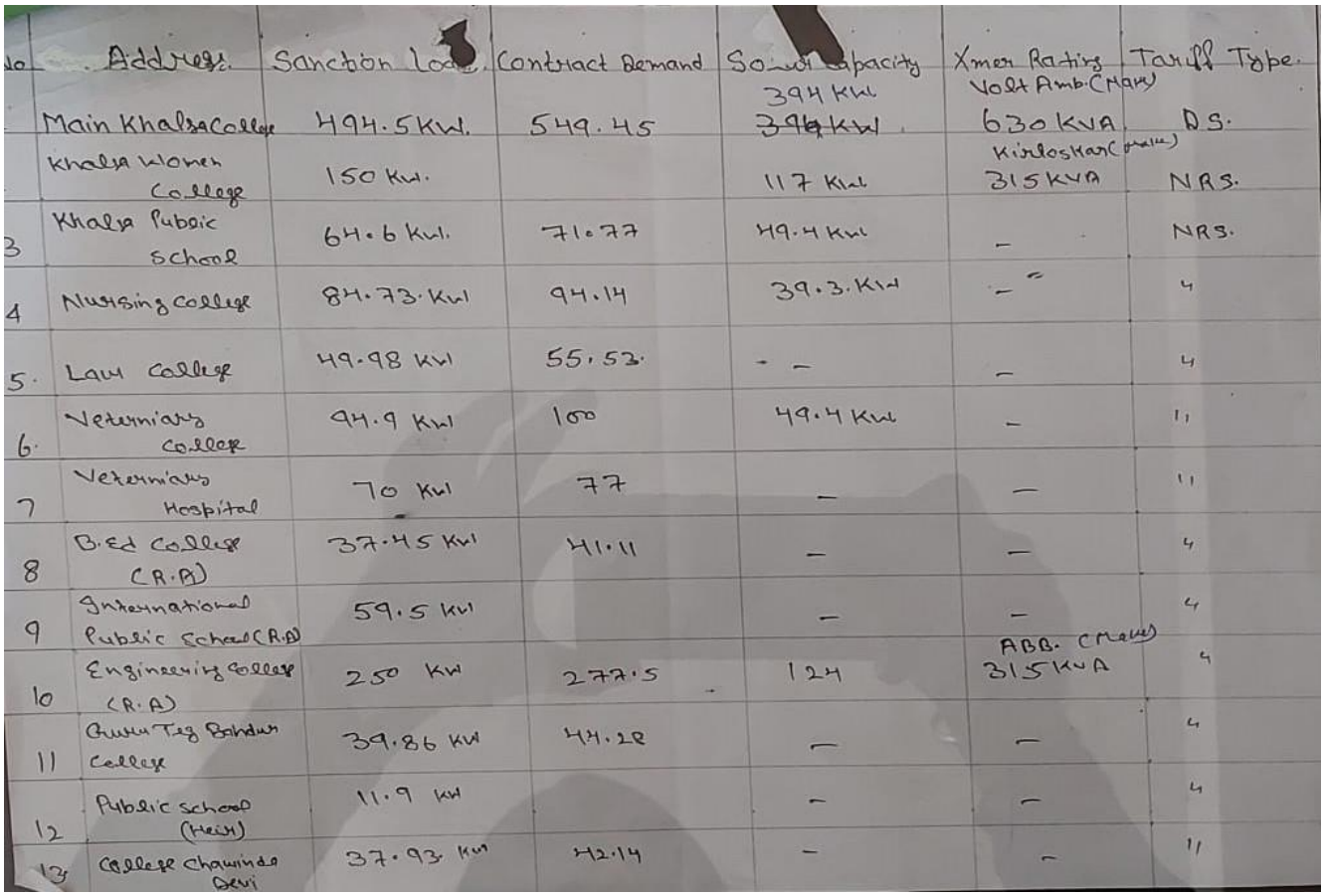


Image shows the Solar Energy used in Campus

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From the above data it is concluded that:

Total Kw of solar energy	=	599.7 KW
Total tariff per unit	=	Rs. 4
Average cost/month from one-year bill	=	Rs. 165799

It is recommended to install at least 34 % of total solar capacity of their own, which is 200 kw

Total installation cost	=	Rs. 50,00,000
Solar bill saved per month	=	Rs. 60,000 (approx.)
Amount payback	=	6 years (approx.)

CONCLUSION

From the above data we conclude that the college is borrowing solar energy at the rate of Rs. 4 per kwh and the average of one-year bill is Rs. 1,65,799 approx. By our recommendation the college should buy at least 34% of solar panel of their own, because of this approximately Rs. 60,000 of solar bill is saved. The tentative cost of 200 Kw of solar plant would cost Rs. 50,00,000. This amount can be payback in less than 6 years.

ENERGY SOURCE FROM FUEL (GENERATOR)

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A diesel generator is used for emergency power supply in case of electricity shutdown. Diesel generator generates electric energy by using a diesel engine along with an electric generator.

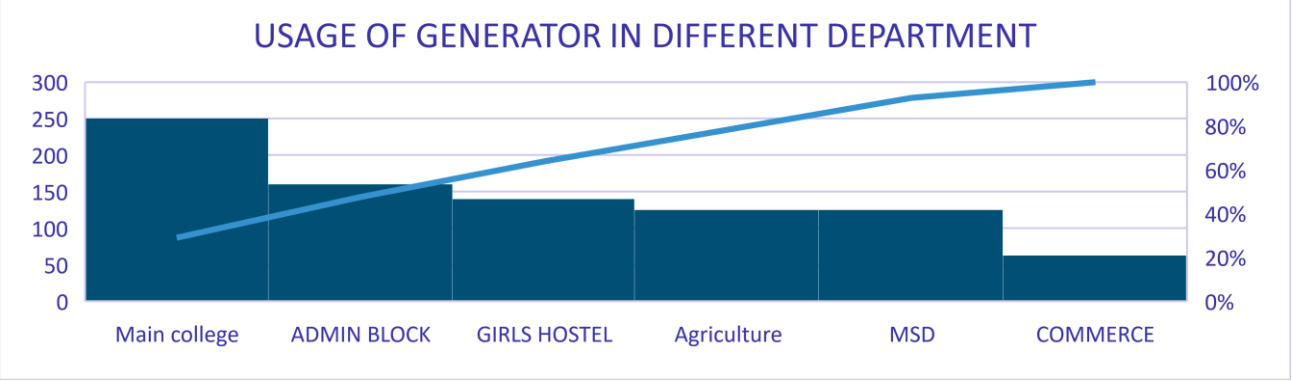
Nowadays, diesel generator usage is essential for industries backup, emergency, and electric systems in case of power failure. Hiring diesel generators for electricity continuously and automatically start the generator when there is a power cut or power shutdown period and generator supplies the power until the power comes back.

The diesel generator is the most important equipment for industries and helps to run the industries' productions continuously. The favourable growth of industries such as oil & gas industries, telecom, mining, constructions, hospitals, and retail shops.

There are mainly 6 Generator in the facility for different department which are shown as below

S.NO.	Department	Rating (in kva)	Fuel consumption @75% of load (liter/ hr)	Tentative use/ month	Total fuel cost/day (in rs.)
1	Main college	250	44	3	11629
2	Agriculture	125	23	3	6078
3	MSD	125	23	3	6078
4	GIRLS HOSTEL	140	26	3	6871
5	ADMIN BLOCK	160	29	3.5	8942
6	COMMERCE	62.5	9.6	3	2537
TOTAL		862.5	154.6	18.5	42000

TABLE - A



GRAPHICAL REPRESENTATION

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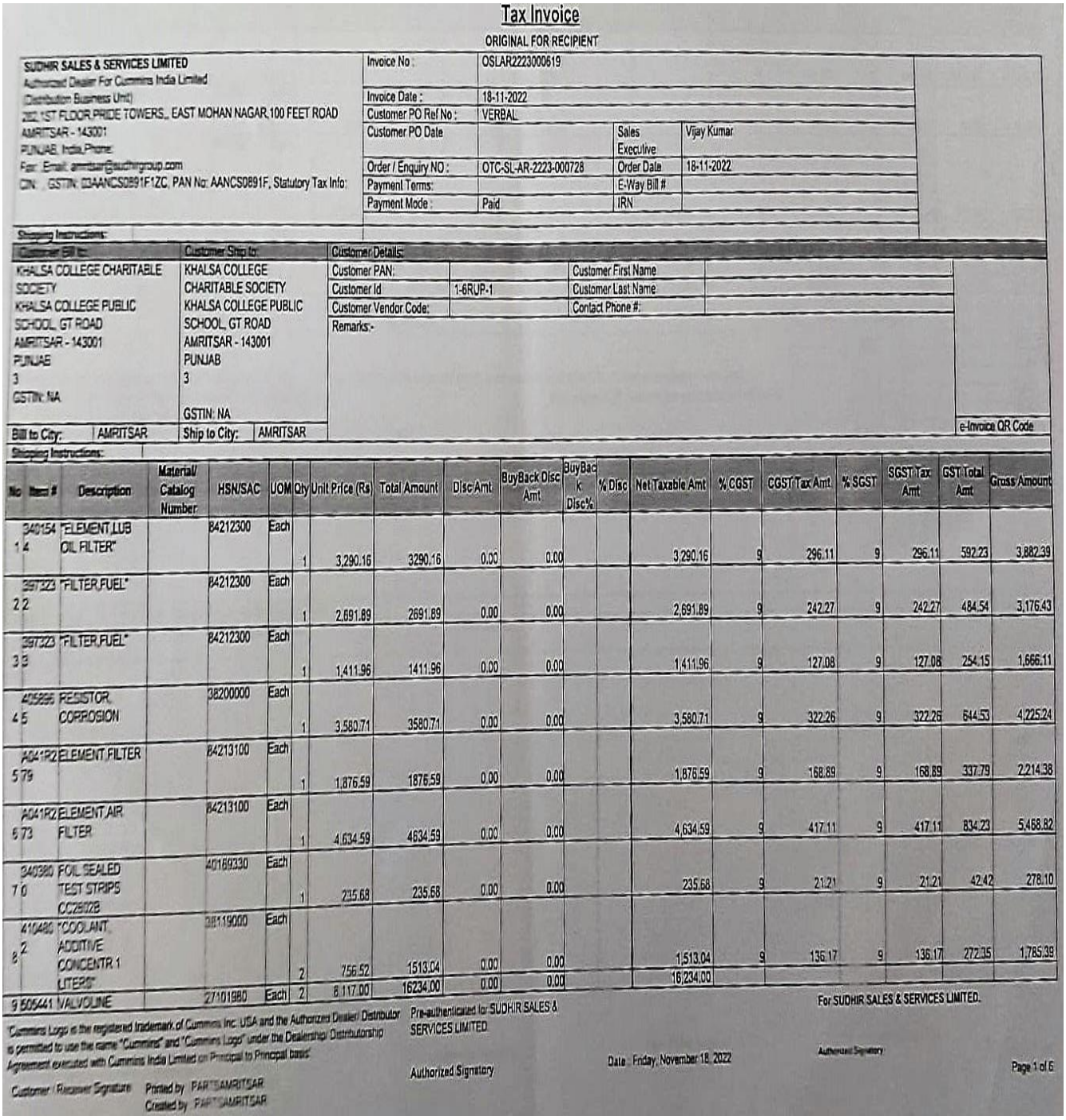
From above data it is observed that there are 6 generators in the campus with different KVA rating the fuel consumption data is derived from the data sheet of Sudhir Power which is provided below:

TECHNICAL DATA

Generator Set Specification	
Model	C250D5P
Duty	Prime
Power Rating kVA / kWe	250/200
No. of Phases	3
Output Voltage and Frequency (V and Hz)	415 V, 50 Hz
Power Factor	0.8 (lagging)
Current (A)	348
RPM	1500
Engine specification	
Make	Cummins®
Model	6L8.9TAA-G4
MoEF Certified Power (bhp)	335
Required Power for Rated kVA (bhp)	303
Cooling	Liquid cooled (EG Compleat 50:50)
Aspiration	Turbocharged, Charge air cooled
No. of cylinders	6, In-line
Bore (mm) x Stroke (mm)	114 x 145
Compression ratio	16.6:1
Displacement (litre)	6.7
Fuel	High Speed Diesel
Fuel consumption @75% load with radiator and fan* (litre/hr)	43.43
Fuel consumption @100% load with radiator and fan* (litre/hr)	59.35
Performance class of generator set	ISO 8528-5 G2
Starting system	24 V DC Electrical
Lube oil specification	CI4+ 15W40
Lube oil sump capacity, High-Low level (litre)	30-20
Total lubrication system capacity (litre)	34
Total coolant capacity (litre)	36.8
Exhaust pipe size (inch)	6
Total wet weight (Engine+Radiator)** (kg)	961
Length x Width x Height (Engine) (mm)	1128 x 791 x1277
Mean piston speed (m/s)	7.2
Combustion air intake @100% load (±5%) (cfm)	637
Exhaust Temperature (°C)	499
Alternator specification	
Make	Stamford (CGT)
Alternator Frame	UCI274K
Enclosure	IP 23
Voltage regulation (Max.)	±1%
Class of Insulation	H Class
Winding Pitch	2/3
Stator Winding	Double layer lap
Rotor	Dynamically Balanced

And the consumption of fuel per month costs nearly about 42000 per month. The service of the generator is up to date and the latest service record is provided by the institution which is provided as below:



Tax Invoice

ORIGINAL FOR RECIPIENT

SUDHIR SALES & SERVICES LIMITED
Authorized Dealer For Cummins India Limited
(Distribution Business Unit)
202,1ST FLOOR,PRIDE TOWERS,, EAST MOHAN NAGAR,100 FEET ROAD
AMRITSAR - 143001
PUNJAB, India,Phone:
Fax: Email: amritsar@sudhirgroup.com
CIN: , GSTIN: 03AANCS0891F1ZC, PAN No: AANCS0891F, Statutory Tax Info:

Invoice No :	OSLAR2223000619		
Invoice Date :	18-11-2022		
Customer PO Ref No :	VERBAL		
Customer PO Date		Sales Executive	Vijay Kumar
Order / Enquiry NO :	OTC-SL-AR-2223-000728	Order Date	18-11-2022
Payment Terms:		E-Way Bill #	
Payment Mode :	Paid	IRN	

Shipping Instructions:

Customer Bill to:	Customer Ship to:	Customer Details:			
KHALSA COLLEGE CHARITABLE SOCIETY KHALSA COLLEGE PUBLIC SCHOOL, GT ROAD AMRITSAR - 143001 PUNJAB 3 GSTIN: NA	KHALSA COLLEGE CHARITABLE SOCIETY KHALSA COLLEGE PUBLIC SCHOOL, GT ROAD AMRITSAR - 143001 PUNJAB 3 GSTIN: NA	Customer PAN:		Customer First Name	
		Customer Id	1-6RUP-1	Customer Last Name	
		Customer Vendor Code:		Contact Phone #:	
		Remarks:-			
Bill to City: AMRITSAR	Ship to City: AMRITSAR				e-Invoice QR Code

Shipping Instructions:

No	Item #	Description	Material/ Catalog Number	HSN/SAC	UOM	Qty	Unit Price (Rs)	Total Amount	Disc Amt	BuyBack Disc Amt	BuyBack Disc%	% Disc	Net Taxable Amt	% CGST	CGST Tax Amt	% SGST	SGST Tax Amt	GST Total Amt	Gross Amount
1	4	340154 "ELEMENT,LUB OIL FILTER"		84212300	Each	1	3,290.16	3290.16	0.00	0.00			3,290.16	9	296.11	9	296.11	592.23	3,882.39
2	2	397323 "FILTER,FUEL"		84212300	Each	1	2,691.89	2691.89	0.00	0.00			2,691.89	9	242.27	9	242.27	484.54	3,176.43
3	3	397323 "FILTER,FUEL"		84212300	Each	1	1,411.96	1411.96	0.00	0.00			1,411.96	9	127.08	9	127.08	254.15	1,666.11
4	5	405696 RESISTOR, CORROSION		38200000	Each	1	3,580.71	3580.71	0.00	0.00			3,580.71	9	322.26	9	322.26	644.53	4,225.24
5	79	A041R2 ELEMENT,FILTER		84213100	Each	1	1,876.59	1876.59	0.00	0.00			1,876.59	9	168.89	9	168.89	337.79	2,214.38
6	73	A041R2 ELEMENT,AIR FILTER		84213100	Each	1	4,634.59	4634.59	0.00	0.00			4,634.59	9	417.11	9	417.11	834.23	5,468.82
7	0	340380 FOIL SEALED TEST STRIPS OC25028		40169330	Each	1	235.68	235.68	0.00	0.00			235.68	9	21.21	9	21.21	42.42	278.10
8	2	410480 "COOLANT ADDITIVE CONCENTR 1 LITER"		38119000	Each	2	756.52	1513.04	0.00	0.00			1,513.04	9	136.17	9	136.17	272.35	1,785.39
9	5	505441 VALVOLINE		27101980	Each	2	8,117.00	16234.00	0.00	0.00			16,234.00						

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Date : Friday, November 18, 2022

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SERVICE DATA OF GENERATORS PROVIDED BY INSTITUTION

But use of generator causes the carbon emission. The typical emission calculation is given as below:

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RETScreen - Emission Analysis **Subscriber: Viewer**

Base case electricity system (Baseline)

Fuel type	Fuel mix %	CO_2 emission factor kg/GJ	CH_4 emission factor kg/GJ	N_2O emission factor kg/GJ	Electricity generation efficiency %	T&D losses %	GHG emission factor $kgCO_2/kWh$
Solar	40.0%	0.0	0.0000	0.0000	20.0%	7.0%	0.000
Diesel (#2 oil)	4.0%	70.0	0.0020	0.0006	80.0%	7.0%	0.340
Electricity mix	44	3.8	0.0001	0.0000		3.1%	0.014

Baseline changes during project life

Base case system GHG summary (Baseline)

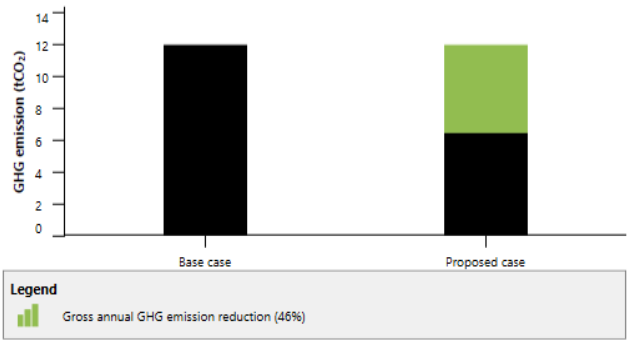
Fuel type	Fuel mix %	CO_2 emission factor kg/GJ	CH_4 emission factor kg/GJ	N_2O emission factor kg/GJ	Fuel consumption kWh	GHG emission factor $kgCO_2/kWh$	GHG emission tCO_2
Electricity	75.9%	3.8	0.0001	0.0000	1,28,107	0.014	1.7
Diesel (#2 oil)	24.1%	70.0	0.0020	0.0006	40,571	0.253	10.3
Total	100.0%	19.7	0.0006	0.0002	1,68,678	0.071	12.0

Proposed case system GHG summary

Fuel type	Fuel mix %	CO_2 emission factor kg/GJ	CH_4 emission factor kg/GJ	N_2O emission factor kg/GJ	Fuel consumption kWh	GHG emission factor $kgCO_2/kWh$	GHG emission tCO_2
Electricity	79.9%	3.8	0.0001	0.0000	83,535	0.014	1.1
Diesel (#2 oil)	20.1%	70.0	0.0020	0.0006	21,024	0.253	5.3
Total	100.0%	17.1	0.0005	0.0001	1,04,559	0.062	6.4

GHG emission reduction summary

GHG emission		
Base case	tCO_2	12.0
Proposed case	tCO_2	6.4
Gross annual GHG emission reduction	tCO_2	5.5



5.5 tCO_2 is equivalent to 1.0

Cars & light trucks not used

From the above data we absorb that the GHG emission of generator is nearly about 10.3. And with the slight increase of the use of solar inverters the GHG emission is reduced to 5.3. And the monthly cost of fuel used is also reduced.

The calculations of solar inverter costing, capacity and the payback time is shown below:

- Capacity of solar inverter = 20kw
- Cost of 5kw solar inverter = Rs. 50000
- So, cost of 20kw solar inverter = Rs. 2,00,000
- Reduction 20kw from generator costs = Rs. 2100

Payback time	=	Less than 6 years

MEHAL SINGH Digitally signed by MEHAL SINGH
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LOAD LIST DEPARTMENT WISE

S.No.	Department name	Equipment name	Type	Load (inw)	Qty.	Total load (KW)
1	**Commerce & Business Administration**	FAN	orient	0.2	117	23.4
		Tube light	Planet gold	20	99	1.9
		Printer	HP	0.3	5	1.5
		UPS	APC by Schneider Electric	0.2	5	1
		LED	sysca	50	1	0.05
		Computer	Lenovo/Dell/HP/Compas	150	34	5.1
		Projector	Benq	1	5	5
		Projector Screen	Benq	1	3	3
		Photo state printer	RICOH	1.2	1	1.2
		Refrigerator	LG	0.25	1	0.25
		Microwave	IFB	0.45	1	0.45
		Food Warmer	kitchen link	1	1	1
		Induction cooktop	sun flame	1.5	1	1.5
	TOTAL					**45.3704**
2	CHEMISTRY	Air Conditioner	Split	2000	2	4
		Air Conditioner	Window	1000	1	1
		Microwave	IFB	1250	2	2.5
		Refrigerator	Whirlpool	300	1	0.3
		Refrigerator	Samsung	300	1	0.3
		Deep Freezer	Ceel Frost	400	3	1.2
		Fuming Hood	NSW	200	2	0.4
		Fuming Hood	Mac	200	2	0.4
		LED Screen	Lenovo	85	1	0.085
		Server (T-440)	Dell	1100	1	1.1
		Fan	Ceiling	80	119	9.52
		Fan	Exhaust	100	30	3
		Tube Light	Fluorescent	80	142	11.36
		Tube Light	LED	18	17	0.306
		Bulb	LED	18	16	0.288
		Bulb	CFL	15	19	0.285
		Spectrophotometer	UV-Visible Carey 60 (Agilent)	150	1	0.15
		Spectrophotometer	Fluorescence (Agilent)	150	1	0.15
		Spectrophotometer	IR (Shimadzu)	100	1	0.1
		Spectrophotometer	Scanning Visible (Elico) SL-177	100	4	0.4
		Spectrophotometer	Visible (Elico) SL-27	120	4	0.48
		Spectrophotometer	UV-Visible (Elico) SL-164	100	1	0.1

		Spectrophotometer	UV-Visible (Labtronics) LT-2900	130	1	0.13
		Spectrometer	Electronics (301E)	120	1	0.12
		Spectrophotometer	Digital (Systronic-105)	120	1	0.12
		Spectrophotometer	Digital (Systronic-106)	120	2	0.24
		Spectrophotometer	Elico (SL-171)	120	4	0.48
		Microwave synthesizer	Biotage	400	1	0.4
		Microscope	Stereozoom with USB Camera	100	1	0.1
		Furnace	Muffel (NSW)	6000	1	6
		Oven	Hot Air (Perfit)	1200	1	1.2
		Oven	Universal (NSW-143)	750	3	2.25
		Oven	Universal (NSW-144)	750	1	0.75
		Oven	High Temperature Oven	750	1	0.75
		Hot Plates	Perfit	3000	3	9
		Hot Plates	NSW	3000	3	9
		Water bath	12 Holes	1500	12	18
		Water bath	6 Holes	1000	4	4
		Computer	(Dell + Lenovo + HP)	70	28	1.96
		Server (ML-110 G5)	HP	200	1	0.2
		UPS	(Datavision + APC + Microtech)	600	23	13.8
		UPS	Datavision	1250	1	1.25
		Online UPS	Datavision	7500	1	7.5
		UPS	Datavision	3000	1	3
		Projector	Ricoh	200	2	0.4
		Projector	BenQ	200	2	0.4
		Projector	Complete Smart Room	200	1	0.2
		Projector	Sony	200	1	0.2
		Projector	Suvira	200	1	0.2
		Printer-Photocopier	Ricoh (1813 L)	1100	1	1.1
		Printer	HP-LJ1020	250	2	0.5
		Printer	3 in 1 (HP-LJ 1005)	250	7	1.75
		Chiller	NSW-136	4000	1	4
		Chiller	Ultra Cryostat Circulator (Metrex)	4000	1	4
		Stabilizer	Automatic Voltage Stabilizer (NSW)	6000	2	12
		Stabilizer	Servo-stabilizer	5500	1	5.5
		Autoclave	Tencho PLT-104	1500	1	1.5
		Aspirator Vacuum Pump	Metrex (MAS-900)	200	3	0.6
		Autovariac	Popular (PT-1005)	500	1	0.5
		Scanner	Canon (CanoScan LiDE 110)	12	1	0.012

		Electrical Balance	Digital (Shimadzu + Citizen)	10	18	0.18
		Electrical Centrifuge	REMI	180	14	2.52
		Polarography	Elico (CL-357)	100	1	0.1
		Aspirator Vacuum Pump	Eyela	200	1	0.2
		pH-Meter	Elico + Systronic	10	11	0.11
		pH, Conductivity & Temp meter	EI (181E)	10	8	0.08
		Colorimeter	EI (312) + Elico	10	10	0.1
		Potentiometer	VSI + Equiptronics + Systronics	300	12	3.6
		Disintegration Apparatus	Lab India (DT- 1000)	125	1	0.125
		Friability Test Apparatus	Lab India (FT-1020)	125	1	0.125
		TDS Meter	EI (651E)	10	1	0.01
		Turbidity meter	EI (331E)	10	1	0.01
		Conductivity meter	Digital/Deluxe (Sys + Elico + Equip + EI)	15	42	0.63
		Flame Photometer	Systronics	10	2	0.02
		Heating Mantel (1L)	Perfit	300	11	3.3
		Heating Mantel (250 ml)	Perfit	200	21	4.2
		Heating Mantel (500 ml)	Perfit	200	15	3
		Deionizer	Ind Ion CA 20	72	1	0.072
		Deionizer	LIP Demineralizer WAT ION VSD 200	72	1	0.072
		Stirrer	REMI (RQG-128A/D)	10	4	0.04
		Stirrer Magnetic	REMI + Swavlamvan + Tarson	12	34	0.408
		Stirrer Magnetic With heating	Remi + Tarson	550	12	6.6
		Centrifuge	REMI	110	1	0.11
		Melting Point Apparatus	Veego VMP-1 + MSW + Perfit + Popular	60	19	1.14
		pH, Temp/ mV meter	Systronic - 361	5	4	0.02
		Public Address System		200	1	0.2
		Polari meter	Advance + Tencho + Focus + Equip. + MSW	100	10	1
		Polaroscan	Systronics 1634	100	1	0.1
		Rotamantel	REMI	500	4	2

		Rotary Shaker	NSW	230	3	0.69
		Rotary Vacuum Film Evaporator	Perfit	300	2	0.6
		Shaking Machine	German Make	300	1	0.3
		Transformer for Polarography		500	1	0.5
		UV-Chromatography Inspection Cabinet	Perfit	100	1	0.1
		Voltage Stabilizer (For Chiller)		50	1	0.05
		Voltage Stabilizer (AC)		50	2	0.1
		Vacuum Pump	Tarson + Perfit	500	4	2
		Water bath Incubator Shaker	NSW BIS-3	1000	1	1
		Water bath Serological	NSW + Perfit	250	3	0.75
		Water bath Shaker	REMI PSB-12	250	1	0.25
	TOTAL					**186.948**
3	BOTONY	Oven	Universal (1), Macro scientific woks (2). Yoroo (1)	2	4	8
		Spectrophotometer	Elico (1), Systronics (1), Environmental Scientific Instruments Co Ltd Model 301E (1)	200	3	0.6
		Distillation Unit	Infusal India , Model Dstilion 2S	3	1	3
		Centrifuge	Remi	500	4	2
		Water bath	Macro scientific works	500	2	1
		Deep freezer	Blue Star	200	1	0.2
		Seed germinator	Remi (1), Adarsh (1)	200	2	0.4
		BOD	SESCO, Model SESCO-152	200	1	0.2
		Autoclave	Narang Scientific Works, NSW-227	2	2	4
		Fridge	LG (2), Kelvinator 165 litre (1)	150	3	0.45
		Tissue Culture Rack	Macro Scientific Works	200	1	0.2
		Laminar Air Flow	SESCO-260 (1), Adarsh (1)	200	2	0.4
		Computer	Hp (1), DELL (1), Lenovo (2), Elico (1)	170	5	0.85
		Printer	HP (3), Canon (1)	50	4	0.2
		AC	Mitashi (1.5 ton)	2	1	2
		Projector	RICOH	200	2	0.4

		Microwave	IFB, Model-17PM-MEC1	900	1	0.9
		RO	Eureka Forbes	50	1	0.05
		Fan	Orient	48	100	4.8
		Tubes	Philips (70), Crompton (12), Surya (10)	35	92	3.22
	TOTAL					**32.87**
4	BIOTECHNOLOGY	Centrifuge With Rotors	R8 C	1200	1	1.2
		Centrifuge With Rotors (R-8C) **(Transferred from Botany dept.)**	R8 C	110	1	0.11
		Centrifuge With Rotors (High Speed Cooling)	RC 24BL	320	1	0.32
		Centrifuge With Rotors	PT 660)	150	1	0.15
		Standard Heating Block	101770 Genei	500	1	0.5
		Standard Heating Block	T C S P 1 Genei	800	1	0.8
		Dry Bath	36326/1793087	150	1	0.15
		Centrifuge with Fixed Rotor (	107944 Genei	1200	1	1.2
		Printer	HPLJ 1008	285	1	0.285
		UPS. Data Vision	V.A 600	600	1	0.6
		Printer	H.P.1005 MFP	1000	1	1
		Computers	(DELL) 660	220	3	0.66
		U.P.S.	600/C /APC	850	3	2.55
		computers	Lenovo	160	2	0.32
		Printer	3745	430	1	0.43
		Electronics Weighing Balance	D307531119	60	1	0.06
		Electronics Weighing Balance	D-432910748	80	1	0.08
		Air Conditioner Split with Auto Stabilizer	LG	530	2	1.06
		Electronic Weighing Balance	912074	80	1	0.08
		Elisa Reader	Thermos 51118170	170	1	0.17
		Ligation Bath	Genei 107945	1000	1	1
		Magnetic Stirrer with Hot Plate	Genei 107945	180	2	0.36
		Magnetic Paddles	Genei 107049	500	1	0.5
		Micro Wave Model	LG393	800	1	0.8

		Micro Wave Model	LG 7040	800	1	0.8
		Power Supply 10.01	Genei PS 100	2500	1	2.5
		Power Supply 10.	01 Genei PS 500	2500	1	2.5
		Power Supply 12.04	Genei PS 3000	2500	1	2.5
		Refrigerator	LG 325	200	1	0.2
		Refrigerator	LG-352	200	1	0.2
		Refrigerator	RLR-200	250	1	0.25
		Electrophoresis Apparatus	Cat No. PT-57	300	1	0.3
		Vortex Mixer 18-01	106887 Genei		1	0
		PH Meter	Systronics	125	5	0.625
		B.O.D. Incubator 570x550x875 mm	NSW 152	3000	2	6
		Rotary Vacuum Film Evaporator	Perfit 959	400	1	0.4
		Heating Mantles	JSGW	130	5	0.65
		Oven 455x455x605	NSW 143	150	1	0.15
		Oven 455x455x605	NSW 143	150	1	0.15
		Oven 300x300x300	NSW 143	100	1	0.1
		Oven 455x455x605	NSW 143	150	1	0.15
		Hot Air Oven 300x300x300	400/25	100	1	0.1
		Hot Air Oven 455x455x605	400/25	150	1	0.15
		Water Bath Incubator Shaker (Serological) 405x300x150 (18 Litre)	NSW	200	1	0.2
		Water Bath Incubator Shaker (Serological) 330x300x175 (18 Ltr)	NSW	150	1	0.15
		Water Bath Incubator Shaker (Serological) 430x240x265	NSW Steel 129	150	1	0.15
		Autoclave 98 Litre	NSW 227	4000	1	4
		Autoclave 300x500 mm	NSW 227	3000	1	3
		Autoclave 80 ltr	NSW	4000	1	4
		Autoclave Portable	8419	150	1	0.15
		Deep Freezer Horizontal	REMI RQFV 170650 -20 C	150	1	0.15

		Deep Freezer Horizontal	BFS150	100	2	0.2
		UV Vis Spectrophotometer	Systronic 118	240	1	0.24
		UV VIS **(Transferred from Botany Dept.)**				
		UV Vis Spectrophotometer	LT 2900	180	1	0.18
		Laminar Air Flow	NSW-01	50	1	0.05
		6x2x2 Horizontal **(Transferred from Botany Department)**				
		Laminar Air Flow	NSW 202	350	1	0.35
		600x600x600 mm Steel				
		Laminar Air Flow	NSW 201	160	1	0.16
		600x600x600 Wood 201				
		Laminar Air Flow	Perfit	180	1	0.18
		High Speed Homogenizer	-	8000	1	8
		(Transferred from Botany Dept.)				
		Hot Plate		4	1	0.004
		Hot Plate with Magnetic Stirrer	(Remi)	330	1	0.33
		Hot Plate) 18x18 cm	Tarson 5030	200	1	0.2
		Tissue Culture Rack	(RP15302) Restolar	400	2	0.8
		Double Distillation Apparatus 3 litre	JSGW 421/6	3000	1	3
		Double Distillation Apparatus (Single)	JSGW 425/6	1500	1	1.5
		Mixer	Remp 101	32	1	0.032
		Incubator 455x455x605	NSW 125 Litre	120	1	0.12
		Incubator (super deluxe) 455x455x605	401324	250	1	0.25
		Incubator Bacteriological 605x605x605	410/25	500	1	0.5

		PID controller		40	1	0.04
		Micro Scopes	Getner	100	5	0.5
		(Transferred from Botany Dept.)				
		Micro Scopes Inverted	Olympus	150	1	0.15
		9C05979				
		Micro Scopes Binocular	MLXI	180	1	0.18
		Co_2 Incubator	S.C.A. 165 DRS	750	1	0.75
		Gel Documentation	Genei) 107947	90	1	0.09
		Fermenter 3Litre	Biospin-03A	2	1	2
		Inverter			1	0
		Air Curtain A.C.	Micro 1200 mm	260	2	0.52
		Multimedia projector	PDCBE02395000		1	0
		Incubator shaker /	Eppendorf	15	1	0.015
		PCR/ ThermoCycler	Eppendorf	100	1	0.1
		Digital colony Meter	PT859	20	1	0.02
		Computer	Lenovo	70	1	0.07
		Micro Colorimeter 8 Filters	ELICO/CL63		1	0
		Dissolved Oxygen meter	L01197023	300	1	0.3
		Soxhlet Heating Mantle for Extraction	-	600	1	0.6
		Auto Clave 450x600mm	(NSW227)	4000	1	4
		Weighing Balance	Shinko Japan (DJ-300)	10	1	0.01
		Turbidity meter	Desible D.B. 1103	10	1	0.01
		LED Bulbs	-	23	81	1.863
		Fans	-	75	137	10.275
	TOTAL					**81.499**
5	FOOD SCIENCE & TECHNOLOGY	APPRATUS DISTILATION		2000	1	2
		VERTICAL AUTOCLAVE	MV Matrix	2000	1	2
		BAKING OVEN	Lablink	200	1	0.2
		BULB (LED)	Syska	18	1	0.018
		BURSTING STRENGH APPRATUS	Lablink	500	1	0.5

		CENTRIFUGE	Lablink	200	1	0.2
		COLONY COUNTER	Temp Star	300	1	0.3
		COMPUTER	Dell	200	5	1
		DISTILATION APRATUS	Punjab	1000	1	1
		ELECTRIC SEALING MACHINE		230	1	0.23
		ELECTRIC TANDOOR	Supercool	3000	1	3
		FAN	Orient	75	115	8.625
		FOOD WARMER	Lablink	2000	1	2
		FOOD WARMER	Lablink	2000	1	2
		GRAMMAGE	Wensar	0.003	1	0.000003
		GRINDER	Orpat	0.6	1	0.0006
		HAMMER MILL	Natraj	2000	1	2
		HAND MIXER	Philips	240	1	0.24
		HEATING MANTLE	Labtherm	400	4	1.6
		HOT AIR OVEN	Labtherm	1500	3	4.5
		INCUBATOR	Labtherm	100	1	0.1
		INFRARED	Philips	150	1	0.15
		LAMINAR AIR FLOW	Toshiba	450	1	0.45
		MAGNETIC STRIRRER WITH HOT PLATE	New India	180	1	0.18
		MELTING POINT APPRATUS	New India	230	1	0.23
		MICROWAVE	LG	450	2	0.9
		OVEN TOASTER GRILLER	LG	1280	1	1.28
		PH- METER	Labtronics	250	1	0.25
		PRINTER	HP	300	6	1.8
		RICE DEHUSKER	Lablink	500	1	0.5
		REFRIGERATED CENTRIFUGE	Lablink	250	1	0.25
		REFRIGERATOR	LG	250	2	0.5
		REFRIGERATOR	LG	200	1	0.2
		REFRIGERATOR	SAMSUNG	230	1	0.23
		RICE POLISHER	Lab link	2000	1	2
		ROTARY SHAKER	New India	1000	2	2
		SIEVE SHAKER		1001	1	1.001
		SPECTROPROTOMETER	Labtronics	500	1	0.5
		TRAY DRIER	Lab link	2500	1	2.5
		TUBLIGHT	Wipro	20	35	0.7
		VACCUM EVAPORATOR	New India	250	1	0.25

		VENTURI ORIFICE METER	Forged	500	1	0.5
		WATER BATH	Permit India	2000	2	4
		WOODEN CABINET DRIER		200	1	0.2
		WEIGHNING BALANCE	Wesner	100	2	0.2
		ICE CREAM PLANT				52.2846
		VAT PASTERIZER	Singer	..	1	3
		HOMOGENIZER	Singer	..	1	
		SURFACE COOLER	Singer	..	1	
		AGEING VAT	Singer	..	1	
		ICE CREAM MAKER	Singer	..	1	
		CONDENSING UNIT (AGEING VAT)	Singer	..	1	
		CONDENSING UNIT (SURFACE COOLER)	Singer	..	1	
		DEEP FREEZER	Blue Star	..	3	
	TOTAL					**55**
6	**Arts and Humanities**	Tube Lights	Tube Light = 36	36x20 = 720 W	36	0.72
		Fans	Celling = 61	61x50 = 3050 W	61	3.05
			Wall Fan = 05	05x50 = 250 W	5	0.25
	TOTAL					**4.02**
7	**SOCIAL SCIENCE**	Tube Lights	CFL = 12	12x20 = 240 W	12	0.24
			LED = 28	28x18 = 504 W	28	0.504
		Fans	Celling = 29	29x50 = 1450 W	29	1.45
			Wall Fan = 01	01x50 = 50 W	1	0.05
		Computer	Electronic	02x 250 = 500 W	2	0.5
		Printer	3 - in - 01	50 W	1	0.05
		Projector	-	250 W	1	0.25
	TOTAL					**3.044**
8	Zoology	Digital weighing scale	Kern, Citizen, And	10 W	3	0.03
		Digital calorimeter	Naina, Eqiup-Tronics	100 W	2	0.2
		Projection microscope	Rexpod	200 W	2	0.4
		Phase Contrast microscope	Magnus	10W	1	0.01

		Autoclave	NSW	2KW	1	2
		Centrifuge	Remi	300 W	2	0.6
		Refrigerated Centrifuge	Eltek	300W	1	0.3
		Mini Centrifuge	Unitron	100W	1	0.1
		Furnace	Metrex	4KW	1	4
		Water bath	JSGW, NSW	300 W	2	0.6
		Oven	NSW	3 KW	2	3
		Rotary Shaker	NSW	230 W	1	0.23
		Tissue Flotation Bath	NSW	300 W	1	0.03
		Hot Plate	Navyug, Shiv Kumar	300W	2	0.6
		Muffle furnace	Navyug	2KW	1	2
		Blade Sharpener	Navyug	150 W	2	0.3
		Refrigerators	Samsung, Whirlpool	350W	3	1.05
		B.O.D Incubator	NSW, Metrex	1500 W	2	3
		Ultra purifier	Rions	11 W	1	0.011
		Digital presenter	Mega Power	20W	1	0.02
		Rotavapor and compressor	JSGW	1 KW	1	1
		Kjeldahl Flask heater		200W	1	0.2
		Electrophoresis Unit	Genei	80 W	1	0.08
		Photo colorimeter	J Mitra	10W	1	0.01
		Chemical analyser	Erba Manhein	50 W	1	0.05
		UV Spectrophotometer	Systronics	150 W	1	0.15
		Egg incubator	Yorco	120 W	2	0.24
		Homogenizer	Eltek	850 W	1	0.85
		U.V. Illuminator	Genei	30 W	1	0.03
		LED Screen (32, 40, 55 inch)	Panasonic, Samsung	~40 W	3	0.12
		Multimedia projector	Panasonic, Zion	150W	3	0.45
		Computer	HP, Dell	30 W	9	0.27
		Printer	HP	30 W	3	0.09
		Fans	Orient	55W	66	3.63
		Lights		20W	60	1.2
	TOTAL					**26.851**
9	**HISTORY**	TUBE LIGHTS	Wipro	40	4	0.16
		CFL	Energetic	20	1	0.02
		FANS	Ceiling	75	4	0.3
		COMPUTER	Lenovo-Desktop	170	1	0.17
		PRINTER	Canon	50	1	0.05

	TOTAL					**0.7**
10	**Economics**	Tube lights		40	36	1.44
		Fans		75	51	3.825
		Computer		170	1	0.17
		Printer		30	1	0.03
		Hot case		600	1	0.6
	TOTAL					**6.065**
11	Physical Education	Bulb	LED Crompton	9	5	0.045
		Fan	Ceiling Orient	48	6	0.288
		AC 2 Ton	Split Dakin	2000	1	2
		Refrigerator 241 LTR	241 LTR Voltas Beko	140	1	0.14
		Computer	Desktop HP	70	1	0.07
		Printer	Laser HP	40	1	0.04
		AC Stabilizer	Automatic	Magnum	1	0
		Heat Blower	Blower	2000	1	2
		Fan	Ceiling Orient	48	5	0.24
		Bulb	LED Ceiling Surface Light	30	3	90
		Bulb	LED Orient	18	5	0.09
		Water Purifier	RO	60	1	0.06
		Water Motor	Under Ground	1000	1	1
		Fan	Exhaust	75	1	0.075
		Motor	Filter Motor	1000	2	2
		Pump	Electric Metering Pump	1000	2	2
		Motor for Swimming Pool Cleaning	Super Section Pump	1000	1	1
		Tube Light	LED Syska	20	3	0.06
		Tube Light	LED Slim Ray	20	1	0.02
		Fan	Ceiling Orient	48	2	0.096
		Bulb	LED Orient	18	1	0.018
		Bulb	LED Havel's	15	1	0.015
		Bulb	LED Orient	18	1	0.018
		Fan	Ceiling Orient	48	1	0.048
	TOTAL					**101.323**
12	**PHYSIOTHERAPY**	Fans		60	93	5.58
		CFL		20	74	1.48
		Tubes		40	18	0.72
		Bulbs		100	9	0.9
		Exhaust fans		40	11	0.44
		Therapeutic Ultrasound		45	2	0.09
		Short wave Diathermy		500	2	1
		Traction		85	2	0.17

		Stimulator		200	2	0.4
		Long wave diathermy		80	1	0.08
		Infra-red lamp		215	1	0.215
		UVR Lamp		220	1	0.22
		Wax Bath		250	1	0.25
		Hydro-collateral Unit		200	1	0.2
		Laser Machine		180	1	0.18
		Detox Machine		150	1	0.15
		Analgesic Pulsar		220	2	0.44
		Intermittent Compression		60	1	60
		Therapy Unit				0
		Continuous Passive Movement		100	1	0.1
		EMG Unit		119	1	0.119
		Stress testing machine		220	1	0.22
		Printers		90	3	0.27
		Computers		150	1	0.15
		CPR machine		200	1	0.2
		Refrigerator		800	1	0.8
	TOTAL					**74.374**
13	**Political Science & Public Administration**	Tube Lights	Tube Light = 12	20	12	0.24
			LED = 08	18	8	0.144
		Fans	Celling = 20	75	20	1.5
		Computer	Electronic	250	1	0.25
		Printer	3 - in - 01	01x50 = 50 W	1	0.05
	TOTAL					**2.184**
14	**Library Department**	A.C. (Complete Set)	A.C.	1500	2	3
		CCTV Cameras	Camera	20	8	0.02
		Celling Fan	Fan	75	79	5.925
		CFL	CFL Bulbs	20	124	2.852
		Computers	Computer	120	11	1.32
		Computer UPS	UPS	50	5	0.25
		Exhaust Fan	Fan	80	7	0.56
		HP 1020 (Printer)	Computer Printer	75	2	0.15
		HP Laser Jet M 1005 (Printer)	Computer Printer	75	1	0.075
		HP LaserJet 1008 (Printer)	Computer Printer	75	1	0.075
		Inverter Battery	Battery	150	4	0.6

		LCD	LCD TV	70	1	0.07
		Online UPS	UPS	2000	1	2
		Refrigerator	Refrigerator	280	1	0.28
		Ricoh Alicia MP 2550 B	Photostat Machine	1500	1	1.5
		Tube Light Long	Tube light	20	22	0.44
		Wall Fan	Fan	75	3	0.225
		Water Filter (R.O)	R.O.	65	1	0.065
	TOTAL					**19.407**
15	**PHYSICS**	Celling fan, exhaust fan, wall fan	Fan	80	124	9.92
		AC	AC	2000	4	8
		Computer System	Computer	150	21	3.15
		UPS	Computer	1440	13	18.72
		Printer	Printer	720	6	4.32
		Instrument B.Sc.-I (Electric kettle efficiency)	Instrument	250	6	1.5
		Instrument B.Sc.-II (battery charger)	Instrument	1500	6	9
		(Na, Hg lamp)	Instrument	55	27	1.485
		Table Lamp	Instrument	100	22	2.2
		DSO	Instrument	30	5	0.15
		CRO	Instrument	45	30	1.35
		Instrument B.Sc.-III	Instrument	30	300	9
		MSc Instrument CMP lab, Electronics, Nuclear, spectroscopy lab)	Instrument	50	540	27
		LED Bulb	Light	18	21	0.378
		Tube lights	Light	40	76	3.04
		thin film deposition unit	Instrument	5000	1	5
		Submersible Pump	Water Pump	1592	1	1.592
		Hot air Oven	Instrument	2000	1	2
		Refrigerator	Instrument	150	1	0.15
	TOTAL					**107.955**
16	**GURMAT STUDY**	FAN	ORIENT	48	31	1.488
		LED TUBE	SYSKA	40	28	1.12
		LED BULB	SURYA	18	18	0.324
	TOTAL					**2.932**
17	**MUSIC**	FANS	CELLING FANS	48	39	1.872
		LED(WHITE)		18	2	0.036

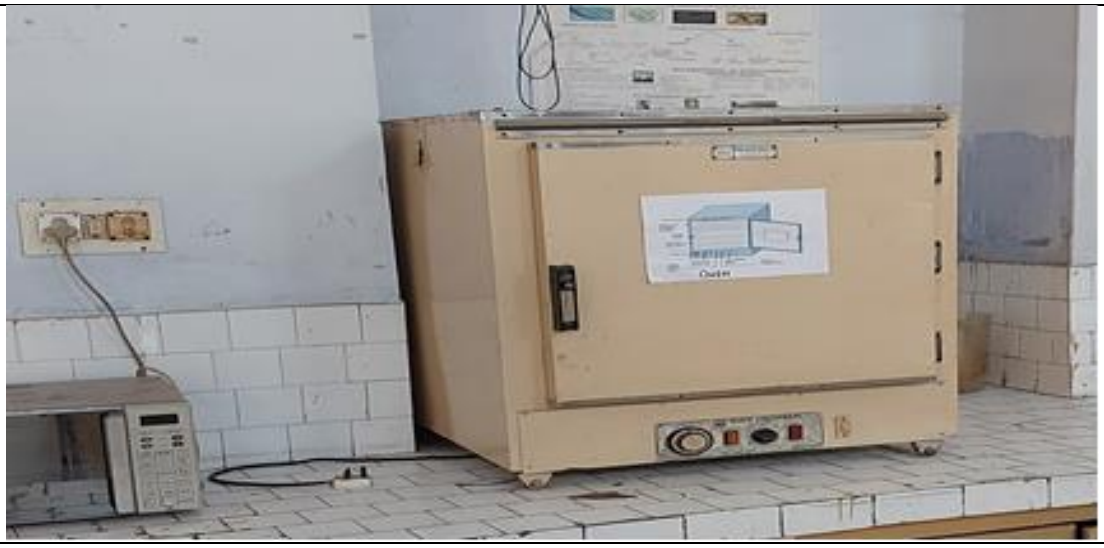
		LED(YELLOW LIGHTS)		18	0	0
		TUBE LIGHTS		40	23	0.92
		COMPUTER SYSTEM	TFT MONITER	170	1	0.17
	TOTAL					**2.998**
19	FASHON DESIGNING	Fans	Ceiling Fan	50	64	3.2
		Fan	Wall Fan	50	1	0.05
		CFL	----------	20	48	0.96
		LED Penal light	----------	15	10	0.15
		Air condition	Split AC	2000	1	2
		Tubes	Fluorescent	42	1	0.042
	TOTAL					**6.402**
20	**ENGLISH**	Ceiling Fans	Crompton	50	39	1.95
		Tube lights	Havel's	40	29	1.16
		Cabin Fans	Orient	50	3	0.15
		Inverter	Luminous	650	1	0.65
		Oven(E. Heater)	Nat raj	100	1	0.1
		Bulb(LED)	Syska	18	3	0.054
		Refrigerator	Samsung 301 LITRE	1500	1	1.5
		T. V	Sony	200	1	0.2
		LED	Panasonic	200	1	0.2
		Induction	Glen	1400	1	1.4
		Printer	Intel	200	2	0.4
		Computer	Dell	150	15	2.25
		Wireless Receiver	Ahuja	500	1	0.5
		A. C	Mitsubishi	2000	1	2
		Speakers	Ahuja	75	5	0.375
		Amplifier	Ahuja	100	1	0.1
		Projector	Rioch	250	1	0.25
	TOTAL					**13.239**
21	**AGRICULTURE**	TRAYDRYER		2000	1	2
		HOT AIR OVEN		1000	11	11
		FRUIT FRUSHER		1000	1	1
		REFRIGERATOR		800	9	7.2
		CANDI COOL		1000	2	2
		CANDI COOL		500	1	0.5
		SIEVE SHAKER		1800	2	3.6
		MUFFLE FURAACE		1200	1	1.2
		OVEN MICROWAVE		1500	4	6
		GRIL OVEN		2300	1	2.3
		BAKING OVEN		1000	1	1
		COMPUTER		350	40	14
		FRUIT PULPER		1000	1	1
		WATER BATH		1000	6	6

		SOIL TESTING MACHINE		2000	1	2
		SPECTRO PHOTO METER		500	2	1
		WEIGHING BALANCE		10	8	0.08
		SPLIT AC		1000	1	1
		SPLIT AC		1000	7	7
		SPLIT AC		2000	3	6
		CENTRI FUGE		1000	4	4
		MICRO KJELDAHL ASSEMBLY		1000	2	2
		FUME HOOD		2000	2	4
		DIGESTION ASSEMBLY		1000	1	1
		ROTARY SHAKER		1000	2	2
		B.O.D		2000	7	14
		PH METER		50	7	0.35
		EC METER		50	5	0.25
		FLAME PHOTO METER		50	2	0.1
		MEGNETIC STIRER		50	2	0.1
		COLORI METER		50	1	0.05
		HOT PLATE		2000	7	14
		JUICER		900	3	2.7
		MIXER		900	1	0.9
		DEEP FREEZER		2000	1	2
		TISSU CULTURE RACK		1000	1	1
		AUTO CLAVE		3000	3	9
		LAMINAR AIR FLOW		500	1	0.5
		AIR CUTTER		500	1	0.5
		SEED GARMINATOR		1500	2	3
		GROTH CHAMBAR		300	1	0.3
		SHAKER		1000	1	1
		KJELDAHL NITROGEN		6000	1	6
		OIL SEED PRESS MACHINE		500	1	0.5
		SOXHLET APPARATUS		1000	1	1
		PROJECTOR		2000	1	2
		HEATING MANTLE		350	1	0.35
		PRINTER		50	14	0.7
		MICROSCOPE STEREO		1000	24	24
		POTER SPRAYER		1000	3	3
		Scanner		1000	2	2
		UPS		450	17	7.65

		ROUTER		20	6	0.04
		SPEAKER		2000	2	4
		AMPLIFIER		1000	1	1
		MIXER		1000	1	1
		AUDIO RECORDER		500	1	0.5
		DISTILLED WATER UNIT		880	1	0.88
		MICRO SCOPE		1000	13	13
		HUMID FIRE WALL		1000	1	1
		FAN		40	389	15.56
		LED BULB		23	92	2.116
		TUBE		40	86	3.44
		EXHAUST FAN		28	28	0.784
		TUBE SMALL		15	11	0.165
		BULB		15	29	0.435
		LED TUBE		20	16	0.32
		SUBMERSIBLE PUMP		2 HPWR	1	1.49
		RO SYSTEM		1 KW	1	1
		WATER CANDY		1 KW	1	1
		LED TV 55"		150	1	0.15
		INTERACTIVE PANEL		240	1	0.24
		ONLINE UPS		3 KW	1	3
		ONLINE UPS		2 KW	2	4
		INVERTER		150	1	0.15
		HOT CASE		1500	3	4.5
		CHIMNI		100	1	0.1
		GRILLEER		100	1	0.1
		INDUCTION		1800	6	10.8
	TOTAL					**256.6**

PHOTOS OF OVENS IN LABS

MEHAL SINGH Digitally signed by MEHAL SINGH
Date: 2023.06.13 12:37:27 +05'30'



NABHA HOSTEL								
Room wise	**Fan**	**Tubes**	**6amp socket**	**16amp socket**	**Geyser**	**Ac**	**Water motor**	**Refrigerator**
Office	4	7	8	-	-	-	1 HP	-
Reading Room	6	6	2	-	-	-	-	-
Guest Room	2X2=4	2X2=4	2X1=2	-	2X1=2 4KW	-	-	-
GYM	6	3	2	-	-	-	-	-
Hostel Room 4X36	2X36=72	2X36=72	36X1=36	-	-	-	-	-
Corridor	-	7X2=14	-	-	-	-	-	-
washroom	-	2X4=8	-	-	2-3KW 2-1.8KW	-	12.5 HP 3Phase	-
Total	92X60=5.520KW	114X20=2.280KW	50X60=3.000KW	-	10.6KW	-	10KW	
NABHA HOSTEL LOAD =31.4KW								

FARIDKOT HOSTEL								
Hostel Room 2X43	2X43=86	2X43=86	1X43=43	-	-	-	-	-
Hostel Room 1X3	1X3=3	1X3=3	1X3=3	-	-	-	-	-
Corridor	-	6X2=12	-	-	-	-	-	-
washroom		2X4=8	-	-	3X1.8=5.4KW 3X1=3KW	-	-	-
Total	89X60=5.340KW	109X20=2.180KW	46X60=2.760KW		8.4KW			
FARIDKOT HOSTEL LOAD =18.68KW								

HARGOBIND HOSTEL								
Hostel Room 1X40	1X40=40	1X40=40	1X40=40	-	-	-	-	-
Hostel Room 2X16	2X16=32	2X16=32	1X16=16	-	-	-	-	-
Corridor	-	4x2=8	-	-	-	-	-	-
washroom	-	3x4=12	1x4=4	-	4x1.8=7.2KW	-	-	-
Total	72X60=4.320	92X20=1.840	60X60=3.600		7.200KW	-	-	-
HARGOBIND HOSTEL LOAD =16.96KW								

NEW JIND HOSTEL								
Hostel Room 1X25	2X47=94	2X47=94	1X47=47	-	-	-	-	-

Hostel Room	10	5	2	-	-	-	-	-
Corridor	-	10	2	-	-	-	-	-
washroom	-	10	-	-	2-6KW 2-3.6KW	-	1.4 KW	-
Total	104X60=6.240KW	119X20=2.380KW	51X60=3.060KW		9.6KW		1.4 KW	
NEW JIND HOSTEL LOAD =22.68KW								

OLD JIND HOSTEL								
Hostel Room 1X25	1X25=25	1X25=25	1X25=25	-	-	-	-	-
Hostel Room 2X13	2X13=26	2X13=26	1X13=13	-	-	-	-	-
Corridor	-	2X4=8	-	-	-	-	-	-
washroom	-	5X2=10	-	-	-	-	-	-
Total	51X60=3.060KW	69X20=1.380KW	38X60=2.280KW	-	2X1=2KW (4KW)	-	1.4 KW	-
OLD JIND HOSTEL LOAD =12.12KW								

WORKSHOP								
WARANDA	7X60=420W	7X20=140W	12(12X60=720W)	5(5/3)2KW	-	-	Wood Cutter Motor All 22HP	-
Total	420W	140W	720W	2KW	-	-	16.412KW	
WORKSHOP TOTAL LOAD =19.69KW								

MEES/CANTEEN/FOOD COURT

	55X60=3.300KW	48X20=960W	24X60=1.440KW	21(21/2) 11KW	GEYSER 3X1800 =5400	1X2500W	-	6X630=3780W
Total	3.300KW	9.600KW	1.440KW	11KW	5.400KW	2.500 KW		3.78

MEES/CANTEEN/FOOD COURT LOAD =37.02KW

TOTAL LOAD =158KW

TOTAL GEYSER LOAD = 45.2KW

WORKSHOP LOAD = 19.69KW

MESS/CANTEEN/ FOOD COURT = 37.02KW

GIRLS HOSTEL

S.No.	Equipment Name	Type	Quantity	Load (Km)
1	Geyser	19 Big(2KW)	19	38
		4 Small(3.2KW)	4	12.8
2	Motor	1 (7 H.P) 3 Phase	1	5.22
		3 (1nd half H.P)	3	3.4
		2 (3 H.P)	2	4.8
3	Plug	5 Amp,	987	19.74
4	Exhaust Fan	2 Big	2	
		9 Small	9	0.668
5	Generator Set	----	1	140
6	RO Plant	Motor (1.36 H.P)	1	1
		Tullu Pump (0.37H.P)		
7	Air Conditioner	1 Ton	1	1.2
8	Computer Set	----	2	0.5
9	LED TV	42 Inch	3	0.18
10	Fan	Ceiling Fan	643	38.53

		wall Fan	12	0.72
11	Tube Rod	LED Set	100	2
		40 watt Rod Tube	636	25.44
12	Street Light	45 Watt	16	0.72
13	CCTV Camera	----	8	0.2
14	Canteen	Plug 15 Amp.	8	4
		Plug 5 Amp.	7	0.14
		Candy (450 Watt)	1	0.45
		Fridge (670 Watt)	1	0.67
15	Mess	Plug 15 Amp.	7	4
		Plug 5 Amp.	3	0.6
		Candy (1500 Watt)	1	1.5
			Total	306.478

SUBMERSIBLE MOTORS			
		THREE PHASE (HP)No.	SINGLE PHASE (HP)No.
1	MAIN GROUND	10X1	
		7.5X1	
2	ADM BLOCK		2.0
3	GURDWARA SAHIB		1.5
4	SIKH HISTORY		1.5X1

From above load list, the observation is given below

Total no of CFL used in campus

Sl.no	Wattage	Qty.
1	15	19
2	20	247

And total no of florescent tube used

Sl.no	Wattage	Qty.
1	20	82
2	40	99
3	80	142

PHOTOS OF LIGHTS USED IN CAMPUS

Efficiency

If we talk about efficiency, CFL & LED are both significantly energy efficient. As for comparison the CFLS are 25% more efficient than incandescent light bulb & LEDs are roughly 75% more efficient.

LIFESPAN

The lifespan of LEDs is much longer than CFLs. As the

Average lifespan of CFLs is 10,000 Hrs.

Average lifespan of LEDs is 25,000 Hrs.

Hence from above we can calculate that the LEDs are almost 40% more efficient than CFLs.

LUMENS

The luminance of CFLs is 60 Lu/w. While the luminance of LEDs 72 Lu/w.

This means that around 10w of power, an LED will be just bright as a 18w of CFLs

CONCLUSION

From the above data we conclude that if we replace the CFL with the LED lights much electricity would be saved and the calculation is given below:

Total no. 15 watt CFLs used = 19

Lumen per watt of CFL = 60 Lu/w

So, Total Lumen of 15w CFL is = 900 Lu

This luminance can be achieved by 12w of LED

Total no. of 20 watt CFLs used = 247

Lumen per watt of CFL = 60 Lu/w

So, Total Lumen of 20w CFL is = 1200 Lu

This luminance can be achieved by 16w of LED

- So, 19 number of 15w CFL will consume almost 285w & same amount of 12w LED will consume 228w. Which is about 57w less
- Also 227 numbers of 20w CFL will consume about 4540w whereas same number of 16 LED will consume about 3632w. Which is about 908w less. Hence, we can save up to 965 watts of energy.

Now talking about the Fluorescent tube lights.

Luminance of Fluorescent tube light = 80 Lu/w

Luminance of LED tube light = 130 Lu/w

Total no. 20 w Fluorescent tube light used = 82

Lumen per watt of Fluorescent tube light = 80 Lu/w

So, Total Lumen of 20w Fluorescent tube light = 1600 Lu

This luminance can be achieved by 12w of LED tube light

Total no. 40 w Fluorescent tube light used = 99

Lumen per watt of Fluorescent tube light = 80 Lu/w

So, Total Lumen of 40w Fluorescent tube light = 3200 Lu

This luminance can be achieved by 25w of LED tube light

Total no. 80 w Fluorescent tube light used = 142

Lumen per watt of Fluorescent tube light = 60 Lu/w

So, Total Lumen of 36w Fluorescent tube light = 4800 Lu

This luminance can be achieved by 36w of LED tube light

So, 82 number of 20w Fluorescent tube light will consume almost 1640w & same amount of 12w LED tube light will consume 984w. Which is about 656w less

Also 99 numbers of 40w Fluorescent tube light will consume about 3960w whereas same number of 25 LED tube light will consume about 2475w. Which is about 1485w less.

Also 142 numbers of 80w Fluorescent tubelight will consume about 11360w whereas same number of 36w LED tubelight will consume about 5112w. Which is about 6248w less

Hence, we can save up to 8386 watts of energy.

COSTING AND PAYBACK TIME FOR REPLACING CFL WITH LED

Cost of 12w LED light = Rs. 160/p

Cost of 16w LED light = Rs. 175/p

Cost of 19 12w LED light =Rs. 3040

Cost of 247 16w LED light =Rs. 43225

Total cost of replacing all the CFLs = Rs.46265

Average use of lights per year = 270 x 7 h = 1890hr

From above value approx. 1kw of energy is saved

Hence, total energy saved per year = 1 x 1890 = 1890kwh

Saving in Rupees/year 1890 x 6.63 = Rs.13000

So, capital cost recovery time = (46265/13000) = 3 years Approx.

COSTING AND PAYBACK TIME FOR REPLACING FLUORESCENT TUBE LIGHT WITH LED TUBE LIGHT

Cost of 12w LED tube light = Rs.130/p

Cost of 16w LED tube light = Rs180/p

Cost of 36w LED tube light = Rs247/p

Cost of 82 12w LED tube light =Rs. 10660

Cost of 99 25w LED tube light =Rs. 17820

Cost of 142 36w LED tube light =Rs. 35074

Total cost of replacing all the tube light = Rs.63550

Average use of lights per year = 270 x 7 h = 1890hr

From above value approx. 9kw of energy is saved

Hence, total energy saved per year = 8 x 1890 = 15120kwh

Saving in Rupees/year = 15120 x 6.63 = Rs.100245

So, capital cost recovery time = (63550/100245) = 6 Months Approx. by replacing the fluorescent tube light with LED tube light

Use of master switch outside each room

Installation of a master switch outside a room can make it easy for a person to switch off all the appliances of a room in case someone forgets to switch off while leaving the room. This helps in improving energy efficiency.

Use of motion sensors in toilets

Toilets have large potential of saving energy by use of automation tools. Motion sensors can be used there to automatically switch on the light when there is any movement and switch off the light Then there is no movement. This can greatly reduce the total load in toilets, each toilet has 4 tube light in average. There will be 2sensors required in a toilet.

Cost analysis of Installing Motion Sensors in Toilets:

- Approximate total no of toilets in campus =28
- Approximate total no of light in toilets = 112
- Average power of the tube light =12 w
- Average no of motion sensor required =28
- Average reduction of usage per day by motion sensor =4hr

Total energy saved in toilets per year:

- Total energy consume by toilets =12X112=1.3kwh
- Energy consumed in normal condition per day =1.3X7=9.4Kwh
- Energy saved by motion sensor per day =1.3X4=5.3kwh
- Hence, energy saved by motion sensor per year =5.3X270=1431kwh
- Total amount saved per year = Rs 7339
- Cost of installation per motion sensor = Rs 500
- Total cost of installing motion sensor in toilets = 500x28=Rs14000
- Capital cost recovery time = 14000/7339 = 1.9 Yr

Hence the capital cost recovery time for installing motion sensor in toilets is 1 years. Hence, this is a highly recommended step to largely reduce the consumption in toilets.

High investment/Long Term Replacement

Energy substitution (electrical energy to solar energy)

As we know in campus there is a huge consumption of electrical energy which is not economical so instead of using electrical energy, we switch to alternate energy source which is solar energy.

THREE PHASE MOTORS CALCULATIONS

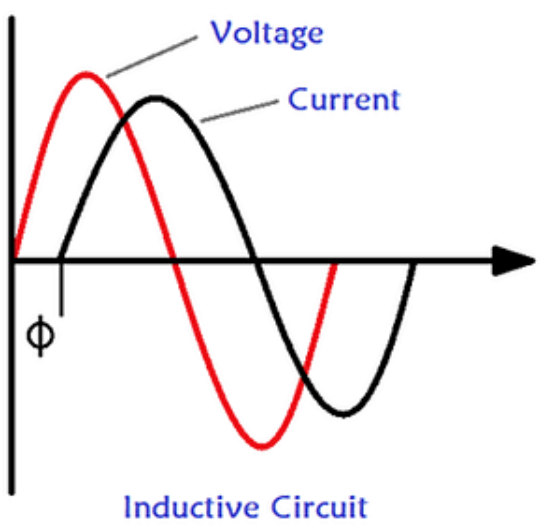
"LOAD LIST FOR 3-PHASE MOTORS"

S.NO.	EQUIPMENT NAME	VOLTAGE	TYPE OF LOAD	RATING IN HP	RATING IN	CURRENT IN AMP	ABSORBED POWER	POWER FACTOR	LOAD FACTOR	DIVERSITY FACTOR	EFF.	TYPE OF LOAD	TOTAL KW	TOTAL KVAR					TYPE OF STARTER
1	SUBMERSIBLE PUMP 1	415	MOTOR/PUMP	7.5	5.6	12.2	4.2	0.75	0.70	1.0	0.85	C	4.9	4.4					DOL
2	SUBMERSIBLE PUMP 2	415	MOTOR/PUMP	10.0	7.5	16.3	5.6	0.75	0.70	1.0	0.85	C	6.6	5.8					DOL
3	WATER PUMP IN NABHA HOSTEL	415	MOTOR/PUMP	12.5	9.3	20.4	7.0	0.75	0.70	1.0	0.85	C	8.2	7.3					S/D
4	WATER PUMP IN GIRLS HOSTEL	415	MOTOR/PUMP	7.0	5.2	11.4	3.9	0.75	0.70	1.0	0.85	C	4.6	4.1					DOL
													24.4	21.5					
	MAXIMUM LOAD		100%	OF CONTINOUS LOAD															
													KW	KVAR	KVA	COSϕ	AMP	VOLTS	
												MAXIMUM NORMAL RUNNING LOAD	24.4	21.5	32.5	0.75	45.2	415	
												PEAK LOAD	24.4	21.5	32.5	0.75	45.2	415	

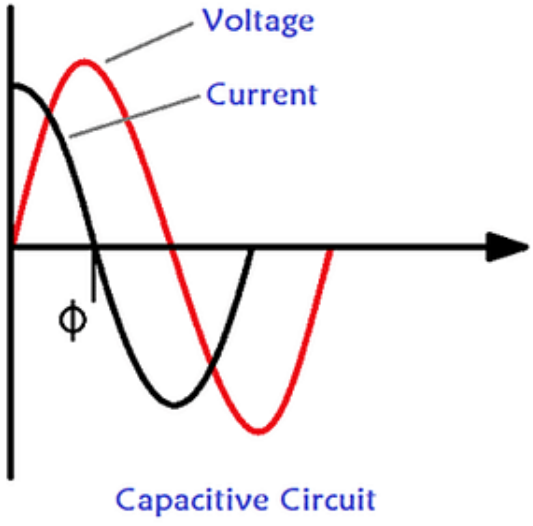
The above table shows 3-phase motors calculations.

Understanding Power Factor and How It Affects Electricity Bills

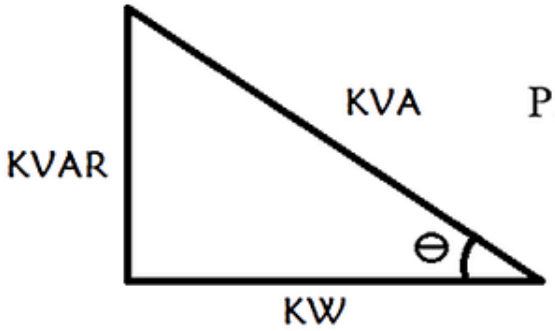
Aside from safety and reliability, several other goals including efficiency should be pursued in the design and implementation of electrical systems. One of the measures of efficiency in an electrical system is the efficiency with which the system transforms the energy it receives into useful work. This efficiency is indicated by a component of electrical systems known as the Power Factor. The **power factor indicates how much power is actually being used to perform useful work** by a load and how much power it is "wasting". As trivial as its name sounds, it is one of the major factors behind high electricity bills, power failures and sometimes the imbalance in electrical networks.



Inductive Circuit



Capacitive Circuit



$$P.F. = \frac{\text{Actual Power}}{\textit{Apparent Power}} \quad \text{or} \quad P.F. = \text{Cos}\Theta$$

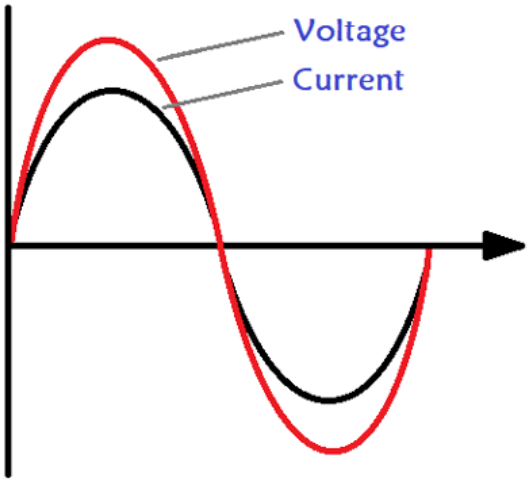
To be able to properly describe power factor and its practical significance, it is important to refresh your memory about the different types of electrical loads and components of Power that exist.

From basic electricity classes, electrical loads are basically of two types;

1. **Resistive Loads**
2. **Reactive Loads**

Resistive Loads

Resistive loads, as the name implies, are loads which are made up of **purely resistive elements**. For this kind of load (considering ideal conditions), all the power supplied to it are dissipated for useful work due to the fact that the **current is usually in phase with the voltage**. A good example of resistive loads includes incandescent light bulbs and batteries.



Resistive Circuit

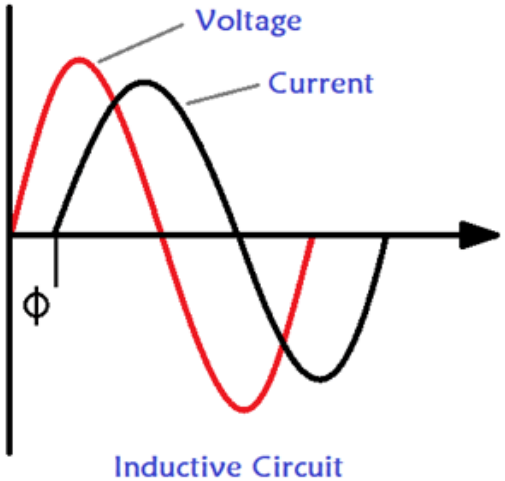
Relationship between current and voltage for a Resistive Load

For this kind of loads, a power component known as Real/Active/working Power is associated. We will take a closer look at it in a bit.

Reactive loads

Reactive loads, on the other hand, are a little bit more complex. While they cause a drop in voltage and draw current from the source like resistive loads, they dissipate no useful power (no work was done).

Reactive loads can either be capacitive or Inductive. In inductive loads, the power drawn is used up in setting up magnetic flux without any direct work performed, while for capacitive loads, the power is used in charging the capacitor and not directly producing work. The power thus dissipated in reactive loads is referred to as **Reactive power**. Reactive loads are characterized by **the current leading (Capacitive loads) or lagging (Inductive loads) behind the voltage**, as such, a phase difference usually exists between the current and the voltage.



Inductive Circuit

Relationship between Voltage and Current for an Inductive Load

The **variations in these two types of load brought about the existence of three power components in electrical systems**, namely;

1. Actual Power
2. Reactive Power
3. Apparent Power

To pick them one after the other;

Actual Power

This is the power associated with resistive loads. It is the power component dissipated to the performance of actual work in electrical systems. From heating to lighting, etc., It is expressed in **Watts (W)** (along with its multipliers, kilo, Mega, etc.) and symbolically represented by the letter P.

Reactive Power

This is the power associated with reactive loads. As a result of the delay between voltage and current in reactive loads (either capacitive or inductive), the energy dissipated, produces no work. It is referred to as reactive power and its unit is **Volt-Ampere Reactive (VAR)**.

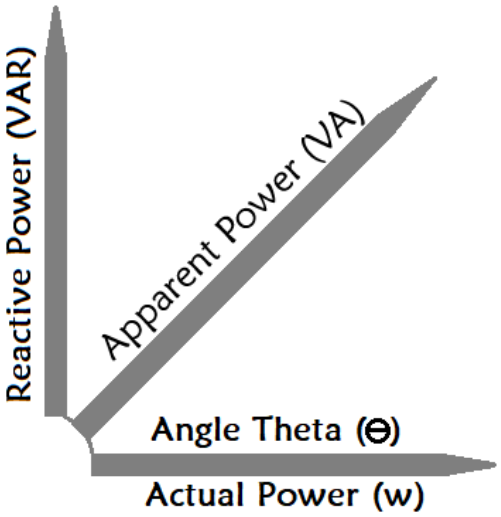
Apparent Power

Typical electrical systems comprise of both resistive and inductive loads, think about your light bulbs and heaters for resistive loads, and equipment with motors, compressors, etc. as inductive loads. Thus in an electrical system, **Total Power is a combination of the actual and reactive power components**, this total power is called the Apparent Power and given by the sum of the Actual power and reactive power. Its unit is **volt-amps (VA)** and represented mathematically by the equation;

$$\text{Apparent Power} = \text{Actual Power} + \text{Reactive power}$$

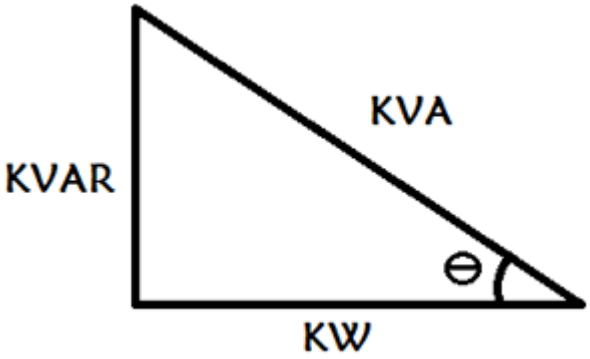
This combination leading to the apparent power is what brings about the **power factor**.

In Ideal situations, the actual power dissipated in an electrical system is usually greater than the reactive power. The image below shows the **vector diagram** drawn using the three Power components.



Vector Diagram

Transforming the vector diagram, we get the triangle below; none as the power triangle.



Power Triangle

By obtaining the cosine of the angle theta, we are able to decipher the efficiency of the system in using the power it receives for work. This efficiency evaluated as the ratio of the actual power to the apparent power is referred to as the **power factor** with values between 0 and 1. From the power triangle, according to the cosine rule (Adjacent over hypotenuse), the power factor can also be estimated as the ratio of actual power to the apparent power. mathematically;

P.F. = Actual Power / Apparent Power or P.F. =CosΘ

Putting this side by side with the equation for determining apparent power, it's easy to see that an increase in reactive power (presence of a high number of reactive loads), leads to an increase in apparent power and a larger value for angle theta, which ultimately results in a low power factor when its cosine (cos) is obtained. On the flip side, a reduction in reactive loads (reactive power) leads to an increased power factor, indicating high efficiency in systems with less reactive loads.

Importance of Power Factor

At very low power factor values, a large quantity of energy from the mains is wasted as a chunk of it will not be used for meaningful work due to the presence of more reactive loads indicated by the low power factor. This place a strain on the supply system as both the real power required by the load and the reactive power used to satisfy reactive loads will be drawn from the system to meet the requirements of the load.

This strain and "wastage" typically leads to huge electricity bills for consumers (especially industrial consumers) as utility companies calculate consumption in terms of apparent power, as such, they end up paying for power which was not used to achieve any "meaningful" work.

Even in situations where the power is being provided by the company's generators, money is wasted on bigger generators, larger sized cables, etc., required to provide power when a good number of it is just going to waste.

Power factor surcharge according to "*Punjab State Electricity Regulatory Commission (P.S.E.R.C)"*

According to para SXI.6 Power Factor Surcharge/Incentive

Consumers shall be required to maintain a monthly average power factor of 0.90. The monthly average power factor shall mean the ratio of total kWh to total kVAh supplied during the month. The ratio shall be rounded up to two decimal points.

According to para SXI. 6.1 Low Power Factor Surcharge

If the monthly average power factor falls below 0.90, the consumer shall pay on the energy charges a surcharge of 1% for each 0.01 decrease in the monthly average power factor below 0.90. The surcharge shall be 2% for each 0.01 decrease of monthly average power factor below 0.80.

According to para SXI. 6.2 Power Factor Incentive

If the monthly average power factor exceeds 0.90, incentive @ 0.25%, for each increase of 0.01 above 0.90 shall be allowed on the energy charges.

HOW TO SOLVE THIS PROBLEM?

To solve the above problem, we have to improve the power factor by installing the APFC panel which can maintain the power factor above 0.9 and helps in generating the power factor incentive, which causes the reduction in bill.

WHAT SHOULD BE THE CAPACITY OF APFC?

APFC Calculations

APFC Calculations

Total running load	=	24.4kw
Correction factor	=	$\tan\emptyset_1 - \tan\emptyset_2$
Actual power factor	=	$\cos\emptyset_1$ =0.75
So, $\emptyset_1$	=	$\cos^{-1}(0.75) = 41.4$
Required power factor	=	$\cos\emptyset_2$ =0.98
So, $\emptyset_2$	=	$\cos^{-1}(0.98) =$ 11.5
Correction factor	=	tan (41.4) – tan (11.5) = 0.68
Capacitor rating in KVAR	=	Running KW x Correction factor
	=	24.4 x 0.68
	=	0.68
	=	20 KVAR Approx.

So the capacitor bank of 5 steps is required and the steps are as follows:
Capacitor bank steps = (2.5 + 2.5 + 5 + 5 + 5) KVAR

Let us take an example by taking the bill

Let the bill amount	=	Rs. 20000
From load list avg. PF	=	0.75
Desired power factor	=	0.9
For 0.9 to 0.8 % cap. Charge	=	10 x 1% = 10%
For 0.8 to 0.75 % cap. Charge	=	5 x 2% = 10%
So, total cap. Charge would be	=	10+10% = 20%

If power factor is 0.9 then reduction in bill would be

20% of total bill amount	=	16000
So reduced bill amount	=	331980-265584= Rs. 4000

After using the APFC panel the average power factor will be 0.97.

So, total hike in power factor = 7%

According to para SXI. 6.2 Power Factor Incentive will be 0.25% for increase of 0.01

So, 7% of Rs. 16000 rebate will be = Rs. 1400

Total bill amount =Rs. 14600

Total saving after installing APFC panel = Rs. 6000

Cost of installing APFC panel = Rs. 32000 approx.

So, the payback time will approximately 6 months by using the APFC panel.

CONCLUSION AND RECOMMENDATIONS

- As per the climatic data of the location it is seen that the annual solar radiation of the area is 4.68 kw/m^2/d, which is very good reading for solar power harvesting and by following this we can see that the energy benchmarks of the campus is 13kwh/m^2 and if only 10% of total kwh/m^2 is reduced i.e. 11.7kwh/m^2 the 156000 units of energy is saved in one year. This can be done by using the 60% of solar water heating system instead of electric geezers. Total cost of installation is Approx. Rs. 2,00,000 which can be recovered in less than 10 months.
- There are mainly 6 generators in the campus of different ratings which is shown in table-A above and also the carbon emission due to generator calculations are given above. According to our recommendations only by reducing the 20kw of power produced by generator with Solar inverters the GHG emission is reduced from 10.3 to 5.3. and the replacement of solar inverters would cost Rs. 2,00,000, which would be recovered back in 6 years.
- The department vise electrical load list of is given above and from the load list most of the lights source used by the campus is CFL's & fluorescent tube lights. According to our suggestion these lights should be replaced with LED & LED tubelights which can play the major role in saving the electricity which can be seen in above calculations. And it is observed that the replacement cost is Rs. 63550, which can be recovered in 6 months.
- The final suggestion is the use of APFC panel for the 3 phase pumps and motors. As it not only saves the loss of energy by increasing the power factor but the increased power factor will also cause the more reduction in electrical bill by giving the power factor incentives. The cost of installing APFC panel is Rs. 32000. Which can be recovered in Approx. 6 months.

About Eco Group (Consultant)

ABOUT ECO GROUP

Eco Group is North India's reputed environmental organization Headquartered in Mohali (Chandigarh) that offers consultancy and environmental-related turnkey solutions for overall pollution abatement and sustainable development. We are a professional engineering firm with National level consultancy approved by QCI/ NABET and Environmental and Mechanical testing laboratory approved by MoEF&CC, NABL (ISO/IEC 17025:2017) and state boards.

Eco Group, established in 1998 has designed, engineered and executed more than 1,000 installations of Water, Domestic Sewage and Industrial Effluent Treatment Plants. With the help of our state-of-the-art technologies and apt infrastructure, we are proud to maintain an impeccable quality record, owing to our customer satisfaction levels. These treatment plants operate with the help of trained staff, including Sewage Treatment Plants (STPs), Effluent Treatment Plants (ETPs), Reverse Osmosis Plants (ROs), etc. In the last 20 years, we have undertaken several projects successfully and have created sustainable solutions to environmental issues.

Eco Group has two major business divisions as Eco Paryavaran Engineers & Consultants Pvt. Ltd. and Eco Paryavaran Laboratories & Consultants Pvt. Ltd. The former caters to consultancy and providing engineering solutions for environmental pollution whereas the latter pertains to the analytical and consultancy services in the field of lab testing and environmental studies. Eco Paryavaran is North India's leading supplier of pollution control equipment with world-class infrastructure.

Eco Paryavaran Laboratories is NABL (National Accreditation Board for Testing and Calibration Laboratories) accredited for ISO/IEC 17025:2017, approved by Ministry of Environment, Forest and Climate Change (MoEF&CC) & State Pollution Control Board (SPCBs) in the field of air, noise, wastes, water/wastewater and microbiological testing. Eco Paryavaran Laboratories & Consultants Pvt. Ltd. is also Government approved (ISO 9001:2015, ISO 14001:2015 and ISO 45001:2018) and National Accreditation Board for Education and Training (NABET).

Team of Experts for the Study

S. No.	Name of Expert	Role of Expert	ID of Expert
1.	Dr. Sandeep Garg (Ph. D. & ME in Env. Sc., BE in Civil)	Managing Director ▪ NABL approved authorized signatory ▪ MoEF&CC approved govt. analyst ▪ NABET approved EIA Coordinator & Functional Area Expert ▪ Chairman IWE & Ex-Advisor, GMADA	
2.	Dr. Rai Singh (Ph. D. & M. Sc. Env. Sc. P.G. Diploma in Industrial Safety, Health & Env.)	Dy. General Manager (Technical & Environment) ▪ MoEF&CC approved Govt. Analyst; ▪ NABL approved authorized signatory ▪ NABET approved Environmental Expert ▪ Worked in CPCB (2001-12) as Research Scientist	
4.	Dr. Simranjit Kaur (M.Sc. & M.Phill.; Ph.D. in Solid Waste Management)	Deputy General Manager – EMS & Biological Lab Quality Manager – Analytical Division ▪ NABL Technical Assessor, ▪ NABL approved authorized signatory ▪ MoEF&CC approved govt. analyst ▪ NABET approved EIA Coordinator & Functional Area Expert	
5.	Dr. Ajay Kumar	Chief Technical Officer Quality Manager ▪ NABL approved authorized signatory	
6.	Mr. Navjot Singh (BE Electrical & specialization in MEP)	Manager (Projects)	
7.	Mr. Umesh Kumar (M. Tech – Nanotech)	Technical Manager & Sr. Laboratory Analyst (Environment & Chemical) ▪ NABL approved authorized signatory	

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Approvals of Eco Paryavaran Laboratory

Approvals of Eco Laboratory

NABET ACCREDITATION CERTIFICATE

Quality Council of India

National Accreditation Board for Education & Training

Certificate of Accreditation

Eco Laboratories and Consultants Pvt Ltd, Mohali

E 207, Phase VIII B, Sector 74, Industrial Area, SAS Nagar, Mohali

*The organization is accredited as **Category-A** under the QCI-NABET Scheme for Accreditation of EIA Consultant Organization, Version 3: for preparing EIA-EMP reports in the following Sectors –*

S. No	Sector Description	Sector (as per)		Cat.
		NABET	MoEFCC	
1	Mining of minerals- opencast only	1	1 (b)	A
2	Metallurgical industries	8	3 (a)	B
3	Cement plants	9	3 (b)	A
4	Synthetic organic chemicals industry (dyes & dye intermediates; bulk drugs and intermediates excluding drug formulations; synthetic rubbers; basic organic chemicals, other synthetic organic chemicals and chemical intermediates)	21	5 (f)	A
5	Distilleries	22	5 (g)	A
6	Sugar Industry	25	5 (j)	B
7	Industrial estates/ parks/ complexes/ Areas, export processing zones (EPZs), Special economic zones (SEZs), Biotech parks, Leather complexes	31	7 (c)	A
8	Common Effluent Treatment Plants (CETPs)	36	7 (h)	B
9	Building and construction projects	38	8 (a)	B
10	Townships and Area development projects	39	8 (b)	B

Note: Names of approved EIA Coordinators and Functional Area Experts are mentioned in RA AC minutes dated July 02, 2021 posted on QCI-NABET website.

The Accreditation shall remain in force subject to continued compliance to the terms and conditions mentioned in QCI-NABET's letter of accreditation bearing no. QO/NABET/ENV/ACO/21/1936 dated Sept 10, 2021. The accreditation needs to be renewed before the expiry date by Eco Laboratories and Consultants Pvt Ltd, Mohali following due process of assessment.

Sr. Director, NABET
Dated: Sept 10, 2021

Certificate No.
NABET/EIA/2023/RA 0211

Valid up to
Dec 17, 2023

For the updated List of Accredited EIA Consultant Organizations with approved Sectors please refer to QCI-NABET website.

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NABL ACCREDITATION CERTIFICATE

National Accreditation Board for Testing and Calibration Laboratories

NABL

CERTIFICATE OF ACCREDITATION

ECO LABORATORIES AND CONSULTANTS PVT. LTD.

has been assessed and accredited in accordance with the standard

ISO/IEC 17025:2017

"General Requirements for the Competence of Testing & Calibration Laboratories"

for its facilities at

ECO GROUP, ECO BHAWAN, E-207, INDUSTRIAL AREA, PHASE VIII-B, (SECTOR 74), MOHALI, PUNJAB, INDIA

in the field of

TESTING

Certificate Number: TC-7477

Issue Date: 01/06/2021 Valid Until: 31/05/2023

This certificate remains valid for the Scope of Accreditation as specified in the annexure subject to continued satisfactory compliance to the above standard & the relevant requirements of NABL.
(To see the scope of accreditation of this laboratory, you may also visit NABL website www.nabl-india.org)

Name of Legal Identity : ECO LABORATORIES AND CONSULTANTS PVT. LTD.

Signed for and on behalf of NABL

N. Venkateswaran
Chief Executive Officer

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MOEF&CC ACCREDITATION CERTIFICATE

रजिस्ट्री सं० डी० एल०-33004/99 REGD. NO. D. L.-33004/99

भारत का राजपत्र
The Gazette of India

असाधारण
EXTRAORDINARY
भाग II—खण्ड 3—उप-खण्ड (ii)
PART II—Section 3—Sub-section (ii)
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No. 758] NEW DELHI, WEDNESDAY, FEBRUARY 28, 2018/PHALGUNA 9, 1939

पर्यावरण, वन और जलवायु परिवर्तन मंत्रालय

अधिसूचना

नई दिल्ली, 26 फरवरी, 2018

NOTIFICATION

New Delhi, the 26th February, 2018

S.O. 857(E).—In exercise of the powers conferred by clause (b) of sub-section (1) of section 12 and section 13 of the Environment (Protection) Act, 1986 (29 of 1986), read with rule 10 of the Environment (Protection) Rules, 1986, the Central Government hereby makes the following further amendments in the notification of the Government of India in the erstwhile Ministry of Environment and Forests, number S.O. 1174(E), dated the 18th July, 2007, namely: -

In the Table appended to the said notification, -

(i) for serial numbers 1,17,24,26,30,39,41,45,81,86,87,93,94,95,96 and 100 the entries relating thereto, the following serial numbers and entries shall be substituted, namely: -

S.No.	Name of the Laboratory	Name of the Govt. Analyst	Recognition with effect from and valid up to
(1)	(2)	(3)	(4)
"1	M/s Mantec Consultants Pvt. Ltd. D-36, Sector-VI, Noida-201301, Uttar Pradesh	(i) Mr. Gaja Nand Mallick (ii) Dr. Vivek Dwivedi (iii) Mr. Sumit Verma	26.02.2018 to 25.02.2023
17	M/s Idma Laboratories Limited	(i) Mr. Ankush Aggarwal	26.02.2018

	391, Industrial Area, Phase-I, Panchkula-160019,Haryana	(ii)Mr. Niranjan Dev Behl (iii) Dr. Rajendra Kumar Jain	to 25.02.2023
24	M/s Newcon Consultants & Laboratories Pvt. Ltd. 8th K.M. Stone, Delhi Meerut Road, Morta (Opp. Manan Dham Mandir), Ghaziabad-201003, Uttar Pradesh	(i) Mr. Pankaj Gupta (ii) Mr. Amit Kumar Singh (iii) Mr. Intekhab Khan	26.02.2018 to 25.02.2023
26	M/s Klean Laboratories & Research Pvt. Ltd. 402, Purushottam Plaza, Opp. Baner Telephone Exchange,Baner Road, Pune-411045, Maharashtra	(i) Mr. Vishwas Waman Kale (ii) Mr. Sanjay Kamalakar Mardikar (iii) Ms. Manjusha Gaikwad	26.02.2018 to 25.02.2023
30	M/s Lawn Enviro Associates, "Lawn House" #184-C, Vengalrao Nagar, Hyderabad-500038, Telangana	(i) Mr. Devireddy Nagarjuna Reddy (ii) Ms. Chevula Anuradha (iii) Ms.Vangani Pallavi	26.02.2018 to 25.02.2023
39	M/s Team Test House. (A Unit of Team Institute of Science & Technology Pvt. Ltd.) G-1-584, RIICO Industrial Area, Sitapura, Jaipur-302022, Rajasthan	(i) Mrs. Kavita Mathur (ii) Mr. Kedar Nath Mukhopadhyay (iii) Mr.Rajesh Maheshwari	26.02.2018 to 25.02.2023
41	M/s Envirochem Research & Test Labs Pvt. Ltd. HIG-79, Sector-E, Aliganj, Lucknow-226024, Uttar Pradesh	(i) Dr. Madan Mohan Agarwal (ii) Sh. Vivek Kumar Gupta (iii) Mrs. Saroj Singh	26.02.2018 to 25.02.2023
45	M/s Mineral Engineering Services 25/XXV, Club Road, Bellary-583103, Karnataka	(i) Mr. M. Sachin Raju (ii) Mr. M.R. Durga Prasad (iii) Mr. A.D. Yashwanth Arun Murthy	26.02.2018 to 25.02.2023
81	M/s Advanced Environmental Testing and Research Lab Pvt. Ltd. 63/1, Kailash Vihar, Near ITO, City Center-II, Gwalior-474011, Madhya Pradesh	(i)Mr. Rajesh Jain (ii)Dr. Dinesh Kumar Uchchariya (iii) Mr. Arvind Kumar Sharma	26.02.2018 to 25.02.2023
86	M/s Care Labs Plot No. 1, 3rd Floor, Sai Sadan Complex, Shiva Ganga Colony, L.B. Nagar, Hyderabad-500074, Telangana	(i) Mr.K. Srinivasa Rao (ii) Ms. Gouthami Gangula (iii) Ms. P. Mamatha	26.02.2018 to 25.02.2023
87	M/s Green Circle Inc. Green Empire, Anupushpam Habitat Centre, Nr. Yash Complex, Above Axix Bank Ltd., Gotri Main Road, Vadodara-390021, Gujarat	(i) Mr. Pradeep Joshi (ii) Mr. Ram Raghav (iii) Ms. Shital Jashvantsinh Parmar	26.02.2018 to 25.02.2023
93	M/s Eco Laboratories & Consultants Pvt. Ltd. E-207, Industrial Area, Phase- VIII B, Sector-74, Mohali-160071, Punjab	(i) Mr. Sandeep Garg (ii) Ms. Simranjit Kaur (iii) Dr. Deepika Thakur	26.02.2018 to 25.02.2023
94	M/s Hubert Enviro Care Systems Pvt. Ltd. No. 18, 92nd Street, Ashok Nagar, Chennai-600083, Tamil Nadu	(i)Dr. J.R. Moses (ii)Dr. Rajkumar Samuel (iii) Mr. A.K. Natarajan	26.02.2018 to 25.02.2023
95	M/s Nawal Analytical Laboratories Plot No. 100, New SIDCO Industrial Estate, Sri Nagar, Hosur-635109, Tamil Nadu	(i) Mr. D.Balakrishnan (ii) Ms. S. Elamathi (iii) Mr. K.B.Krishnamoorthy	26.02.2018 to 25.02.2023

Approved

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ISO 9001: 2015 Certificate

Certificate of Registration

ISO 9001:2015

This is to Certify that
Quality Management System of

ECO PARYAVARAN ENGINEERS & CONSULTANTS PRIVATE LIMITED

E-204 & 205, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74),
MOHALI-160071, PUNJAB, INDIA.

has been assessed and found to conform to the requirements of

ISO 9001:2015

for the following scope :

DESIGNING, MANUFACTURING, SUPPLY AND COMMISSIONING OF POLLUTION CONTROL EQUIPMENTS.

Certificate No	: **22IQJH70**		
Initial Registration Date	: 21/04/2022	Issuance Date	: 21/04/2022
Date of Expiry	: 20/04/2025		
1st Surve. Due	: 21/03/2023	2nd Surve. Due	: 21/03/2024

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

AQC MIDDLE EAST LLC

Head Office: Office No. 02, Ground Floor, Sharjah Media City, Sharjah, UAE. e-mail : info@aqcworld.com
Key Location: A-60, Sector - 2, Noida, Uttar Pradesh, 201301, India.
**Validity of the Certificate is subject to successful completion of surveillance audit on or before of due date. (in case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawal).*
Certificate Verification: Please Re-check the validity of certificate at http://www.aqcworld.com/activeclients.aspx or www.aqcworld.com at Active Clients.
Certificate is the property of AQC Middle East LLC and shall be returned immediately when demanded

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ISO 14001: 2015 Certificate

Certificate of Registration

ISO 14001:2015

This is to Certify that
Environmental Management System of

ECO PARYAVARAN LABORATORIES & CONSULTANTS PRIVATE LIMITED

E-207, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74), MOHALI–160071, PUNJAB, INDIA.

has been assessed and found to conform to the requirements of

ISO 14001:2015

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/EMP REPORTS.

Certificate No	: **22IEJS76**		
Initial Registration Date	: 21/04/2022	Issuance Date	: 21/04/2022
Date of Expiry	: 20/04/2025		
1st Surve. Due	: 21/03/2023	2nd Surve. Due	: 21/03/2024

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

AQC MIDDLE EAST LLC

Head Office: Office No. 02, Ground Floor, Sharjah Media City, Sharjah, UAE. e-mail: info@aqcworld.com,
Key Location: A-60, Sector - 2, Noida, Uttar Pradesh, 201301, India.
**Validity of the Certificate is subject to successful completion of surveillance audit on or before of due date. (in case surveillance audit is not allowed to be conducted, this certificate shall be suspended/withdrawal).*
Certificate Verification: Please Re-check the validity of certificate at http://www.aqcworld.com/activeclients.aspx or www.aqcworld.com at Active Clients.
Certificate is the property of AQC Middle East LLC and shall be returned immediately when demanded

MEHAL SINGH Digitally signed by MEHAL SINGH
Date: 2023.06.13 12:37:27 +05'30'

ISO 45001: 2018 Certificate

Certificate of Registration

ISO 45001:2018

This is to Certify that
Occupational Health & Safety Management System of

ECO PARYAVARAN LABORATORIES & CONSULTANTS PRIVATE LIMITED

E-207, INDUSTRIAL AREA, PHASE VIII B (SECTOR–74), MOHALI–160071, PUNJAB, INDIA.

has been assessed and found to conform to the requirements of

ISO 45001:2018

for the following scope :

TESTING SERVICES IN BIOLOGICAL, CHEMICAL AND MECHANICAL CATEGORIES & EIA CONSULTANTS FOR PREPARING EIA/EMP REPORTS.

Certificate No	: **22IOJA85**		
Initial Registration Date	: 21/04/2022	Issuance Date	: 21/04/2022
Date of Expiry	: 20/04/2025		
1st Surve. Due	: 21/03/2023	2nd Surve. Due	: 21/03/2024

Director

IAS ACCREDITED Management Systems Certification Body MSCB-119

MEMBER OF MULTILATERAL RECOGNITION ARRANGEMENT IAF

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Head Office: Office No. 02, Ground Floor, Sharjah Media City, Sharjah, UAE. e-mail: info@aqcworld.com,
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Date: 2023.06.13 12:37:27 +05'30'

Approvals of Eco Experts

NATURE SCIENCE FOUNDATION

(A Unique Research and Development Centre for Society Improvement
(ISO 9001:2015, 14001:2015, 45001:2018 & 50001:2018 Certified Organization
& Ministry of MSME Registered Organisation)
Coimbatore - 641 004, Tamil Nadu, India. [www.nsfonline.org.in]

Regd. No. 114 / 2017

Certificate of Lead Auditor Course

This is to certify that Dr. RAI SINGH, Department of Environment, Eco Paryavaran Laboratories and Consultants Pvt. Ltd., Mohali, Punjab has successfully completed a Lead Auditor Course on "Environment Management System, Green Campus Audit, Energy Audit and Hygiene Audit to Educational Institutions and Industrial Sectors" (Fourth Series) organized by the Nature Science Foundation, Coimbatore – 641 046, Tamil Nadu, India from 26th September 2022 to 30th September 2022.

Motto of NSF
'Save the Nature to Save the Future' & 'Go Green to Save the Planet'

Chairman	Certified ISO Auditor	Certified Auditor IGBC AP	Certified BEE Auditor
Nature Science Foundation	*Environment Management System*	*Indian Green Building Council*	*Bureau of Energy Efficiency*

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Date: 2023.06.13 12:37:27 +05'30'

Acknowledgement

Acknowledgement

Eco Paryavaran Laboratories and Consultants Pvt. Ltd. is thankful to the Management and the Principal/Director of Khalsa College Amritsar for entrusting processes of Energy Audit with us.

We thank all the participants of the auditing team especially students, faculty and non-teaching staff who took pain along with us to gather the data through survey.

We also thank the office staff who helped us during the document verification.

For Eco Paryavaran Laboratories and Consultants Pvt. Ltd.

***** End of Report *****

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Date: 2023.06.13 12:37:27 +05'30'