

D.Y.PATIL
EDUCATION
SOCIETY,
KOLHAPUR

*(INSTITUTE DEEMED TO BE
UNIVERSITY)*

Detailed Energy & Electrical Safety Audit Report



TECHNOVILLE ENGINEERING
Kolhapur



Technoville Engineering

277, E-Ward, Near CSIBER Chowk, Kolhapur - 416008
Email - info@technovilleengineering.com
Website - www.technovilleengineering.com

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i. Acknowledgement

We are grateful to the management of D.Y. Patil Education Society (Institution Deemed to be University), Kolhapur (Client) for giving us an opportunity to contribute in their efforts towards efficient energy management by undertaking this Energy Audit exercise.

Technoville Engineering acknowledges with thanks the co-operation and support extended by management and operating personnel from client side during the audit exercise. Detailed discussions and interaction were held with facility personnel throughout the course of the audit and awareness of energy conservation was noted as exemplary. We would also like to place on record our sincere thanks and appreciation for all facility (engineering) executives.

We are also thankful to the other staff members who were actively involved while collecting the data and conducting the field studies. We take this opportunity to also thank all the team members at various departments associated with this study of energy audit for extending cooperation during collection of on-site data.

We trust that the findings of this study will help plant management in improving the equipment performance thereby giving optimum energy consumption at the premise.

ii. Energy Audit Team

| | |
|---|--|
| Technoville Engineering | Mr. Gaurav Ghewade (BEE Certified Energy Auditor) Mr. Ajay Toraskar (M.tech Energy Technology) Mr. Sunny Pangire (M.Tech Energy Technology) |
| D.Y. Patil Education Society (Institution Deemed to be University), Kolhapur | Mr. Raosaheb Patil – Chief Electrical Engineer Dr. V. V. Bhosle – Registrar Mr. Tejshil Ingale – Blood Bank Technician Dr. Sudhir Sase – Energy Audit Coordinator |

Date of Measurement 29th Dec, 2019

iii. Instruments

1. Power Quality Analyser
2. Ultrasonic Flow meter
3. Thermal Imager
4. Temperature – RH logger
5. Lux Meter
6. Power Clamp Meter
7. Measuring Tape

iv. Executive Summary

D.Y. Patil Education Society (Institution Deemed to be University), Kolhapur (Client) has decided to do detailed energy audit of their premise (6 facilities including colleges and hospital etc.) at different locations in Kolhapur city. Client has already implemented most of energy efficiency measure into their premises. Client is focusing and successful in reducing their energy demand.

Following are some energy saving and sustainability approach driven measures that are taken by college management.

1. Replacement of fluorescent lights with energy efficient LED lights.
2. Selection of Energy Efficient Equipment's (BEE 5 Star Labeled) whenever replacement of any equipment is to be done.
3. College is also maintaining energy consumption records of each section to track energy consumption of the premise.
4. Use of Solar energy for water heating purpose instead of electric geysers.
5. Use of Solar Photovoltaic system to generate own electricity using rooftop area available at the premise.

The action taken for energy conservation measures and use of renewable energy by the college management shows the sustainable approach towards energy use and environment friendly behaviour which is appreciable.

The major energy saving initiatives and associated CO₂ emission reduction achieved is summarised in table below.

| Sr. No. | Energy Saving / CO ₂ Emission Reduction Measures Implemented by College Management | Savings | | CO ₂ Emission Reduction For Year 2019 (kg of CO ₂) | CO ₂ Emission Reduction From Year 2016 to 2019 (kg of CO ₂) |
|--------------|---|-----------------|--------------|---|--|
| | | Electricity | Rs. Lakhs | | |
| | | (kWh) | | | |
| 1 | Use of LED Lights and replacement of existing fluorescent Lights (on failure) with LED lights | 2,52,000 | 40.32 | 2,06,640 | - |
| 2 | Use of Rooftop Solar Photovoltaic system for Energy Generation from Renewable source | - | 22.51 | 1,15,396 | 4,43,297 |
| 3 | Use of Solar Water Heaters for hot water generation | 83,721 | 13.39 | 68,651 | - |
| Total | | 3,35,721 | 76.22 | 3,90,687 | 4,43,297 |

**Unit Rate Considered as 16 Rs./kWh based on available data from billing history*

Although the college management is doing well in energy efficiency area further improvements can be done by the management for additional savings.

1. Use of aerators for water taps to reduce water and pumping energy consumption up to 15%.
2. Use of occupancy sensors for lights in Washroom area.
3. Fine tuning of Automatic Power Factor Correction system to improve PF to unity.

1 Introduction

1.1 General Description of Facility

Guided by well-defined, clearly articulated Vision, Mission and Goals the University offers contemporary & innovative programs through its Medical College, College of Nursing, School of Hospitality, College of Physiotherapy and the Centre for Interdisciplinary Research. Skill based employability-driven programs include DMLT, OT Technician Training Certificate, Dialysis Technician Certificate in addition to MBBS, MD/MS, Medical Fellowships, B.Sc. in Hospitality, B.Sc. PB. B.Sc. and M.Sc. Nursing, M.Sc. programs in Medical Physics, B.PTh, Stem Cell and Regenerative Medicine, Medical Biotechnology and Doctoral programs in Interdisciplinary and Medical subjects.

Organisational values of transparency, participative management and decentralisation are reflected in internal quality assurance efforts, modernisation of the examination system, regular meetings of the Heads of Department and various statutory and non-statutory bodies. University has introduced an Annual Quality Assurance Exercise attesting to the pursuit of quality in all aspects at all times. Feedback from different stakeholders is used to assess, improve and excel in performance. Through this efforts University has been re-accredited with 'A' grade in 2017 which is valid for the period of five years. The University was ranked in top 100 Universities in India in 2018 by NIRF.

An ISO: 9001-2015 certified, 800-bedded multispecialty Hospital provides academic, clinical training and a research platform. Free, rural medical camps and subsidized treatment ensure that primary to tertiary services are available to the poorest of the poor.

In keeping with global trends in higher education, University imparts to all students a globally relevant and locally applicable curriculum of international standards. Outcome and Skill based training is achieved through the Clinical Skill Labs, Cadaveric Skill Lab, an active Medical Education Training Unit, adoption of the latest pedagogy and assessment methods. Incorporation of research in both UG and PG programs, evidence-based teaching, interactive and case-based learning, early clinical exposure, industry-academia collaborations, remedial classes and emphasis on field and community-based visits ensure our graduates are competitive for both higher education and employment opportunities.

Go-Green initiatives include using LED lights, roof-top solar panels, biogas plants, sewage treatment plants, recycling of e-waste, biomedical and sewage waste, composting, tree plantations etc. in our campus, in addition to spreading awareness and education in the rural areas adopted. Twice in succession the campus has been shortlisted in the National Swachh Bharat competition for educational institutions.

Following is the list of institutes that have undergone this energy audit exercise.

1. D.Y. Patil Education Society (Institution Deemed to be University)
2. D.Y. Patil Medical College
3. Dr. D.Y. Patil Hospital & Research Institute
4. D.Y. Patil College of Nursing
5. D.Y. Patil College of Physiotherapy
6. D.Y. Patil School of Hospitality

1.2 Objectives

- To undertake an energy audit so as to identify areas for energy saving, both without and with investment.
- To prioritize distinct areas identified for energy savings depending upon saving potential, skills and time frame for execution, investment cost, paybacks etc.

1.3 Scope of Work

- To correlate monthly data of production with electricity, fuels & water consumption for a period of 12 months of normal operation to establish bench mark values for energy consumption.
- To study electrical energy metering, monitoring and control system existing at the plant and to recommend a suitable system for future monitoring.
- To study monthly power factor, maximum demand, working hours, load factor etc. for the reference period along with monthly electricity consumption and establish scope for MD control through possible optimization of load factor and through detailed load management study.
- Based on above, to evaluate the possibility of replacing major motors with energy efficient motors. To provide cost benefit analysis for the replacement policy.
- To study existing requirements of energy provisions at present locations and to identify distinct possibilities of rationalization / savings.
- To study existing maintenance practices for utility systems and recommend areas for improvement in energy efficiency / savings.
- To identify, evaluate and priorities energy saving opportunities into short, mid and long-term time spans depending upon investments, quantum of savings, skills and time required for implementation, etc.
- To prepare draft energy audit report, present to management, undertake necessary modifications based on presentation meeting and submit the final report.

1.4 Electricity Consumption

Client is receiving electricity supply from Maharashtra State Electricity Distribution Company Limited (MSEDCL). Following table represents bill analysis for last 12 months energy use for different colleges and buildings of the premise.

Table 1. Bill Analysis – D.Y. Patil Medical College

| Consumer No. 266519101556 | | | |
|----------------------------|--------------------|---------------|------------------|
| D.Y. Patil Medical College | | | |
| Month | Energy Consumption | Billed Demand | Bill Amount |
| | kWh | kVA | Rs. |
| Jan-19 | 16526 | 86 | 403978 |
| Feb-19 | 15638 | 86 | 384713 |
| Mar-19 | 20418 | 102 | 318123 |
| Apr-19 | 22918 | 111 | 361980 |
| May-19 | 23832 | 118 | 381375 |
| Jun-19 | 19470 | 89 | 310324 |
| Jul-19 | 16230 | 89 | 210425 |
| Aug-19 | 15332 | 89 | 234551 |
| Sep-19 | 17972 | 89 | 321031 |
| Oct-19 | 18866 | 89 | 299407 |
| Nov-19 | 20326 | 89 | 328857 |
| Dec-19 | 18814 | 89 | 307083 |
| Total | 226,342 | - | 3,861,847 |
| Average | 18,862 | 94 | 321,821 |

Energy consumption, billed demand & Bill Amount trends are represented in graphical format as below.

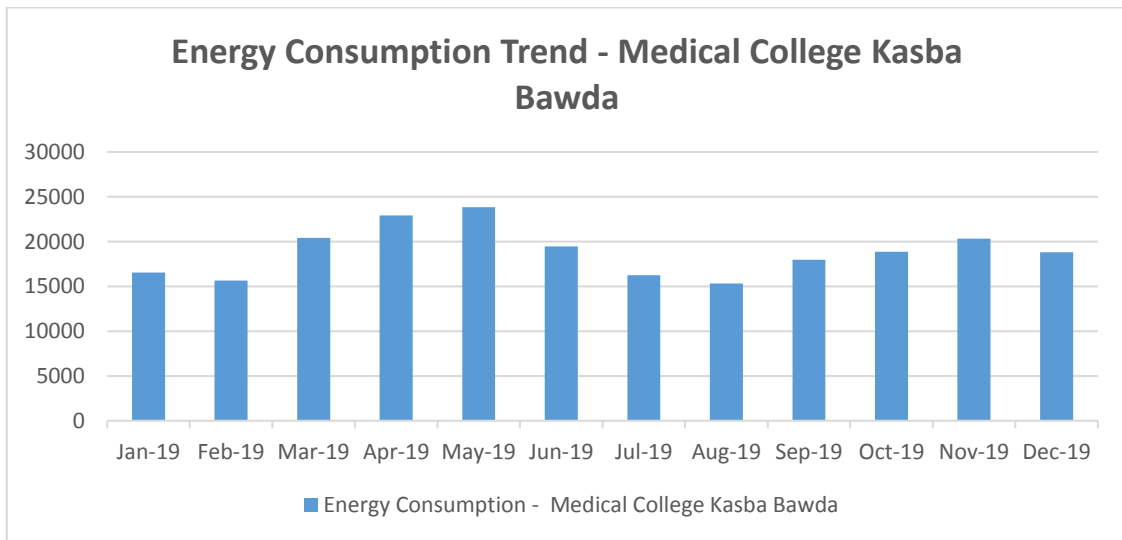


Figure 1. Energy Consumption Trend - D.Y. Patil Medical College

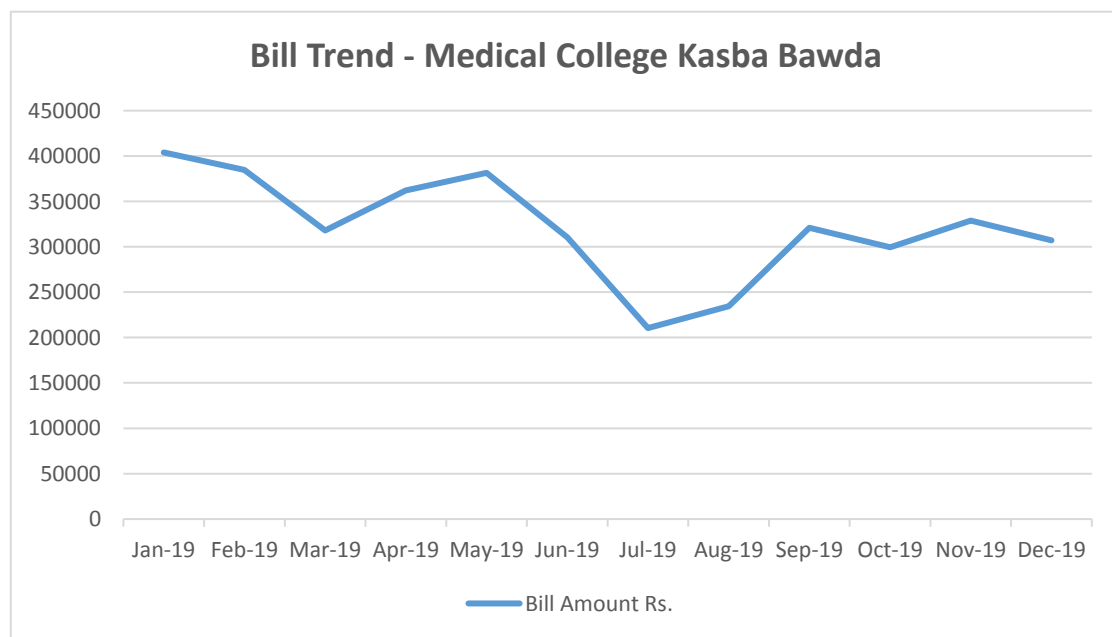


Figure 2. Bill Amount Trend - D.Y. Patil Medical College

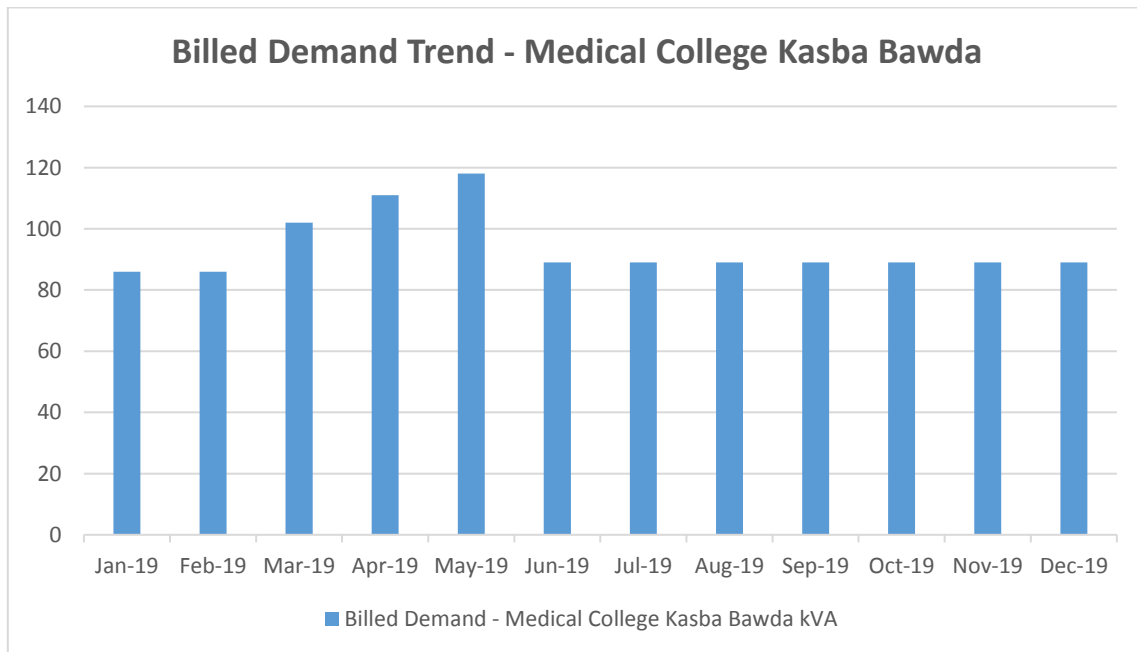


Figure 3. Billed Demand Trend - D.Y. Patil Medical College

Table 2. Bill Analysis – D.Y. Patil School of Hospitality

| Consumer No. 266511372861 | | | |
|----------------------------------|--------------------|---------------|----------------|
| D.Y. Patil School of Hospitality | | | |
| Month | Energy Consumption | Billed Demand | Bill Amount |
| | kWh | kVA | Rs. |
| Feb-19 | 712 | 13 | 15207 |
| Mar-19 | 1076 | 13 | 20703 |
| Apr-19 | 2330 | 13 | 38792 |
| May-19 | 1817 | 13 | 32077 |
| Jun-19 | 1379 | 13 | 25261 |
| Jul-19 | 1288 | 13 | 23281 |
| Aug-19 | 1638 | 13 | 27169 |
| Sep-19 | 1726 | 13 | 29121 |
| Oct-19 | 1967 | 13 | 32904 |
| Nov-19 | 1120 | 13 | 22236 |
| Dec-19 | 1487 | 13 | 27732 |
| Total | 16,540 | - | 294,483 |
| Average | 1,504 | 13 | 26,771 |

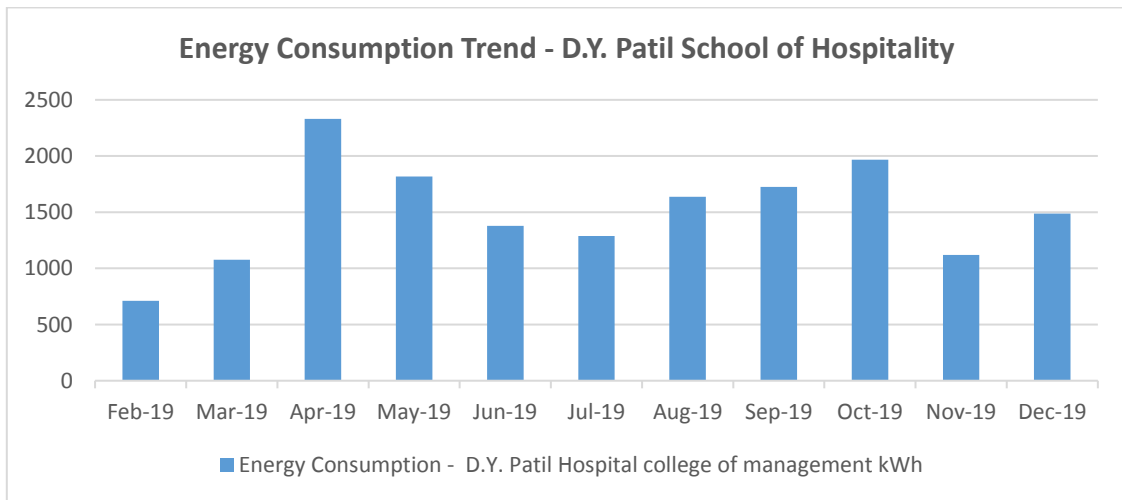


Figure 4. Energy Consumption Trend - D.Y. Patil School of Hospitality

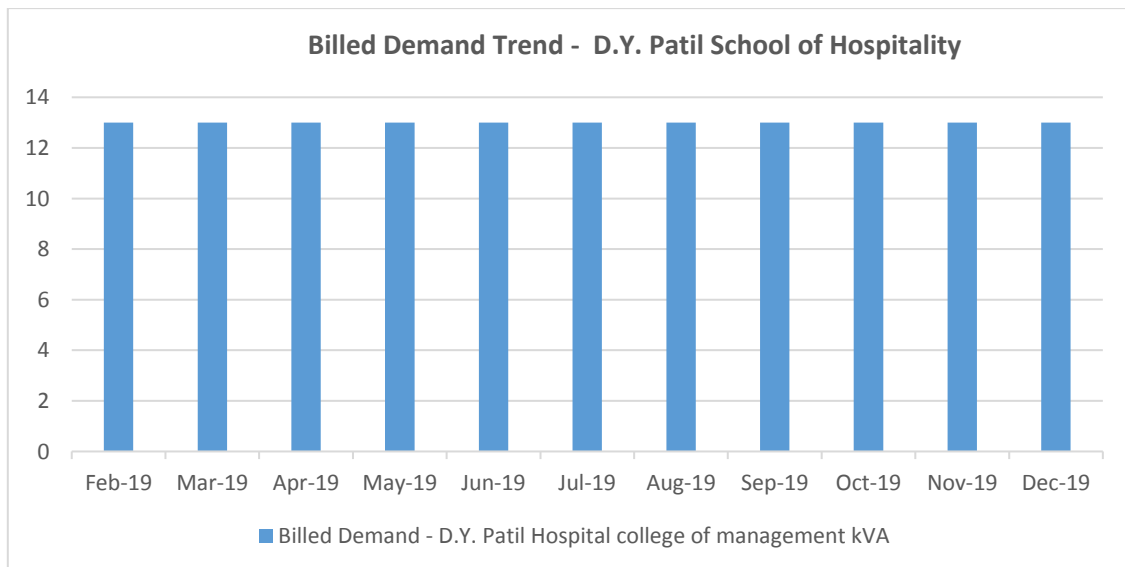


Figure 5. Billed Demand Trend - D.Y. Patil School of Hospitality

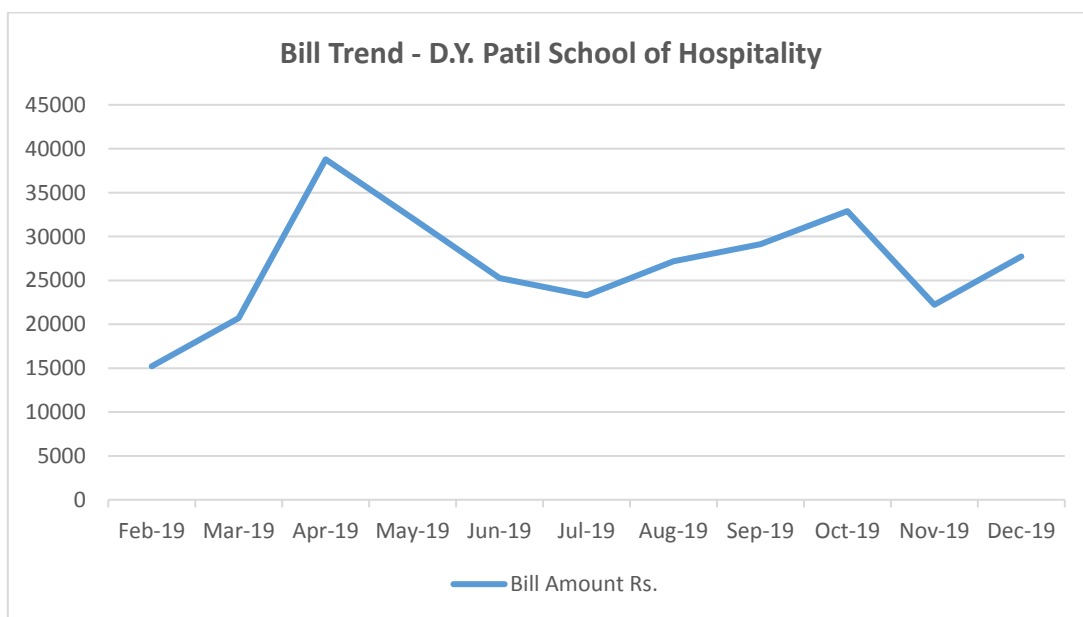


Figure 6. Bill Amount Trend - D.Y. Patil School of Hospitality

Table 3. Bill Analysis– D.Y. Patil Hospital, Nursing College, Physiotherapy College

| Consumer No. 266519005520 | | | |
|---|--------------------|---------------|-------------------|
| D.Y. Patil Hospital, Nursing College, Physiotherapy College | | | |
| Month | Energy Consumption | Billed Demand | Bill Amount |
| | kWh | kVA | Rs. |
| Jan-19 | 51678 | 185 | 1351731 |
| Feb-19 | 52412 | 185 | 1348400 |
| Mar-19 | 65444 | 185 | 965213 |
| Apr-19 | 71546 | 204 | 1072249 |
| May-19 | 82610 | 211 | 1230402 |
| Jun-19 | 73676 | 201 | 1097852 |
| Jul-19 | 66302 | 254 | 816982 |
| Aug-19 | 76810 | 242 | 1088101 |
| Sep-19 | 95925 | 350 | 1584362 |
| Oct-19 | 116400 | 350 | 1778585 |
| Nov-19 | 103680 | 350 | 1665670 |
| Dec-19 | 93415 | 350 | 1503491 |
| Total | 949,898 | - | 15,503,038 |
| Average | 79,158 | 256 | 1,291,920 |

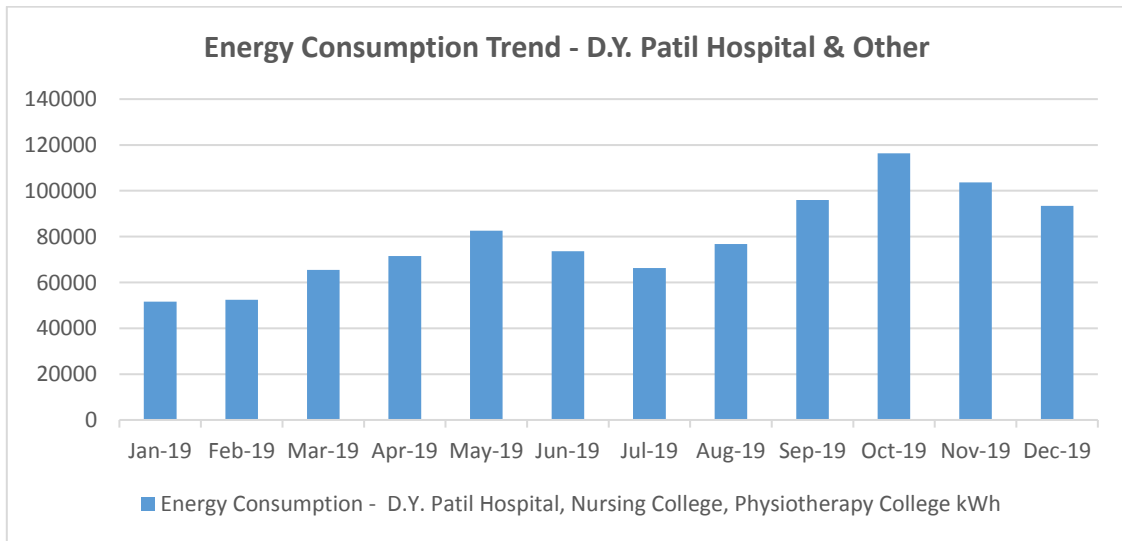


Figure 7. Energy Consumption Trend - D.Y. Patil Hospital, Nursing College, Physiotherapy College

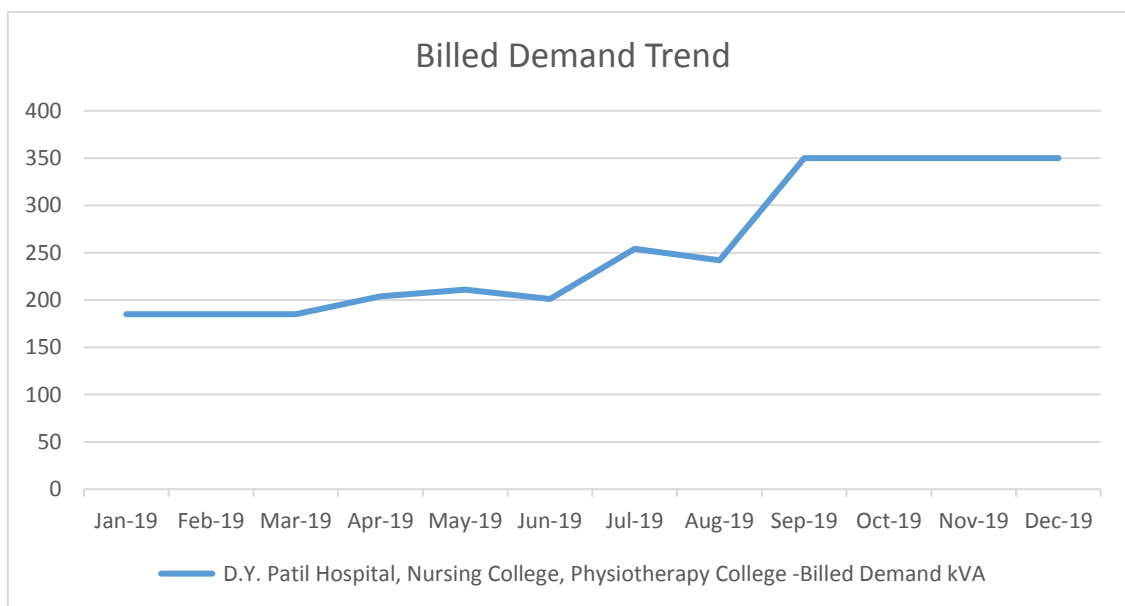


Figure 8. Bill Demand Trend - D.Y. Patil Hospital, Nursing College, Physiotherapy College

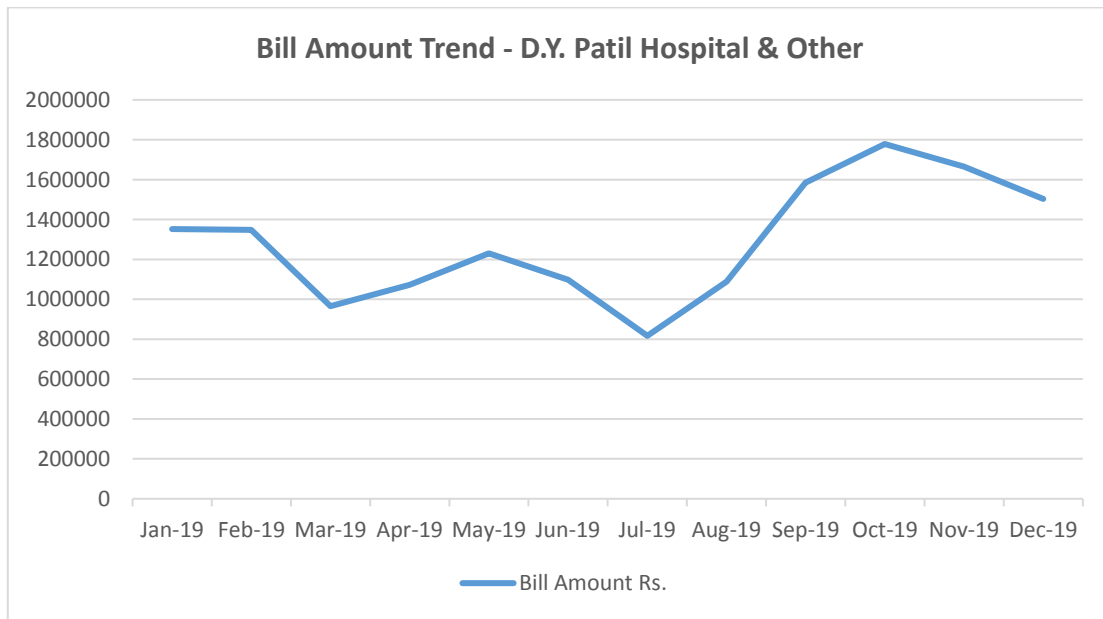


Figure 9. Bill Amount Trend - D.Y. Patil Hospital, Nursing College, Physiotherapy College

Table 4. Bill Analysis– Boys Hostel (Medical College)

| Consumer No. 266511515777 | |
|-------------------------------|--------------------|
| Boys Hostel (Medical College) | |
| Month | Energy Consumption |
| | kWh |
| Jan-19 | 2200 |
| Feb-19 | 2672 |
| Mar-19 | 2560 |
| Apr-19 | 3224 |
| May-19 | 3299 |
| Jun-19 | 3314 |
| Jul-19 | 2602 |
| Aug-19 | 1536 |
| Sep-19 | 2061 |
| Oct-19 | 1878 |
| Nov-19 | 1123 |
| Dec-19 | 1821 |
| Total | 28,290 |
| Average | 2,358 |

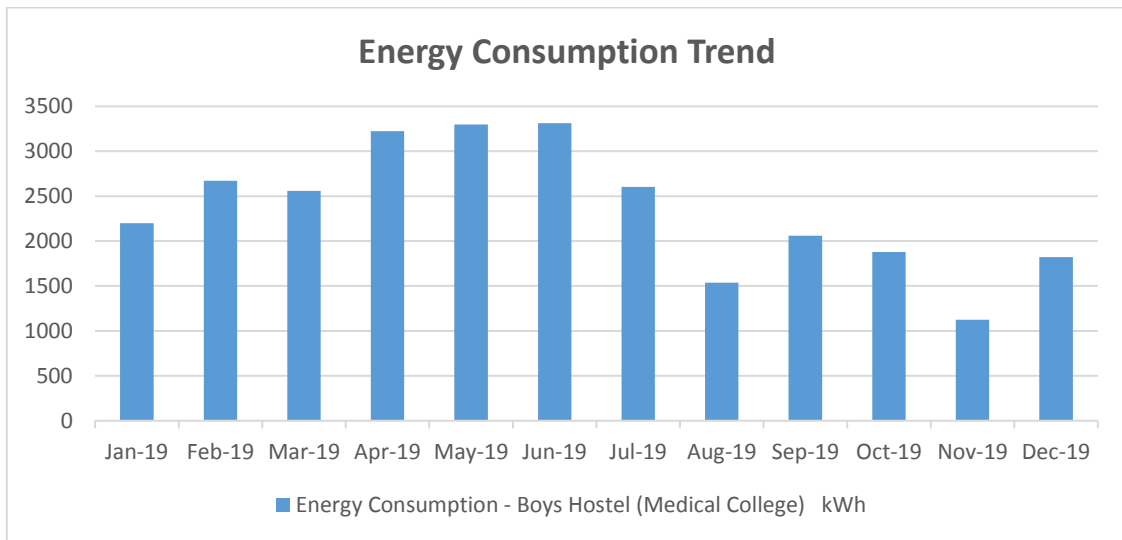


Figure 10. Energy Consumption Trend - Boys Hostel (Medical College)

Table 5. Bill Analysis – D.Y. Patil University - Girls Hostel

| Consumer No. 266511320275 | |
|--------------------------------------|--------------------|
| D.Y. Patil University - Girls Hostel | |
| Month | Energy Consumption |
| | kWh |
| Jan-19 | 4126 |
| Feb-19 | 4306 |
| Mar-19 | 4577 |
| Apr-19 | 5299 |
| May-19 | 6059 |
| Jun-19 | 5999 |
| Jul-19 | 5209 |
| Aug-19 | 3254 |
| Sep-19 | 5410 |
| Nov-19 | 4156 |
| Dec-19 | 4945 |
| Total | 53,340 |
| Average | 4,849 |

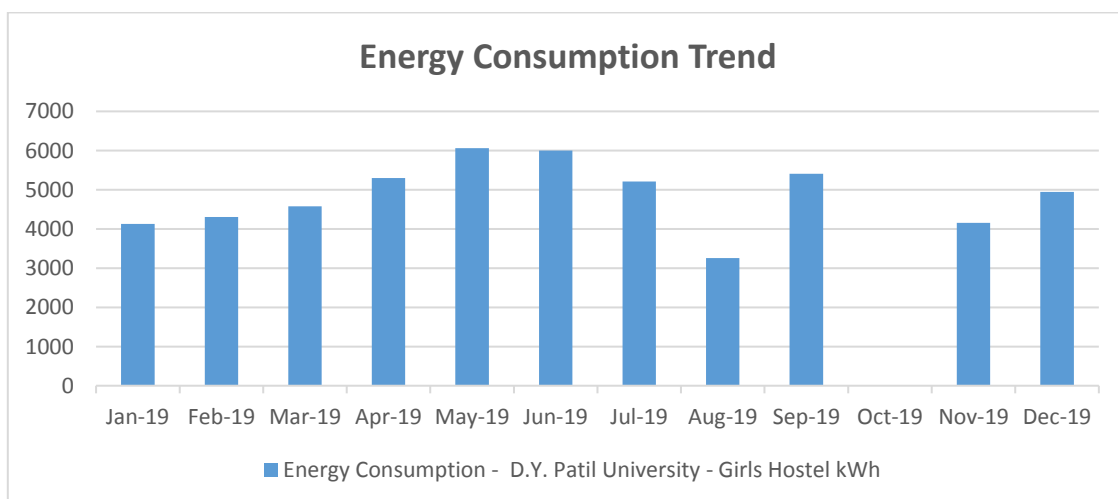


Figure 11. Energy Consumption Trend – D.Y. Patil University - Girls Hostel

1.5 Harmonics Study

Harmonic of a wave is the wave which has frequency as the positive integer multiple of the frequency of the original wave, known as the fundamental frequency.

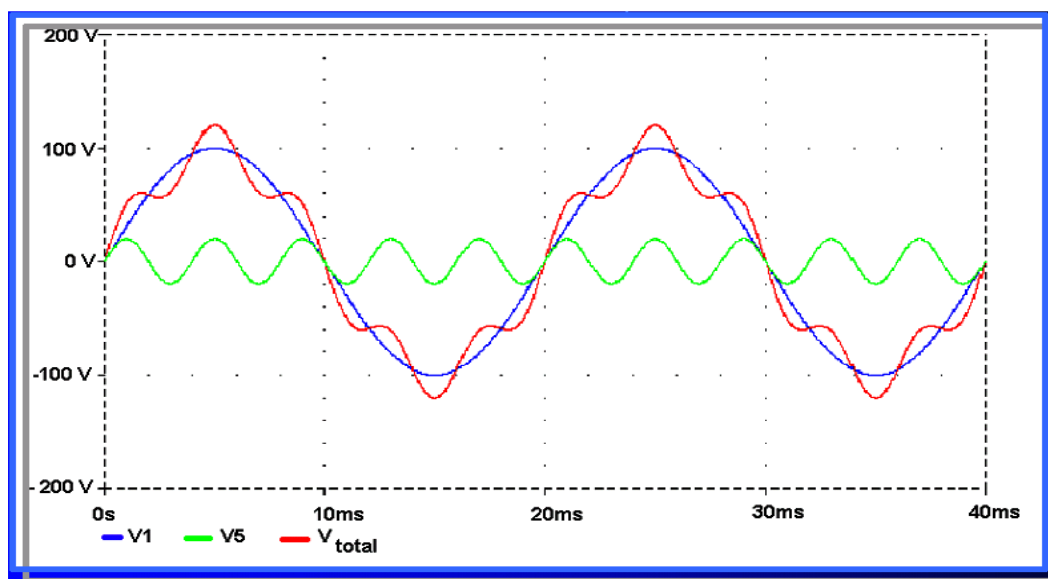
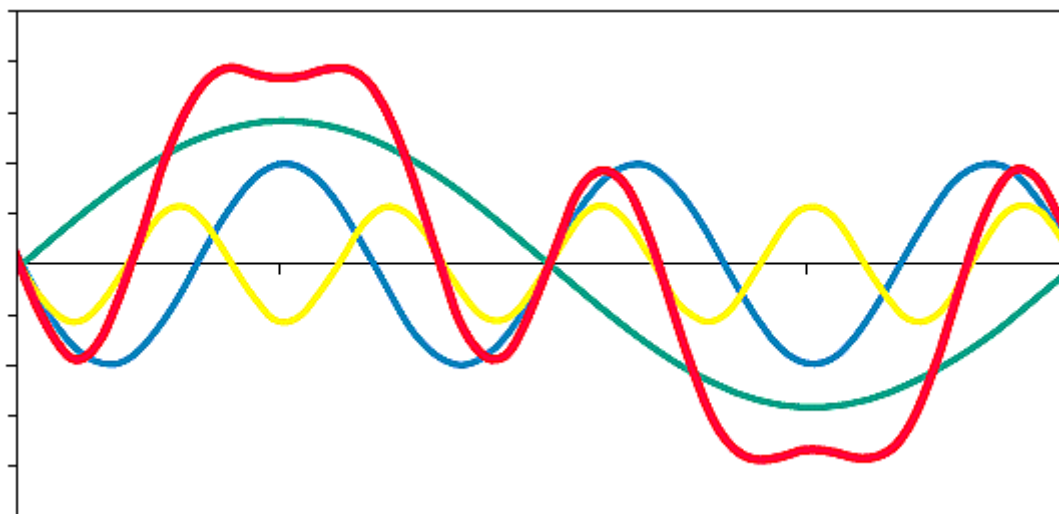


Figure12. Harmonics



V_1 – 1st Harmonic (Fundamental wave)

V_5 – 5th Harmonic

V_3 – 3rd harmonic

V total – Resultant Wave form

Figure13. Harmonics Generation

Electrical loads can be classified as linear and non-linear loads. A linear load is one, which draws a sinusoidal current when subjected to sinusoidal voltage. The current wave may or may not have a phase difference with respect to the voltage. A pure resistance, inductance or capacitance or any combination of these forms a linear load. On the contrary, a non-linear load is one, which draws non-sinusoidal or pulsating current when subjected to sinusoidal voltage.

Any non-sinusoidal current can be mathematically resolved into a series of sinusoidal components (Fourier series). The first component is called as fundamental and the remaining components whose frequencies are integral multiples of the fundamental frequency are known as harmonics. If the fundamental frequency is 50 Hz, then 2nd harmonic will have a frequency of 100Hz and the 3rd will have 150Hz and so on.

Non-linear loads that draw current in abrupt pulses rather than a smooth sinusoidal manner create harmonics. The pulses of current cause distorted current wave shape, which in turn cause harmonic currents to flow back into other parts of the power system.

1.5.1 Voltage Harmonics

Main reason for voltage harmonics is current harmonics. The voltage wave form from voltage source is distorted by the current harmonics due to source impedance. Larger the source impedance, higher will be the voltage harmonics caused by current harmonics. It is typically the case that voltage harmonics are indeed small compared to current harmonics. Thus, harmonic voltage can be defined as the product of harmonic current and source impedance at the harmonic frequency.

The source impedance includes the Impedance of the power source (Transformer, Generator, and Grid etc.), Impedance of the Bus bars, Cables, Switchgears and other loads in the network.

Following are some of the non-linear loads, which generate harmonics:

- ❖ Static power converters and rectification circuits, which are used in ups, battery chargers, etc.
- ❖ Arc furnaces
- ❖ Power electronics drivers for motor controls (AC/DC) drives.

- ❖ Computers
- ❖ Television receivers
- ❖ Saturated transformers
- ❖ Fluorescent lighting
- ❖ Telecommunication equipment's

1.5.2 Current Harmonics

In a normal alternating current power system, the current drawn by a linear load will be sinusoidal at the specified frequency. The current wave may or may not have a phase difference with respect to the voltage. Current harmonics are caused by non-linear loads which draw current that is not necessarily sinusoidal. The current wave form can be distorted and complex depending on the load and the interaction between other components of the system. Using Fourier series, the complex wave form can be resolved into simple sinusoidal waves of multiple frequency for analysis purpose.

Any non-sinusoidal current can be mathematically resolved into a series of sinusoidal components (Fourier series). The first component is called as fundamental and the remaining components whose frequencies are integral multiples of the fundamental frequency are known as harmonics. If the fundamental frequency is 50 Hz, then 2nd harmonic will have a frequency of 100Hz and the 3rd will have 150Hz and so on.

1.5.3 Limits of Harmonics

IEEE recommended practices and requirements for harmonic control in electrical power system: It represents a standard level of acceptable harmonic distortion in a power system.

Table 6. Harmonics Distortion Limits: – IEEE – 519C:2014

| | |
|----------------------|--|
| I_{sc} | Short Circuit current at the point of common coupling (PCC), under normal operating conditions |
| I_L | Fundamental full load current in Amps |
| H | Harmonic number |
| 11<h<17 | Limits of individual current at PCC |
| THD | Total harmonic distortions |

Table 7. Current distortion limits for systems rated 120 V to 69 kV – User's responsibility

| Maximum harmonic current distortion in percent of I_L | | | | | | |
|---|-----------------|------------------|------------------|------------------|------------------|-----|
| Individual harmonic order (odd harmonics) | | | | | | |
| I_{sc}/I_L | $3 \leq h < 11$ | $11 \leq h < 17$ | $17 \leq h < 23$ | $23 \leq h < 35$ | $35 \leq h < 50$ | TDD |
| <20* | 4.0 | 2.0 | 1.5 | 0.6 | 0.3 | 5.0 |
| 20<50 | 7.0 | 3.5 | 2.5 | 1.0 | 0.5 | 8.0 |
| 50<100 | 10.0 | 4.5 | 4.0 | 1.5 | 0.7 | 12 |
| 100<1000 | 12.0 | 5.5 | 5.0 | 2.0 | 1.0 | 15 |
| >1000 | 15.0 | 7.0 | 6.0 | 2.5 | 1.4 | 20 |

*All power generation equipment is limited those values regardless their I_{sc}/I_L .

- Odd harmonics are represented as % of fundamental at PCC

- Even harmonics are limited to 25% of odd harmonic's limits.

2 Load List for the College Premises

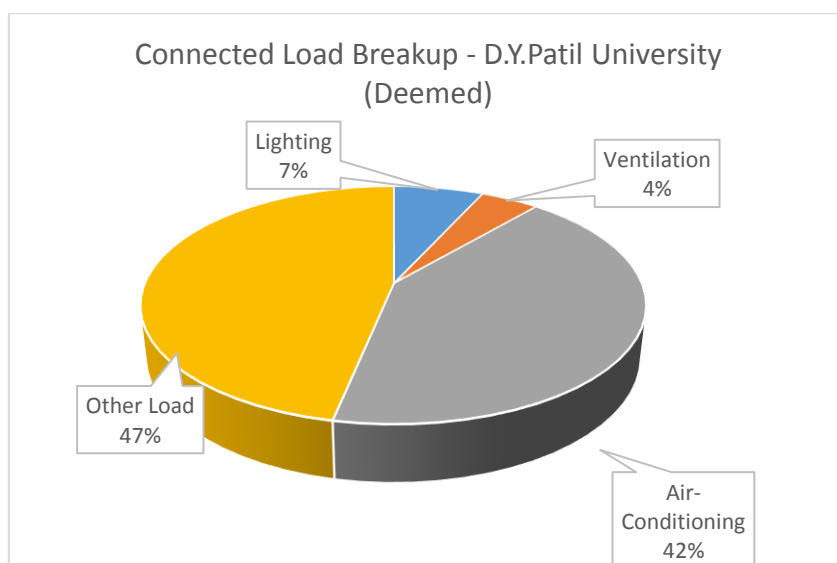
Following is the list of equipment's or utilities available in the different college premises.

1. D.Y. Patil Education Society (Institution Deemed to be University)

Following table represents load distribution of the premise and other load includes lab instruments, computers, Printers, pumping, heaters etc.

Table 8. Connected Load Breakup - D.Y. Patil University (Institution Deemed to be University)

| Connected Load | D.Y. Patil University (Institution Deemed to be University) kW |
|------------------|---|
| Lighting | 15 |
| Ventilation | 9.8 |
| Air-Conditioning | 92.4 |
| Other Load | 103 |



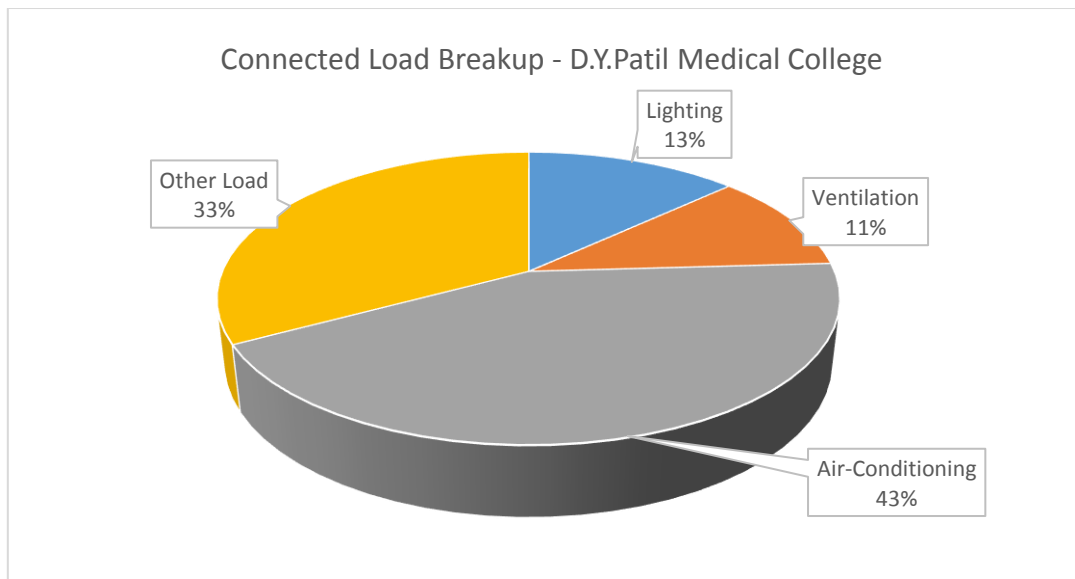
Pie Chart 1 : Connected Load Breakup - D.Y. Patil University (Institution Deemed to be University)

2. D.Y. Patil Medical College

Following table represents load distribution of the premise and other load includes lab instruments, computers, Printers, pumping, heaters etc.

Table 9. Connected Load Breakup - D.Y. Patil Medical College

| Connected Load | D.Y. Patil Medical College kW |
|------------------|----------------------------------|
| Lighting | 48.20 |
| Ventilation | 40.22 |
| Air-Conditioning | 158 |
| Other Load | 120.58 |



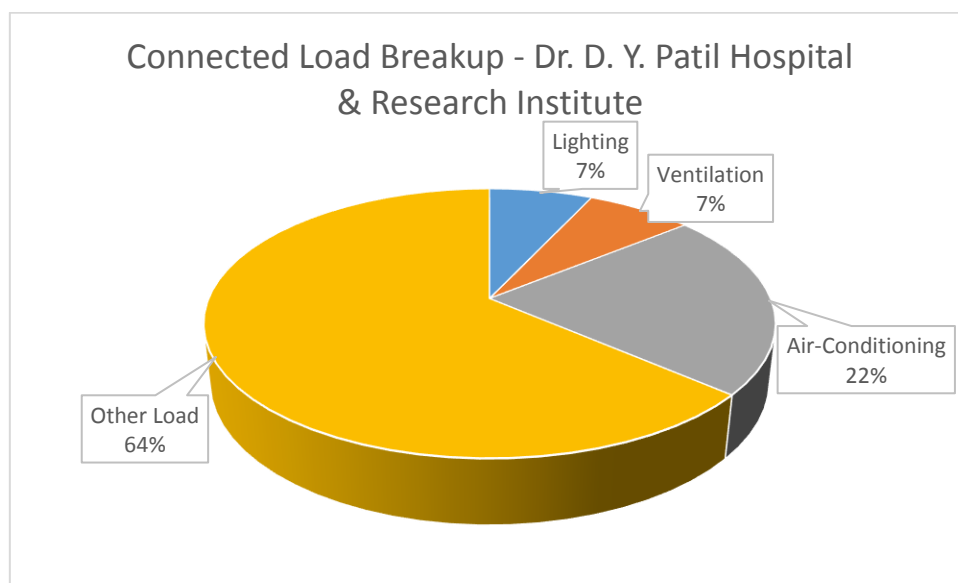
Pie Chart 2 : Connected Load Breakup - D.Y. Patil Medical College

3. Dr. D.Y. Patil Hospital & Research Institute

Following table represents load distribution of the premise and other load includes lab instruments, computers, Printers, pumping, heaters etc.

Table 10. Connected Load Breakup - Dr. D. Y. Patil Hospital & Research Institute

| Connected Load | D. Y. Patil Hospital & Research Institute kW |
|------------------|---|
| Lighting | 57.80 |
| Ventilation | 59.60 |
| Air-Conditioning | 184 |
| Other Load | 528.60 |



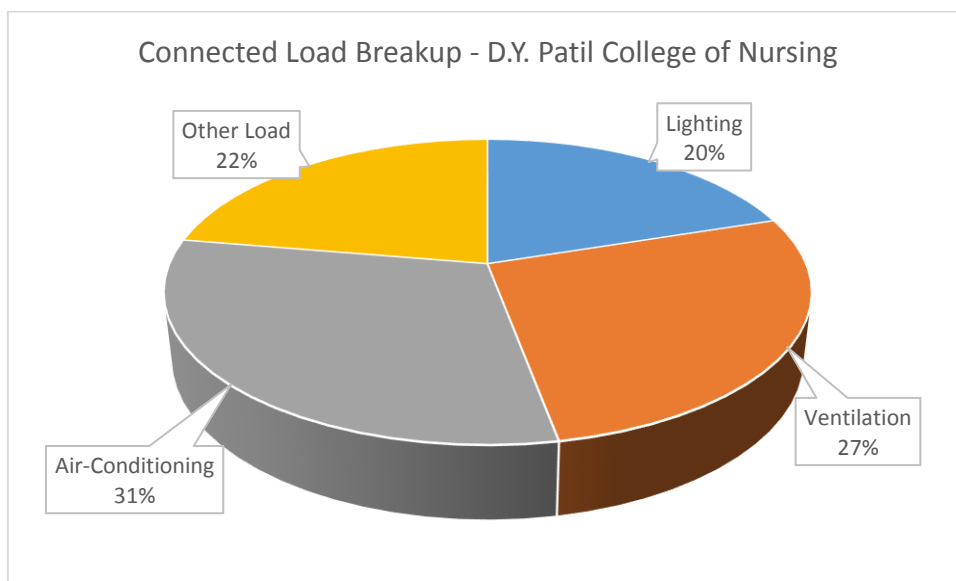
Pie Chart 3 : Connected Load Breakup - Dr. D. Y. Patil Hospital & Research Institute

4. D.Y. Patil College of Nursing

Following table represents load distribution of the premise and other load includes lab instruments, computers, Printers, pumping, heaters etc.

Table 11. Connected Load Breakup - D.Y. Patil College of Nursing

| Connected Load | D.Y. Patil College of Nursing kW |
|------------------|-------------------------------------|
| Lighting | 3.40 |
| Ventilation | 4.60 |
| Air-Conditioning | 5.20 |
| Other Load | 3.80 |



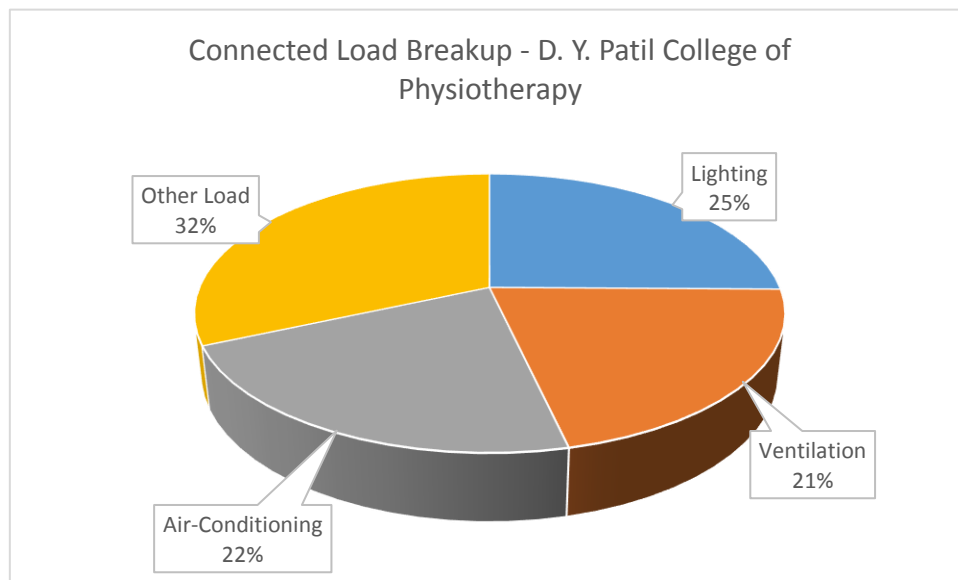
Pie Chart 4 : Connected Load Breakup - D.Y. Patil College of Nursing

5. D.Y. Patil College of Physiotherapy

Following table represents load distribution of the premise and other load includes lab instruments, computers, Printers, pumping, heaters etc.

Table 12. Connected Load Breakup - D. Y. Patil College of Physiotherapy

| Connected Load | D. Y. Patil College of Physiotherapy kW |
|------------------|--|
| Lighting | 6.3 |
| Ventilation | 5.3 |
| Air-Conditioning | 5.5 |
| Other Load | 7.9 |



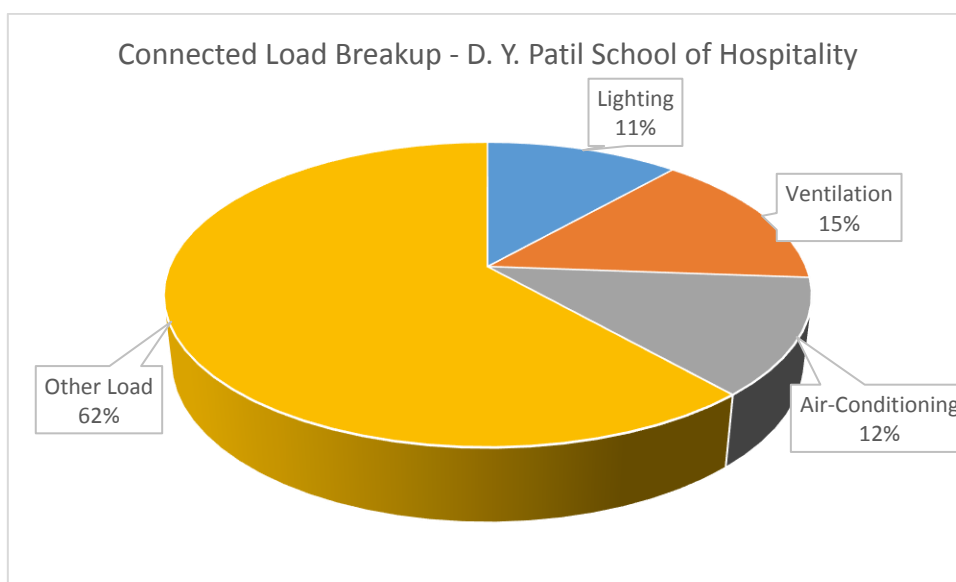
Pie Chart 5 : Connected Load Breakup -D. Y. Patil College of Physiotherapy

6. D.Y. Patil School of Hospitality

Following table represents load distribution of the premise and other load includes lab instruments, computers, Printers, pumping, heaters etc.

Table 13. Connected Load Breakup -D. Y. Patil School of Hospitality

| Connected Load | D. Y. Patil School of Hospitality kW |
|------------------|---|
| Lighting | 4.5 |
| Ventilation | 5.7 |
| Air-Conditioning | 4.8 |
| Other Load | 24 |



Pie Chart 6 : Connected Load Breakup - D. Y. Patil School of Hospitality



3 Energy & Sustainability Measures

3.1 Sustainability Measures already implemented

3.1.1 Use of Energy from Rooftop Solar Photovoltaics Plant

Management of D.Y. Patil Education Society is keen on implementation of sustainability measures into their premises. Client is using solar energy for electricity generation as well as for hot water generation which is sustainability measure resulting into reduction in carbon footprint of the institution.

Following is the details of electricity generation from solar Photovoltaics system installed in the premise and equivalent reduction in CO₂ emission by the institution.

Table 14. CO₂ Emission Reduction With use of Energy from Renewable energy source – Solar PV system

| Solar Energy Generation & Associated CO ₂ Emission Reduction Details | | |
|--|------|---------------------------------------|
| Plant Capacity | | 100 kW |
| Commissioning Date | | 19th April 2016 |
| Total Area Covered with solar photovoltaics system (Approx.) | | 1000 m ² |
| Sr. No | Year | Units Generation KWh |
| 1 | 2016 | 98,029 |
| 2 | 2017 | 1,53,288 |
| 3 | 2018 | 1,48,563 |
| 4 | 2019 | 1,40,727 |
| Total Unit Generation (kWh) | | 5,40,607 |
| MSEDCL Landing Rate in Rs. | | 16 |
| Saving Amount in Rs. | | 86,49,712 |
| CO₂ Emission Factor for Indian Grid (Weighted average emission factor of the Indian Grid for FY 2017-18 (adjusted for cross-border electricity transfers)) | | 0.82 ton of CO₂/MWh |
| CO₂ Emission Reduction Equivalent to total units generated in 2019 | | 1,15,396 kg CO₂ |
| CO₂ Emission Reduction Equivalent to total units generated till date | | 4,43,297 kg CO₂ |

3.1.2 Use of LED Lights & Replacement of Existing Fluorescent lights with LED lights

Nearly 60 to 65% of Fluorescent lights have been replaced with LED Lights. All the facilities under client management have decided to use star labelled energy efficient products as per BEE guidelines. Following is the detailed quantification of energy savings achieved with use of LED lights instead of fluorescent lights; table also includes CO₂ emission reductions achieved with this initiative.

Table 15. Energy Savings & Associated CO₂ Emission Reduction Details – Use of LED lights for the year 2019

| Energy Savings & Associated CO ₂ Emission Reduction Details – Use of LED lights for the year 2019 | | | |
|--|---|----------|---------------------------------------|
| LED Lighting load (kW) | | | 84 |
| LED Lighting Percentage (%) | | | 62% |
| Sr. No. | Description | Unit | Values |
| 1 | Total Lighting Load | kW | 135.2 |
| 2 | Operating Hours | hrs./Day | 10 |
| 3 | Days of Operation per annum | Days | 300 |
| 4 | Annual Energy Consumption with use of LED | kWh | 405600 |
| 5 | Total Lighting Load with use of 100% Fluorescent lights | kW | 219.2 |
| 6 | Energy Consumption with use of 100% Fluorescent lights | kWh | 657600 |
| 7 | Energy Savings achieved with use of LED lights | kWh | 252000 |
| Total Energy Savings achieved in year 2019 | | | 2,52,000 kWh |
| CO₂ Emission Factor for Indian Grid <i>(Weighted average emission factor of the Indian Grid for FY 2017-18)</i> | | | 0.82 ton of CO₂/MWh |
| CO₂ Emission Reduction Equivalent to total Energy Savings in year 2019 | | | 2,06,640 kg of CO₂ |

3.1.3 Use of Solar Water Heaters instead of Electric Geysers

Client is using solar water heaters to cater hot water needs of the premise. Installed capacity of the solar water heating system is 12,000 liter per day. Energy savings & Associated CO₂ Emission Reduction achieved with use of solar water heater instead of electric geysers is quantifies and shown in table below.

Table 16. Energy Savings & Associated CO₂ Emission Reduction Details - Use of Solar Water Heaters

| Energy Savings & Associated CO ₂ Emission Reduction Details - Use of Solar Water Heaters | | | |
|--|---|------------|---------------------------------------|
| Sr. No. | Description | Unit | Values |
| 1 | Total Plant Capacity | Liter /day | 12000 |
| 2 | Annual Average Hot water generation temperature | °C | 47 |
| 3 | Energy required for hot water generation (@47 °C) per day | kWh | 279 |
| 4 | Days of Operation per annum | Days | 300 |
| 5 | Annual Energy Savings | kWh | 83721 |
| Total Energy Savings achieved in year 2019 | | | 83,721 kWh |
| CO₂ Emission Factor for Indian Grid <i>(Weighted average emission factor of the Indian Grid for FY 2017-18)</i> | | | 0.82 ton of CO₂/MWh |
| CO₂ Emission Reduction Equivalent to total Energy Savings in year 2019 | | | 68,651 kg of CO₂ |

3.2 Other energy saving measures & cost saving measures

Although the college management is doing well in energy efficiency area further improvements can be done by the management for additional savings.

1. Use of aerators for water taps to reduce water and pumping energy consumption upto 15%.
2. Use of occupancy sensors for lights in Washroom area.
3. Fine tuning of Automatic Power Factor Correction system to improve PF to unity.

4 Electrical Safety Aspects

Electrical safety assessment is done based on relevant CEA regulations, IEEE, IEC and IS standards. The activities coming under the electrical safety audit is given below.

- Visual inspection of electrical panels and installation.
- Verification of earthing system and lightning protection system.
- Verification of statutory compliance with CEA.
- Physical inspection to electrical hazards and suggesting electrical safety solutions.

Based on the observations, discussions with various staff, the safety aspects considered are

1. Electrical statutory compliances
2. Lightning protection
3. Overloading
4. Preventive maintenance
5. Electrical protection

A Review based on above safety aspects is represented below.

Table 17. Electrical Safety Aspects - Review

| SR. No. | Assessment Check Point | Answer | Answer and Remarks |
|---|---|------------------------------|--------------------|
| Statutory Clearances and Compliances | | | |
| 1 | Danger Sign board available at "point of commencement of supply of electricity? i.e Near Main MCCB after electricity meter | Compliance/Non Compliance/Na | Compliance |
| 2 | Single line diagram of the electrical system available? | Compliance/Non Compliance/Na | Compliance |
| 3 | CO2 Type Fire extinguisher available near Main Electrical panel? | Compliance/Non Compliance/Na | Compliance |
| 4 | Shock Restoration chart pasted near Main Electrical panel? | Compliance/Non Compliance/Na | Compliance |
| 5 | Electrical panels are efficiently earthed? | Compliance/Non Compliance/Na | Compliance |
| 6 | Does the ISI marked Electrical insulated rubber mats conforming to IS 15652 provided before electrical panel? | Compliance/Non Compliance/Na | Compliance |
| 7 | Main Switch (MCCB, MCB) to cut off entire Power supply is marked labelled? | Compliance/Non Compliance/Na | Compliance |

| SR. No. | Assessment Check Point | Answer | Answer and Remarks |
|---|--|------------------------------|---|
| 8 | Electricity Meter is enclosed properly? | Compliance/Non Compliance/Na | Compliance |
| 9 | No material is stored near the electrical meter or electrical panels? | Compliance/Non Compliance/Na | Compliance |
| 10 | There is No opening or Holes in the Panels/DB's | Compliance/Non Compliance/Na | Compliance |
| Electricity Bill Analysis & Load Calculation | | | |
| 1 | Copy of Electricity Bill of last 1 year available for analysis? | Yes/No/NA | Yes |
| 2 | Copy of 1 year electrical bills? | | Received |
| Earthing System as per IS 3043 | | | |
| 1 | Earth Pits are available? | Compliance/Non Compliance/Na | Compliance |
| 2 | All earth pits are provided by suitable inspection housing and removable Lid/Cover? | Compliance/Non Compliance/Na | Compliance Lids are jammed with surrounding material overlapped on it. |
| 3 | Serial Numbers are marked on all earth pits? | Compliance/Non Compliance/Na | Compliance |
| 4 | Last Date of earth resistance test, due date and obtained values in OHM are displayed on each earth pit? | Compliance/Non Compliance/Na | Compliance |
| 5 | All earth strips /conductors are protected against damage, corrosion, and vibration? | Compliance/Non Compliance/Na | Compliance |
| 6 | Whether the down-conductor/earth rod termination are visible and accessible for physical inspection and testing purpose? | Compliance/Non Compliance/Na | Compliance |
| 7 | Is there any drawing showing the main earth connection and earth electrodes for each installation? | Compliance/Non Compliance/Na | Compliance |
| 8 | Annual Earth Resistance test record is available? | Compliance/Non Compliance/Na | Compliance |
| Electrical Distribution Network and Protection devices | | | |
| 1 | MCB's installed for controlling Air conditioners, Heaters and any other heavy electrical equipment's? | Compliance/Non Compliance/Na | Compliance |

| SR. No. | Assessment Check Point | Answer | Answer and Remarks |
|--|--|------------------------------|--|
| 2 | ELCB/RCCB of 30 mA installed in all Distribution boards for Human protection against Electric shocks? | Compliance/Non Compliance/Na | Compliance |
| 3 | Distribution Panels of Air conditioning units are provided with Earthing? | Compliance/Non Compliance/Na | Compliance |
| 4 | Does the ISI marked Electrical insulated rubber mats conforming to IS 15652 provided before electrical panel? | Compliance/Non Compliance/Na | Non Compliance |
| 5 | Cable Glands are used in electrical panels, Distribution boards? | Compliance/Non Compliance/Na | Compliance |
| 6 | Cables are laid smoothly using suitable clamps along wall or in cable trays. There is no sharp bend? | Compliance/Non Compliance/Na | Compliance |
| 7 | Are all Electrical Panel are free of dust and cob web? | Compliance/Non Compliance/Na | Compliance |
| 8 | Lugs are used for wire termination in the MCB in distribution boards? | Compliance/Non Compliance/Na | Compliance |
| 9 | Electrical panel is closed properly and no openings? | Compliance/Non Compliance/Na | Compliance |
| 10 | No temporary electrical connection existing? | Compliance/Non Compliance/Na | Compliance |
| 11 | IF any false ceiling, then wires are laid in conduits and wires are connected with light fixtures, Fans etc using wire connectors? | Compliance/Non Compliance/Na | Compliance |
| Power Backup System- UPS & DG | | | |
| 1 | UPS inspection and Testing records available? | Yes/No/NA | No (Preventive Maintenance Service report available) |
| 2 | Turn Off the main supply and check UPS can take load? | Yes/No/NA | No provision to do so |
| 3 | UPS and UPS distribution boards are body earthed? | Yes/No/NA | Yes |
| 4 | Body earth provided for metal Battery rack? | Yes/No/NA | Yes |
| 5 | CO2 or clean agent Fire extinguisher available outside UPS/Battery room? | Yes/No/NA | Yes |

| SR. No. | Assessment Check Point | Answer | Answer and Remarks |
|--------------------------|--|------------------------------|--------------------|
| 6 | DG set Maintenance records available? | Yes/No/NA | Yes |
| 7 | DG set has separate Earth Pit For Body and Neutral? | Yes/No/NA | Yes |
| 8 | CO2 Fire extinguisher provided near DG set? | Yes/No/NA | Yes |
| Lighting Arrester | | | |
| 1 | Is there any sharp bend or loops in down conductor? | Compliance/Non Compliance/Na | Compliance |
| 2 | Whether routing of down conductor is direct as far as practical? | Compliance/Non Compliance/Na | Compliance |
| 3 | Check Whether Down conductor is not passing through enclosed shafts or enclosed structure? | Compliance/Non Compliance/Na | Compliance |
| 4 | There are no parts damaged by corrosion? | Compliance/Non Compliance/Na | Compliance |
| 5 | Down conductors are fastened properly on the insulators? | Compliance/Non Compliance/Na | Compliance |
| 6 | Down conductors are jointed at different intervals using bolts? (Any joint other than welded represents a discontinuity in the current conducting system and is susceptible to variation and failure.) | Compliance/Non Compliance/Na | Compliance |
| Compound Area | | | |
| 1 | Lighting Poles, High masts are connected with body earth? | Compliance/Non Compliance/Na | Compliance |
| 2 | Electrical wire, cables if laid along boundary wall are laid in conduits or in concealed manner? | Compliance/Non Compliance/Na | Compliance |
| 3 | Earth pits are not getting damaged by vehicles? | Compliance/Non Compliance/Na | Compliance |
| 4 | There is no Temporary wiring/joints in compound area walls/lawns etc. for lighting etc. | Compliance/Non Compliance/Na | Compliance |

For Technoville Engineering,



Swapnil Narayan Lotake
BEE Certified Energy Auditor
EA No. – 34316

