# REPORT ON ENERGY AUDIT

SHRI RAMSWAROOP MEMORIAL GROUP OF PROFESSIONAL COLLEGES

**Tiwariganj, Faizabad Road,**

**Lucknow (UP) - 226028**

**Submitted by**

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**Certified Energy Auditor EA-549**

**Retd. Executive Director UP Power Corporation**

SHRI RAMSWAROOP MEMORIAL GROUP OF PROFESSIONAL COLLEGES (SRMGPC)

## *Energy Audit Committee*

| Sr. No. | Name | Designation | Role |
|---|---|---|---|
| **1** | Dr VK Singh | Director (Admin) | Coordinator |
| **2** | Ashoutosh Kumar | Audit Agency | Engineer & Certified Energy Auditor |
| **3** | Siddharth Srivastava | Audit Agency | Assistant |

# ENERGY AUDIT CERTIFICATE

This is to certify that Walk-Through Energy Audit for Shri Ramswaroop Memorial Group of Professional Colleges (SRMGPC), Tiwariganj, Faizabad Road, Lucknow 226028 has been conducted in July 2021 to assess energy costs, availability, and reliability of supply of energy, energy conservation technologies and to explore energy saving avenues to reduce energy consumption.

Place: Lucknow

Date: Sept 12, 2021

Dr V. K Singh

Director Administration, SRMGPC

Ashoutosh Kumar

Certified Energy Auditor

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# ACKNOWLEDGEMENTS

An energy audit study is a joint exercise of consultant and organization to account & contain energy usage without sacrificing the purpose of usage of energy. The contribution of organization's team is equally important in this endeavor.

We take this opportunity to convey our sincere thanks and gratitude for the kind cooperation extended by the management and staff of Shri Ramswaroop Memorial Group Of Professional Colleges and acknowledge the contribution of the following dignitaries and site engineering personnel for providing timely assistance and guiding the team for conduct of this vital energy audit study.

Er. Pankaj Agrawal – Founder & Executive Director

Prof (Dr) Bhavesh Kumar Chauhan – Group Director

Dr V. K. Singh - Director Administration

We are sure; this report will be quite useful for Energy Management to intensify and implement energy conservation measures in the organization and achieve desired savings.

We appreciate the keen interest taken by the management to save precious energy in the interest of the organization as well as our Nation.

# Executive Summary

The objective of the audit was to study the energy consumption pattern of the facility, identify the areas where potential for energy/cost saving exists and prepare proposals for energy/cost saving along with investment and payback periods.

The salient observations and recommendations are given below. Electricity bill of SRMGPC monthly electricity bill varies from maximum Rs1673525/- to minimum Rs 540410/-.

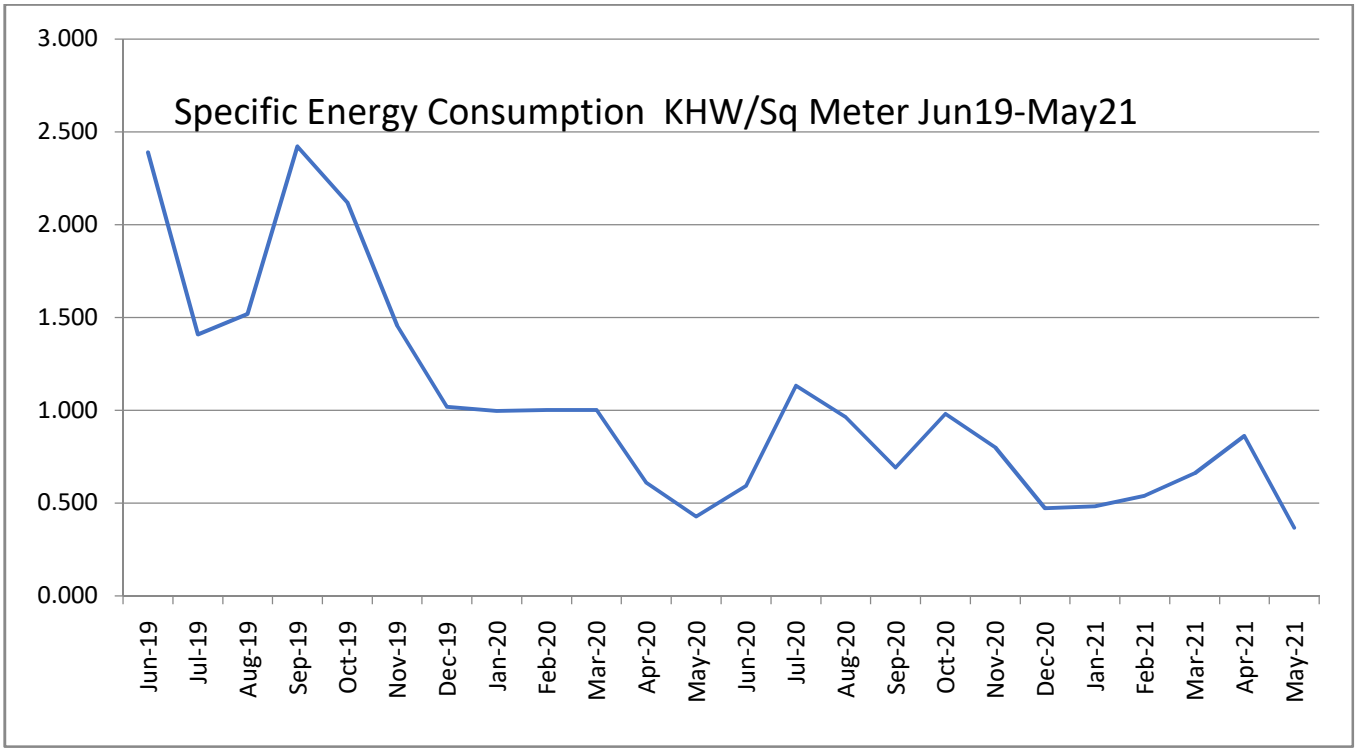
SRMGPC uses energy in the following forms:

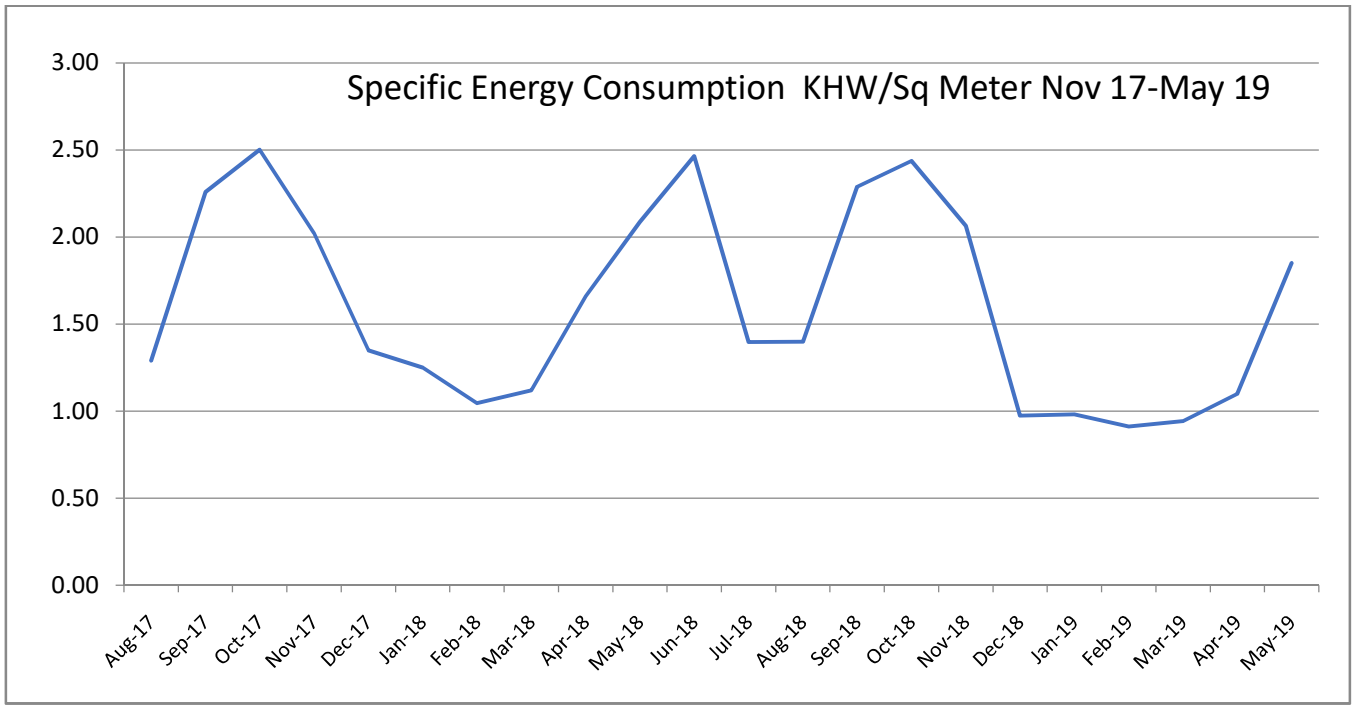
a. Electricity from MVVNL
b. High Speed Diesel (HSD)
c. LPG in Hostel Mess

1. Electrical energy is used for various applications, like:
   a. Computers
   b. Lighting
   c. Air-Conditioning
   d. Fans
   e. Other Lab Equipment
   f. Geysers in Hostel
   g. Water lifting submersible Pumps
   h. Deep Freezers & Refrigerators
   i. Motors of Various Lab Equipment's
   j. Water Coolers
   k. Motors for Pumps of Sewage Treatment Plant
2. The average cost of energy is around Rs. 8,35,194/Month.
3. Area Of Campus

| **Area of Campus in Square Metres** | |
|---|---|
| **Total area covered at ground** | 15598 |
| **Round and open area** | 35676 |
| **Total ground area of campus** | 51274 |
| **Total floor area** | 60606 |
| **Ground coverage** | 15598*100/60606=25.73% |

4. The Specific Energy Consumption (SEC) is the ratio of energy required per square meter. In this case the SEC is evaluated as electrical units consumed per square meter of area. SEC is calculated and plotted as below.




Presently maximum specific energy consumption with summer load in normal functioning of institute is around 2.5 and we should try to achieve around 2.0 in one year and finally settle for 1.75.

5. After the analysis of data and equipments installed, we propose herewith following Energy Efficiency Improvement measures.

| Sr. No | Recommendations | Monthly Savings (Rs.) | Annual Saving Potential (Rs.) | Estimated Investment (Rs.) | Payback Period (Months) | Remarks |
|---|---|---|---|---|---|---|
| **1** | By reducing Contracted Demand to 700KVA | 79,000 | 9,48,000 | 0 | Immedi ate | Without Delay |
| **2** | By Installing IGBT based device for reactive power management | 45,000 | 5,10,000 | 5,00,000 | 12 | Medium cost- Medium Payback |
| **3** | Depositing Electricity Bill within due date | 4,000 | 48,000 | 0 | Immedi ate | Without Delay |
| **4** | Replacing tube lights with choke by LED Tube lights | 1,16,600 | 14,00,000 | 4,46,800 | 4 | Medium cost- Short Payback |
| **5** | By replacing Rheostatic regulators by electronic regulators 1500 Nos | 50,000 | 6,19,000 | 3,00,000 | 6 | Low cost –Short Payback |
| **6** | By Replacing 25% ie 575 Nos old and repaired fans by energy efficient fans every year | 25,000 | 2,93,250 | 6,90,000 | 28 | Medium cost – Medium Payback |
| **7** | By providing Solar water geysers in Hostels and Mess | 1,00,000 | 12,24,700 | 24,95,000 | 24 | Medium cost- Medium Payback |
| **8** | By Replacing 200 Nos Desktops by Laptops | 72,250 | 8,67,000 | 50,00,000 | 72 | Heavy Cost- Long Payback |
| **9** | Replacing repairable / defective 36 Nos AC by Energy Efficient 3 Star AC | | 4,90,000 | 10,80,000 | 26 | Medium Investment- Medium payback |
| **10** | Replacing 40 Nos AC w/o star by Energy Efficient 3 Star AC every year | | 5,44,000 | 12,00,000 | 26 | Medium Investment- Medium payback |
| **11** | By Providing 250 KW Solar Power plant | | 24,00,000 | 100,00,000 | 24 | Heavy Investment- Medium Payback |
| | Total | | 93,00,000 | 2,17,00,000 | 28 | |

NOTE: Total savings is estimated at 93 Lakhs which is 31 % of the total energy cost with an overall payback period of 5.78 Years

# CHAPTER 1

# INTRODUCTION TO ENERGY AUDIT

## General

The Shri Ramswaroop Memorial Group of Professional Colleges entrusted the work of conducting a Walkthrough Energy Audit of campus at Tiwariganj, Lucknow with the main objectives as below:

a. To study the present pattern of energy consumption
b. To identify potential areas for energy optimization
c. To recommend energy conservation proposals with cost benefit analysis.

## Scope of Work, Methodology and Approach

Scope of work and methodology were as per the proposal.While undertaking data collection, field trials and their analysis, due care was always taken to avoid abnormal situations so as to generate normal / representative pattern of energy consumption at the facility.

## Approach to Energy Audit

We focused our attention on energy management and optimization of energy efficiency of the systems, sub systems and equipments. The key to such performance evaluation lies in the sound knowledge of performance of equipments and system as a whole.

## Energy Audit

The objective of Energy Audit is to balance the total energy inputs with its use and to identify the energy conservation opportunities in the stream.

Energy Audit also gives focused attention to energy cost and cost involved in achieving higher performance with technical and financial analysis. The best alternative is selected on financial analysis basis.

## Energy Audit Methodology

Energy Audit Study is divided into following three steps:

### *A. Historical Data Analysis*

The historical data analysis involves establishment of energy consumption pattern to establish base line data on energy consumption and its variation with change in different months of year.

### *B. Identification and evaluation of Energy Conservation Opportunities*

This step involves evaluation of energy conservation opportunities identified during the energy audit. It gives potential of energy saving and investment required to implement the proposed modifications with payback period. All recommendations for reducing losses in the system are backed with its cost benefit analysis.

# Chapter 2

## About SRMGPC

| Sr. No. | Particulars | Details |
|---|---|---|
| **1** | Name of the Institute | Shri Ramswaroop Memorial Group of Professional Colleges |
| **2** | Address | Tiwariganj, Faizabad Road<br>Lucknow-226028 |
| **3** | Year of Establishment | 1999 |
| **4** | Courses Offered | B. Tech.<br>Computer Sciences & Engineering<br>Artificial Intelligence & Machine Learning<br>Information Technology<br>Electrical & Electronics Engineering<br>Electronics & Communication Engineering<br>Mechanical Engineering<br>Electrical Engineering<br>Civil Engineering<br>M.Tech.<br>Computer Science & Engineering<br>Civil Engineering<br>Environmental Engineering<br>Master Of Business Administration<br>Master of Computer Application |
| **5** | Affiliation | Dr. A.P.J. Abdul Kalam Technical University<br>Lucknow |
| **6** | Total Building Carpet Area | 60606 Sq meter |

# CHAPTER 3

## HISTORICAL DATA ANALYSIS

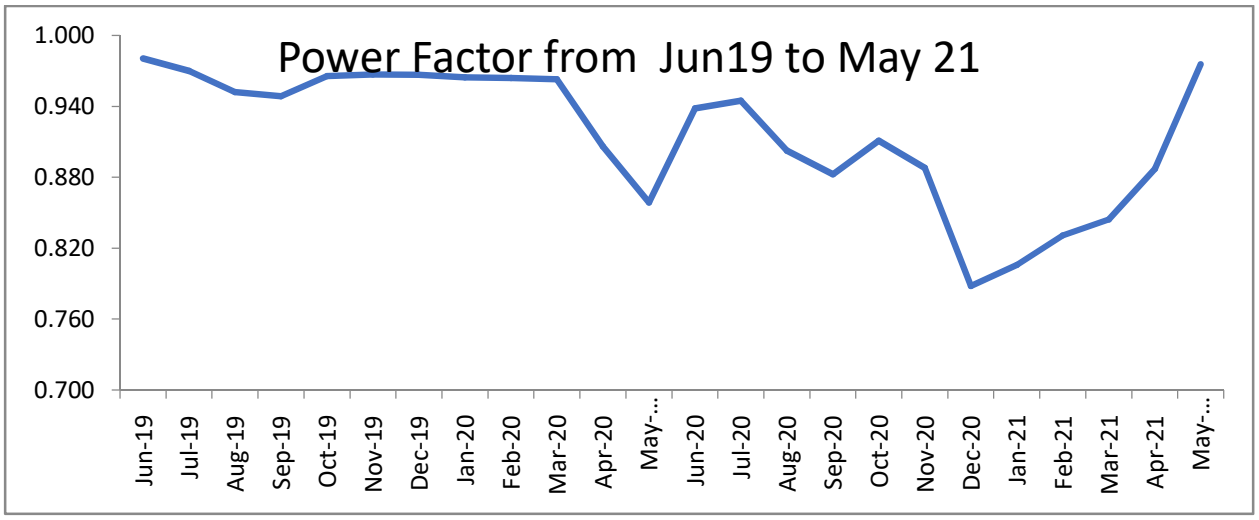
### Study of Variation of Monthly Units consumption & Power Factor:

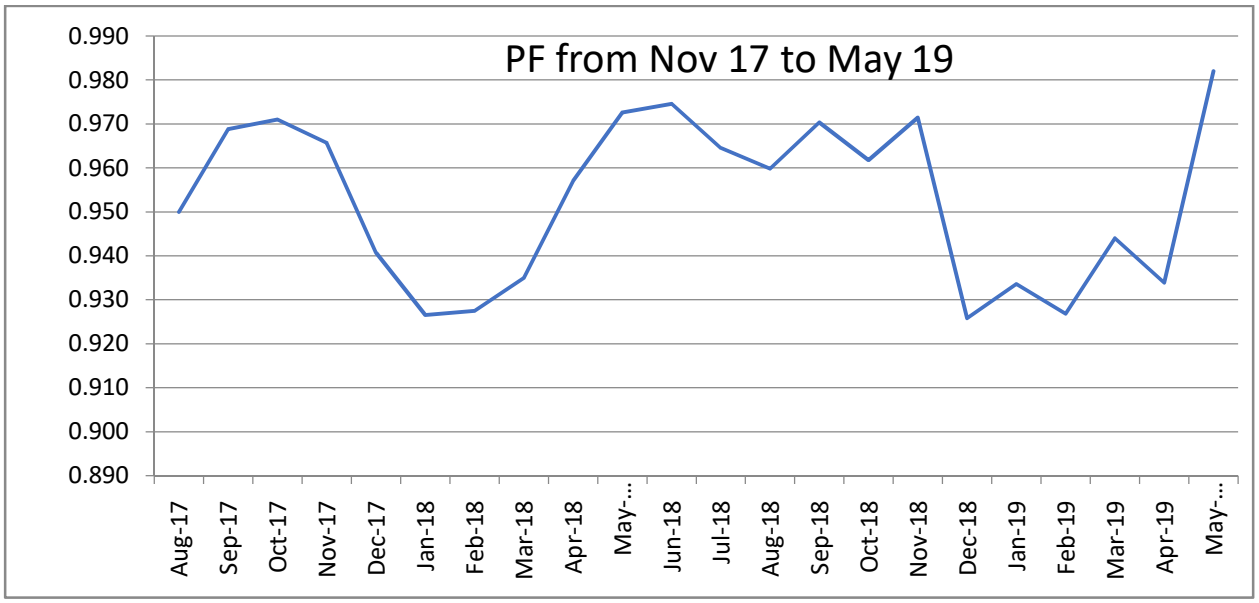
In this Chapter, we study the details of last 24 months Electricity Bills. Main points of study are as follows.

| Month | KVAH | KWH | Diff | Power Factor | SEC KWH/sq m | Month | Power Factor | SEC KWH/sq m |
|---|---|---|---|---|---|---|---|---|
| **Jun-19** | 144807 | 141982 | 2825 | 0.980 | 2.389 | Aug-17 | 0.950 | 1.29 |
| **Jul-19** | 85418 | 82852 | 2566 | 0.970 | 1.409 | Sep-17 | 0.969 | 2.26 |
| **Aug-19** | 92012 | 87601 | 4411 | 0.952 | 1.518 | Oct-17 | 0.971 | 2.50 |
| **Sep-19** | 146774 | 139216 | 7558 | 0.949 | 2.422 | Nov-17 | 0.966 | 2.02 |
| **Oct-19** | 128476 | 124058 | 4418 | 0.966 | 2.120 | Dec-17 | 0.941 | 1.35 |
| **Nov-19** | 88205 | 85280 | 2925 | 0.967 | 1.455 | Jan-18 | 0.926 | 1.25 |
| **Dec-19** | 61774 | 59718 | 2056 | 0.967 | 1.019 | Feb-18 | 0.927 | 1.05 |
| **Jan-20** | 60448 | 58297 | 2151 | 0.964 | 0.997 | Mar-18 | 0.935 | 1.12 |
| **Feb-20** | 60765 | 58568 | 2197 | 0.964 | 1.003 | Apr-18 | 0.957 | 1.66 |
| **Mar-20** | 60704 | 58454 | 2250 | 0.963 | 1.002 | May-18 | 0.973 | 2.08 |
| **Apr-20** | 37055 | 33567 | 3488 | 0.906 | 0.611 | Jun-18 | 0.975 | 2.46 |
| **May-20** | 25966 | 22293 | 3673 | 0.859 | 0.428 | Jul-18 | 0.965 | 1.40 |
| **Jun-20** | 35957 | 33737 | 2220 | 0.938 | 0.593 | Aug-18 | 0.960 | 1.40 |
| **Jul-20** | 68641 | 64844 | 3797 | 0.945 | 1.133 | Sep-18 | 0.970 | 2.29 |
| **Aug-20** | 58432 | 52730 | 5702 | 0.902 | 0.964 | Oct-18 | 0.962 | 2.44 |
| **Sep-20** | 41953 | 37018 | 4935 | 0.882 | 0.692 | Nov-18 | 0.971 | 2.06 |
| **Oct-20** | 59483 | 54179 | 5304 | 0.911 | 0.981 | Dec-18 | 0.926 | 0.97 |
| **Nov-20** | 48523 | 43076 | 5447 | 0.888 | 0.801 | Jan-19 | 0.934 | 0.98 |
| **Dec-20** | 28606 | 22544 | 6062 | 0.788 | 0.472 | Feb-19 | 0.927 | 0.91 |
| **Jan-21** | 29309 | 23617 | 5692 | 0.806 | 0.484 | Mar-19 | 0.944 | 0.94 |
| **Feb-21** | 32736 | 27195 | 5541 | 0.831 | 0.540 | Apr-19 | 0.934 | 1.10 |
| **Mar-21** | 40083 | 33841 | 6242 | 0.844 | 0.661 | May-19 | 0.982 | 1.85 |
| **Apr-21** | 52307.4 | 46399 | 5908 | 0.887 | 0.863 | | | |
| **May-21** | 22287 | 21744 | 543 | 0.976 | 0.368 | | | |
| **Total** | 1510721 | 1412810 | 97911 | | | | | |
| | % Units Paid Extra | | 6.94 | | | | | |

*Table: Unit Consumption Specific Energy Consumption & Power Factor*

*Variation of Power factor*




The Power Factor (KWH/KVAH) is a measure to reduce the utility power bill. Most utility bills are based on KVAR usage. Difference between KWH and KVAH is loss due to reactive power generated internally. A good Power Factor provides a better voltage, reducing the pressure on electrical distribution network, reducing cable heating, cable over loading and cable losses, reducing over loadings of control gears and switchgears etc. Above all good power factor indicates efficiency of electrical energy utilization.

Reactive power management in SRMGPC is being done through AEC make 398 KVAR APFC panel and voltage is being maintained with the help of 350KVA Servo stabilizer.

Though power factor is being maintained normally in range of .98 to 0.788 but due to lack of effective and proper reactive power management especially in low load period SRMGPC has paid 97911 units ie Rs 8.5

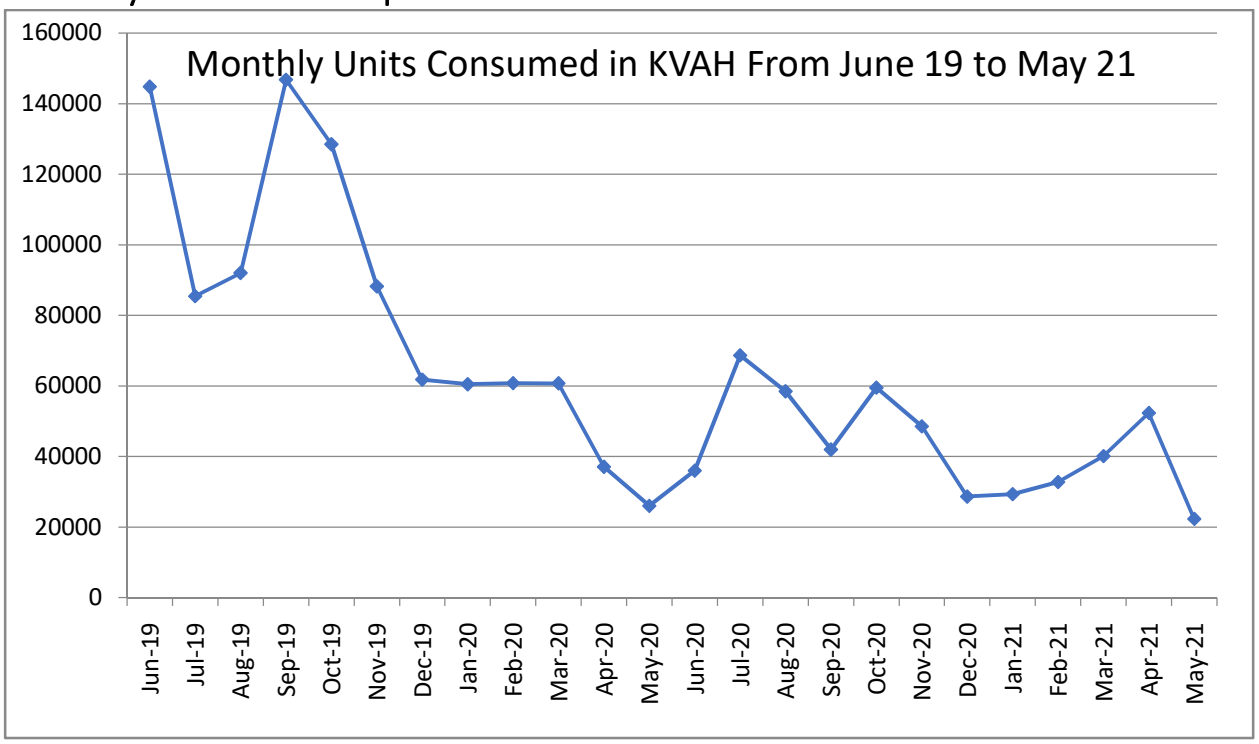
Lakhs extra during last 24 months' time. It is mainly due to limitation of APFC and frequent outing of contactors and capacitors decay.

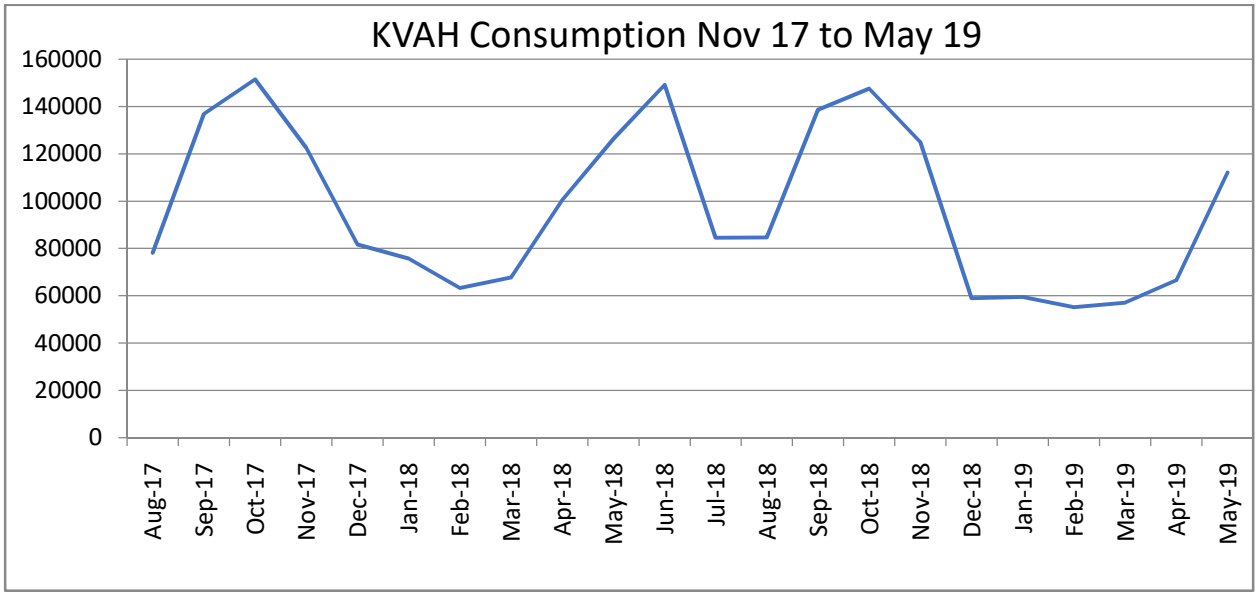
During low load period i.e., less than 25 % load, APFC does work so reactive power generated at low load remained uncompensated. Further transformer remained energized throughout and reactive power generated remains uncompensated as sensing CT of APFC is placed towards LT side of transformer.

Now hi-tech devices such as IGBT based compensators are available wherein sensing is being done from HT of transformer by which compensation of reactive power generated from transformer as well as during low load period can be efficiently done which in turn can take care of 90% of present KVAH and KWH unit difference.

Installing IGBT based device will substantially improve PF and will result in more saving.

## Monthly Units consumption



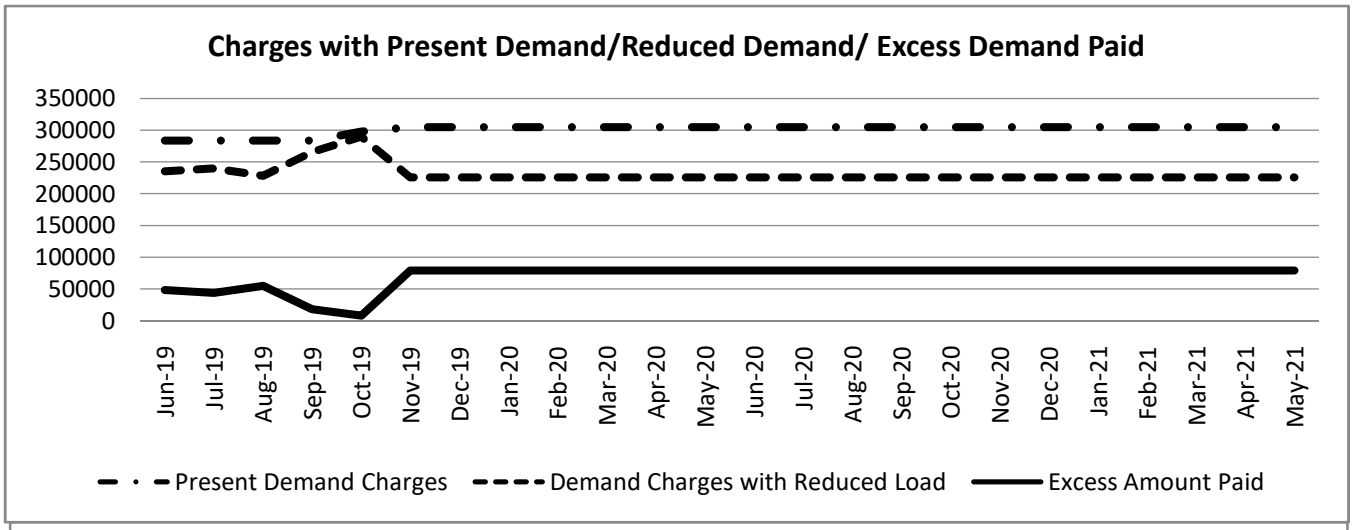



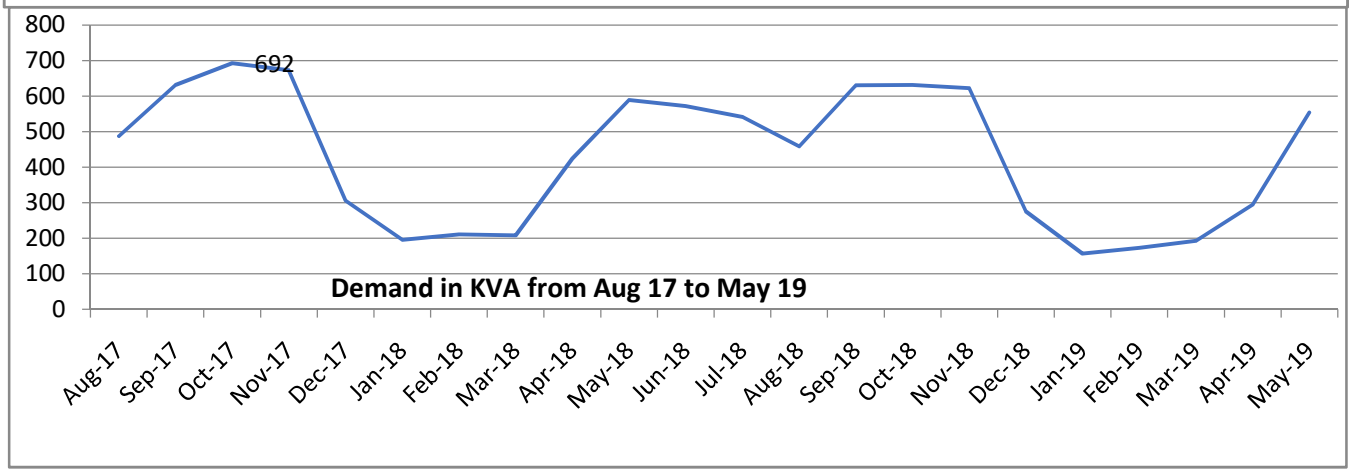

There is very large variation in energy usage over period under study, from max 146774 to min 22287 units which is obvious due to seasonal change but sharp decay from April 20 onwards is due to suspension of activities on account of corona.

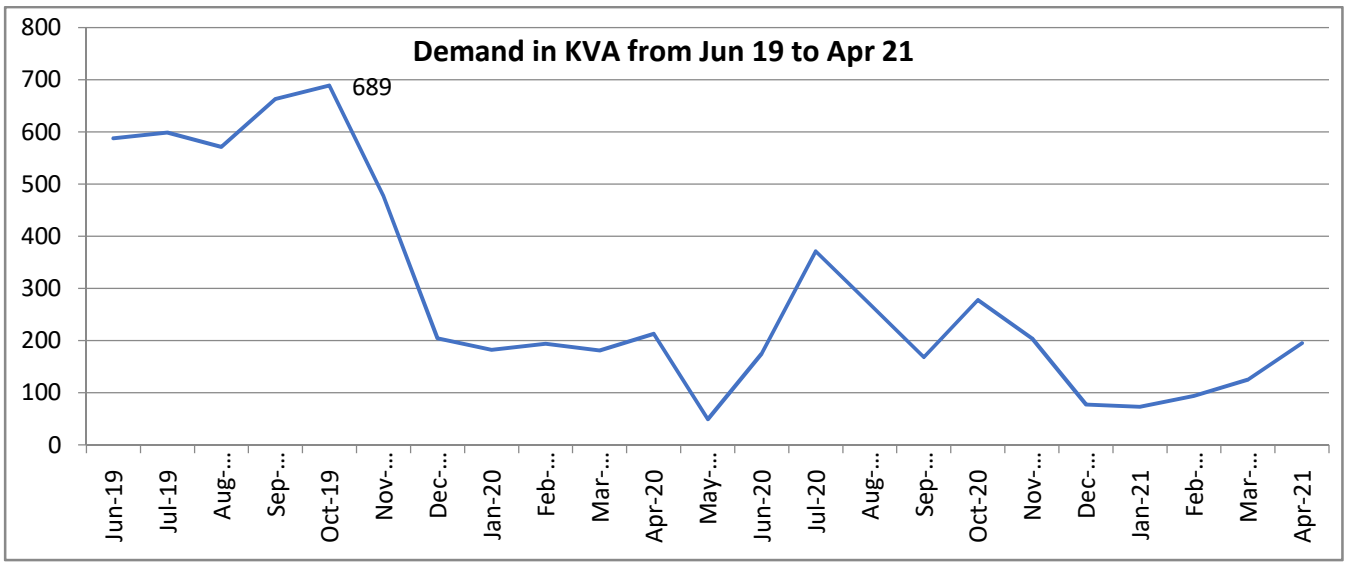
## Maximum Recorded Demand/ Demand Charges

There is very large variation in maximum recorded monthly demand over period under study, from max 692 to min 49 units which is obvious due to seasonal change but sharp decay from April 20 onwards is owing to suspension of activities on account of corona.

| Paid Month | Max Demand in KVA | PF | Present Demand charges Paid | Demand Charges Rate (Rs) | Demand Charges with 700KVA | Saving in Demand Charges | Late Payment Penalty Paid | Month | Max Demand KVA |
|---|---|---|---|---|---|---|---|---|---|
| **Jun-19** | 588 | 0.980 | 283500 | 400 | 235200 | 48300 | 4727 | Aug-17 | 487 |
| **Jul-19** | 599 | 0.970 | 283500 | | 239600 | 43900 | 4953 | Sep-17 | 631 |
| **Aug-19** | 571 | 0.952 | 283500 | | 228400 | 55100 | 4414 | Oct-17 | **692** |
| **Sep-19** | 663 | 0.949 | 283500 | | 265200 | 18300 | 4075 | Nov-17 | 672 |
| **Oct-19** | 689 | 0.966 | 297575 | 420 | 289380 | 8195 | 6677 | Dec-17 | 305 |
| **Nov-19** | 477 | 0.967 | 304762 | 430 | 225750 | 79012 | 3037 | Jan-18 | 195 |
| **Dec-19** | 204 | 0.967 | 304762 | | 225750 | 79012 | 3449 | Feb-18 | 210 |
| **Jan-20** | 182 | 0.964 | 304762 | | 225750 | 79012 | 5418 | Mar-18 | 207 |
| **Feb-20** | 194 | 0.964 | 304762 | | 225750 | 79012 | | Apr-18 | 424 |
| **Mar-20** | 181 | 0.963 | 304762 | | 225750 | 79012 | 5361 | May-18 | 588 |
| **Apr-20** | 213 | 0.906 | 609524 | | 451500 | 158024 | | Jun-18 | 571 |
| **May-20** | 49 | 0.859 | | | | | | Jul-18 | 541 |
| **Jun-20** | 175 | 0.938 | 304762 | | 225750 | 79012 | 18752 | Aug-18 | 458 |
| **Jul-20** | 372 | 0.945 | 304762 | | 225750 | 79012 | 4925 | Sep-18 | 630 |
| **Aug-20** | 270 | 0.902 | 304762 | | 225750 | 79012 | 529 | Oct-18 | 631 |
| **Sep-20** | 168 | 0.882 | 304762 | | 225750 | 79012 | 2224 | Nov-18 | 622 |
| **Oct-20** | 278 | 0.911 | 304762 | | 225750 | 79012 | 2598 | Dec-18 | 275 |
| **Nov-20** | 204 | 0.888 | 304762 | | 225750 | 79012 | 3147 | Jan-19 | 156 |
| **Dec-20** | 77 | 0.788 | 304762 | | 225750 | 79012 | 2420 | Feb-19 | 172 |
| **Jan-21** | 73 | 0.806 | 304762 | | 225750 | 79012 | 1528 | Mar-19 | 192 |
| **Feb-21** | 94 | 0.831 | 304762 | | 225750 | 79012 | 1552 | Apr-19 | 294 |
| **Mar-21** | 125 | 0.844 | 304762 | | 225750 | 79012 | 2238 | May-19 | 553 |
| **Apr-21** | 195 | 0.887 | 304762 | | 225750 | 79012 | 1807 | | |
| **May-21** | | 0.976 | 304762 | | 225750 | 79012 | 5798 | | |
| **Total Excess Demand Charges & Late Payment Surcharge** | | | | | | 1675023 | 89629 | | |


Charges with Present Demand/Reduced Demand/ Excess Demand Paid
350000
300000
250000
200000
150000
100000
50000
0
Jun-19
Jul-19
Aug-19
Sep-19
Oct-19
Nov-19
Dec-19
Jan-20
Feb-20
Mar-20
Apr-20
May-20
Jun-20
Jul-20
Aug-20
Sep-20
Oct-20
Nov-20
Dec-20
Jan-21
Feb-21
Mar-21
Apr-21
May-21
Present Demand Charges
Demand Charges with Reduced Load
Excess Amount Paid


800
700
600
500
400
300
200
100
0
692
Demand in KVA from Aug 17 to May 19
Aug-17
Sep-17
Oct-17
Nov-17
Dec-17
Jan-18
Feb-18
Mar-18
Apr-18
May-18
Jun-18
Jul-18
Aug-18
Sep-18
Oct-18
Nov-18
Dec-18
Jan-19
Feb-19
Mar-19
Apr-19
May-19


800
700
600
500
400
300
200
100
0
Demand in KVA from Jun 19 to Apr 21
689
Jun-19
Jul-19
Aug-...
Sep-...
Oct-19
Nov-...
Dec-...
Jan-20
Feb-...
Mar-...
Apr-20
May-...
Jun-20
Jul-20
Aug-...
Sep-...
Oct-20
Nov-...
Dec-...
Jan-21
Feb-...
Mar-...
Apr-21

## Sanctioned Load Vs Maximum recorded demand

From above table it is very much clear that in last two years recorded monthly demand has never gone beyond 75% of sanctioned load. Billable minimum demand charge is 75% of sanctioned load or actual in case it is above 75%.

For specific purpose to evaluate and recommend reduction in contracted demand, maximum demand attained , study of further period from Aug 17 to May 19 was done. Meaning thereby in total period of 40 months ie Aug 17 – May 21 , maximum recorded demand is 692 KVA in month of Oct 17. So safely contracted demand can be reduced to 700 KVA means reduction of 250 KVA.

So, if demand before period under study has been in same range it will be advisable to reduce to 700 KVA which will result in monthly saving of Rs 79000/. From above table it evident that had load reduction been done earlier it would have resulted in saving of Rs 16.75 Lakhs in last two years alone and would have further saved Rs 12.64 if period from Aug 17 to May 19 also considered ie total more than 30 lakhs extra.

Apart from above SRMGPC has paid Rs 89629 / extra due to late payment of bills.

## General Observations based on Electricity Bill

1. For SRMGPC Campus the Contract Demand (CD) is 944 kVA and minimum billing Demand is 75% of the Contract Demand (709 KVA) or the 75% of actual recorded Demand whichever is higher. Since, the MD recorded in last 24 months is only 689 KVA, contacted demand can be reduced to 700 KVA.
2. The average electricity cost is Rs. 14.99 considering the last 24 months consumption and amount paid.
3. Average monthly Power Factor is maintained near 0.980, can be further improved by more than 1%
4. Rs 89629/- has been extra in form of late payment surcharge.

# Chapter 4

## Details of Energy consuming Equipment's Installed

### 4.1 Lighting Fixtures

| Sr. No. | Place of Installation | Tube with Choke | | Tube LED | | LED Bulbs | | Down Lights | | Streetlights | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | No | Watt @50 | No | Watt @18 | No | Watt | No | Watt | No | Watt @ | Watt |
| **1** | A Block | 114 | 5700 | 28 | 504 | 62 | 1426 | 304 | 4222 | 48 | 60 | 2880 |
| **2** | B Block | 176 | 8800 | 6 | 108 | | | | | 6 | 170 | 1020 |
| **3** | C Block | 265 | 13250 | 19 | 342 | | | | | | | |
| **4** | D Block | 240 | 12000 | 7 | 126 | 12 | 84 | 10 | 240 | | | |
| **5** | E Block | 157 | 7850 | 219 | 3942 | 4 | 28 | 18 | 432 | | | |
| **6** | F Block | 149 | 7450 | 29 | 522 | | | 48 | 624 | | | |
| **7** | G Block | 311 | 15550 | 105 | 1890 | | | | | | | |
| **8** | CV Raman Hostel | 119 | 5950 | 32 | 576 | | | | | | | |
| **9** | RK Hostel | 168 | 8400 | 53 | 954 | | | | | | | |
| **10** | Saraswati Hostel | 406 | 20300 | 60 | 1080 | | | | | | | |
| **11** | Boys Mess | 40 | 2000 | 11 | 198 | | | | | | | |
| **12** | Canteen | 5 | 250 | 8 | 144 | | | | | | | |
| **13** | | 45 | 2250 | 19 | 342 | | | | | | | |
| **14** | Workshop, Gym, Store | 139 | 6950 | | 0 | | | | | | | |
| **Total** | | 2334 | 116700 | 596 | 10728 | 78 | 1538 | 1538 | 5518 | 54 | | 3900 |
| **Grand Total** | | | | | | | | | 138384 | | | |
| | | | | | | | | | Say 138.38 KW | | | |

## 4.2 Fans

| Sl No | Place of Installation | Fans | | Wall Fan | |
|---|---|---|---|---|---|
| | | No | Watt @80 | No | Watt @70W |
| **1** | A Block | 127 | 10160 | 40 | 2800 |
| **2** | B Block | 191 | 15280 | | 0 |
| **3** | C Block | 237 | 18960 | | 0 |
| **4** | D Block | 213 | 17040 | 1 | 70 |
| **5** | E Block | 134 | 10720 | | 0 |
| **6** | F Block | 145 | 11600 | 4 | 280 |
| **7** | G Block | 418 | 33440 | | 0 |
| **8** | CV Raman Hostel | 193 | 15440 | | 0 |
| **9** | RK Hostel | 203 | 16240 | | |
| **10** | Saraswati Hostel | 417 | 33360 | | |
| **11** | Boys Mess | 48 | 3840 | | |
| **12** | Canteen | 12 | 960 | | |
| **13** | Workshop, Gym, Store etc. | 99 | 960 | | 0 |
| **Total** | | 2338 | 188000 | 45 | 3150 |
| **Grand Total** | | | | | 191150 |
| | | | Say | | 190 KW |

## 4.3 Air Conditioners

As per ratings provided total tonnage of ACs installed is 428.5 Ton.

| Sl. No. | Tonnage | Numbers | @ Watt | Total Watt |
|---|---|---|---|---|
| **1** | 1.5T 3Star | 36 | 1500 | 54000 |
| **2** | 1.5T W/o Star | 213 | 2500 | 532500 |
| **3** | 1.0T W/o Star | 08 | 2000 | 16000 |
| **4** | 5 T W/o Star | 08 | 7000 | 56000 |
| **Total** | | | 658500 say 658 KW | |

## 4.4 Other equipment

| A. Geyser @2000W | | | |
|---|---|---|---|
| **Sr. No.** | Place of Installation | No | Watt |
| **1** | CV Raman Hostel | 14 | 42000 |
| **2** | RK Hostel | 16 | 48000 |
| **3** | Saraswati Hostel | 24 | 72000 |
| **4** | Boys Mess | 1 | 3000 |
| **Total** | | 55 | 165000 |
| B. Exhaust Fan | | | |
| **1** | 18" Fan @200W | 18 | 3700 |
| **2** | 12" Fan @100W | 12 | 1200 |
| **Total** | | 30 | 4900 |
| **C. Water Cooler 150 Lts @1780 W** | | 41 | 72980 |
| | | | |
| **1** | Desktop @180 W | 972 | 174960 |
| **2** | Laptop @30 watt | 11 | 330 |
| **3** | Server | 1 | 1000 |
| **Total** | | 16290 | |
| **E. Heavy Duty Printers/Copiers @1 KW** | | 17 | 17000 |
| | | 23 | 4600 |
| G. Submersible Pumps | | | |
| **1** | 3 HP | 1 | 2200 |
| **2** | 1.5 HP | 14 | 14000 |
| | | | 16200 |
| **H. Deep Freezers/ Fridge @276 Watt** | | 12 | 3312 |
| | | | |
| **1** | AC Phase Motor Lab Total 52 HP | 20 | 38792 |
| **2** | Lathe M/C 25.5 HP | 22 | 19023 |
| **3** | Hydraulic M/c Lab 12.5 HP | 3 | 9325 |
| **4** | Civil lab & Filter Pump STP @5 HP | 3 | 11190 |
| **5** | Garbage Pump @3 HP | 1 | 746 |
| **6** | Air Blower @7.5 HP | 2 | 11190 |
| **7** | 2 HP Motor | 8 | 5968 |
| | | | 96234 |
| **Grand Total** | | 556516 say 557 KW | |

***Total Connected Load: (4.1 to 4.4 above) = 138+190+658+557 say 1543 KW***

# Chapter 5

## STUDY OF ELECTRICAL SYSTEMS

SRMGPC has mainly two sources of Electricity Supply:

Electricity Connection

SRMGPC is getting power from Madhyanchal Vidyut Vitaran Nigam Ltd against A/c no 4217593000 with sanctioned load of 944 KVA under HV1/H11 under EUDD Chinhat Lucknow through 1250KVA, 11/0.4 KV transformer.

Diesel Generators

For back power SRMGPC has two Cummins India make diesel generators of 600 & 250 KVA capacity.

Annual consumption of diesel is 9400 Lts and yearly running hours is 135 Hrs. Annual cost of Diesel is approximately 7.0 Lakhs i.e. Rs 58750/per month.

| Sr. No. | Details of electricity Demand | Tariff | HV-2/H21T |
|---|---|---|---|
| **1** | Sanctioned Demand | 944 | kVA |
| **2** | Minimum Billable Demand | 708 | kVA |
| **3** | Recorded Maximum Demand | 692 | kVA |

# Chapter 6

## Analysis of Data & Saving Avenues

Based on detailed discussion, analysis of data in chapter 4 above following conclusions has been arrived.

## Study of Utility Bill

A. Demand Charges: As it is evident from above table and discussed in detail at Sl No 4.2 that demand has never reached even to level of minimum billable demand of 708 KVA. SRMGPC has paid Rs 16.75 Lakhs extra as demand charges which could have been saved by reducing sanctioned demand to 700 KVA. Reducing sanctioned demand to 700KVA will result in monthly saving of Rs 79000/.
B. Power Factor: For Reactive power management AEC make 398 KVAR APFC panel and for voltage regulation 350KVA Servo stabilizers are installed. Power factor during period under study varied from 0.988 to 0.788 and total 97911 Units i.e., Rs 8,82 ,000/- have been paid extra. Though PF is maintained quite efficiently but it can be seen from table of PF that with less consumption PF drops as during low load period APFC ceases to work due to its inherent limitation. Further APFC uses Capacitors and Contractors which its performance is affected on account of periodic de-rating of capacitors and damage to contractors. With advent of IGBT based solid state devices with sensing from HT side of transformer PF can be further improved. By implementing this technology PF can be further improved and this will save around 45000/ per month i.e., Rs 5.1 Lakhs per annum. Investment around Rs 5.0 Lakhs, payback period 12 months.
C. Late Payment Surcharge: By paying monthly electricity bills within due date an average saving of Rs 4000/ per month can be achieved.

## Study of Equipment/Appliances

### *Lighting equipment*

As per 5.1 there are 2234 Nos of 4' Tube light with magnetic choke and only 596 Nos 18 W LED tube lights. Tube with magnetic chokes should be replaced with LED tube lights which will result in saving as follows.

Tubes with magnetic chokes- 2234 Nos

Wattage of each - 50 watts

Total Monthly electricity consumption= 2234*50*8*30*0.8/1000= **21446 KWH**

With LED tubes of 18W consumption= 2234*18*8*30*0.8/1000=**7721 KWH**

Saving in units =21446-7721= **13725 KWH**

Monthly Saving in Rs =9436*8.5=**116660/-**

Cost of replacement @ Rs 250/- = 2234*200= **446800**

Payback period =446800/116660= **3.82 Months**

In above calculation unit rate has been taken @Rs 8.5/ unit, switch on time of 8 hrsand diversity factor of 80%.

## *Ceiling Fan*

There are a total 2338 ceiling fans installed in campus more than 50% of them are fitted with rheostatic regulators and almost all fans are regular fans. Saving in ceiling fans can be achieved in two ways

a. By replacing all rheostatic regulators by electronic regulators

   Out of total 2338 fans approximately 1500 fans are still operating with rheostatic regulators or regulators are not working. There is considerable loss due to use of rheostatic regulator. Further using fan without regulator causes energy loss as power drawn by fan varies with speed.

   A case study with comparative performance of both types regulators are tabulated below, wherein it is evident that saving % is maximum at lowest speed and same keep on decreasing with increase in speed. There will be an average reduction in energy consumption by 27 % with an electronic type of regulator as against a conventional type regulator.

| Regulator Position | With Conventional Regulator | | With Electronic Regulator | | Relative Energy Saving % |
|---|---|---|---|---|---|
| | Watt | Energy Saving % | Watt | Energy Saving % | |
| **1** | 50 | 32 | 28.4 | 61.4 | 43.2 |
| **2** | 54 | 26.5 | 37.5 | 49.0 | 30.5 |
| **3** | 60.5 | 17.7 | 47.5 | 35 .4 | 21.5 |
| **4** | 65.3 | 11.1 | 57.3 | 22 .0 | 12.2 |
| **5** | 75.0 | 0 | 75.0 | 0 | 0 |

**Saving Economics**: Assuming that ceiling fan is operated for12 hrs/day, 200 days per year and saving achieved is 27% in energy consumption:

Annual Energy Consumed by one ceiling fan w/o regulator=Annual Cost of Energy Consumed by one ceiling fan w/o regulator= 75X12X200x8.5=Rs 1530

Annual cost of energy saved for one ceiling fan = 1530x0.27 = Rs 413/year

Total saving in a year by replacing all 1500 rheostatic regulators/defective electronic regulator = 413*1500=Rs 619500/-

Cost of providing regulator @200 =200*1500=300000/-

Payback period =300000/619500=0.48 years say Six months

b. Replacing Existing Fans with Energy Efficient Fans

   By replacing existing fans with energy efficient fans considerable saving in electricity consumption can be achieved.

   One normal fan consumes around 75x12x200/1000 =**180 KWH**

   Energy efficient fan consumes around 12X200X50/1000=**120 KWH**

   Saving per fan /year =180-120= **60 KWH**

   Saving in Rs = 60X8.5= **Rs 510/-**

   Pay-back period =1200/510= **2.35 Yrs i.e., 28 months**

   It is proposed that 25 % of total fans i.e., 575 nos be replaced every year resulting in saving of Rs 293250/- with investment of Rs 690000/ (Cost/fan @1200/- as per EESL).

   Payback 2 years

   First very old fans/those which has been repaired be replaced.

## *Geysers*

It has been observed that total 54 Nos 2000 W and one 3000W electric geysers have been installed for providing hot water in hostel bathrooms and mess respectively. Its operation cannot be controlled as same is required by students at various time slots of day being situated in hostel. It is proposed that 1500 Lts solar water heater be provided as detailed below. To ensure hot water supply even during cloudy or no bright sun light day Hybrid type Solar geysers with auto cut facility is proposed.

It has been assumed that geyser being used from Oct to March ie 6 months around 200 days in a year for 8 hrs per day.

- Annual Consumption of electricity by one geyser: 2000x8x200=**2880 KWH**
- Let with solar geyser electric geyser consumption is reduced by 90%
- Unit saved by each geyser will be = 2880X0.9=**2592 KWH ie Rs 22032/-**
- Cost of 1500Lts Solar Geyser =2,00,000+20000 (pipe and fittings)=**2,20,000/-**

Saraswati Hostel: No of inmates of 500 Nos and both boys' hostel 600 Nos.

Maximum total requirement of hot water @ 20 Lts/student assuming 75% students uses daily = 500*20*0.75= **7500 Lts/day**

Nos of 1500 LPD Solar Geysers required = **5 Nos**

Investment = 220000x5= **11,00,000/-**

Energy saving by installing Solar Geysers/yrs = 2592x24x8.5=**Rs 5,28,000/-**

Payback Period= 528000/ 1100000= **2 years**

CV Raman & RK Hostel Number of students in each boy's hostel 300Nos each

Maximum total requirement of hot water @ 20 Lts/student assuming 75% students uses daily = 300*20*0.75= **4500 Lts/day**

Nos of Solar Geysers Required = **3 each**

Cost of Energy saving by installing Solar Geysers/yrs= 2592x30x8.5=**660000/-**

Investment = 220000x6= **13,20,000/-**

Payback period = 1320000/660000= **2 years**

Boys Mess: One 200 Lts hot water requirement is assumed. Which will cost around Rs 70000/-

- Annual Consumption of electricity by mess geyser: 3000x8x200=**4800 KWH**
- Let with solar geyser electric geyser consumption is reduced by 90%

Annual saving by solar geyser will be = 4800X0.9=**4320 KWH i.e., Rs 36700/-**

Pay Back Period= 75000/36700= **2.04 yrs say 2 yrs**

Total saving =5,28,000+6,60,000+36,700=**12,24,700/-**

Total Investment =13,20,000+11,00,000+75,000=**24,95,000/-**

**It may please be noted that**

Hot water produced by the solar heating system during the day is stored in an insulated storage tank. The insulation of the tank is such that water should remain hot without significant drop in temperature for around 24 hrs. Thus, water heated during the previous day should be available for use in the next morning.

## *Computers*

Computers and monitors account for 30%-40% of the energy used by office equipment. Their energy consumption is second only to office lighting. It is estimated that a power managed computer consumes less than half the energy of a computer without power management.

There are 972 desk top computers and 11 laptops, and one server installed incampus. Apart from this there are 17 heavy duty printers and 23 normal printers.

Desktop on average consumes

Saving in this section cam be attained by following measures

### Replacing Desktop Computers by laptop:

A lot of it depends on the type of screen. A CRT (Cathode Ray Tube) screen consumes more than LCD (Liquid Crystal Display) screens. LCD screens can save up to 75% electricity over a CRT screen. A desktop also requires a UPS (Uninterruptible Power Supply) to keep it running during power loses which can eat significant amount of electricity. Laptops also have various other power management features. 70-80% of power consumption in a laptop is by CPU, and the rest of the components consume very less electricity. Laptops typically consume 20-50 Watts of electricity that can be trimmed down in power saver modes.

Desktop along with UPS normally consumes 200 W with CRT monitor and with LCD monitor it comes down to approx 100 W whereas Laptop power consumption is around 30 W.

If desktop is replaced with laptop, then assuming average use of 10 hrs for 300 days in a year saving calculations are as given below.

Power consumed by one desktop = 200x300x10/1000= **600 KWH**

Power consumed by laptop= 30x300x10/1000=**90 KWH**

Annual Saving by replacing one desktop = 600-90=**510 KWH**

If 20% i.e., 200 desktops are replaced every year then saving /year= 510x 200= **102000 units/year**

Yearly Saving in Rs =102000x8.5=**Rs 867000**

Monthly saving = 867000/12=**Rs 72250/-**

Cost of 200 laptops adjusting 10,000/salvage value of desktop=25000x200= **Rs 50,00,000/-**

So, payback period will be around 6 years.

However, it is recommended that whenever there is replacement / new purchase is required always go for Laptop.

Switching to a laptop may be a smart decision for someone who is concerned about how much energy a computer uses.

## By Replacing Monitors:

If replacing desktop by Laptops is not possible due to cost factor replace all CRT and LCD monitors by LED monitors. Power consumed by different type of monitors is follows.

| | |
|---|---|
| **Typical 17" CRT** | **80 Watts** |
| **Typical 17" LCD** | **35 Watts** |
| **Typical 19" LED** | **20 Watts** |
| **Sleeping Monitor** | **0-15 Watts** |
| **Monitor Turned OFF** | **0-10 Watts** |

## Other Measures:

Following measures by which considerable saving can be achieved.

1. Laptops are an additional 20 percent more power efficient when running on AC adapter power over battery power so always use laptops with AC adopter on.
2. On stand-by, the power consumption of both a desktop and a laptop computer falls to about a third.
3. Putting the monitor on stand-by reduces its consumption by 15%.
4. If the monitor is switched off completely, then of course it does not use power.
5. Switch off the loudspeakers if you are not using them.
6. Switch off the printer when it's not needed.
7. Switch off the screen if you are not working on the PC just now.
8. Switch off your computer or put it in stand-by mode if you are not going to work on your PC for more than 30 minutes. A multiple socket makes it easy to switch off all your computing equipment.
9. Switch off the modem at night.
10. One common misconception is that using a screensaver saves power, but this is not true

## *Air Conditioners*

As per reports available from Maintenance staff out of total 265 Nos 1.5T ACs 25 are serviceable and 11 are unserviceable. Most of ACs other than 36 Nos 3star are very old and needs replacement which will increase cooling efficiency as well as considerable saving in electricity consumption.

Calculations and payback period by replacing one w/o star AC is as given below. It has been assumed Ac running hours daily as 8 hrs and period from April to Sept around 200 days.

Electricity consumed by one AC in a year = 2500*8*200/1000= **4000 KWH**

Energy consumed if replaced by 3-star AC = 1500*8*200/1000= **2400 KWH**

Saving in Units = **1600 KWH**

Saving in Rs = 1600*8.5= **Rs 13600/-**

Cost of one 3 Star 1.5 T Ac= **27000/- for Window**

= **35000 for Split**

Payback period = **2 years for Window and 2.5 Years for Split AC**.

Keeping in view heavy capital involved in replacing all at a time following is recommended:

a. In first phase replace all repairable AC i.e., 36 Nos which will result in saving of 4.90 Lakhs in year. Even repairable AC should be replaced not repaired. Start replacement with criterion of oldest one first. Investment 10,80, 000/ assuming average cost @30000/-.
b. Out of balance 229-36= 193 Nos, 40 be replaced every year resulting in saving of Rs 5.44 Lakhs every yearwith investment of 12,00,000/-.

**Other Best Practices to save Energy in ACs:**

Apart from above following routine maintenance practices and checks should be enforced to get maximum efficiency of existing ACs by periodic checking.

1. Insulation of room should be properly maintained by keeping all doors/ windows of AC rooms and check for any broken window glasses / door closure malfunctioning to prevent cold air to go out and hot air to go in.
2. AC should be switched on only 15 min before actual use and switched off while going out.
3. Normal air conditioning temperature should be kept not less than 24 degrees present BEE mandate. By thumb rule, increase in 1degrees in indoor air temperatures can save 6% of electricity.
4. Room should have curtains on windows preferably dark colour.
5. If you are spending long hours in an air-conditioned room, try this tip. Keep it on for a couple of hours and then switch off for another one or two hours
6. Keep the ceiling/wall fan switched on when the AC is running. Together, they keep the room ventilated and circulate the cool air in all corners. Also, you will not have to keep decreasing the temperature.
7. All the dirt which gets accumulated in the ducts/filter and vents of the AC just make it work extra hard to ensure the cool air reaches your room. Regular cleaning of filters can lower an AC's energy consumption by 5-15 per cent! Plus, it saves the device from breaking down or in need of repair.

8. Most found defects leading to poor efficiency and consuming extra power are dirty air filters, thermostat not working, ice formation, water leakage, fan and swing not working. Ensure fort nightly checking of these points.

## *Other Low investment saving options:*

1. Providing Master Switch outside every room will make it very easy for a person to switch off all appliances if someone forgets to switch off few appliances of room while leaving. This will save a lot of energy.
2. Providing motion sensors in toilets has big energy saving potential. Motion sensor will automatically switch on lights when there is any movement and switch off when no movement for few minutes. Two to three motion sensors be installed in each toilet as per size. In view of very low price of motion sensors it is highly recommended.
3. Regular Cleaning of fiber sheet provided in roof shed of workshop/ labs be ensured and few more opening in shed be provided, which will save considerable electricity being spent on lighting.
4. Regular cleaning of fans and exhaust fan blades be ensured otherwise efficiency will be compromised.
5. Harnessing Solar Power for Energy source substitution: I have been told that 25 KW solar plant in process of installation. But in my view there is very huge scope for solar power in SRMGPC as quite big chunk of consumption is during day hour only. Though there is huge variation in monthly energy consumption over period under study let us take 60000 KVAH as monthly consumption and assuming 50% ie 30000 KVA is consumed during day hour. It will come as 1000 units per day.

For generating 1000 KWH per day 250 KW Solar plant is required. Cost benefit analysis of same is as follows:

Units generated per year (10 months) = 30000x10= **300000 KWH**

Saving due to generated units = 300000X8.5 =**Rs 25.5 Lakhs**

Monthly saving =**Rs 2.12 Lakhs**

Investment required @40000/KW =250x40000= **Rs 100 Lakhs**

Accelerated Depreciation for 1st year= **Rs 40 Lakhs**

Accelerated Depreciation for 2nd year= **Rs 24 Lakhs**

Saving due to generated units in 2 years= 25.5x2= **Rs 51 Lakhs**

Return in two years = 51+40+24= **Rs 115 Lakhs**

**Payback period is less than 2 years**

# Chapter 7

## Carbon Di-oxide Emission

In this Chapter we compute the CO2 emissions.

For consumption of 1 Unit (1 kWh) of Electricity, the CO2 emitted is 0.8 Kg. OR the Emission is0.8 Kg/kWh. In the following Table we present the total units consumed and CO2 emitted as under:

| Month | KVAH | Carbon Emission in Tons |
|---|---|---|
| Jun-19 | 144807 | 116 |
| Jul-19 | 85418 | 68 |
| Aug-19 | 92012 | 74 |
| Sep-19 | 146774 | 117 |
| Oct-19 | 128476 | 103 |
| Nov-19 | 88205 | 71 |
| Dec-19 | 61774 | 49 |
| Jan-20 | 60448 | 48 |
| Feb-20 | 60765 | 49 |
| Mar-20 | 60704 | 49 |
| Apr-20 | 37055 | 30 |
| May-20 | 25966 | 21 |
| Jun-20 | 35957 | 29 |
| Jul-20 | 68641 | 55 |
| Aug-20 | 58432 | 47 |
| Sep-20 | 41953 | 34 |
| Oct-20 | 59483 | 48 |
| Nov-20 | 48523 | 39 |
| Dec-20 | 28606 | 23 |
| Jan-21 | 29309 | 23 |
| Feb-21 | 32736 | 26 |
| Mar-21 | 40083 | 32 |
| Apr-21 | 52307.4 | 42 |
| May-21 | 22287 | 18 |

Table 8.1: CO2 Emission

# General Recommendations

In addition to the recommendations given above, a few more general ones are presented here. The savings due to their implementation could not be easily quantified, but their importance cannot be understated. Implementing all these measures will result in considerable saving without compromising much on the existing facilities and comforts.

- All Class Rooms, hostels, labs and common places to have Display Messages regarding optimum use of electrical appliances in the room like lights, fans, computers ,projectors etc.
- Most of the time, all the tube lights in a class room are kept ON, even though, there is sufficient light level near the window opening. In such cases, the light row near the window may be kept OFF.
- All appliances to be kept OFF or in idle mode if there will not be used for at least next one hour .
- All computers to have power saving settings to turn off monitors and hard discs, say after 10 minutes/30 minutes.
- The comfort air conditioning temperature to be set between 24˚C to 26˚C.
- Lights in toilet area may be kept OFF during day time
- Lighting • Photo sensors to be installed in central library to utilize optimum day lighting.
- street lights be fitted with day light sensors to minimize losses due to human error
- Split switching system to be adopted in inside corridors of Hostels and college building by clubbing alternate tube/ bulbs
- The heating load can also be reduced by reducing the consumption by other sources like lights, computers etc. and the occupancy needs to be considered. Explore the possibility of occupancy sensors.

# Chapter 9

# Way Forward:

## Energy Management Cell

In order to streamline the use of energy in the campus and to ensure its efficient utilization, it is proposed following three possible energy management structures. A final decision on the type of energy management structure suitable for the institute should be taken by the Institute management.

- I. Appointment of an Energy Manager for the institute, with suitable experience and a proven track record. The person shall be responsible for the day to day energy conservation activities. New staff should be allotted to the Energy Manager or some staff members from Electrical Maintenance Section be made responsible to him/her. An annual review of the energy performance of the institute is to be performed and a certain percentage of the quantified savings be shared with the Energy Manager.
- II. Maintenance Head (Electrical) should himself take over the responsibility of ensuring efficient energy use on the campus. This will ensure prompt implementation of measures. This system may also require additional staff. A performance related incentive in the form of a bonus can be provided to the Electrical Maintenance staff based on savings achieved.
- III. Formation of an Institute level committee headed by the Senior Professor to review the implementation of energy conservation measures. All departments and section heads should submit a bi-annual report of compliance for review and action. Sections/ departments not achieving savings to be penalized and suitable incentives may be given to the performing departments. An annual review of the implementation of the energy saving measures should be taken up and performance should be monitored. A report of the same should be sent to the Director.
- Electrical energy consumption should be made a subject in the Institute budget with separate heads for departments and hostels. Energy performance can be a basis for providing incentives to hostels and departments.

Apart from implementing suggestions as per financial investment availability it is also suggested to get detailed Energy Audit Conducted for identifying energy guzzling equipments.