ENERGY AUDIT REPORT
February'24

Institute of Applied Medicines and Research

9th Km Mile Stone, NH-58, Delhi-Meerut Road, Duhai, Ghaziabad

ENGINEERING FACILITY SERVICES
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Energy Service Companies empaneled with Bureau of Energy Efficiency (BEE)

ACKNOWLEDGEMENT

We take the opportunity to express our deep sense of gratitude towards Energy Audit Coordinator – – Mr. J.P. Singh (Admin Officer), Environment Audit Coordinator – Dr. Monika Bajpai & Green Audit Co-coordinator – Dr. Fanish Pandey (HOD, Faculty of Life Sciences) & Supporting Staff of College for awarding the work of executing Energy Audit in Institute of Applied Medicines and Research, Ghaziabad. In particular we wish to thank him for his timely initiative, advice and valuable support extended to the project.

Engineering Facility Services is special thankful to Dr. Pradeep Kumar Vashistha (Director) for providing us an opportunity to conduct an Audit conducting of their college & providing the coordination with officers and staff.

We are also grateful for extending all sorts of help while carrying out energy audit and also for their valuable help regarding the data collection and details at various stages of the project. We are also thankful to them for providing support while conducting survey in Institute of Applied Medicines and Research, Ghaziabad.

We would be failing in our duty if we do not thank our respondents who gave their valuable time and answered the survey questions with tremendous patience and understanding.

DISCLAIMER

This Energy audit report of Institute of Applied Medicines and Research, Ghaziabad is prepared by Engineering Facility Services, Noida on interest of the organization.

This report need not necessarily represent the views of building management and its employees. The building management, any employee of Institute of Applied Medicines and Research, Ghaziabad or any person acting on behalf of any of them makes no warranty or representation whatsoever express or implied with respect to use of any information, process, method or similar item disclosed in this report and assumes no legal liability for the information in this report, nor does any party represent that the use of this information will not infringe upon privately owned rights.

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The Director

IAMR Group Of Institution, Ghaziabad

TEAM MEMBERS

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	Mr. Deepak Kumar (Engineer-Energy Audit)
	Mr. Gaurav (Engineer-Energy Audit)

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1. ABOUT ENGINEERING FACILITY SERVICES

1 ABOUT Engineering Facility Services

1.1 PROFILE OF THE COMPANY

"Engineering Facility Services" is an energy centric organization involved in Generation (Renewable), Measurement & Efficiency enhancement of energy. Our focus is towards greener & cleaner economy with three dimensional approach viz Generation of power from renewable sources, manufacturing of world class energy monitoring devices and Energy Audit Services. Our Manufacturing facilities are located in North India.

1.2 VISION & MISSION

We shall "**GENERATE", "MEASURE" & "MANAGE"** the "**ENERGY."**

It is evident that organization has been launched with a very thoughtfully nurture division of being the leader in a basket of High Technology Business fields with far-reaching & all-encompassing implication on the Industry, Society & Ecology. We

- ✓ Shall "Generate" only "Renewable" or "Green" Energy;
- ✓ Shall Design & Manufacture the most advanced, accurate & reliable "Measurement" Products & Systems for Energy & Power Sector;
- ✓ Shall "Manage" the "Energy Consumption" by helping Monitor the "wastage" and/or "consumption" ternsofcommercial,industrial,municipalorganizations;hencehelpimprovetheir "Energy Efficiency".

Our Vision to dedicate all our Resources in 'Generation', 'Measurement' and 'Management' of 'Power& 'Energy' is very unique in a way that shows our deep compassion for the Society & Ecology.

The promoters have committed their organization to the business, which shall practice & advocate the tenet of "Sustainable Development" which makes us responsible & account to "Meeting the needs of the present generation without compromising the ability of future generations to meet their needs".

1.3 APPROVALS/CREDENTIALS

BEE Accredited Energy Auditors & Certified Energy Auditors/Managers (Under Ministry of Power, Govt. of India).

1.4 PRODUCTS & SERVICES

In Brief, our company operates in several business Segments:-

Power Generation- Green Energy
Consultancies & Services
Energy Audit
PAT Assistance
Support for energy efficiency enhancement projects
Green Buildings
Renewable energy project implementation
Trainings to improve Energy Efficiency

1.5 ENERGY AUDIT & MANAGEMENT

The Objective of this division is to provide solutions for the efficient management of every form of energy. The management service begins with the energy audit process comprising of an inspection and survey of the total energy consumption in a building, process system with the end objective to reduce the amount of energy used without any negative effect. The available consumer base of this division covers a single residential consumer to the largest industrial establishment or commercial complex however the focus for now is 4 main areas.

Commercial - Malls, Commercial Buildings etc.

Power Plant – Energy audit of thermal power plant and captive power plant.

Industrial – Energy intensive industrial establishments.

Hospitality – Building and Resort complex

2. INTRODUCTION TO ENERGY AUDIT & METHODOLOGY

2 INTRODUCTION TO ENERGY AUDIT & METHODOLOGY

2.1 OBJECTIVE OF ENERGY AUDIT

The objective of this study is to carry out investment grade audit of building followed by submission of Detailed Energy Audit Report to the building management & maintenance department. The implementation support provided is for the benefit of the building management so as to make sure that the recommended savings potential are met and monetary savings achieved to the fullest.

2.2 SCOPE OF WORK

Broadly, the following scopes are limited to the building:-

Review of present electricity, fuel oil, fuel gas, lighting, and HVAC and Water consumption.

Review and Study of existing Electrical Distribution System, Lighting System, HVAC System, and Diesel Generator sets etc. along with respective energy conservation options.

Review and Study of Energy Monitoring & Accounting System.

Review of present maintenance practices.

Cost benefits analysis of each energy conservation options.

Preparation and submission of Detailed Energy Audit Report.

2.3 METHODOLOGY

The study has been conducted by the Energy consultants, Auditors of Engineering Facility Services and consists of the following components.

Preliminary visits to each of the sub-systems to obtain an overview. Brief discussions with concerned executives, preparation of data collection forms/checklists instrumentation requirements, etc.

We have used diagnostic portable instruments for power measurement, Water Flow measurement, Thermograph study, Lux meter, Infra-red and conventional temperature measurement instruments, and would also draw upon the inferences from onsite instrumentation data, etc.

Carried at field studies in each of the sub-systems, involving performance assessment trials of Refrigeration & Air Conditioning System, vis-à-vis existing conditions. To the extent possible, trials have been conducted without disturbing normal operation of working equipment.

Detailed analysis of field data outputs and evaluation of energy performance of equipment studied, with respect to operation efficiencies, comparison of these values with Performance Guarantee figures, or typical industry norms and establishing margins for improvements.

Identification of Energy Conservation opportunities (ENCON).

2.4 APPROACH

The Energy Audit & Investment Grade Audit is planned in five parts:

Part-I: Energy Audit

This part involves performance assessment of the key energy consuming equipment such as A/C machines, Fans, Deep freezers, Lighting, and all major electrical motors to establish margins for improvement.

Part-II: Energy Conservation

This part as a fall out of the Energy Audit Study would involve identification of Energy Saving measures, detailing of measure to achieve improvements in efficiency and reduction in energy consumption, backed by operational trial data wherever possible, in-depth analysis and techno-economic feasibility reports along with relevant vendor information.

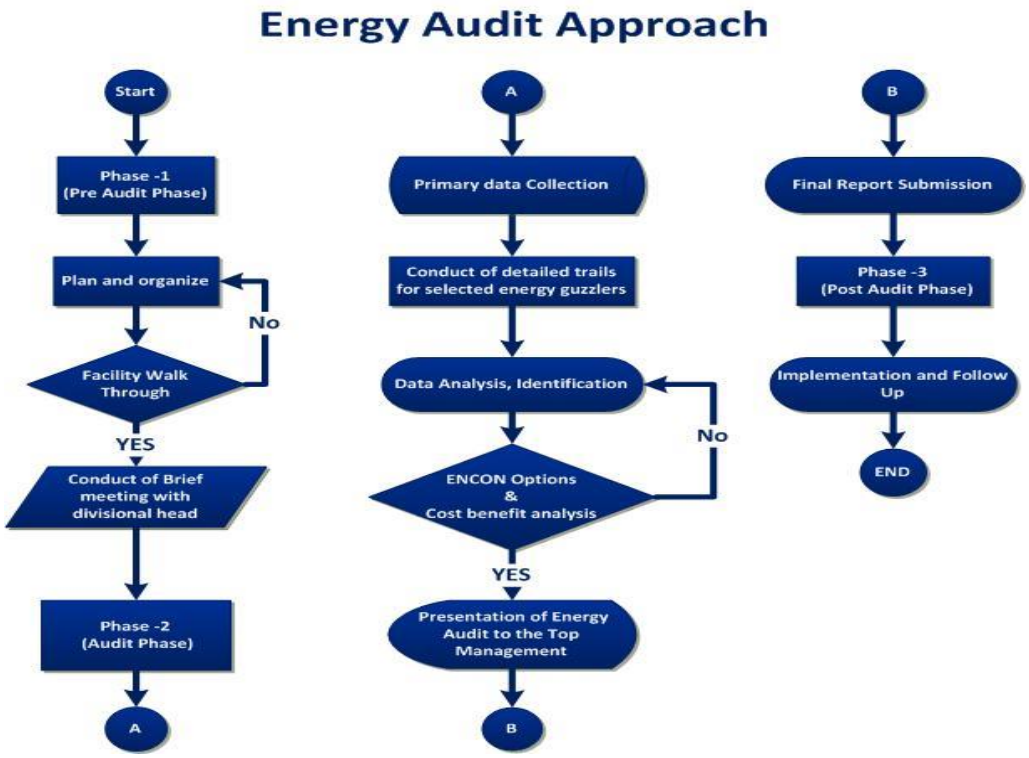
Part-III: Preparation of Investment Grade Proposals

This part involves preparation of Investment Grade proposal, based on the identified Energy Conservation Options with cost benefits and vendor details

Part – IV: Preparation of Draft Report

In this phase, the draft report would be prepared and submitted to Building Management.

Part – V: Final Report Submission



After presentation of the report and getting comments from Building Management the final report would be submitted after incorporating all the comments and suggestions.

Figure 1: Energy Audit Approach

2.5 INSTRUMENTS USED IN ENERGY AUDIT

Master List Of EA Instruments

Sr. no.	Instruments	Model	Instrument Number	OEM	Image of Instruments
1	Power Analyzer	ALM 30 ALM 35	00302929	KRYKARD INDIA	
2	Flow Meter	PT878	PT 7 6186 E	GE USA	
3	Thermal Imager	881 – 2	02214667	TESTO GERMANY	
4	Infrared Thermometer	62 Mini	14841880	FLUKE USA	
5	Digital Thermo Hygrometer	288 ATH	2027386	HTC CHINA	
6	Digital Anemometer	AM 4201	AE.09961	LUTRON CHINA	
7	Digital Lux Meter	LX 101	AE.09143	LUTRON CHINA	
8	Digital Multimeter	801 AUTO	201061078	MECO INDIA	
9	Digital Clampmeter	DT 3150	YC-209634	MECO INDIA	
10	Digital TDS Meter	CD 610	S358236	HANNA ITALY	

Figure 2: Energy Audit Instruments

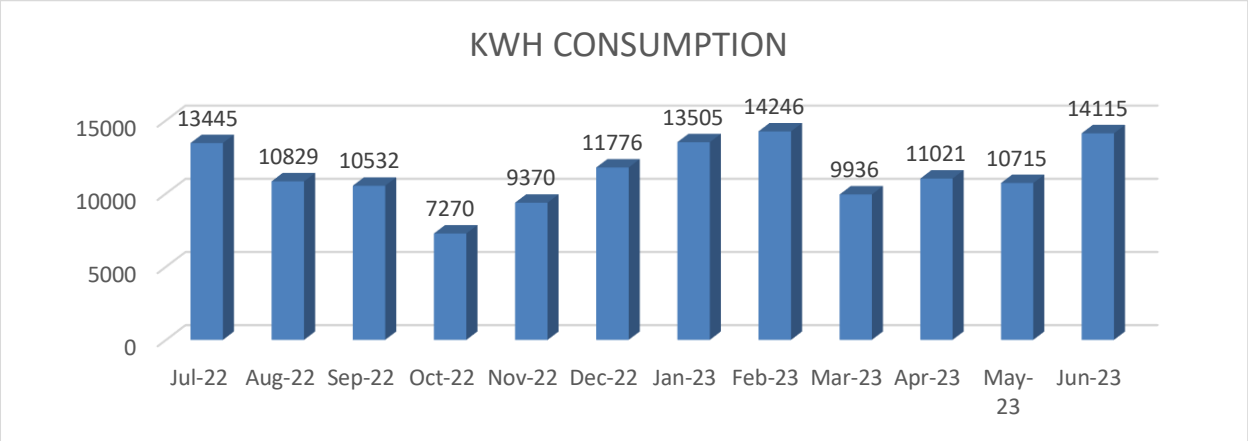
3. BASELINE ENERGY CONSUMPTION

3 BASELINE ENERGY DESCRIPTION

Building is consuming different sources of energy - Grid Electricity, Solar Energy & Electricity from Diesel Generating Sets. Electricity is generally used for all electrical devices while diesel is used to operate the DG sets.

The building is obtaining the power supply from Pashchimanchal Vidyut Vitran Nigam Limited through 11kV line which directly feeds into transformer (150 KVA) which steps down voltage from 11kV to 433V.

Graph shows the total billed amount in KWH



Lighting, pump/ motor load and HVAC are the major energy consuming components in the building, followed by diesel (very less consumption) used in DG sets.

Billing details of Institute is given below:

MONTH	KWH CONSUMPTION	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	PF	SANCTIONED LOAD (KVA)	BILLING DEMAND (KVA)	MDI (KVA)	NET AMOUNT PAYABLE (INR)
Jul-22	13445	13688	36120	117911.8	0.98	112	84	62	1179112
Aug-22	10829	11145	36120	95838	0.97	112	84	56	137104
Sep-22	10532	10893	36120	90826	0.97	112	84	58	136478
Oct-22	7270	7779	36120	64725	0.93	112	84	34	108417
Nov-22	9370	10072	36120	83799	0.93	112	84	33	128921
Dec-22	11776	12229	36120	101742	0.96	112	84	40	148207
Jan-23	13505	14084	36120	117180	0.96	112	84	58	164806
Feb-23	14246	14626	36120	121686	0.97	112	84	49	169899
Mar-23	9936	10718	36120	89175	0.93	112	84	42	136039
Apr-23	11021	11527	36120	95904	0.96	112	84	49	141935
May-23	10715	10998	36120	91505	0.97	112	84	69	137204
Jun-23	14115	14428	36120	120042	0.98	112	84	70	167883
Max	**14246**	**14626**	**36120**	**121686**	**0.98**	**112**	**84**	**70**	**1179112**
Min	**7270**	**7779**	**36120**	**64725**	**0.93**	**112**	**84**	**33**	**108417**

MONTH	KWH CONSUMPTION	KVAH CONSUMPTION	FIXED CHARGE	ENERGY CHARGES (INR)	PF	SANCTIONED LOAD (KVA)	BILLING DEMAND (KVA)	MDI (KVA)	NET AMOUNT PAYABLE (INR)
Avg	11397	11849	36120	99194	0.96	112	84	52	229667

Building is getting the power supply from Pashchimanchal Vidyut Vitran Nigam Limited through 11kV line which directly feeds into the transformer that is of 150 KVA, which steps down voltage from 11kV to 433V. Details of transformers are given below.

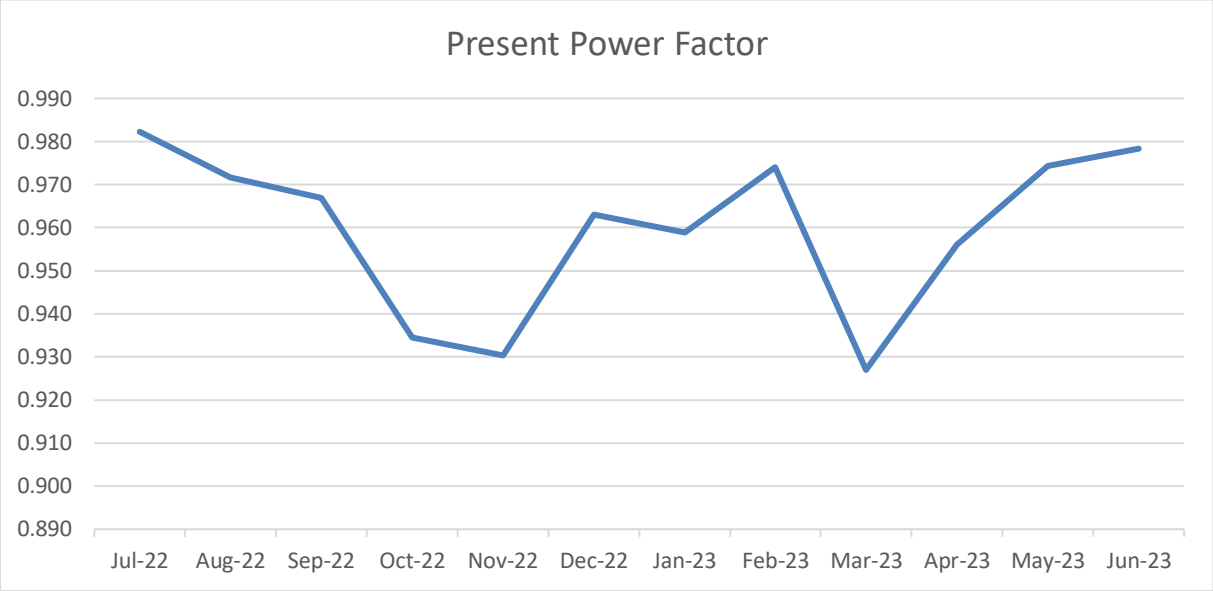
Transformer name plate		
Make & Model No.	**Capacity (kVA)**	**No Load Voltage (kV)**
TR (on loading)	150	HV-11/LV-0.433

Pashchimanchal Vidyut Vitran Nigam charge as per tariff HV1 is as under

Description	Avg. Unit Price (Rs./KVAh)
Unit charge	Rs 8.68 per KVAH
Fix Charge	Rs 430 per KVA per month

Billing is done on KVAH basis so recommended to maintain the power factor unity.

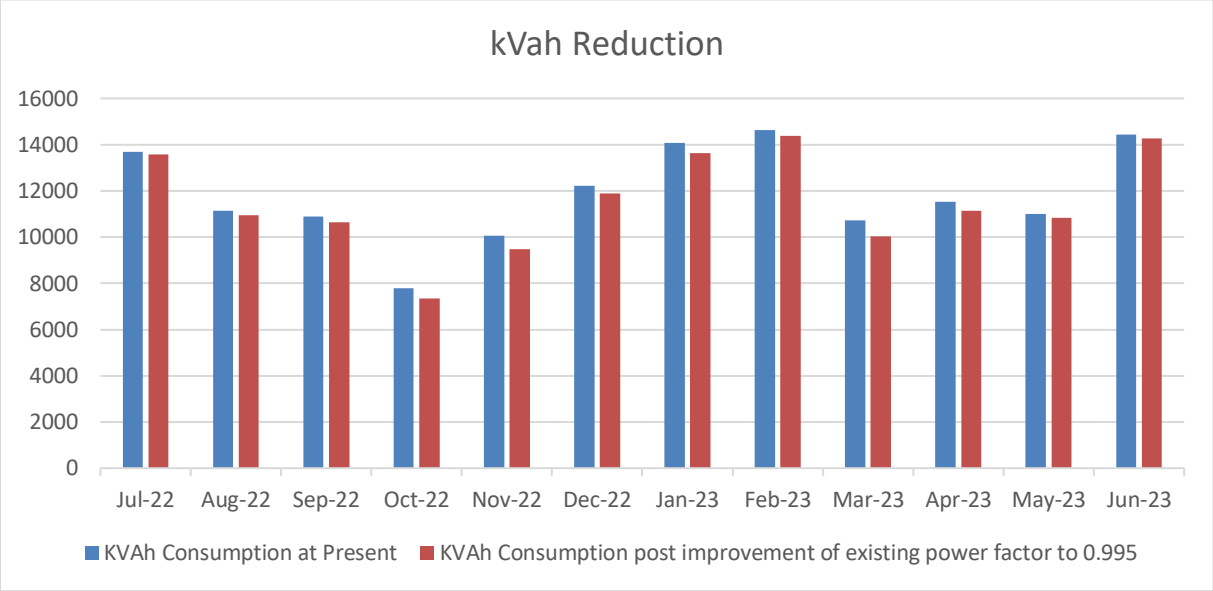
Present Power Factor graphical representation is shown below:



Saving calculation shown below by maintain power factor from current level to 0.99 (By considering power cost Rs 8.68 per KVA)

Bill Period	KVAh Consumption at Present	Present Power Factor	KVAh Consumption post improvement of existing power factor to 0.995	Net Reduction in KVAh Consumption	Corresponding reduction in Energy Charges (Rs)	Total Monitory Benefit (Rs)
Jul-22	13688	0.982	13581	107	927	927
Aug-22	11145	0.972	10939	206	1790	1790
Sep-22	10893	0.967	10638	255	2212	2212
Oct-22	7779	0.935	7344	436	3781	3781
Nov-22	10072	0.930	9465	607	5272	5272
Dec-22	12229	0.963	11895	333	2894	2894
Jan-23	14084	0.959	13641	443	3842	3842
Feb-23	14626	0.974	14390	236	2048	2048
Mar-23	10718	0.927	10036	682	5922	5922
Apr-23	11527	0.956	11132	395	3426	3426
May-23	10998	0.974	10823	175	1517	1517
Jun-23	14428	0.978	14258	170	1479	1479
Total	**142187**		**138142**	**4045**	**35109**	**35109**

Graphical representation of reduction in KVAh after maintaining the power factor 0.99


kVah Reduction
16000
14000
12000
10000
8000
6000
4000
2000
0
Jul-22
Aug-22
Sep-22
Oct-22
Nov-22
Dec-22
Jan-23
Feb-23
Mar-23
Apr-23
May-23
Jun-23
KVAh Consumption at Present
KVAh Consumption post improvement of existing power factor to 0.995

4. LIGHTING/ILLUMINATION SYSTEM

4 LIGHTING SYSTEM

4.1 LUMINARY DETAILS

The building management had already changed all the old high energy consuming light with the energy efficient LED lights.

We have measured lux area wise for the sample basis.

AREA WISE LUX LEVEL

Sr.No	Location	Lux	
		Min	Max
1	Principal Office	220	270
2	HOD, Faculty of Life Sciences	235	265
3	BBA	245	280
4	BCA	255	275
5	Physiotherapy	205	230
6	Bio-Tech Lab	260	285
7	Computer lab-1	240	268
8	Computer lab-2	245	275
9	Computer lab-3	255	280
10	Lecture Theatre Life Science	265	270
11	Lecture Theatre BBA	210	240
12	Lecture Theatre BCA	220	260
13	Lecture Theatre Physiotherapy	265	285
14	DG Set Area	230	265
15	Canteen	255	270
16	Reception	220	245
17	Admin	225	250
18	Main Gate College	265	280
19	Parking Area	255	275

4.2 OBSERVATIONS

It was observed that the building has opted the Energy efficient lighting system that is LED which was good option to save energy and we personally felt good to observe it and checked whether the lux level we are getting is sufficient or not and was observed that the lux level was good.

It was observed that the lux level in some of the areas is within limits and in some areas it is bit more.

4.3 RECOMMENDATION

LED lights are highly recommended as they are the best in technology available in the illumination market and will provide good amount of energy and monetary savings since major lighting includes halogens which are the most inefficient light in the market. So please go for the Led lights for the areas where it is still remaining to go for 100% LED lightings.

LED's also help in heat load reduction since the heat dissipated by the halogens is much higher than the heat dissipated by LED lights thus intangible savings by reduction in cooling can be easily be achieved. Also, we recommend to not using GLS Bulbs as they are inefficient lights and also dissipates heat increase HVAC load.

It is recommended to install photo sensor for all the outdoor light and also in working floor near to the glass's envelope in the building.

It is recommended to install occupancy sensor in Stores/office cabins and toilets to save energy.

It is recommended to install the day light sensor on the outdoor lights for automation and control of the lights and this will also help us reduce the unwanted running hours of the lights.

5. AIR CONDITIONING

5 Air Conditioning

The building is having the 77 nos AC with capacity of 1.5 TR.

Variable refrigerant flow

Variable refrigerant flow (VRF), also known as variable refrigerant volume (VRV), is an HVAC technology invented by Daikin Industries, Ltd. in 1982. Like ductless minisplits, VRFs use refrigerant as the cooling and heating medium. This refrigerant is conditioned by a single outdoor condensing unit, and is circulated within the building to multiple indoor units.

VRFs are typically installed with an Air conditioner inverter which adds a DC inverter to the compressor in order to support variable motor speed and thus variable refrigerant flow rather than simply perform on/off operation. By operating at varying speeds, VRF units work only at the needed rate allowing for substantial energy savings at load conditions. Heat recovery VRF technology allows individual indoor units to heat or cool as required, while the compressor load benefits from the internal heat recovery. Energy savings of up to 55% are predicted over comparable unitary equipment. This also results in greater control of the building's interior temperature by the building's occupants.

VRFs come in two system formats, two pipe and three pipe systems. In a heat pump two pipe system all of the zones must either be all in cooling or all in heating. Heat Recovery (HR) systems have the ability to simultaneously heat certain zones while cooling others; this is usually done through a three pipe design, with the exception of Mitsubishi and Carrier, whose systems are able to do this with a two pipe system using a branch circuit (BC) controller to the individual indoor evaporator zones. In this case the heat extracted from zones requiring cooling is put to use in the zones requiring heating. This is made possible because the heating unit is functioning as a condenser, providing sub-cooled liquid back into the line that is being used for cooling. While the heat recovery system has a greater initial cost, it allows for better zoned thermal control of a building and overall greater efficiencies. In heat recovery VRF systems, some of the indoor units may be in cooling mode while others are in heating mode, reducing energy consumption. If the coefficient of performance in cooling mode of a system is 3, and the coefficient of performance in heating mode is 4, then heat recovery performance can reach more than 7. While it is unlikely that this balance of cooling and heating demand will happen often throughout the year, energy efficiency can be greatly improved when the scenario occurs.

6 Ceiling Fan

List of Fan:

Ceiling Fan in Bio Tech			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	65
2	B	70	54
3	C	70	42
4	D	70	41
Total			**202**

Ceiling Fan in A Block			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	53
2	B	70	61
3	C	70	70
Total			**184**

Ceiling Fan in PGDM			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	29
2	B	70	25
3	C	70	56
4	D	70	42
Total			**152**

Ceiling Fan in Boys Hostel			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	9
2	B	70	12
Total			**21**

Ceiling Fan in Girls Hostel			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	29
2	B	70	32
Total			**61**

Ceiling Fan in DG Room			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	1

Total	1

Ceiling Fan in Grid Room			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	4
Total			**4**

Ceiling Fan in Mesh			
Sr No	**Section**	**Power (watts)**	**Quantity**
1	A	70	11
Total			**11**

6.1 Replace Ceiling Fan with BLDC Fan

Background

Ceiling fan are in operation at each office for human comfort. Ceiling Fan are working with conventional motor.

Findings

Conventional fan used for ceiling fan operation.

Recommendations

Replace convention fan with BLDC fan. Consider first phase to replace 100 ceiling fans.

Benefits

By replacing conventional ceiling fan with BLDC fan, the power consumption will reduce.

Cost benefit Analysis of replacing ceiling fan to EC BLDC fan

Parameter	Unit	Value
Average power consumption of the ceiling fan at present	Watt	70
Average power consumption of energy efficient star rated (BLDC) fans	Watt	28
Equivalent Power saving per fan	Watt	42
Numbers of fans to be replaced	Nos	100
Working Hours Per annum	Hr	4000
Overall electric Power Cost	Rs/KWH	8.68
Annual Energy Saving	KWH	16800
Monetary saving	Rs/Year	145824
Investment	Rs	300000
Payback	Month	25

It is recommended to replace the girls and boys hostel fan with BLDC fan immediately and plan to replace the all fan with BLDC fan.

6. AREA OF IMPROVEMENT

Energy Management has become crucial to the competitors of the facility. Rising fuel costs coupled with increased global competition is forcing industries/buildings and other facilities to slash energy costs. It was aimed at obtaining a detailed idea about the various end use energy consumption activities and identifying, enumerating and evaluating the possible energy savings opportunities. However, Energy conservation is a continuous process and there is always scope for further improvements. With this objective the Energy Audit team with the active involvement of office we have identified the following Energy Conservation Opportunities (ECO's). Implementation of the ECO's can further help improve the energy consumption

The following energy saving/conservation measures were identified for the plant.

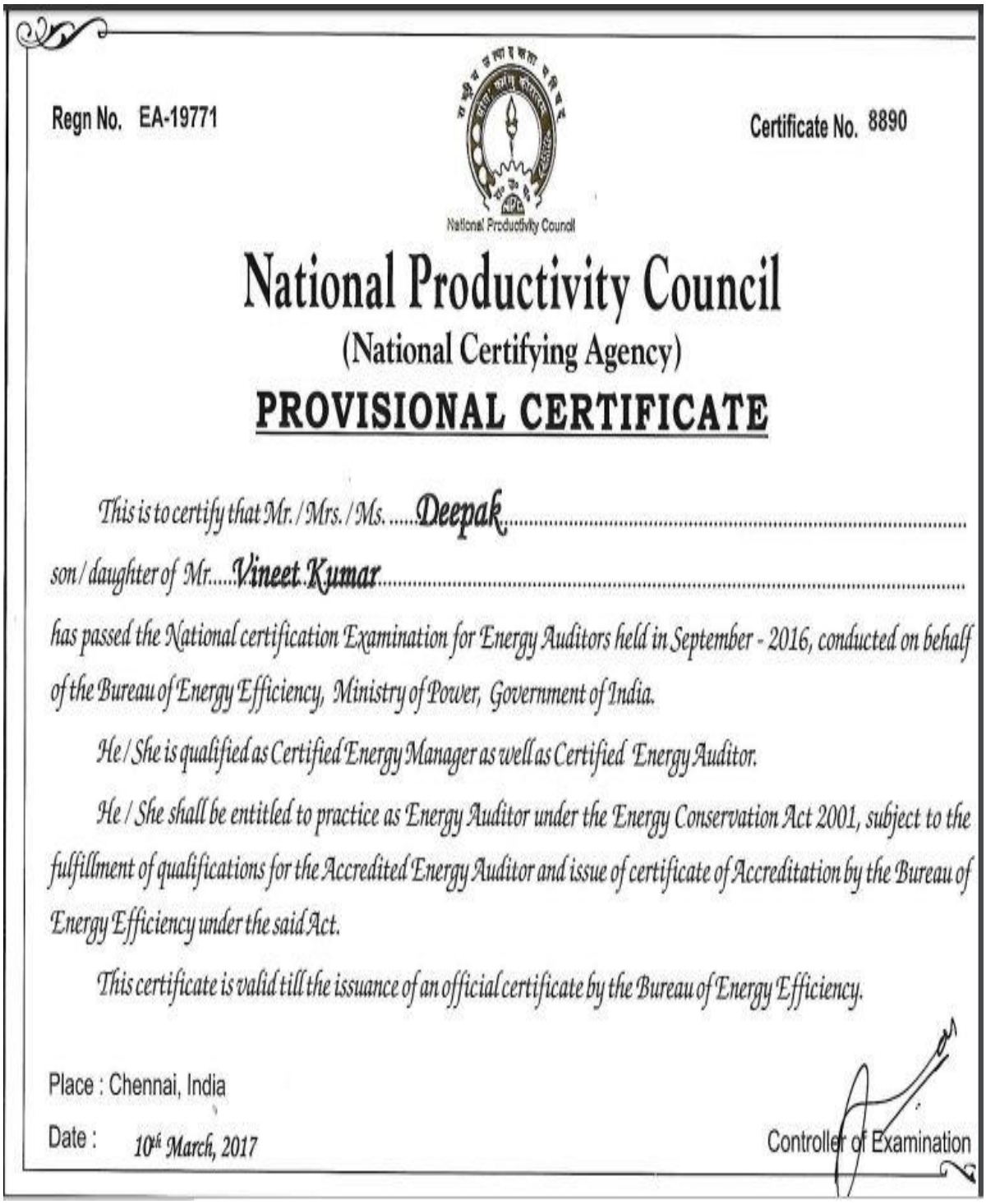
Table: List of Energy saving / conservation recommendations

Sr. No.	Recommended Measure
1	Replace the boys and girls hostel ceiling fan with BLDC fan
2	Recommended to maintain the power factor near unity
3	Reduce contract demand from 112 KVA to 75 KVA
4	It is recommended to install occupancy sensor in office cabins and toilets to save energy
5	It is recommended to install the day light sensor on the outdoor lights for automation and control of the lights and this will also help us reduce the unwanted running hours of the
6	Replace AC with VRV Technology

Some Energy Saving measure already taken by Institute as listed below:

- The institute has a very clear environmental vision and trying to reduce the energy
- The institute has planted a lot of trees and has maintained very good greenery.
- The institute generates more than 35 percent of energy through solar power plant for its domestic needs.
- It was observed that the building has opted the Energy efficient lighting system that is LED which was good option to save energy and we personally felt good to observe it.
- Most of the building have sufficient day light which saves the energy in the institutes.

7. ENERGY AUDITOR CERTIFICATES



Regn No. EA-19771

Certificate No. 8890

National Productivity Council

National Productivity Council

(National Certifying Agency)

PROVISIONAL CERTIFICATE

This is to certify that Mr./Mrs./Ms. .....Deepak.....

son/daughter of Mr.....Vineet Kumar.....

has passed the National certification Examination for Energy Auditors held in September - 2016, conducted on behalf of the Bureau of Energy Efficiency, Ministry of Power, Government of India.

He/She is qualified as Certified Energy Manager as well as Certified Energy Auditor.

He/She shall be entitled to practice as Energy Auditor under the Energy Conservation Act 2001, subject to the fulfillment of qualifications for the Accredited Energy Auditor and issue of certificate of Accreditation by the Bureau of Energy Efficiency under the said Act.

This certificate is valid till the issuance of an official certificate by the Bureau of Energy Efficiency.

Place : Chennai, India

Date : 10th March, 2017

Controller of Examination

THANKS