

Energy Audit and Energy Conservation in Iraq: A Case Study

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Abstract- The concept of energy auditing (although it has been in known for a long time all over the world) is a recent concept in Iraq, which suffers from a significant shortage of power supplies, despite being one of the richest countries in the world of fossil energy sources such as oil and natural gas. This concept helps to check the consumption of electricity and identify the areas of imbalance and causes of waste of energy. Most studies have shown that most energy waste comes from personal actions and carelessness in energy conservation. This concept helps to determine the possibilities of regulation and reduce waste of energy, and increases attention to rationalize electricity consumption. Knowing that any reduction in electricity consumption means reducing GHG emissions and turning the working environment or housing into a safer and more comfortable environment that ensures the health and safety of the residents. The rationalization of consumption and reduction of waste of energy through the process of the studied energy auditing, and the commitment of the management of property and working persons and residents of these facilities in following the instructions and directives required of them.

In this study, energy audit and assessment is carried out in the Department of Physical Education at the University of Technology-IRAQ. A list of a number of pertinent questions has been prepared, in which energy costs, waste areas, and potential rationalization can be determined. Energy audit needs to make every effort to reach the concept of as many people as possible, especially with regard to changing energy consumption methods. Changing the behavior and habits of individuals is one of the most important tasks that must be accomplished for a little consumption and rationalization. Some waste areas of energy can be difficult to identify without the use of specialized bodies (such as those that can identify building and roof insulators to name a few).

Keywords: *Energy conservation, carbon free environment, management.*

I. INTRODUCTION

Electric power has become an integral part of the lives of citizens and nations [1]. The world's countries progress is measured by the electricity it provides to citizens [2]. The welfare of citizens and the conduct of their work depend mainly on electricity [3]. However, the production of electric power calls for the burning of fossil fuels (coal, oil, and natural gas) [4]. These fuels emit at the onset of many pollutants, most of which cause diseases and pollution to the external environment and some of them cause global warming [5]. The increase in demand for electricity is caused by the increase in the population worldwide and the need to provide conditions for the comfort of citizens [6]. The increase in electricity production has sparked more fossil fuels, sparking the world's red light, as climate change is becoming a reality that two are not arguing about [7, 8]. The need for fuel has made countries

and a large part of their budgets at the mercy of the prices of these materials [9]. As oil price have fluctuated over the past decade, the economic recession has hit many countries, both exporting and importing this material [10].

The availability of energy has a decisive impact on the economy and development of any country [11]. Iraq suffers from a severe shortage of power supplies [12]. This country has been subjected to many wars and tragedies, in addition to 13 years of unjust and cruel siege, which has destroyed the country's infrastructure [13, 14]. After the occupation of Iraq in 2003, successive governments spent billions of dollars to revive and raise the capacity of electricity generation so that the citizen is equipped with fixed electricity [15]. Unfortunately, till today, the Iraqi state treasury has spent 80 billion dollars, but the electricity is still cut off for long hours [16]. This has led the Iraqi citizen to rely on generators of small size with capacities not exceeding 1 MW to equip electricity when the national power outages [17]. In addition to these generators, many citizens relied on personal generators that are fueled with gasoline generators and diesel, which are produced locally [18]. These two substances are considered the worst types of fuel globally, as the Iraqi diesel contains 1% of the sulfur and weight, and contains Iraqi gasoline at the rate of 0.50% sulfur and large amounts of lead compounds [19, 20]. The electricity crisis in this country has caused an increase in air pollution and low quality, which negatively affects the health and safety of Iraqi citizens [21].

The annual electricity generation capacity in Iraq since 2003 has increased by about 11,000 MW from about 4000 MW in 2003 to more than 15,000 MW in 2017 [22]. Demand for electricity also increased from 8000 megawatts to 22,000 megawatts [23]. The industrial demand for electricity represents 35% of the electricity requirements, electricity demand for household use is about 42%, agriculture 19%, commercial 10%, and the rest are public lighting and others [24].

Energy management means preserving it and reducing energy consumption without reducing the type of service provided or sacrificing the quantity supplied [25]. A successful energy management program starts with a specific idea of energy conservation [26]. To apply this idea needs to classify all equipment and equipment, using high-efficiency measuring equipment. Energy management also requires changing habits that cause significant waste of energy [27].

Energy auditing is a concept based on the study, survey, and analysis of energy flow to identify waste and energy conservation in a building, organization, or residential complex [28]. It represents a process to reduce the amount of power input in the system without affecting the output negatively [29]. It also tests and analyzes the use of buildings, institutions, and other energy organizations in accordance with the

regulations, national regulations and laws on energy consumption, as well as when energy audits are investigated and a comprehensive review of energy expenditure accounts is carried out [30].

Energy audit activities include specific points [31, 32]:

- Identify and define all energy-consuming systems.
- Evaluate the working conditions of these devices or systems.
- Analyzing and suggesting ways to improve the work of these systems and the impact of the resulting improvement on the energy management of the studied complex as a whole.
- Prepare a detailed report to review the energy and results achieved.

Following the audit process, an economic analysis must be performed using all available data [33]. Iraq as an oil country rich in crude oil and natural gas make the consumption of these resources locally at low prices [34]. During the period from 1977 to 2003, electricity was provided to the citizens subsidized and cheap, which rose generations of citizens educated on the waste of this energy and excessive use [35]. Today, after less power is being provided to the citizens, the waste of energy consumption is still high due to bad habits, particularly in the hot summer, with many air conditioners operated in empty rooms [36].

Working with the concept of energy audit has positive results because it reduces energy bills [37]. It is considered to be an effective preventive tool, resulting in a reduction in the cost of energy consumed, and high quality control of electricity supply, resulting in improved electricity delivery in terms of production and maintenance of public, economic, commercial, and residential activities [38].

Ref. [39] has experimentally studied number of factors that increase energy efficiency in some small and medium projects. The findings of the study showed that high investment costs reduce the ability to adopt energy efficiency measures, although these measures are profitable, in the final result. Lack of capital also reduces the adoption of energy efficiency measures, especially when investments are larger. The researchers recommended increasing investment subsidies or soft loans (for larger investments) because of their impact on accelerating and expanding energy efficiency measures in these projects.

Ref. [40] studied the possibility of energy audit on an industrial project, which is a cement production plant. This plant is characterized by its high energy and cost-effective approach. The studied cement factory works for a large number of hours (8784 hours per year), and produces about 640,809 tons of clinker. The researchers worked on measuring and preparing data needed for analysis and for developing an effective and studied energy management plan. During the study, thermal energy was analyzed and checked in the heat treatment plant of the cement plant where the most fuel is spent in this unit and the combustion here generates the largest part of the thermal energy needed for manufacturing up to 95.48%. Data and measurements showed significant waste of energy lost in exhaust gases up to 27.9% of the total amount of heat entering. So, the researchers have revisited the heat recovery methods of exhaust gases to improve unit performance in terms of energy consumption. The researchers' proposals enabled savings in energy and thermal power of 42.88 MW/year and high financial benefits due to the best use

of energy conservation methods. These methods have resulted in environmental benefits of 14.10% in GHG emissions.

Ref. [41] study examines the possibility of reducing energy use in a great country such as China, which consumes up to 20% of the world's total energy. China's efforts are focused on enhancing energy efficiency, especially in the industrial sector, which consumes up to two-thirds of the country's energy production. China is using the industrial energy review in strenuous efforts to improve its energy density. These energy audits are used to identify energy efficiency efficiencies in industrial enterprises and are used as a means of gathering data required for energy consumption. The authors have reviewed the Chinese policies and programs used in energy audits and the amount of information collected by surveying many Chinese enterprises involved in energy audits. In this study, the best ways to rationalize energy consumption, gaps, and practices through which energy was wasted were analyzed. The researchers compared Chinese energy auditing practices with practices in different parts of the world.

The energy audit concept has not been used in Iraq on a clear scale. Therefore, this concept is unknown to ordinary citizens, which his ignorant and wasteful considered the primary reason in wasting energy, and one of the main reasons for increasing electricity consumption [42]. The data of the Iraqi Ministry of Electricity showed that about one-third of the energy produced is lost as a waste of irresponsible and ill-considered behavior [43, 44]. Awareness-raising on the use of energy auditing and rationalization of consumption is therefore incumbent on all government agencies and authorities because of the energy production full impact on the environment and public health.

In this study, this concept is used and applied to the buildings of the Physical Soil Department which is one of the University of Technology-Iraq units. This department includes a football field, two basketball courts, two tennis courts, an indoor hall, a clothes section and Administrationrooms. The objective of this study is to promote the concept of energy management at the University of Technology and to put forward constructive practical proposals to rationalize electricity consumption in its various facilities.

II. RESEARCH METHODOLOGY

The study was formed using a form that included a list of requirements and questions that needed answers. The focus was on four key parameters in which most electricity is consumed in buildings and facilities. These parameters are lighting, heating, cooling, ventilation, electrical equipment. Appendix A represents the application form and the points of focus of the study.

III. RESULTS AND DISCUSSIONS

Figure 1 shows the distribution of high electricity consumption lights in the Department of Sport Education and the Playgrounds at the University of Technology. The stadiums were divided into football, basketball, gymnasium, and tennis playgrounds. In the football field there are four high towers installed on each of 104 lights and a total of 416 lights. The basketball court has four towers in each tower and a line of lights with a total of 224 lights. There are two closed halls for indoor sports; there are hall (A) with 35 lights and an indoor sports hall (B) where there are 112 lights available.

As shown by the figure, the lights used are of high capacity and the cost of maintenance is very high and expensive. The heat emitted from the lights causes thermal pollution of the area. In the indoor areas, the damage is not less, but it becomes

a direct impact on the inhabitants. The replacement of these lights with energy-saving types reduces the current waste of electricity and protects the health of its members and students. It is possible to take advantage of sunlight in the lighting of external spaces, and the interior areas must increase the open areas that allow the entry of sunlight into the rooms of the building. Taking advantage of the sunshade light can be considered one of the most important ways to reduce the number and intensity of lights. This solution is a solution through which renewable energy is used, sustainable, green, and above all, free energy is available in Iraq throughout the year.

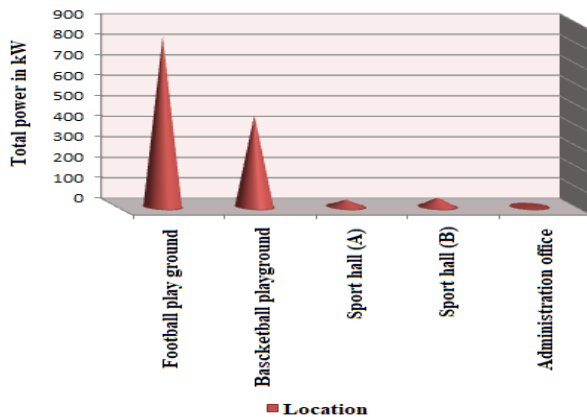


Fig. 1, the lighting consumption power in the studied Department

Fig. 2 shows the electrical power consumed by the water heaters used in the water of the student rooms and the washing of the staff, as well as the pumps used to raise water to the tanks above the building.

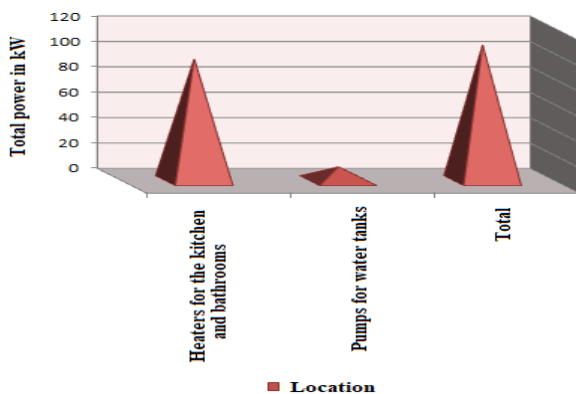


Fig. 2, the heaters and pump consumption in the studied Department

The figure shows that the energy used is very high and expensive. New heaters and pumps should be used to reduce this energy consumption. One of the proposed new types is replacing the electric water heater with a solar heater. Pumps can be used with low-capacity pumps and solar cells. This is also a renewed and sustainable solution.

Fig. 3 shows the cooling units used in the studied section and their power consumption. These refrigeration units include AC power units and perforated units used in the offices of administrations and closed rooms.

Air conditioning units consume a lot of energy and to reduce the energy consumption through these devices programmable thermostat should be set up to determine the operation of the air conditioners and extinguish them when the rooms are free from the occupants, and restart them when occupied by the occupants with the lowest discharges of electricity. Reducing

the temperature difference between the outside air and the indoor environment of the building reduces energy loss. It is also recommended if the programmable thermostat is not available, this process should be done by manual adjustment.

Figure 4 shows the electricity consumed by some office equipment in the Department of Sport Education studied. Devices evaluated are computers, printers, and water coolers. Electric air heaters are not included with office equipment because they consume high electricity and prefer to use solar air heaters or hot water radiators that take heat from solar heaters.

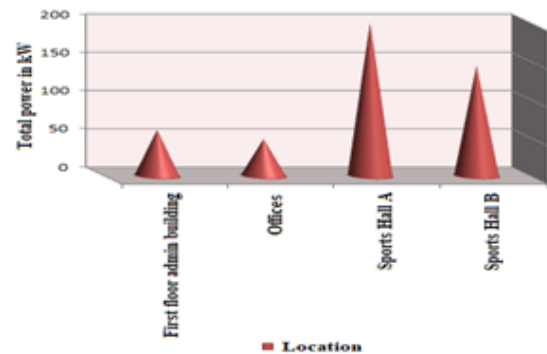


Fig. 3, the air conditioning units' consumption in the studied Department

The figure indicates that the total electricity consumed by office equipment is very high, confirming the use of high-consumption devices. The Department must be equipped with modern devices with lower electricity consumption, preferably the devices that have self-extinguishing ability or reduce the operating power used when the device is in silent mode. Energy-saving appliances include laptops with less power consumption than desktop computers. It should be emphasized here that office equipment such as computers, printers, scanners, and other office equipment should be switched off automatically if they are not used.

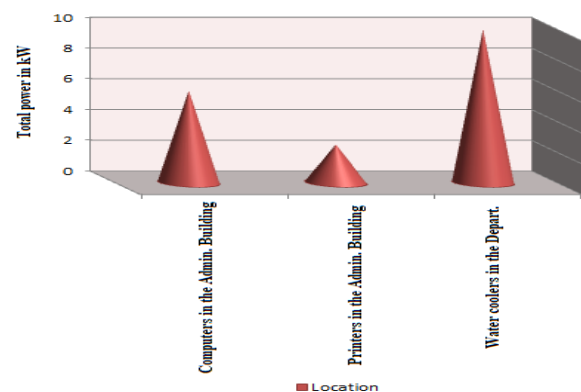


Fig. 4, the electrical equipment consumption used in the studied Department

The use of the behavioral patterns proposed in this study in addition to the replacement of some devices with other depend on the consumption of energy generated from the sun gives savings in the electricity bill, which brings the university, its employees, and the environment a great benefit. The University of Technology Presidency should launch an advertising campaign using posters encouraging university staff and students to save energy and explaining the importance of rationalizing electricity consumption and the benefits of using it. The optimal use of electrical appliances in the office while reducing the waste of electricity consumed is by encouraging employees to turn off the lighting. The

Presidency of the University should also establish controls of a legal nature that would hold those who do not work under the concept of energy management and rationalization of consumption accountable.

CONCLUSIONS

The concept of energy audit takes care to check the energy expenditure of any institution or building and proposes solutions to reduce the waste of energy consumed, which benefits the institution or building concerned, whether cost or environmental. Energy management is therefore a way of life and a change in human behavior, whose main purpose is to save energy. The interest in energy review comes from the serious environmental situation caused by the burning of millions of tons of fossil oil and gas to obtain electricity. Reducing energy consumption means reducing the burning of fossil fuels, resulting in improved environmental and air quality. The energy preservation starting from homes, public buildings, commercial, and industrial factories mean reducing reliance on fossil fuel consumption and saving large sums of money in the state budget that can be used to rebuild the country. Therefore, the government and its affiliates should be concerned with the development of legislation that would set pollution and emissions rates, as is the case in EU countries and the United States.

The present study presented some areas of waste of energy and some proposals to provide electricity consumption in the Sports Department at the University of Technology. Much of the waste of electricity comes from lighting, air conditioning, heating, and office equipment. The most important suggestions made by the study are to rely heavily on the engineering of the buildings of the Department to use the sunlight for rooms and gymnasiums instead of lighting with electric lights. The use of solar water heaters has a significant role in reducing electricity consumption.

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