

ENERGY AUDIT WITH EFFICIENCY RECOMMENDATION ON DENTAL CLINIC

Utkarash Khare¹, Kushal Singh Nagra², Shubham Patel³, Shubham Paswan⁴, Shekhar Shinde⁵

^{1,2,3,4}Students, Mechanical Engineering Department, Bharti Vidyapeeth (Deemed to be university), College of engineering, Pune

⁵Asst. Professor, Mechanical Engineering Department, Bharti Vidyapeeth (Deemed to be university), College of engineering, Pune

Abstract - This paper form parts of a series of papers which have been requested by a number of colleagues to help them understand sustainability as it relates to dentistry. This paper focuses on energy and how the dental team can influence the amount and type of energy it uses, in order to become more sustainable. It is the author's hope that this paper stimulates interest, debate and discussion that, as well as being motivates and inspires dental practices to be more socially and environmentally sustainable, which will in turn help promote health and illness prevention. Energy management and audit aware people about the consumption of electricity as it save energy as well as money. Audit report encourages implementation and to use efficient energy. Efficient management of energy creates a good source of energy for consumers. The main purpose of energy audit is to increase the energy efficiency and energy cost saving.

Key Words: Energy management, Audit Report, Efficient energy, Sustainable

1. INTRODUCTION

Energy play a vital role for the economic development of any country. In case of developing countries have a large investment for increasing energy needs. The goal of energy management is to provide energy at low cost and more eco-friendly which fulfil the need of consumers.

It is seen that many countries dental hospital have large consumption of energy. For saving energy the energy audit was conducted. It is seen that private hospitals have large electric consumption than that of private. For the reduction of electricity we use new gadgets with new technologies instead of an old once, thus energy efficiency increases.

Buildings energy use makes up 15% of the carbon footprints of primary dental care. As well as contribution to green house gas emission, energy generation from fossil fuels is a significant source of air pollution, which in turn is responsible for 40,000 premature death year in UK.

Reducing energy consumption and investing in renewable electricity generation after significant environmental health and cost benefits for dental practices.

There are a number of ways practices can reduce both their costs and carbon emission associated with energy. This paper will focus on the following element.

This paper will focus on the following element -

- 1) Buying green energy.
- 2) Generating their practice's own energy.
- 3) Evaluating how the practice heats its building and water using space more effectively.

Whether your dental office is up and coming or already established, the utilization of more energy efficiently process and equipment is a great step towards eco - dentistry.

From eco friendly building materials to designing your practice to capture more natural light, there are a number of ways to reduce your carbon footprint and still provide super care to patients.

There are a number of ways practices can reduce both their costs and carbon emission associated with energy. This paper will focus on the following element.

This paper will focus on the following element -

- 1) Buying green energy.
- 2) Generating their practice's own energy.
- 3) Evaluating how the practice heats its building and water using space more effectively.

Whether your dental office is up and coming or already established, the utilization of more energy efficiently process and equipment is a great step towards eco - dentistry.

From eco friendly building materials to designing your practice to capture more natural light, there are a number of ways to reduce your carbon footprint and still provide super care to patients.

Need of energy audit in dental clinic

India is the world's 3rd largest country in the use of electricity. Most of energy is used from coal, natural gas,

crude oil, nuclear energy, hydro-electricity etc. With day-by-day demand of the energy supply is also increasing. To meet the future demand, the effective use of energy must be there so that there is no energy scarcity.

If any proper steps are not taken then energy scarcity will be there and it cannot fulfil the future demand, also use of renewable energy must be their because it has move advantage over the non-renewable energy. Renewable energy includes sunlight, wind, rain, tides, waves, and geothermal heat etc.

So, the reduction of energy loss can be done by use of effective knowledge. Energy Conservation can also lead to healthy environment.

In dental clinic, energy is the main requirement without this energy non of the operations can be performed. Day by day demand as well as usage of energy is also increasing. So effective use of this energy must be there to reduce the loss of energy.

In dental clinic, electrical machine always remain ON 24/7. Sometime when electrical machine are not in use but still remain ON due to which loss of energy occur. So the effective use of energy is not occur. With the help of energy audit the maximum use and minimum loss of energy can be managed.

Energy Audit helps to analyse the energy consumption thereby providing a path to identify the areas, where wastage of energy occurs and provide the scope for reducing the wastage.

Main Objective of Energy Management in dental clinic are :-

1. Effective use of energy without any loss.
2. To minimise energy waste without affecting the working operation
3. For use sustainable energy to meet the future demand.
4. Cost effective use of energy so that minimum amount money can be spend.

Energy audit is best possible method that can be use to minimise the energy loss and meet the future demand without affecting supply. Energy audit provide method which covert idea into reality with technical solution. Therfore with the help of energy audit we can save 10 to 20 % of energy.

GROWTH CHART

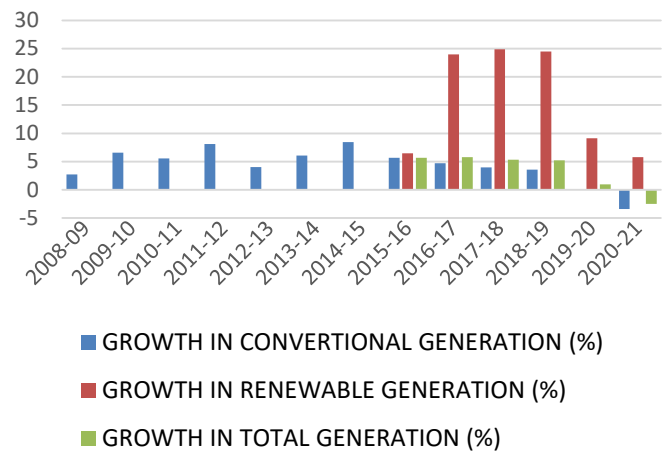


Chart 1- According to Government of India Ministry of Power annual growth in power generation during recent years is as under

POWER CONSUMPTION OF DENTAL EQUIPMENTS

Sample The team members of our group conducted energy audit at dental clinic. This study tells us about the energy (electrical) consumption of equipments used in dental clinics.

According to the audit of a dental clinic, the daily utilization chart is given in Fig.1. By graph 1, we can analyze the consumption of the energy in 24 hours by the lighting and the major equipment's like X-ray, dental chair, ac, computer etc. The daily utilization graph makes easy to understand the utilization of energy in a particular day. The electric current (in watts) of all the equipments are also represented by pie chart.

The tariff details are collected to check the unit consumption of the particular dental clinics in which the data have been collected for the past years. In general, it was found that at the time of the rush hour the consumption was very high and also at the time of ideal hour the consumption is low, this is due to the maximum use of the heavy electricity consuming equipment during rush hour. As we can be clearly analyzed that in the month when there is rush, the unit consumption was around 400 units. The average unit consumption of this dental clinic is 321.44 units per month.

By looking at figures, the most energy consuming equipment in clinic is ac and dental chair. IN winter use of AC is negligible so around 102 unit/m of energy is saved same goes for FAN around 22.5 unit/m saved during winter. The X-ray machine operate only for few seconds for each patient so it is the very least energy consuming equipment in the clinic. Every Equipment in this figures contains single equipment.

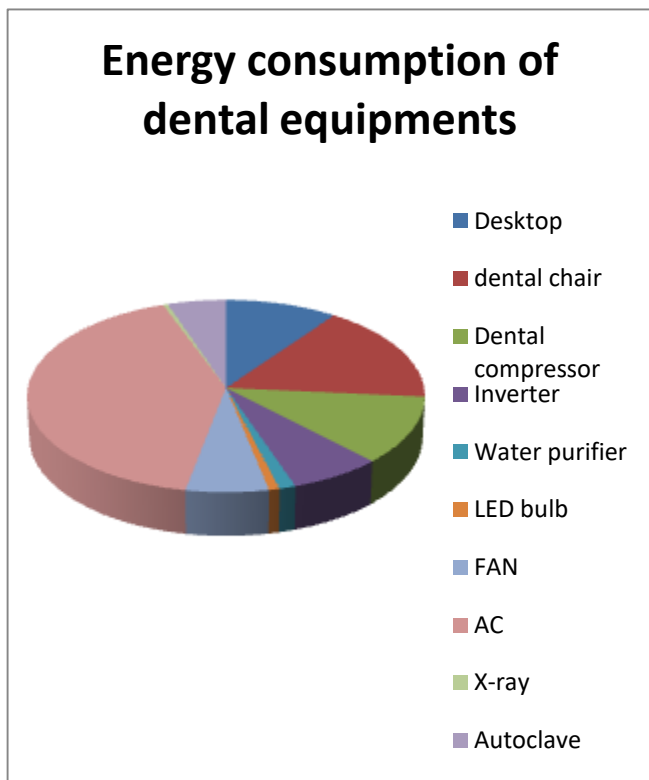


FIGURE 1-This figure tells us about the power consumption of equipments in unit/month in the form of piechart

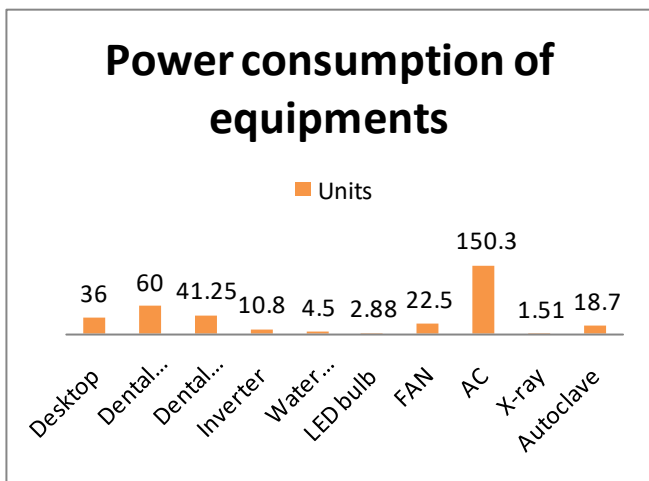


Chart 2- This graph tells us about which equipment consumes how much unit of energy

We convert power of equipments which is in Watts/hr to Unit/month by given formula :-

$$\text{Unit/month} = (W * H/1000) * 30$$

W = power of equipment in watts

H = how many hours equipment is in function

Detailed description of Equipments :-

- 1) Desktop :- A complete desktop is used to store the data like in this case data of patients and also to display the x-ray of patient. It also includes wifi , printer etc. uses around 200 watts/hr. Let's say it operates 6 hrs a day.

$$\text{Unit/month} = (W * H/1000) * 30$$

$$= (200*6/1000)*30 = 36$$

unit/month

- 2) Surgical Dental chair :- It is to support a patient's body during the time of procedure. It is also equipped with other small instruments which helps th doctor in his/her surgery operation .A dental chair used in dentistry consumes around 800 watts/hr. Let's say it operates for around 2.5 hrs a day.

$$\text{Unit/month} = (800*2.5/1000)*30 = 60 \text{ unit/month}$$

- 3) Dental Compressor :- A dental compressor pressurize air for use in dental procedure. A compressor uses around 550 watts/hr. Let's say it uses 2.5 hrs a day with dental chair.

$$\text{Unit/month} = (550*2.5/1000)*30 = 41.25 \text{ unit/month}$$

- 4) Inverter :- A traditional inverter consumes around 120 watts/hr to charge. let's say it takes 3 hrs to charge.

$$\text{Unit/month} = (120*3/1000)*30 = 10.8 \text{ unit/month}$$

- 5) Water purifier :- a water purifier used in households consume about 25 watts/hr. Let's say it operates for 6 hrs per day.

$$\text{Unit/month} = (25*6/1000)*30 = 4.5 \text{ unit/month}$$

- 6) LED Bulb :- A LED bulb uses 12 watts/hr. Let's say it uses for 8 hrs per day.

$$\text{Unit/month} = (12*8/1000)*30 = 2.88 \text{ unit/month}$$

- 7) FAN :- Fan operates for 10 hrs per day during summer some places it operates for more than 15 hrs. It consumes around 75 watts/hrs.

$$\text{Unit/month} = (75*10/1000)*30 = 22.5 \text{ unit/month}$$

- 8) Air conditioner :- An AC is a machine which uses to provide cool air in the time of summer. An AC of 1.5 ton consumes 1607 watt/hr. And let's it operates for 3 hr per day in a clinic.

$$\text{Unit/month} = (1607*3/1000)*30 = 150.34 \text{ unit/month}$$

9) Dental X-Ray machine :- Dental X-ray uses to take x-ray of gums and teeth. This equipment uses around 100 watts/hr. But it uses least time among another equipments . It uses for few seconds to capture the x-ray. Let's say it operates for only 10-11 min (0.17 hr) each day for patients.

$$\text{Unit/month} = (100 \times 0.17 / 1000) \times 30 = 1.51 \text{ unit/month}$$

10) Autoclave :- Autoclave is a cylindrical or rectangular vessel which is used to sterilise a surgical tools. It uses 625 watt/hr and operate for about 20 min depending the size of tools at 121 degree Celsius of pressurized saturated air. Let's say it operates for 3 times a day that makes 1 hr each day to sterilise dental tools.

$$\text{Unit/month} = (625 \times 1 / 1000) \times 30 = 18.7 \text{ unit/month}$$

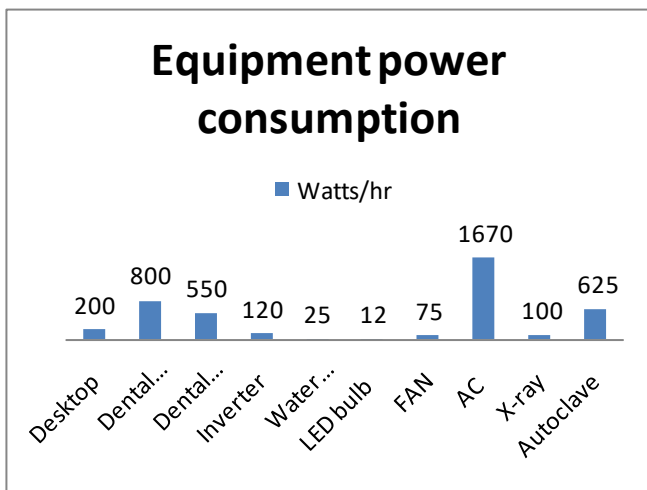


Chart 3-This graph tells us about the power consumption of equipments in watts/hr.

As we can see in next figure, 3 star AC of 1.5 ton consumes 1670 Watts/hr. Which is highest of all equipments in clinic. Least power consumed by is LED bulb which is 12 watt/hr. But when you compare previous figure1 with figure 2 you notice that x-ray consume 100 watt/hr but it's unit is less than LED bulb this is due to the use of LED bulb is constant in clinic while x-ray is used for few seconds for each patient that is why x-ray consumes least unit of energy

Table 1- Data on single piece of equipment used in Dental clinic

Equipments	Energy (watts/hr)	Energy (Watts/hr)
Desktop	200	36
Dental chair	800	60
Dental compressor	550	41.25
Inverter	120	10.8
Water purifier	25	4.5

LED bulb	12	2.88
FAN	75	22.5
AC	1670	150.3
X-ray	100	1.51
Autoclave	625	18.7
Total	4177	321.44

As we can see from above table, the energy consumption of equipments in unit/month is 321.44 unit. The tariff of the location of clinic is about RS.3.25 per unit so the monthly bill of small scale clinic with single equipment each is Rs.1044.28. If equipments exceeds more than one then bill may exceeds more than RS.2000. Here we count every equipment as a single equipment if their are 5 LED bulbs so unit/month is $5 \times 2.88 = 14.4$ unit/month same goes for other equipments in clinic.

Recommendations for dental clinic energy audit

1. Turn OFF the machine when it is not in use.
2. Install LED bulb over the Incandescent light bulb. Because LED consumes 12 watt/hr so it uses 2.88unit/month whereas incandescent light bulb use 75 watt/hr so it uses 18unit/month. By changing incandescent light bulb to LED bulb we save around 15unit/month just by shifting towards light bulb.
3. Purchase five star BEE labelled electrical equipment as it save lot of energy. A 3 star AC of 1.5 ton uses 1.67 kw/h which is 150 unit/month and 5 star AC of 1.5 ton uses 134 unit/month by switching to 5 star AC will saves us about 16 unit/month.
4. Replace retrofit T12 lamp with T8 lamp, T5 lamp or T-LED.
5. Install lighting sensor so that when light is required it get ON otherwise it remains OFF specially room like restroom, storeroom, etc.
6. Install thermostat to avoid overheating.
7. To turn OFF light when it not required and use of natural light is also their.
8. Replace old equipments with energy-saving models as old ones consume lot of energy over new equipments.
9. Use renewable energy over non-renewable energy such as use of solar energy. As it can also be use as back up their non electric power and it's cost-efficient
10. Use of new dental x-ray machine instead of old x-ray machine. It saves power as well as old ones has the risk of radiation exposure.
11. Switch to LCD screens from CRT monitor in computer as a 19 inch display of LCD consumes 45 watt/hr so it

consumes 8.1 unit/month where as 19 inch display CRT monitor uses 100 watt/hr so it consumes 18 unit/month. Just by switching between CRT to LCD we just save 10unit/month.

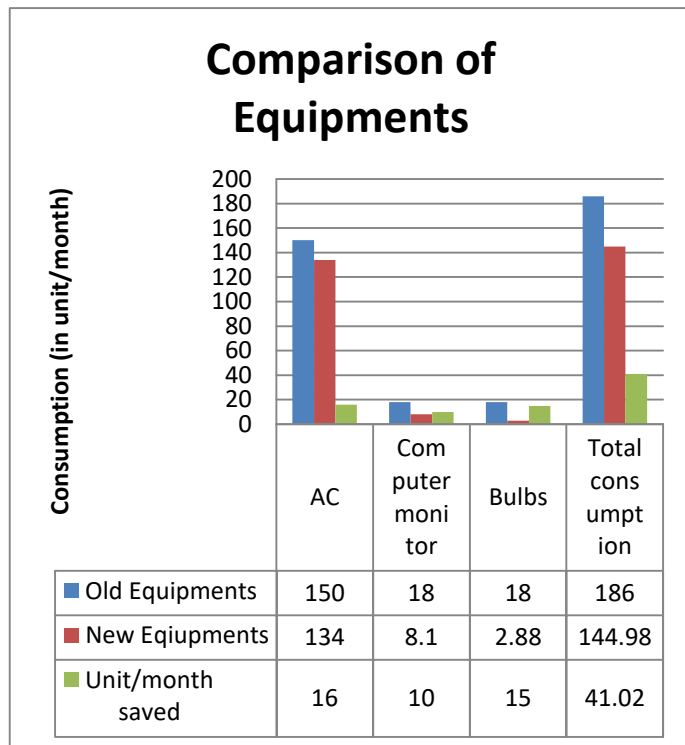


Chart 4 – Comparison of equipments

CONCLUSIONS

In 21st century as we burned away our non-renewable resources without any thoughts about future. A simple and minor changes in the system can conserve energy and down the utility of energy to a greater extent and various solution have been suggested to the hospital for using energy efficient instead of wasting energy into excessive consumption. The energy audit tells us about the ways how we can conserve energy without any technicality and energy consumption in our firms, households, clinics etc. This paper covers the detail about the energy audit of a small scale dental clinic.

Just by converting CRT monitor into LCD we saves 10 unit/month and so on. Applying to every other appliances/equipments we can save sufficient amount of energy from each and every dental clinic in India. By converting their devices to energy efficient 5 star devices the owner of clinic can save electricity energy and it reduce the cost of electricity bill.

REFERENCES

[1] Brett Duane, Sara Harford, Inge Steinbach, Rachel Stancliffe, James Swan, Richard Lomax, Eleni Pasdeki-Clewer and Darshini Ramasubbu, " Enivromentally sustainable dentistry : energy use within the dental practice" - British Dental journal , march 2019

[2] Government of India "Ministry Of Power" "Power sector at a glance ALL INDIA" - website

[3] Environmental sustainability and waste within the dental practice Brett Duane,*1 Darshini Ramasubbu,2 Sara Harford,2 Inge Steinbach,2 James Swan,1 Kim Croasdale3 and Rachel Stancliffe2

[4] ENERGY AUDIT FOR CHENGALPATTU MEDICAL COLLEGE HOSPITAL BUILDINGS Rajavel. V and Dr. S. Ganapathy Venkatasubramanian21M.E Environmental Management, Final year, Anna University, Chennai, Professor in Centre for Environmental Studies, Anna University, Chennai.

[5] Energy Consumption Analysis and Characterization of Healthcare Facilities in the United States by Khaled Bawaneh, Farnaz Ghazi Nezam, Md. Rasheduzzaman and Brad Deken

[6] Gautam V, Thapar R, Sharma M. Biomedical waste management: incineration vs. environmental safety. India JMed Microbiol 2010 ; 28: 191–192

[7] Nzihou A, Themelis NJ, Kemiha M, Benhamou Y. Dioxin emissions from municipal solid waste incinerators (MSWIs) in France. Waste Management 2012; 32: 2273–2277