ENERGY AUDIT REPORT

Netaji Subhas Ashram Mahavidyalaya
(Affiliated to Sidho-Kanho-Birsha University)
P.O.: Suisa, Dist: Purulia, Pin: 723217
West Bengal

May, 2023

Conducted By

Centre for Total Quality Management
36, Kantapukur, 3rd Bye Lane,
Howrah – 711101, West Bengal

Table of Content

1.0 INTRODUCTION

CTQM has been entrusted with the task of conducting Energy Audit & Energy Management study for the Netaji Subhas Ashram Mahavidyalaya. The field work and data collections were carried out in May, 2023 by following Engineers:

1. Sutapa Manna (Diploma in Electronics & Telecommunication)
2. Oindrila Das Mukherjee (B.Tech in Electrical)
3. Ghanshyam Jana (Diploma in Electrical)
4. Sayantani Das (B.tech in Electrical)
5. Soumobrata Ganguly (B.tech in Electrical)
6. Subhas Bayen (Diploma in Electrical)

The study encompassed the examination of the existing pattern of energy use in the college and identification of areas where energy & monetary savings could be achieved by employing suitable techno-economic measures.

This report gives the details of observations of the team along with appropriate recommendations and supporting calculations. We hope that the findings of the team will supplement the efforts of the management in bringing the energy consumption of the office to the lowest possible level.

Note:

This report is based on the present operating status of the office. The recommendations are based on various operational parameters examined by the team and the information supplied to the team by the management of Netaji Subhas Ashram Mahavidyalaya.

2.0 EXECUTIVE SUMMARY

Assignment was conducted and the following areas have been covered in the study.

1. Electricity Bill
2. Distribution Network
3. DG Sets
4. Lights

The summary of the observations and recommendations evolved out of the energy management study of the college building is given below:

1. The Running Maximum Demand (kVA) of the college varies from 2 kVA to 19 kVA. The running maximum Demand depends on power factor which also varies from 0.73to 0.92 and average monthly P.F. is 0.852 which is considered as poor. Details of Power Factor is given in the report.

   It is advisable to reduce the sanctioned load of 66.5 kW to 25 kW with the Electricity Board. This will be helpful in reducing the fixed cost in electricity bill by Rs. 3.22 lacs per yearas shown under para 5.0 'Sanctioned Demand'. For precaution, a Demand controller can be installed which will help in keeping the maximum running demand within the limit. The payback period will be around 1 month.

2. The average monthly power factor is 0.852 which is not good. If the power factor improves to 0.99 or unity then it will further reduce the fixed cost by Rs. 65000/- per year as shown under para 6.0 'Power Factor'. The payback period will be around 8 months.
3. Lux level in the class room at the entrance wall was found less. It is advisable to install some reflectors with each tubelight for better light intensity.

The summary at a glance of the observations and the return on investment is tabulated below:-

SUMMARY OF ANTICIPATED ANNUAL RECURRING SAVINGS

S. N.	OBSERVATIONS	SAVINGS		SAVINGS	Investment	REMARKS
		kWh	Lit.	(Rs. In lacs)	(Rs. In lacs)	
1	By reducing the sanction load from 66.5 kW to 25 kW	-	-	3.22	0.32	Payback period of 2 months.
2	By improving Power factor near to 0.99 or unity	-	-	0.65	0.25	Payback Period of 8 months
Total		-	-	3.87	0.57	

3.0 STATUS OF THE COLLEGE BUILDING

General

Netaji Subhas Ashram Mahavidyalaya comes under the University of Siho-Kanho-Birsha and it is established in the year 1985, imparting higher education in the field of Arts. It is located in Vill + P.O.: Suisa, Dist.: Purulia, Pin: 723212, West Bengal, India

The College admits students from all social milieus and empowers them through intensive mentoring and counselling to face the challenges of life and become responsible and sensitized citizens of the country. Netaji Subhas Ashram Mahavidyalaya provides a caring and nurturing environment where students come into their own, blossoming into confident young men and women ready to face the world.

Energy Sources

Electricity is the major energy sources of the college. Electricity is supplied by WBSEDCL, West Bengal. Diesel oil is being used in the DG sets for in-house generation of electricity during powercut.

Energy Consumption

For the Unit / college, the applicable WBSEDCL electrical tariff is in two parts i.e., a fixed cost (Demand Charges) and unit (kWh) rate. The average monthly unit consumption of the college is 2216 kVAh and the average monthly electricity bill amount is around Rs. 17432/- (Period: July 2022-June 2023). The average monthly unit cost would be around Rs. 8.26/-kVAh.

DG Sets

There is one DG set Kirloskar Green, 7.5 KVA, 230 volts, 1500 RPM, 1 Phase, Self Excited, Self Regulated A. C. Generator, Coupled with 16 BHP, Diesel Driven, Air Cooled, Self Start Engine Eco friendly, Pollution free, Sound Proof, installed in the college. There is hardly any power cut so the running hour of DG set is very less.

Air Conditioning

No air condition has been installed in any room or building of the college.

4.0 ELECTRICAL SUPPLY

The college is getting electrical supply by the WBSEDCL, West Bengal. There is one energy meter installed in the premises.

5.0 SANCTIONED DEMAND

The sanctioned demand for the unit is 66.5 kW from WBSEDCL, West Bengal. Its sanctioned demand kVA varies every month because of change of power factor every month. The recorded running maximum demand of the college from the electricity bill is given below:

Months	Sanction Demand (kVA)	Running Max. Demand kVA	Fixed Cost (Rs.)	Difference (S.D. - R.M.D.)kVA
July, 22	79.92	10.5	20000	69.42
Aug, 22	79.84	10.6	20000	69.24
Sep, 22	79.56	10.8	19900	68.76
Oct, 22	79.67	10.9	20000	68.77
Nov, 22	80.28	11.1	20100	69.18
Dec, 22	80.29	11.2	20100	69.09
Jan, 23	80.31	11.3	20100	69.01
Feb, 23	92.13	11.3	23100	80.83
Mar, 23	93.87	11.4	23500	82.47
Apr, 23	93.45	11.4	23400	82.05
May, 23	94.56	11.5	23700	83.06
Jun, 23	94.34	11.5	23600	82.84

The difference between Sanctioned Demand and running maximum Demand (R.D.) varies between 68.76 kVA to 83.06 kVA. It is advisable to reduce the sanctioned Load from 66.5 kW to 25 kW. This will yield an annual saving in the electricity bill under fixed cost of aroundRs. 1.63 lacs as shown below:

Months	Present SanctionLoad (S.L.) kW	MonthlyPower Factor (P.F.)	Sanction Demand(S.D.) (kVA)	RunningMax. DemandkVA	Fixed Cost (Rs.)	RecommendedSanction Load (kW)	Recommended S.D. (kVA)	Difference(S.D. - RecommendedS.D.)	Saving in Fixed cost / month
July, 22	66.5	0.735	79.92	10.5	20000	25	34.013	45.907	11476.75
Aug, 22	66.5	0.74	79.84	10.6	20000	25	33.783	46.057	11514.25
Sep, 22	66.5	0.77	79.56	10.8	19900	25	32.467	47.093	11773.25
Oct, 22	66.5	0.79	79.67	10.9	20000	25	31.645	48.025	12006.25
Nov, 22	66.5	0.794	80.28	11.1	20100	25	31.486	48.794	12198.5
Dec, 22	66.5	0.811	80.29	11.2	20100	25	30.826	49.464	12366
Jan, 23	66.5	0.819	80.31	11.3	20100	25	30.525	49.785	12446.25
Feb, 23	66.5	0.822	92.13	11.3	23100	25	30.413	61.717	15429.25
Mar, 23	66.5	0.826	93.87	11.4	23500	25	30.266	63.604	15901
Apr, 23	66.5	0.832	93.45	11.4	23400	25	30.048	63.402	15850.5
May, 23	66.5	0.849	94.56	11.5	23700	25	29.446	65.114	16278.5
Jun,23	66.5	0.852	94.34	11.5	23600	25	29.342	64.998	16249.5
Saving in fixed cost due to change in fixed load from 66.5 kW to 25 kW in a year (Rs.)									163490

Since the supply is in LT connection. The transformer belongs to the college as told by the concerned officer. Then it is advisable to change the electrical supply from LT to HT supply i.e. 11 kV. This will reduce the energy charge by 3% per month which will be a equal to i.e. Rs. 6275.52 per year. (As per electrical tariff, Rebate of 3% on the Energy Charges for supply at 11kV).

For the purpose of precaution, A maximum Demand Controller (DC) can be installed at the main LT panel to avoid the maximum demand penalty. In case the running maximum demand increases, the demand controller will switch off some non-essential load like Air-conditioning load etc.and simultaneously it will also give alarm for further action.

Saving by reducing the sanctioned demand	=	163490	Rs.
Cost of Demand controller	=	50000	Rs.
No of Demand controller	=	1	No.
Total Cost of Demand controller	=	50000	Rs.
Simple Payback period	=	3.269	Month

USE OF ELECTRICITY DURING PEAK HOUR AND OFF PEAK HOUR

The applicable electricity tariff is not also based on timing of the day but it may not be applicable in case of domestic LT/ HT type connection. This will also helpful in maintaining the demand graph. It is recommended to avoid use of electrical gadget for cleaning, watering etc. during the peak hours. This type of work should be operational during the off peak hour.

6.0 POWER FACTOR

The college has installed one Automatic Power Factor controller (APFC) with capacity 125 kVAr capacitor bank i.e. 25 kVAr x 5. All the capacitors were tried to examine during the study. Details of test report are given below.

Capacitor Bank						
S. No.	Place of Installation	Capacity (kVAr)	R	Y	B	Remarks
1	Capacitor	25	29.2	29.3	29.7	OK
2	Capacitor	25	0	29.4	29.3	Recheck, tight the loose wire
3	Capacitor	25	34.3	34.4	34.1	OK
4	Capacitor	25	34.3	34.1	33.9	OK
5	Capacitor	25	34.7	34.2	34.1	OK

It is clear from the above table that all the capacitors are all right except one capacitor. It is advisable to recheck the capacitor, its contactor and connected wire. Since the load of the college is very low so it is advisable to put small capacity capacitors like 1x25 kVAr, 1 x 10 kVAr, 2 x 5kVAr, 2 x 2kVAr and 1x1kVAr in the panel. This will be helpful in fine tuning of the power factor of the system to maintain unity power factor. If the unit even maintains unity or 0.99 power factor, it will yield saving in the bill (in fixed cost) by around Rs. 92000/ year as shown below:

Months	Recommend edSanction Load (S.L.) kW	Monthl yPower Factor (P.F.)	Recommended S.D. (kVA) at25 kW on existing P.F.	Recommended to maintain unity P.F. then chargeable F.C.	Recommended to maintain 0.99 P.F. then chargeable F.C.	Difference in F.C. between existing P.F. - F.C. at unity P.F.)	Difference in F.C. between existing P.F. - F.C. at 0.99 P.F.)
July, 22	25	0.735	34.013	25	25.25	2253	2191
Aug, 22	25	0.74	33.783	25	25.25	2196	2133
Sep, 22	25	0.77	32.467	25	25.25	1867	1804
Oct, 22	25	0.79	31.645	25	25.25	1661	1599
Nov, 22	25	0.794	31.486	25	25.25	1622	1559
Dec, 22	25	0.811	30.826	25	25.25	1457	1394
Jan, 23	25	0.819	30.525	25	25.25	1381	1319
Feb, 23	25	0.822	30.413	25	25.25	1353	1291
Mar, 23	25	0.826	30.266	25	25.25	1317	1254
Apr, 23	25	0.832	30.048	25	25.25	1262	1200
May, 23	25	0.849	29.446	25	25.25	1112	1049
Jun,23	25	0.852	29.342	25	25.25	1086	1023
Extra Annual saving in Fixed cost by maintaining recommended P.F. unity/ 0.99 (Rs.)						18567	17816

If the unit is providing some small capacitor (as said above) and maintaining Power Factor near to unity or 0.99 with the help of Automatic (Intelligent) Power Factor Controller (all ready installed) then its payback period would be around 1 month as given below:

Annual (Approximate) saving in Fixed cost for maintaining unity/ 0.99 P.F.	=	17816	Rs.
Cost of capacitors (Small capacity capacitor)	=	32000	Rs.
Payback Period	=	1	Month

Testing procedure of the capacitor is given below:

Good healthy capacitors should deliver 1.3 times amperage in all the three phases compared to its rating in kVAr. Thus, a 10 kVAr capacitor should deliver about 13 amps in each of the three phases. Due to development of internal faults, the capacitors get derated/ damaged in the course of time. A capacitor derated to less than 75% of its rating should be replaced. On the other hand, if there is considerable unbalance between the phases, that can be indication of possible damage of the capacitor and may be removed immediately.

7.0 DISTRIBUTION NETWORK

There is a main electrical panel installed near the DG Set. All the distribution cables are going from the main panel to all the buildings, submersible pump, street light etc.Sub panels are installed in the buildings. There is a taping on each floor from the raising mains.

During the study, it was observed that the conductor size is good according to ampereload. No any conductor was found over heated or its insulation burnt. Adequate size of conductor is going to feed the utility area. So, distribution losses are within the limit.

8.0 D G SETS

There is one DG set Kirloskar Green, 7.5 KVA, 230 volts, 1500 RPM, 1 Phase, Self Excited, Self Regulated A. C. Generator, Coupled with 16 BHP, Diesel Driven, Air Cooled, Self Start Engine Eco friendly, Pollution free, Sound Proof, installed in the college. As the power supply is very good in the area so the running hour of DG set is veryless.

It is advisable to put an energy meter on DG set then it would be easy to conduct the efficiency of DG set. This way, the operator could also note down the unit generation and oilconsumed. The operator may record the operating parameters of the sets in the following manner in future.

Start Time	***Off Time***	***Diesel consumption***	***Unit Generated***	***Loading***	***KW Loading***	***Voltage***	***KVAh/ lit.***
				R Y B	***R Y B***		

The mechanical details like temperature, lube oil etc. should be in addition to the above. From the above data, the management may calculate the offices generated by the DG set in an hour and total diesel consumption. The offices generated per litre of diesel consumed can hence be calculated on an hourly basis. Thereafter, the monthly figures can be calculated in the similar fashion.

It may be noted that the efficiency of the DG set depends largely on the operating load factor. The maximum efficiency of the DG set is available at about 80-85% load factor.

9.0 LIGHTING

The total lighting (luminary) load of the college is about 8 kW which includes Fluorescent tubes 36w/ 40w, LED lights 12w/ 36w etc. LED lights is good from energy efficiency point of view.

LED tube lights are also available in the market, which is also good from energy efficiency point of view. Whenever 36/40w tube gets fuse (not in warranty period) then it could be replaced by 18w/ 9w LED tube. There are 20 nos of street lights which are working on solar power with battery. These lights are switched ON in the night with the help of timer.

During study, tube lights were ON in the class room and it was observed that lux level was good (240 – 320) in the class room near to window. But Lux level was down (120 – 200) near the entrance door and its wall side. It is advisable to increase some tube lights in the class room for better lux value.

10.0 AIR CONDITIONING LOAD

No air condition has been installed in any room, building of the college. However, it is advised to install one 2-ton ac in each laboratory where computers are present.

11.0 SOLAR POWER GENERATION

The college authority in association with govt has plant solar power generation project .The best use of solar power is to put all lighting, exhaust fan load, fan load etc. on it. The energy meter should also be calibrated by 3rd party once in a year.

12.0 General Energy Conservation Tips

Electricity

- Schedule your operations to maintain a high load factor
- Minimize maximum demand by tripping loads through a demand controller
- Use standby electric generation equipment for on-peak high load periods.
- Correct power factor to at least 0.99 under rated load conditions.
- Set transformer taps to optimum settings.
- Shut off unnecessary computers, printers, and copiers at night.

Motors

- Properly size to the load for optimum efficiency.
- (High efficiency motors offer of 4 - 5% higher efficiency than standard motors)
- Check alignment.
- Provide proper ventilation
- (For every 10°C increase in motor operating temperature over recommended peak, the motor life is estimated to be halved)
- Check for under-voltage and over-voltage conditions.
- Balance the three-phase power supply.
- (An Imbalanced voltage can reduce 3 - 5% in motor input power)
- Demand efficiency restoration after motor rewinding.

Fans

- Use smooth, well-rounded air inlet cones for fan air intakes.
- Avoid poor flow distribution at the fan inlet.
- Minimize fan inlet and outlet obstructions.
- Clean screens, filters, and fan blades regularly.
- Use aerofoil-shaped fan blades.
- Minimize fan speed.
- Use low-slip or flat belts.

- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable fan loads.
- Use energy-efficient motors for continuous or near-continuous operation
- Eliminate leaks in ductwork.
- Minimize bends in ductwork
- Turn fans off when not needed.

Blowers

- Use smooth, well-rounded air inlet ducts or cones for air intakes.
- Minimize blower inlet and outlet obstructions.
- Clean screens and filters regularly.
- Minimize blower speed.
- Use low-slip or no-slip belts.
- Check belt tension regularly.
- Eliminate variable pitch pulleys.
- Use variable speed drives for large variable blower loads.
- Use energy-efficient motors for continuous or near-continuous operation.
- Eliminate ductwork leaks.
- Turn blowers off when they are not needed.

Pumps

- Operate pumping near best efficiency point.
- Modify pumping to minimize throttling.
- Adapt to wide load variation with variable speed drives or sequenced control of smaller offices.
- Stop running both pumps -- add an auto-start for an on-line spare or add a booster pump in the problem area.
- Use booster pumps for small loads requiring higher pressures.
- Increase fluid temperature differentials to reduce pumping rates.
- Repair seals and packing to minimize water waste.

- Balance the system to minimize flows and reduce pump power requirements.
- Use siphon effect to advantage: don't waste pumping head with a free-fall (gravity) return.

Chillers

- Increase the chilled water temperature set point if possible.
- Use the lowest temperature condenser water available that the chiller can handle.
- (Reducing condensing temperature by 5.5°C, results in a 20 - 25% decrease in compressor power consumption)
- Increase the evaporator temperature
- (5.5°C increase in evaporator temperature reduces compressor power consumption by 20 - 25%)
- Clean heat exchangers when fouled.
- (1 mm scale build-up on condenser tubes can increase energy consumption by 40%)
- Optimize condenser water flow rate and refrigerated water flow rate.
- Use water-cooled rather than air-cooled chiller condensers.
- Use energy-efficient motors for continuous or near-continuous operation.
- Specify appropriate fouling factors for condensers.
- Do not overcharge oil.
- Install a control system to coordinate multiple chillers.
- Study part-load characteristics and cycling costs to determine the most-efficient mode for operating multiple chillers.
- Run the chillers with the lowest operating costs to serve base load.
- Avoid over sizing - match the connected load.
- Isolate off-line chillers and cooling towers.
- Establish a chillers efficiency-maintenance program. Start with an energy audit and follow-up, then make a chillers efficiency-maintenance program a part of your continuous energy management program.

HVAC (Heating / Ventilation / Air Conditioning)

- Tune up the HVAC control system.
- Consider installing a building automation system (BAS) or energy management system (EMS) or restoring an out-of-service one.
- Balance the system to minimize flows and reduce blower/fan/pump power requirements.
- Eliminate or reduce reheat whenever possible.
- Use appropriate HVAC thermostat setback.
- Use building thermal lag to minimize HVAC equipment operating time.
- In winter during unoccupied periods, allow temperatures to fall as low as possible without freezing water lines or damaging stored materials.
- In summer during unoccupied periods, allow temperatures to rise as high as possible without damaging stored materials.
- Improve control and utilization of outside air.
- Use air-to-air heat exchangers to reduce energy requirements for heating and cooling of outside air.
- Reduce HVAC system operating hours (e.g. -- night, weekend).
- Optimize ventilation.
- Ventilate only when necessary. To allow some areas to be shut down when unoccupied, install dedicated HVAC systems on continuous loads (e.g. -- computer rooms).
- Provide dedicated outside air supply to kitchens, cleaning rooms, combustion equipment, etc. to avoid excessive exhausting of conditioned air.
- Use evaporative cooling in dry climates.
- Clean HVAC office coils periodically and comb mashed fins.
- Upgrade filter banks to reduce pressure drop and thus lower fan power requirements.
- Check HVAC filters on a schedule (at least monthly) and clean/change if appropriate.

- Check pneumatic controls air compressors for proper operation, cycling, and maintenance.
- Isolate air-conditioned loading dock areas and cool storage areas using high-speed doors or clear PVC strip curtains.
- Install ceiling fans to minimize thermal stratification in high-bay areas.
- Relocate air diffusers to optimum heights in areas with high ceilings.
- Consider reducing ceiling heights.
- Eliminate obstructions in front of radiators, baseboard heaters, etc.
- Check reflectors on infrared heaters for cleanliness and proper beam direction.
- Use professionally-designed industrial ventilation hoods for dust and vapor control.
- Use local infrared heat for personnel rather than heating the entire area.
- Use spot cooling and heating (e.g. -- use ceiling fans for personnel rather than cooling the entire area).
- Purchase only high-efficiency models for HVAC offices.
- Put HVAC window offices on timer control.
- Don't oversize cooling offices. (Oversized offices will "short cycle" which results in poor humidity control.)
- Install multi-fueling capability and run with the cheapest fuel available at the time.
- Consider dedicated make-up air for exhaust hoods. (Why exhaust the air conditioning or heat if you don't need to?)
- Minimize HVAC fan speeds.
- Consider desiccant drying of outside air to reduce cooling requirements in humid climates.
- Seal leaky HVAC ductwork.
- Seal all leaks around coils.
- Repair loose or damaged flexible connections (including those under air handling offices).
- Eliminate simultaneous heating and cooling during seasonal transition periods.

- Zone HVAC air and water systems to minimize energy use.
- Inspect, clean, lubricate, and adjust damper blades and linkages.
- Establish an HVAC efficiency-maintenance program. Start with an energy audit and follow-up, then make an HVAC efficiency-maintenance program a part of your continuous energy management program.

Lighting

- Reduce excessive illumination levels to standard levels using switching; de-lamping, etc. (Know the electrical effects before doing de-lamping.)
- Aggressively control lighting with clock timers, delay timers, photocells, and/or occupancy sensors.
- Install efficient alternatives to incandescent lighting, mercury vapour lighting, etc. Efficiency (lumens/watt) of various technologies range from best to worst approximately as follows: low pressure sodium, high-pressure sodium, metal halide, fluorescent, mercury vapour, incandescent.
- Select ballasts and lamps carefully with high power factor and long-term efficiency in mind.
- Upgrade obsolete fluorescent systems to Compact fluorescents and electronic ballasts
- Consider lowering the fixtures to enable using less of them.
- Consider day lighting, sky lights, etc.
- Consider painting the walls a lighter colour and using less lighting fixtures or lower wattages.
- Use task lighting and reduce background illumination.
- Re-evaluate exterior lighting strategy, type, and control. Control it aggressively.
- Change exit signs from incandescent to LED.

DG sets

- Optimize loading
- Use waste heat to generate steam/hot water /power an absorption chiller or preheat process or utility feeds.
- Use jacket and head cooling water for process needs

- Clean air filters regularly
- Insulate exhaust pipes to reduce DG set room temperatures
- Use cheaper heavy fuel oil for capacities more than 1MW

Buildings

- Seal exterior cracks / openings / gaps with caulk, gasketing, weather stripping, etc.
- Consider new thermal doors, thermal windows, roofing insulation, etc.
- Install windbreaks near exterior doors.
- Replace single-pane glass with insulating glass.
- Consider covering some window and skylight areas with insulated wall panels inside the building.
- If visibility is not required but light is required, consider replacing exterior windows with insulated glass block.
- Consider tinted glass, reflective glass, coatings, awnings, overhangs, draperies, blinds, and shades for sunlit exterior windows.
- Use landscaping to advantage.
- Add vestibules or revolving doors to primary exterior personnel doors.
- Consider automatic doors, air curtains, strip doors, etc. at high-traffic passages between conditioned and non-conditioned spaces. Use self-closing doors if possible.
- Use intermediate doors in stairways and vertical passages to minimize building stack effect.
- Use dock seals at shipping and receiving doors.
- Bring cleaning personnel in during the working day or as soon after as possible to minimize lighting and HVAC costs.

Water & Wastewater

- Recycle water, particularly for uses with less-critical quality requirements.
- Recycle water, especially if sewer costs are based on water consumption.
- Balance closed systems to minimize flows and reduce pump power requirements.

- Eliminate once-through cooling with water.
- Use the least expensive type of water that will satisfy the requirement.
- Fix water leaks.
- Test for underground water leaks. (It's easy to do over a holiday shutdown.)
- Check water overflow pipes for proper operating level.
- Automate blow down to minimize it.
- Provide proper tools for wash down -- especially self-closing nozzles.
- Install efficient irrigation.
- Reduce flows at water sampling stations.
- Eliminate continuous overflow at water tanks.
- Promptly repair leaking toilets and faucets.
- Use water restrictors on faucets, showers, etc.
- Use self-closing type faucets in restrooms.
- Use the lowest possible hot water temperature.
- Do not use a heating system hot water boiler to provide service hot water during the cooling season -- install a smaller, more-efficient system for the cooling season service hot water.
- If water must be heated electrically, consider accumulation in a large insulated storage tank to minimize heating at on-peak electric rates.
- Use multiple, distributed, small water heaters to minimize thermal losses in large piping systems.
- Use freeze protection valves rather than manual bleeding of lines.
- Consider leased and mobile water treatment systems, especially for deionized water.
- Seal sumps to prevent seepage inward from necessitating extra sump pump operation.
- Install pre-treatment to reduce TOC and BOD surcharges.
- Verify the water meter readings. (You'd be amazed how long a meter reading can be estimated after the meter breaks or the meter pit fills with water!)
- Verify the sewer flows if the sewer bills are based on them

Miscellaneous

- Meter any unmetered utilities to know what normal efficient use is. Track down causes of deviations.
- Shut down spare, idling, or unneeded equipment.
- Make sure that all of the utilities to redundant areas are turned off -- including utilities like compressed air and cooling water.
- Install automatic control to efficiently coordinate multiple air compressors, chillers, cooling tower cells, boilers, etc.
- Renegotiate utilities contracts to reflect current loads and variations.
- Consider buying utilities from neighbours, particularly to handle peaks.
- Leased space often has low-bid inefficient equipment. Consider upgrades if your lease will continue for several more years.
- Adjust fluid temperatures within acceptable limits to minimize undesirable heat transfer in long pipelines.
- Minimize use of flow bypasses and minimize bypass flow rates.
- Provide restriction orifices in purges (nitrogen, steam, etc.).
- Eliminate unnecessary flow measurement orifices.
- Consider alternatives to high-pressure drops across valves.
- Turn off winter heat tracing that is on in summer.

13.0 List of Energy Efficient Equipment Suppliers

Product/ Equipment	**Contact Details**
LED lighting	Synergy Solar (P) ltd SCO 133, sector 28D, ChandigarhPh 0172- 6451133 www.synergysolars.com
Energy Saving products	Techmark Engineers & Consultants, K-1/28 Ground Floor, Chittaranjan Park New Delhi-110019 Telephone: 91-011-26238349, Fax : 91-011-51603925
Capacitors and APFC Panels	Standard Capacitors, B-70/43, DSIDC Complex, Lawrence road Industrial Area,Delhi –110035 Ph: 011 –27181490, 27151027 www.standardcapacitors.com
Capacitors and APFC Panels	Matrix Controls & Engineers Pvt Ltd., Rajeev Batra 9811624440, Rajeev@matrixcapacior.comE- 725 DSIDC, Industrial Complex, Narela, GT Road, Delhi – 110040 Ph: 01127786945 / 46 / 47 www.matrixcapacitor.com
Lighting Systems	OSRAM India Ltd. Signature Towers, 11th Floor, Tower B, South City-I, Gurgaon 122001,Haryana Tel: 0124- 6526175, 6526178, 6526185 Fax: 0124- 6526184

Centre for Total Quality Management

Soumobrata Ganguly
Energy Auditor
Date: 10/07/2023