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Faculty of Engineering & Information Technology

Department of Energy Engineering and Environment

Graduation Project

Review of energy conservation studies in Palestinian territories

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الإهداء

إذا غامرت في شرفٍ مرومٍ

فلا تقنع بما دون النجوم

اللهم لك الحمد كما أنت أهله ووليه وكما ينبغي لجلال وجهك وعظيم سلطانك، الحمد لله الذي منّ عليه بفضله الوصل لهذا اليوم ، الحمد لله على توفيقه وتيسره .

نجوم جامعتي العريقة، نجومٌ تتلألأ بضوءٍ ساطعٍ إنهم دكاترتي العظماء الذين سعوا دائماً في توفير طاقةً وبيئة محفزة ترنو حولنا، المشرف الموجه د. أيسر ياسين لك مني كل التقدير والاحترام لجهدك ودعمك المستمر . دكاترة القسم الرائعين أدعو الله لكم جميعاً بالبقاء بالصحة والهناء لما حفزتمونا وأنرتم بصيرتنا به ،وأخص بالذكر د. محمد السيد و د. عبد الرحيم أبو الصفا.

عائلي الرائعة ، كل الشكر والتقدير لكم يا أعمدة بيتي الصغير (أبي وأمي) ، إخوتي وأخواتي الأقرب لقلبي أشكركم لما تحملتموه معي من العناء ، واشكركم على تشجيعكم ودعائكم .

وأخيراً وليس أخراً السد والسند الدائم ، رفيقات عمري المؤنسات الغاليات لكن مني كل الشكر والمحبة .

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Nomenclature

| Abbreviation | Nomenclature |
|--------------|------------------------|
| BG | British Gas |
| GDP | Gross Domestic Product |
| EM | Energy Management |
| EE | Energy Efficiency |
| kW/Y | kilowatt/ Year |
| GWH | Gigawatt Hours |

Abstract

With the increasing pressure on the political and economic situation in Palestine in general, the increase in electricity consumption in particular, the scarcity of energy sources, and the difficulty of establishing private power plants. All of these have been the primary motivation for searching for more efficient methods of energy auditing. There are many energy audit studies in different sectors, good and bad. Therefore, to achieve higher efficiency in such projects, previous studies had to be evaluated.

In this research, the reports of a specific institution were relied upon, as the reports that it provided regarding energy audit studies in different sectors were taken. These reports have been analyzed and their strengths and weaknesses are put on scientific grounds.

In the end, the results were clear, as they showed how poorly the reports compared to their peers from research studies on the same topic. In the end, the most important things that future studies must rely on while conducting such studies were laid down to open the way for the institutions and bodies concerned with these studies to present them more Efficiency and achieving higher rates of energy conservation.

Chapter I :Introduction

Overview

We express Energy Efficiency (EE) by using less energy to provide the same service, and to achieve the best level of energy efficiency, a good Energy Management (EM) strategy should be followed, based on controlling and improving energy consumption to increase profits and enhance competitive positions. This is key to making energy decisions as it balances the input of energy for its use and as a tool for monitoring energy management.

The energy audit methodology is summarized in three phases: (Phase 1: Preparing for the audit visit, Phase 2: Conducting the Facilities Survey, and Phase 3: Implementing the audit recommendations). In this study, we will rely on the third stage so that previous reports are evaluated and analyzed, and to clarify the effectiveness of the review in some facilities through simulation questions that explain the success of projects in rationalizing energy consumption in Palestine and present proposals that will achieve higher energy savings.

Many agencies have been interested in conducting energy survey studies for several establishments distributed in different ways and making suggestions about the status of the facility to improve the quality of energy consumption.

Problem statement

Despite the interest of many energy stakeholders in energy audit studies within the various facilities, unfortunately, these works have not been evaluated before, so it was necessary to evaluate these procedures to determine their success rate, impact, and further development. Proposals that did not focus on previous studies to develop research for such projects, in order to help future researchers focus on important points and follow a methodology that provides opportunities for higher energy conservation.

Project objectives

Many studies and activities have been conducted aimed at reducing electricity bills in all sectors, and with the increase in reliance on energy auditing programs and raising efficiency, it has become necessary to conduct an evaluation that clarifies and analyzes the path followed by the concerned authorities.

The main objective of the project is to evaluate the reports pertaining to a specific institution, in order to clarify the extent of its weakness or strength compared to the scientific foundations of such studies.

In the end, the main differences that make the reports more successful than others are explained, in addition to a simplified explanation of the basics that the researcher should follow in such studies.

Scope of the work

We will mainly rely on the reports of previous energy efficiency projects, so that these reports are analyzed and weaknesses are identified, along with observations and suggestions to raise energy efficiency at a higher rate and benefit from the procedures of successful projects and apply them to other projects in the future, taking into account the case of each study.

Research questions

The idea of research stems from the answers to these questions

1. Are data and calculations based on measurements?
2. Has a scientific approach been taken in the calculations?
3. Were the proposed measures effective and comprehensive?
4. Did the report identify the most energy-consuming points within the facility?
5. Are the financial accounts realistic and explained in detail?

Significance of work

In recent years, we have observed an increase in energy consumption in various sectors, and it was necessary to conduct studies that identify the causes of this problem and find solutions to it. Many researchers interested in the energy sector have conducted studies to audit energy consumption in various sectors. Each researcher relied on his conditions and assumptions in analyzing the facility and the causes of high consumption and solutions.

However, what was not addressed is the evaluation of these projects and the identification of positive paths. Where it was necessary to conduct a comprehensive research that evaluates what was previously worked on and forms the basis of future research, so that it reduces the effort and time of the future researcher. The final report of the research shows the most important points that must be taken into account to raise energy efficiency and the efficiency of these projects.

Organization of the report

Chapter One: (Introduction to the project): This chapter talks about the project in terms of importance, scope of work and research questions.

Chapter Two: (Energy situation in Palestine): This chapter presents the general energy situation in Palestine.

Chapter Three: Obstacles and the previous decision): This section explains the research challenges and what has been relied upon.

Chapter four: (Literary reviews): presents a set of previous literature on energy conservation studies to enhance knowledge in researching energy consumption points for the application of an effective review, as the study relied on studies covering various sectors.

Chapter Five: (Methodology): This chapter presents the methodology that will be relied upon during the course review process.

Chapter Six: This chapter generally talks about the sectors that will be worked on.

Chapter Seven: (Reviewing energy conservation studies in various sectors): This section forms the heart of the project. Here, studies have been reviewed and appropriate suggestions made for each sector.

Chapter Eight: (Future Studies) This chapter presents a blueprint to assist future researchers in applying energy management and evaluation studies in a highly efficient manner.

Chapter Nine: (Results & Discussion): This part focuses on presenting the results that we have reached in this research.

Chapter Ten: (The Recommendations) : This section shows some points that would enhance energy efficiency in Palestine

Chapter Eleven: (References) The references that were relied upon for the study appear here

Chapter II: Energy situation in Palestine

Overview

Energy is an important element that determines the level of economic and cultural development of countries. Therefore, countries are generally interested in promoting and developing energy in them. Palestine is one of these countries, but the situation in Palestine is different from other countries, as it is considered one of the poorest countries in traditional energy sources such as oil and electricity. Also, its consumption of solar energy is relatively limited, and wind energy is used in a small way, in addition to the uses of biomass in rural areas with a few percentages in cooking. And heating. Palestine depends on importing energy from Israel and other countries.

Energy sources in Palestine

Palestine lacks energy sources because it depends mainly on electricity, and uses photovoltaic energy to heat water. Natural gas was recently discovered by the British Gas Company (BG) in December 2000 on the Gaza coast [1]. Gas reserves are estimated at 1.4 trillion cubic feet.

The Palestinian Energy Authority sought to develop energy in Palestine, as it built a power plant in Gaza (140 megawatts), but it is now operating at a production capacity (40 megawatts) according to the plan. This plant was supposed to be fed with natural gas, but for political reasons, the plant is dependent on diesel. Palestine imports 95% of its electricity needs from Israel and the rest from Egypt and Jordan as shown in Table 1 .

Table 1: Energy imported or locally generated (MWh) for Palestine in 2013

| Imports | | | | Local Production | Total |
|---------|-----------------------------|---------|--------|------------------|-----------|
| Source | Israel Electric Corporation | Egypt | Jordan | Gaza Power plant | |
| kw/y | 4,484,808 | 208,045 | 41,401 | 402,607 | 5,136,861 |

(Source: World Bank own elaboration based on DISCOs data) [2].

Energy consumption

Energy consumption in Palestine differs from one sector to another. Table 2 shows the energy balance in Palestine for the year 2016, showing different sources of energy and the dependence of the sectors on each source.

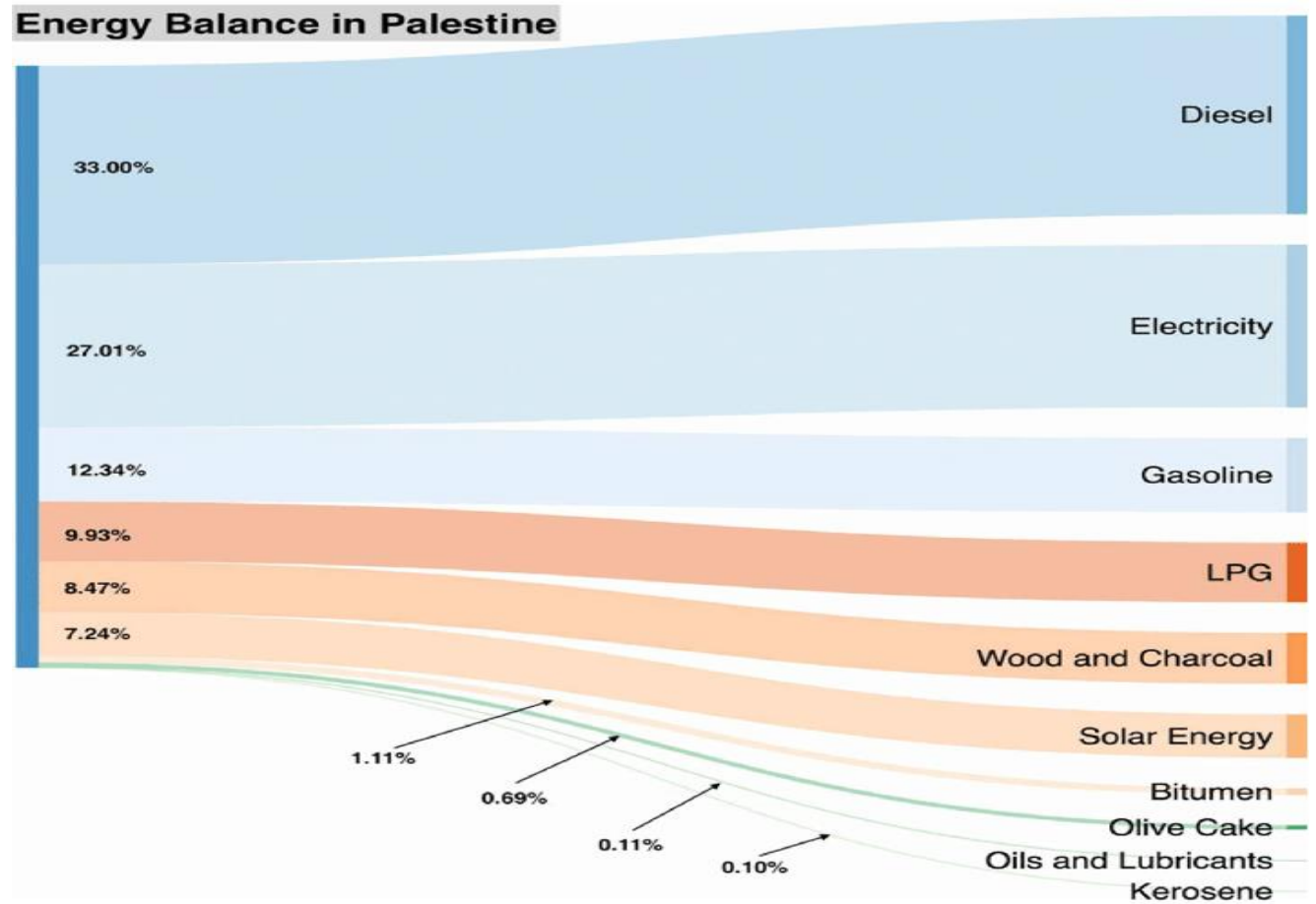


Figure 1: Balance of Palestine in 2013

(Source: Energy balance for Palestine 2016 – PCBS) [3]

The most important thing that can be noted in the energy balance

1. Palestine is highly dependent on energy imports.
2. Electricity represents 27% of final energy consumption. Annual electricity consumption is 10% of GDP. Therefore, it is necessary to focus on rationalizing the consumption of electrical energy.
3. Electricity losses are technical losses or energy produced, but not consumed (transmission and distribution networks)

Distribution of energy consumption by source

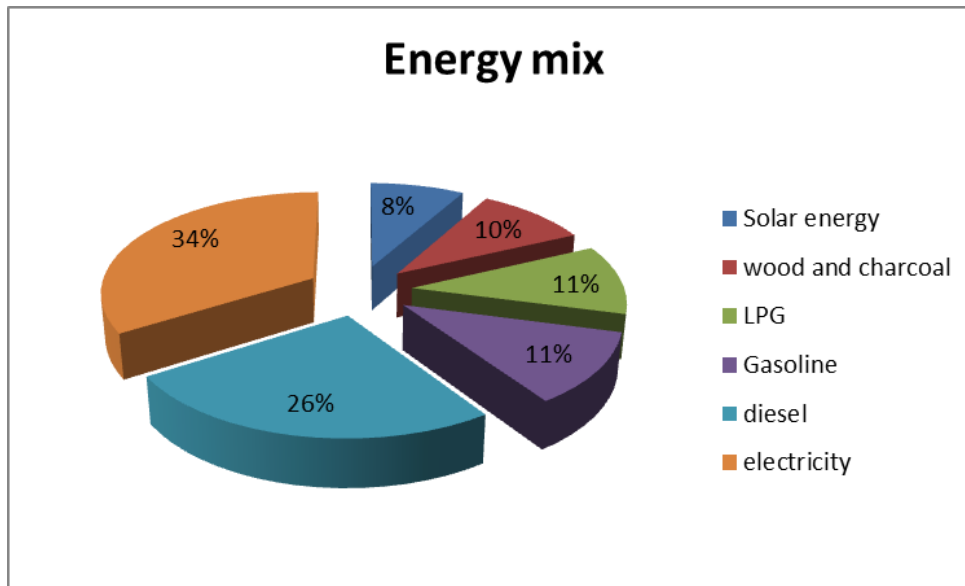


Figure 2: (Consumption per type of energy – 2013 World Bank own elaboration based on PCBS data)

The picture shows the source of energy that is relied on more, as we note (Diesel, liquefied petroleum gas, electricity, then gasoline), and we also note that the percentage of dependence on solar energy is small, so there must be projects that encourage an increase in this percentage, especially since the climate in Palestine is good for the exploitation of solar energy.

Electricity consumption

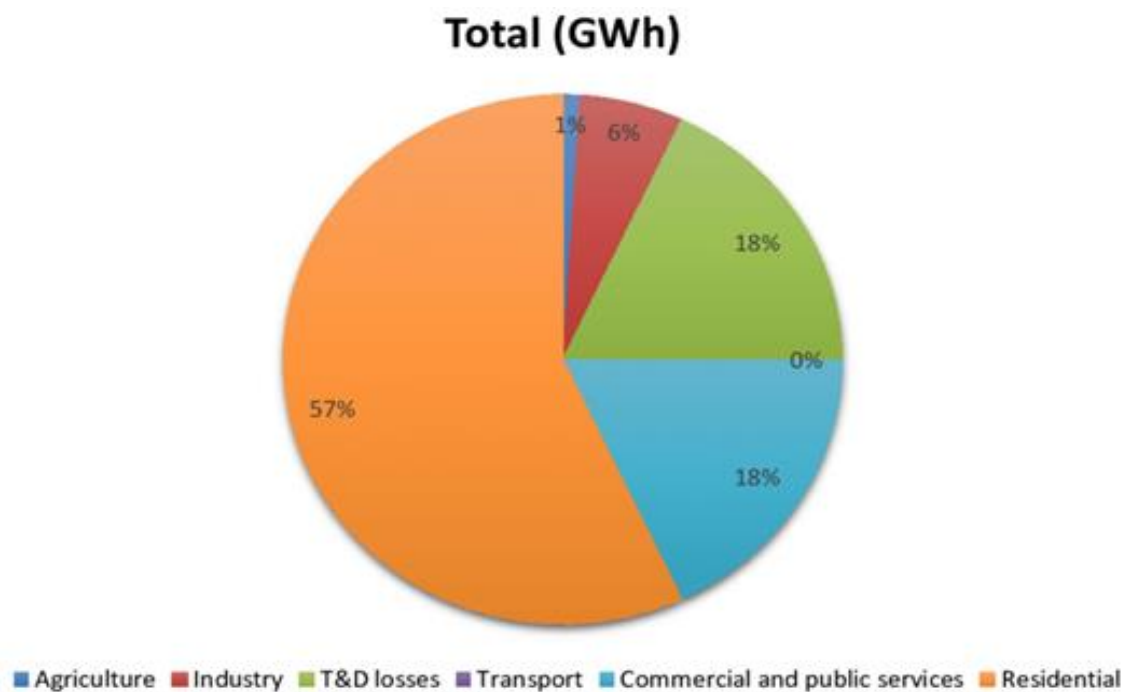


Figure 3: Electricity consumption in different sectors[5]

(Consumption per type of energy – 2013 World Bank own elaboration based on PCBS data)

The attached picture shows that the household sector is the most consuming of electrical energy, as the household sector consumes 57% of electricity. It is followed by the commercial and general services sector, with losses in transmission and distribution estimated at 18%. And 6% for the industrial sector and 1% of the agricultural sector.

Energy consumption

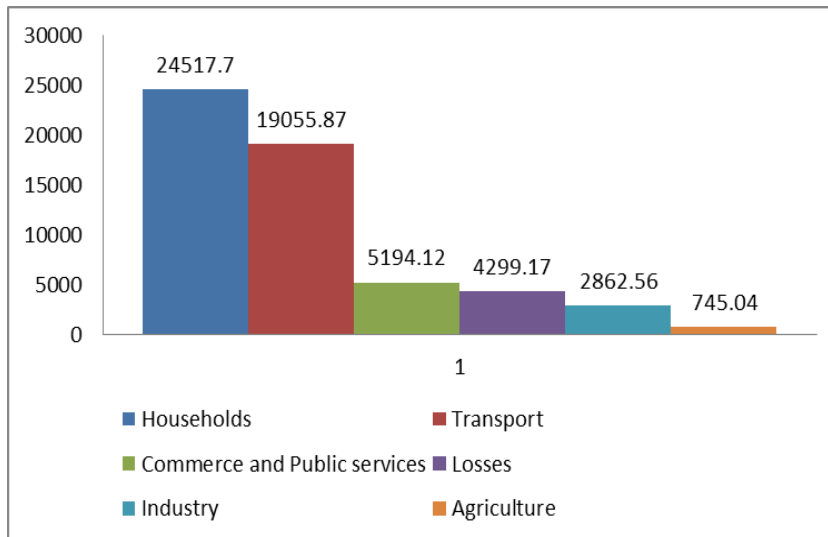


Figure 4: Energy consumption

Energy challenges

The State of Palestine faces various challenges in the energy sector

- The scarcity of traditional energy sources such as oil, gas and electricity and their high prices compared to other countries.
- The occupation policy, which is monopoly in energy prices, when it is allowed to enter, when to prevent and determine the percentage of its availability.
- Occupation control over different lands in Palestine and dividing it into two geographical areas (Gaza Strip and West Bank).
- The restrictions it imposes to limit the work and development of the energy sector.
- Energy uses with low efficiency.
- High losses (technical, administrative).

Chapter III :Constraints and Earlier course- work

3.1 Constraints

The project's limitations were the analysis of recorded data for various sectors, as previous reports lacked primary information about energy systems because the information available was public.

Here lies the difficulty of writing proposals for each system, so the systems were dealt with in general in all sectors due to the lack of information, and this point has been focused on so that future researchers mention this information that helps in its evaluation. Study and understand the content and results.

3.2 Earlier course work

The following courses will be used in the project

Energy and Environment - 10656251

This course deals with energy and environmental systems, conventional and renewable energy sources, the energy situation in Palestine, rationalizing energy consumption on the environment and reducing harmful emissions, and the implications thereof.

Professional Principles in Engineering - 10626301

From a broad perspective, this course introduces basic concepts related to scientific research and technical writing in an engineering environment. This course covers and explains the importance of scientific research and effective professional technical writing.

Energy Efficiency, Auditing, and Laboratory - 10656301

This course forms the basis of this research, as this course included talking about the concepts of energy efficiency, effective management, and rationalization of consumption. Then it provides details explaining the basics of dealing with different systems, calculating their efficiency, and providing them with energy management projects, programs, and equations that help achieve the highest energy efficiency.

Heating, air conditioning, and laboratory - 10621440

This course presents the mechanism of effective design for heating and air conditioning systems, the typical numbers and results that must be relied upon, the mechanisms of rationalizing energy consumption in these systems, and the importance of insulation in reducing losses from the facility.

Solar and wind energy systems - 10656341

This course deals with renewable energy projects and the foundations for the correct design of a highly efficient system

Energy Policy - 10656505

This course talks about the challenges of the energy sector in different countries and then focuses on analyzing the energy policy in Palestine.

Life Cycle and Sustainability Assessment of Energy Systems - 10656402

This course focuses on studying the economic feasibility of projects, as this course helped greatly in analyzing the available reports, and also helps in understanding the percentage of profit from energy conservation projects, their usefulness, and the payback period.

Chapter IV :Literature Review

This study is concerned with identifying the first steps to raise energy efficiency and adopting effective methods. Therefore, it was necessary to study the various effective and clear projects in managing and reviewing energy consumption in the various sectors in Palestine in particular, so that this step would facilitate the establishment of appropriate foundations and standards to raise energy efficiency within each sector and to know the most energy-consuming points and the best ways to address them. Hence, it contributes to increased experience in evaluating energy audit projects.

[15] K. Natarajan, (2015) investigated electrical energy conservation strategies and energy management practices and policies, which enhance the conservation of electrical energy in industries. A three-pronged approach to energy conservation was presented: capacity utilization, fine-tuning, and technology up-gradation.

[16] Alajlan, Smlai, and Elain, (1998) studied the sharp increase in electrical energy consumption in Saudi Arabia and the need for energy efficiency technology. They divided energy efficiency technologies into three main groups; electrical equipment, energy conservation in building (throw thermal insulation to the building envelope), and energy conservation supporting tools (public awareness and information). The researchers estimated that 25% of the new energy generating capacity will be reduced if the three factors were implemented.

[17] Palestinian energy & environment research center, (2011) studied energy consumption for “JACIR PALACE INTERCONTINENTAL HOTEL” in Bethlehem, Palestine, and the possible energy conservation, the study was carried out on the lighting system, boilers, HVAC system, and motors load, they found out there was a good energy-saving opportunity with low-cost investment. The saving was estimated at around 30% with an SPBP of 1.31 years.

[18] M. Sa'di, (2008). The researcher relied on his studies on universities, where he took a sample to study, An-Najah National University, and focused on large colleges (engineering and information technology, science and optics, pharmacy and medicine, fine arts, law, and higher studies), the results showed that the savings rate in the university sector ranges from Between (15-25%), he focused on the most energy-consuming equipment in universities. The energy conservation measures followed by the researcher showed several savings within colleges, 24% in the lighting system, 7% in the cooling system, 5% in the heating system.

In addition to the researchers' design and implementation of an automated lighting control system based on motion sensors And the distribution of daylight and lecture times, this system achieved additional savings of 45%.

[19] B. Da'as (2008), The researcher focused on the hospital sector in Palestine as it is considered one of the most energy-consuming sectors, taking Nablus Governorate hospitals as a sample as it combined government and private hospitals (Al Ittihad Hospital, Arab Specialist, Rafidia, Al Watani) The results of his research showed that energy consumption in government hospitals is higher Much on special for several reasons

The researcher followed in his study on effective standards for energy conservation, as the estimated savings were estimated at (10-25%) in the hospital sector. The researcher was interested in the most energy-consuming equipment in hospitals, as it achieved various savings, 14% in heating and adaptation, 43% in generating units Oxygen, 5% in luminance, 17% in the improvement of power factor.

[20] B. Yassin (2008), the researcher Yassin cared a lot in the industrial sector, as it is considered an important sector in which energy consumption must be managed effectively. Eng. Yassin collected in his study several factories such as (Al-Safa Dairy Factory, Carton Factory, Cedar Ice Cream Factory, and Al-Akkad Textile Factory) so he took the factories for different products, each of which has its equipment for the engineer to come out with comprehensive results for effective energy conservation measures in the factory sector in general.

The results showed that the savings rate in the industrial sector ranges between (10-20%) of the total energy consumption in the sector. The researcher focused on the most consuming points of energy (lighting, boilers, compressors, and power factor). Electricity consumption was 277.8 MWh, and fuel savings were 66,000 liters

[21] A. Tartir (2010), the researcher focused on the trade sector and the Palestinian Telecommunications Company took a sample for the study. This study included most of the energy-consuming devices in the facility such as (lighting, cooling, and air-conditioning systems, office equipment, power factor improvement, rectifiers, and rates), the savings rate reached 15.3%, and the saving in electricity consumption is 1597.76 MWh

Chapter V :Methodology

This part presents the methodology that has been relied upon during the review of literature studies to show effective results based on a scientific basis and prior planning.

Here, the planning and implementation steps for the research that relied entirely on developing knowledge skills in energy audit studies were summarized from beginning to end. This diagram (Figure 5) presents the methodology followed.

Review studies evaluating energy saving projects in various sectors



Figure 5: Methodology Evaluating energy saving project

1- Put a reference: In the beginning, the most important focus was on increasing knowledge in energy consumption assessment projects, what the researchers rely on during their studies, and the effectiveness of those studies, as the focus was on increasing knowledge and experience in several aspects:

1. Many different studies have been read for different sectors, whether on the scale of university student projects or other projects.
2. Review the courses that have been studied during the learning phase that will increase experience in matters of energy management, rationalization, and auditing
3. An overview of the status and energy policy in Palestine and the neighboring countries
4. After that, references were drawn up to be relied upon during the review of the studies applied to the various sectors, so that the focus was on the positives of the references that were relied upon.

2- Study reports: In the beginning, everything that includes each sector and the permissible limit for energy consumption in each sector was identified. Then the available studies were read and two or more samples were identified on each of the sectors that will be worked on (industrial, commercial, education, and hospitals.).

3- Analysis and identification of strengths and weaknesses: After determining the samples that will be worked on, samples are analyzed in detail and the weaknesses and strengths of previous studies are identified and what has been relied upon (hypotheses, values, analyzes, and research methodology). After that, we produced a report explaining the strengths, weaknesses, and deficiencies of each study.

4- Writing results and recommendations: Based on the observations that have been recorded, a report is prepared that clarifies what should be approved and reconsidered in the available projects based on the knowledge that has been focused on raising their level. And points that would achieve more returns in such projects.

Chapter VI :Sectors overview

This report focuses on providing an overview of each of the sectors whose studies will be reviewed. So that the concept of what each sector includes in terms of equipment and devices and the General consumption of the different sectors is expanded. Points to focus on within each sector.

Sectors that will be worked on

Education sector (schools in particular)

Industry sector

Commercial sector

Hospital sector

The report focuses in its content on taking two samples or more on each sector and analyzing them in detail so that the points to focus on in the future is known and where to benefit from renewable energy systems in each sector

Education sector

In general, Palestine contains a large number of educational facilities, whether at the level of (institutes, schools, colleges, and universities). Therefore, reviewing energy consumption audit studies in the education sector has a significant positive impact, whether on the level of energy efficiency or the level of awareness-raising of students in these institutions.

In this study, the focus will be on the school sector in particular as one of the educational establishments

Schools are considered one of the sectors in which energy consumption must be analyzed due to the high rates of consumption and misuse recorded in them.

Therefore, we see many studies and projects concerned with the school sector, whether in the field of raising energy efficiency or increasing students' awareness of energy matters.

Opportunities to raise energy efficiency are available in schools well, and the nature of school attendance helps to achieve a good increase in efficiency, as schools operate at times of availability of natural light that can be exploited greatly, whether on the scale of solar energy systems or exploitation in the natural lighting of halls and corridors. Therefore, it was necessary to focus on every point that contributes to rationalize energy consumption in schools, large and small.

Figure 6 illustrates the general distribution of energy consumption in the different school sector. It appears that lighting systems are the most energy-consuming in the school sector (Lighting system 65% , Heating and air conditioning 7% , Office Equipments 8% ,Others 20%)

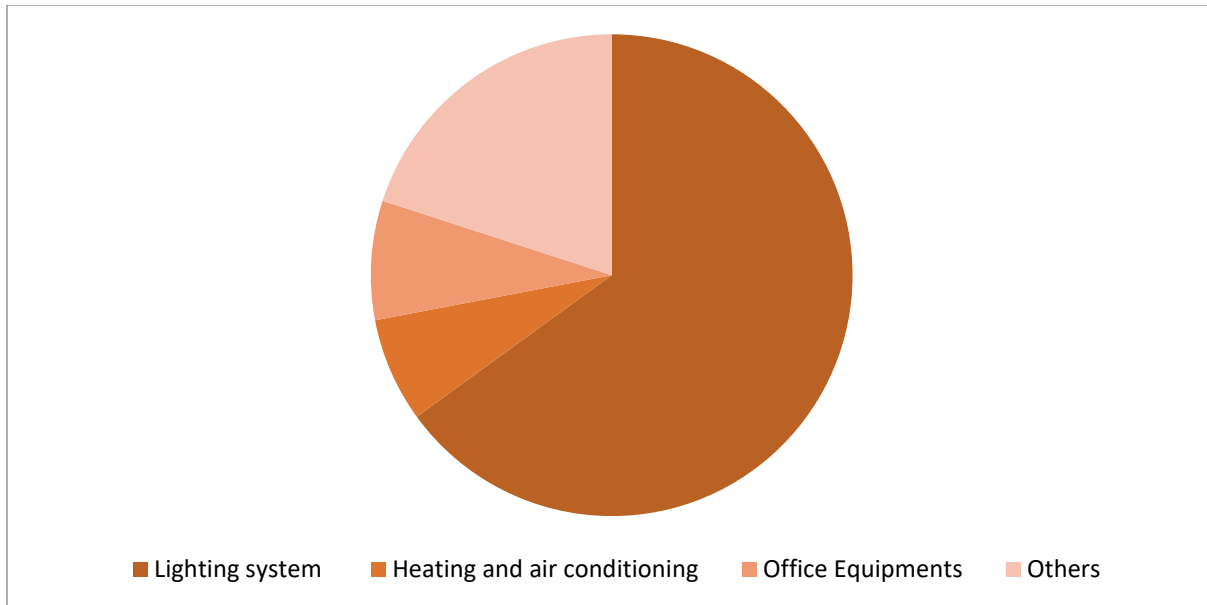


Figure 6: Electrical energy consumption breakdown at the School

Industry sector

The industrial sector in Palestine is considered a diversified sector, as it includes large and small workshops for various industries. It is necessary to focus on studying and analyzing energy consumption in factories, as they are the most places where energy efficiency has to be higher to achieve higher production efficiency in the industry. High energy efficiency has a positive effect on reducing consumption and reducing the bill in addition to reducing pollution and toxic emissions from factories.

The industrial sector relies mainly on electricity, liquefied petroleum gas, and diesel. Therefore, it is necessary to study and analyze previous energy assessment studies in factories, whether small or large, to arrive at effective strategies for rationalizing energy consumption in factories.

Figure 7 shows the distribution of energy consumption in the industrial sector (Compressors 13%, Boiler 25%, Heating and air conditioning 11%, Lighting 15%, Production equipment (factory supplies) 30%, Office equipment 3%)

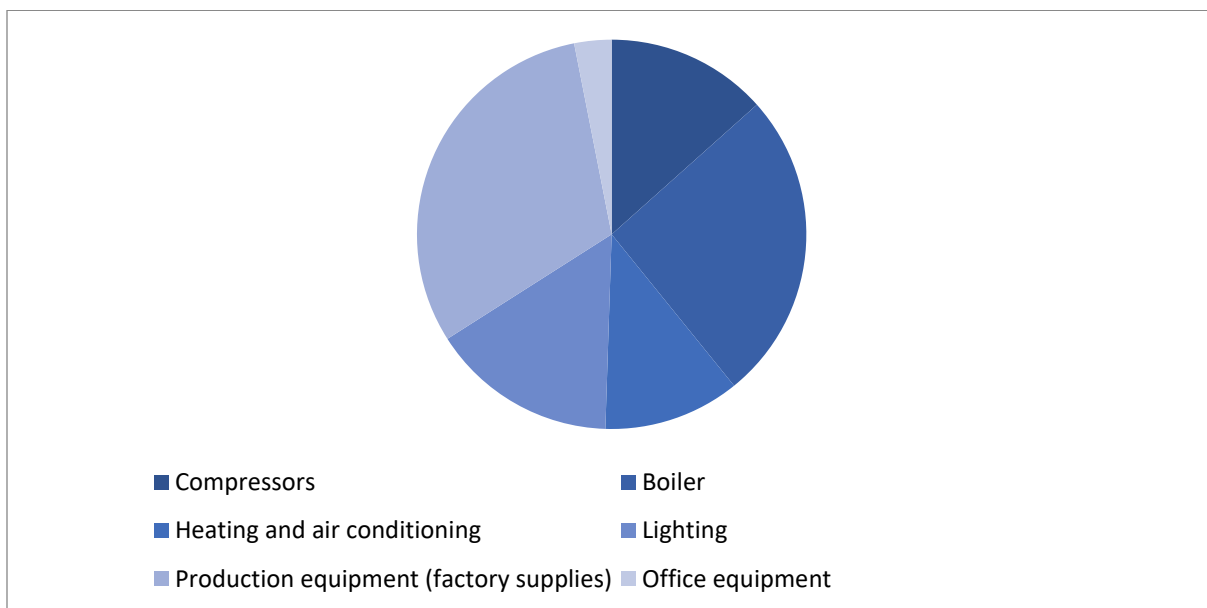


Figure 7: Distribution of electrical energy consumption in factories

Hospital sector

Hospitals in Palestine are divided into governmental and private hospitals, and it is known that hospitals operate 24 hours throughout the year and consume energy greatly, so it was necessary to focus on the necessary measures to conserve energy in this sector.

Figure 8 shows energy consumption in the hospital sector (lighting 15%, air-conditioning, 30%, boiler 25%, office equipment 3%, hospital equipment 25%, others 2%.)

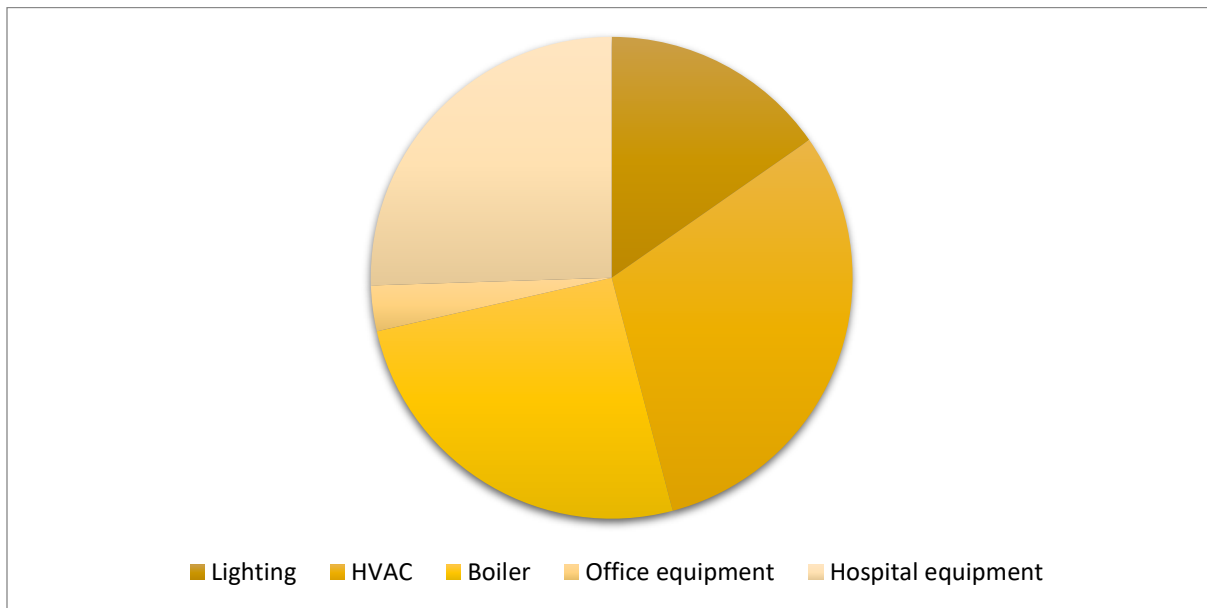


Figure 8: Distribution of electrical energy consumption in the hospital

Commercial Sector

The commercial sector consists of offices, companies, marketing centers, universities, hotels, and restaurants.

The trade sector consumes energy greatly, like air conditioning, lighting, and electrical equipment are among the most energy-consuming systems within the sector, so it was necessary to rely on energy-saving and efficiency measures to be effective in enhancing efficiency levels

Figure 8 shows energy consumption in the Commercial sector. (Lighting 20%, HAVC 35%, Office Equipment 35%, Other 10%)

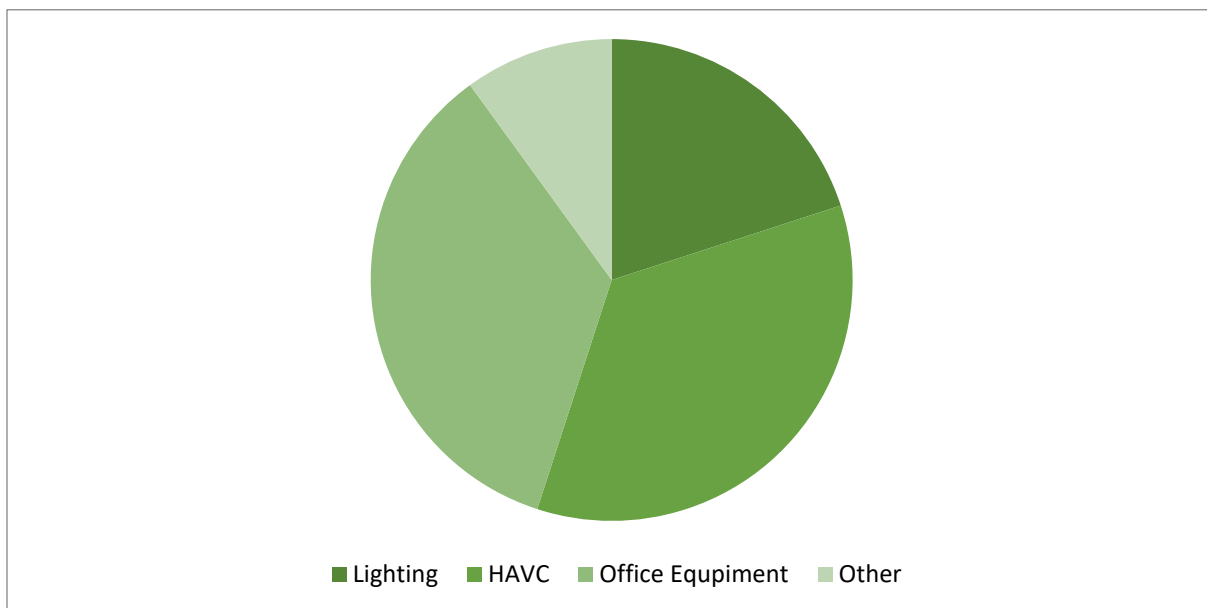


Figure 9: Electrical energy consumption breakdown at the Commercial

Chapter VII: Reviewing energy conservation studies in various sectors

This section forms the heart of the report, as previous studies were collected here so that two or more reports were taken for each facility and analyzed in detail and the main points that the previous report relied on upon solving the problem of energy consumption and evaluating them.

- Part One: simplified points are set to help the review logically and scientifically, as this part shows the mechanism of dealing with each system in general in all sectors
- Part Two: This part shows the gaps and advantages of the previous studies that have been reviewed
- Part Three: This part shows the different sectors and the mechanism of work for them depending on the first part in general. In addition to a simple comparison between previous studies and what should be relied upon.

Part One: An overview of how to deal with systems

This part presents a simplified summary of the reading yield and an increase in the knowledge that was relied upon before starting to review the studies.

Based on the courses that have been studied and the research that has been read, this part clarifies the mechanism of dealing with each system in general in all sectors without entering into the details of the equations and calculations.

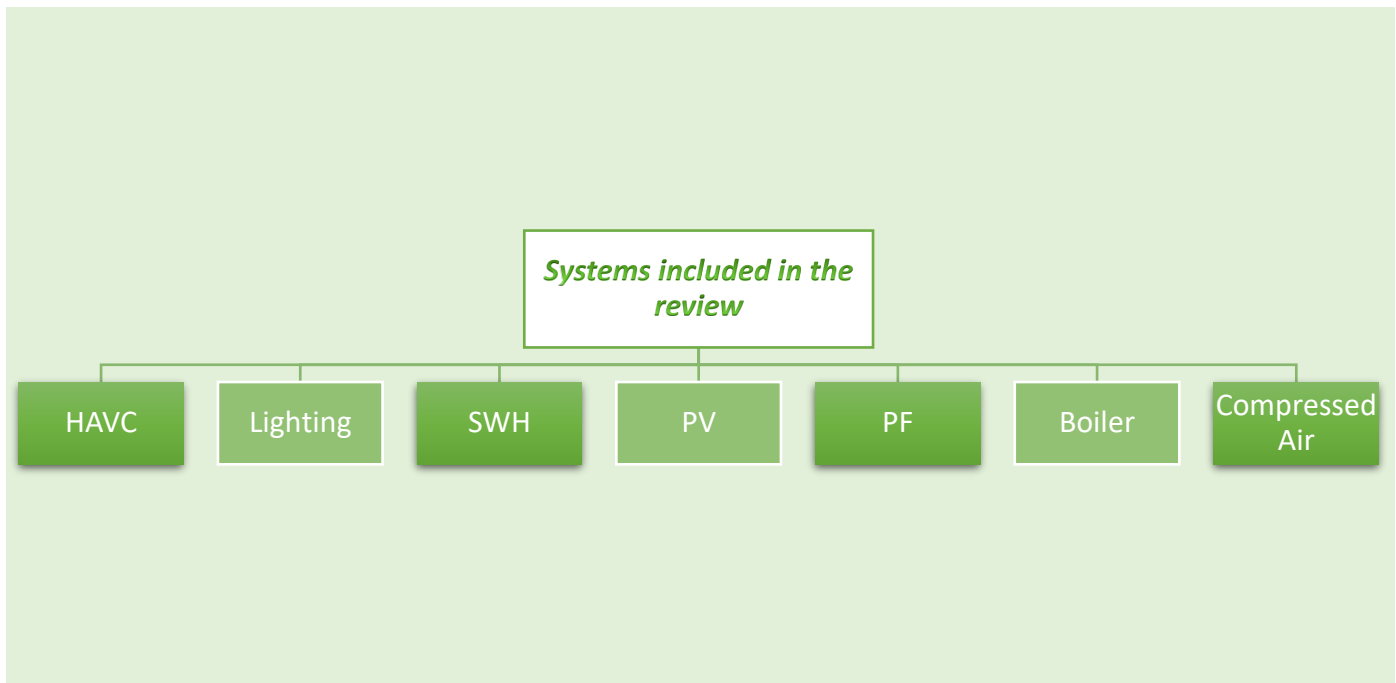


Figure 10: Systems that will be reviewed

Lighting system

The most important thing to know

1. The physical characteristics of the building (number of rooms, size of rooms, location, number of hours in these rooms, the purpose of this room)
2. The ceiling height of the room for the devices to be worked on
3. The type of lamps used and the basis chosen for them (then the lamp data is entered into a special program to verify the number and replace the increase)
4. Where is the light reflected?

Energy conservation recommendations

1. Replace damaged bulbs
2. Relying on regular maintenance
3. Install lamps with higher efficiency
4. Installing reflectors
5. Take advantage of natural sunlight (including adding curtains designed to penetrate the light and exploit natural light in places that allow this, such as corridors from the top)
6. Turn off or reduce the lighting in our corridors in half, so that natural light is available
7. Taking into account the design of the building to complement the design of the building so that it enters the largest amount of light.
8. Relying on control and sensing systems so that the lights are turned off automatically when the room is empty.

Heating and air conditioning systems

Cooling system

The most important thing to know

1. Characteristics of the rooms and their number
2. The number of refrigeration units
3. The Power source in cooling systems (electricity, diesel)
4. The location, number and types of windows ,and doors
5. The number of working hours
6. Number of people in each room (nature of use)
7. Ambient temperatures

Energy conservation recommendations

1. Install the coolant temperature at 22 ° C
2. Repair any faults in windows, closed doors, and HVAC systems
3. Good insulation

Heating system

The system works on diesel fuel in some facilities

The information

1. Characteristics of the room
2. The number, quality, efficiency and characteristics of units
3. Type and price of fuel used

Energy conservation recommendations

1. Increase the system efficiency by controlling the air volume well
2. Regular maintenance
3. Heat recovery from flue gas (economizers)
4. Replace the diesel boiler with a gas boiler

Office equipment

Energy conservation recommendations

1. Use of high-efficiency equipment
2. Follow-up maintenance and periodic inspection of equipment
3. Supervising the operation and shutdown of this equipment
4. Designing a control system so that any equipment that is not being worked on is
5. Shut down.

Solar Water Heater System

Energy conservation recommendations

1. Linking system efficiency with the amount of water to be heated and working hours
2. Continued maintenance of the system to improve efficiency
3. Using highly efficient equipment and effective control devices
4. Ensure the correct design and correct location

Improve the power factor

Power factor is one of the most important things to pay attention to because any defect in the PF value will affect the overall bill, reduce the voltage, and is also an indicator of energy efficiency.

The power factor value is expressed in the ratio of the active power (p) W to the apparent power (S) VA if PF = 90%, it means that 90% of S goes to P and the remaining 10% goes to the reaction (x) rule the video

The preferred value of PF is $0 < PF < 1$. (You pay a fine if the percentage is less than 92%). It is corrected by installing capacitors in parallel to the lighting circuits or motors, etc. (in turn, switches the circuit from the inactive circuit to Resistance).

Benefits of power factor improvement

1. Reducing losses (I^2R)
2. Reducing the bill
3. An increase in the current value
4. Reducing the voltage drop
5. Reducing the burden on electrical cables and equipment, thus extending their service life

The Boiler

The boiler is one of the most energy-consuming inside the factory, so it is necessary to ensure its efficiency as its efficiency can be increased through several plans.

To reduce energy consumption inside the boiler:

1. Increase operating efficiency
2. Periodic maintenance
3. Use more efficient fuel (replacing diesel with gas)
4. Reliance on solar water heating

Boiler efficiency is improved through

1.1 Control the amount of air/oxygen

Controlling the amount of excess air is one of the most important measures to increase the efficiency of the boiler and reduce emissions. We express the excess air as the air necessary to complete the combustion of the fuel inside the boiler. Excess air is controlled by an oxygen

indicator and many boilers are now designed to absorb specific amounts of excess air due to its negative effect on boiler efficiency (if the oxygen level increases, the temperature will rise, fuel consumption increases, and boiler efficiency decreases)

1.2 Heat recovery from flue gas (economizers)

It is used to extract thermal energy from flue gas to heat the boiler feedwater. The only condition to benefit from this step is that the temperature of the exhaust gases (inside the provider) is not lower than the dew point temperature (if it is lower, this will cause calcification and a deficiency of the saver).

1.3 water treatment

In order not to cause the formation of calcifications inside the boiler and reduce its efficiency.

Compressed air systems

One of the things that must be taken care of in factories is compressed air, due to its low efficiency, as its efficiency is estimated at 10% [8]. Therefore, if it is to be used, you must consider the use of necessity and a short time.

Reducing energy consumption in compressed air systems:

1. Reducing leaks in pipes

Leakage in the pipes increases the energy consumption as well as reducing the efficiency of the system tools, thus damaging the production. Therefore, it is necessary

Address these leaks as the rate of leakage from pipes in the factory that is not well maintained (20% -50%), both maintenance and follow-up, leaks will be reduced to 10% [9; 10].

2. The amount of cold air

When a ventilation device is installed to draw air from outside the building, the temperature of the air entering the system will decrease. According to the rule, every drop of 5 ° F (3 ° C) will reduce 1% of compressor strength [12; 13]. This not only saves energy but also increases compressor capacity.

3. Heat recovery for preheating water

The air compressor converts an estimated 80-93% of electrical energy into thermal energy. Therefore, it is necessary to take advantage of this heat either to heat water or places of heating or industrial drying [14]. This scale, recovers up to 20% of the energy of compressed air systems annually for space heating [14].

Solar energy systems

The idea of installing solar energy systems is one of the most important means that reduce the monthly bill in various installations, as the solar system distributes the loads and covers a large proportion of the load, whether on the facility itself or the surrounding areas. . Or return it to the network.

The principle of working solar cells in a simple way is to convert solar energy into electrical energy and use it in daily work to reduce the burden on the main grid and thus reduce the import of electricity and reduce the problems of high bills in various facilities.

In their previous studies, the researchers focused heavily on the importance of installing solar energy systems as a solution to the high consumption of electricity, but the researchers did not mention the points that would raise the efficiency of these systems to ensure they function properly and achieve the desired goal. Where it should be:

1. Well designed with (shade, weather and other factors) in mind
2. The presence of a supervisor with experience in the affairs of the system and its work, who conducts periodic tests to reveal the system's performance
3. Maintenance and periodic inspection of the system
4. Continuous monitoring of system production
5. Not to disrupt the system during vacation days in the facility, but to take advantage of this produced energy (storing it or pumping it into the network)

Part Two: Identify the gaps and positives of previous studies

The gaps in previous studies are generally based on:

- Lack of information available
- General information about the system and the efficiency of the equipment used were not recorded, working hours and other important matters was not specified
- Mathematical equations and scientific drawings were not relied upon. Rather, studies were oral
- Studies consider that the only solution to reduce energy consumption is to install solar energy systems
- The studies did not focus on the importance of monitoring the application of the study

Positives

- The studies recorded the most energy-consuming points for each facility
- Studies have focused on the importance of improving infrastructure and maintenance in general
- Studies have shown that the electricity bill shows the percentage of consumption in each system
- Studies have encouraged reliance on solar energy

Part Three: Work on different sectors

In this part, the different sectors that have been reviewed are presented and what must be worked on in each sector is presented, with a simple mention of what has been worked on in the previous studies of these sectors.

Education Sector

Previous studies in the school sector focused on lighting systems in particular, as it was clear that lighting is the largest system that consumes electricity and is the main reason behind the high electricity bill.

- ☒ The solution: the previous ones relied on building solar cell systems to alleviate the burden of electricity without focusing on the quality of the lighting used, its replacement or maintenance.

This mechanism is considered useless in energy management, as all systems must be taken into account and all necessary information about the available systems must be mentioned so that the economic viability of these systems is verified in case we are forced to replace.

The figure 11 shows the most important energy-consuming systems in the school sector, which must be focused on in the work based on what has been mentioned in this research



Figure 11: Points to be reviewed

Industry sector

The previous studies relied on electricity and fuel bills in general and did not specify the main reasons for the increase in energy consumption within each factory, but rather took generally about the devices available in the factories and boilers.

- ☒ Previous studies suggested improving boiler efficiency and improving plant equipment, infrastructure as a solution to rationalize energy consumption

To achieve high efficiency in the rationalization of energy consumption in factories, it must focus on all points that would reduce general consumption, so that damaged and old systems with low efficiency are replaced, maintenance and isolation of any leaks, reduction of harmful emissions and the introduction of renewable energy to factories.

The figure 12 illustrates the most important focus on the industrial sector.

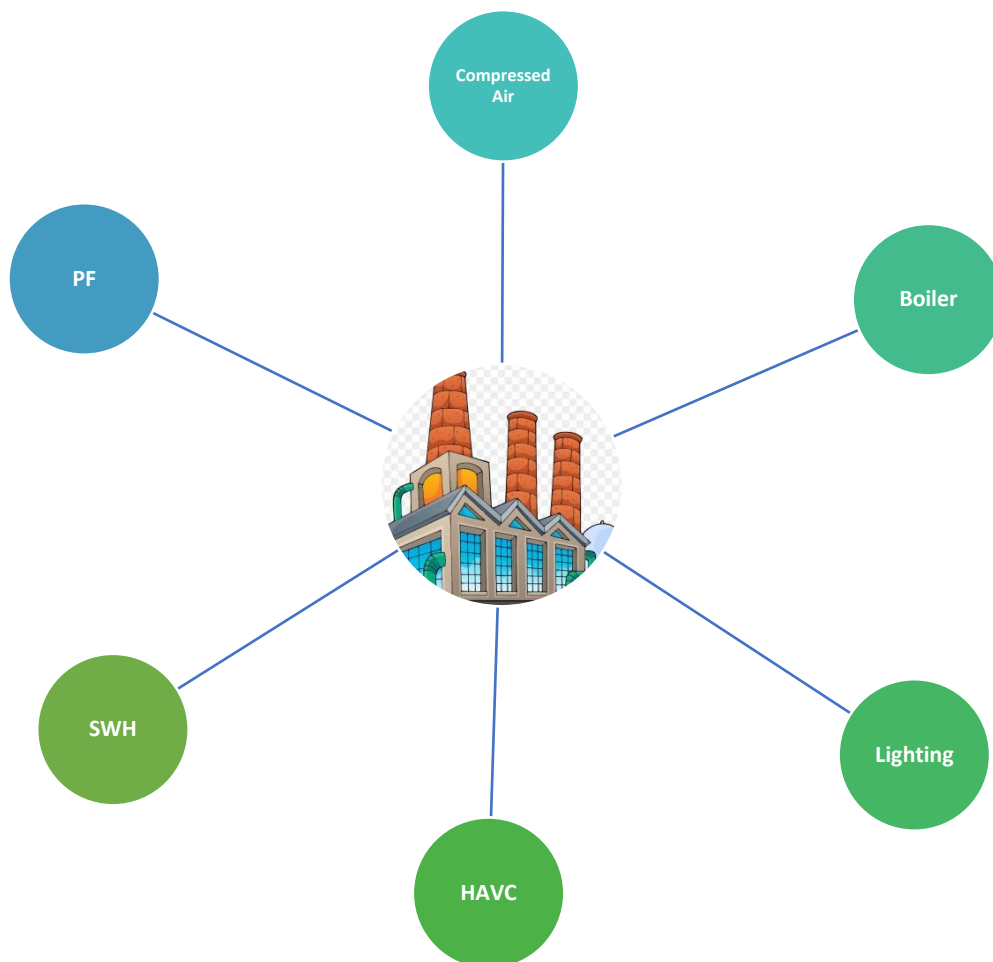


Figure 12: Points to be reviewed

Hospital sector

Previous studies focused on taking complete information about the building and the energy source for each part of the hospital, then clarified the importance of focusing on solar water heating systems and what it saves from the total energy consumption in the building.

- ☒ It was imperative to focus on all parts of the building to achieve the highest rate of energy conservation, not just focus on solar water heating systems.

The figure 13 shows the energy systems included in hospitals that must be studied and analysed to achieve the highest energy efficiency.

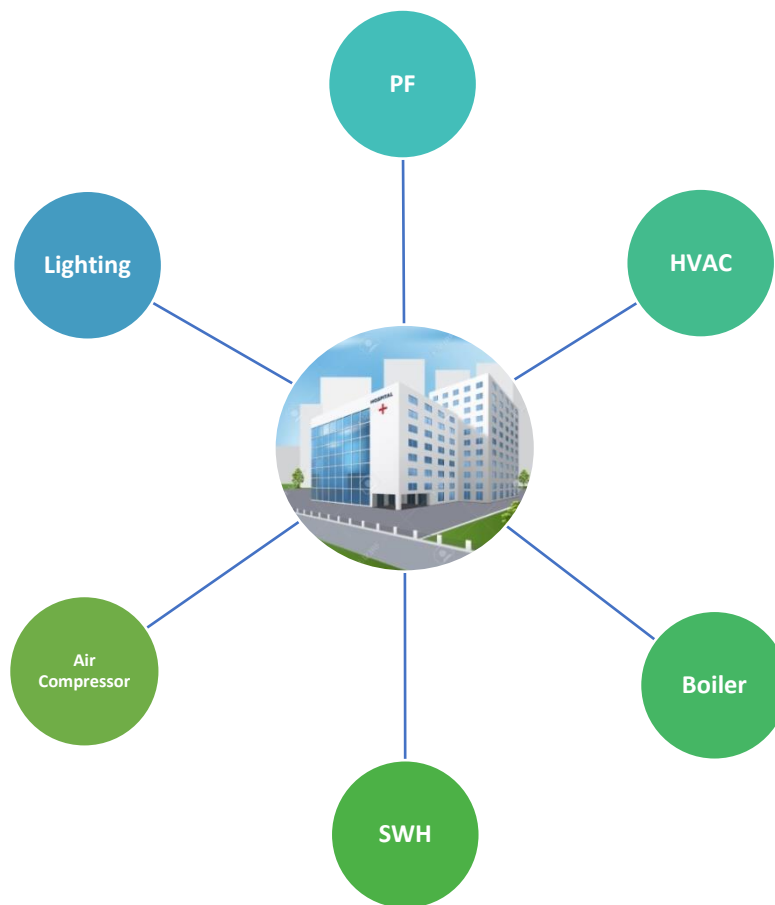


Figure 13: Points to be reviewed

Commercial sector

According to the references read, office equipment, heating and air conditioning systems, were the most energy consuming

- ☒ Therefore, previous studies focused on analysing heating and cooling systems and monitoring maintenance of equipment.

But studies should not be limited only to that, as the focus must be on all systems, replacing damaged systems and raising the efficiency of systems and equipment, in addition to focusing on installing control and sensor systems to close the systems when leaving the facility.

The figure 14 shows the most important focus in the commercial sector.



Figure 14: Points to be reviewed

Chapter VIII: Future Studies

After reviewing previous studies and putting in place some points that should be focused on in future studies, it was necessary to develop a plan that clarifies the mechanism that helps the future researcher to focus on the points that will raise the efficiency of his study in assessing and managing energy consumption in different facilities. see Figure 15.

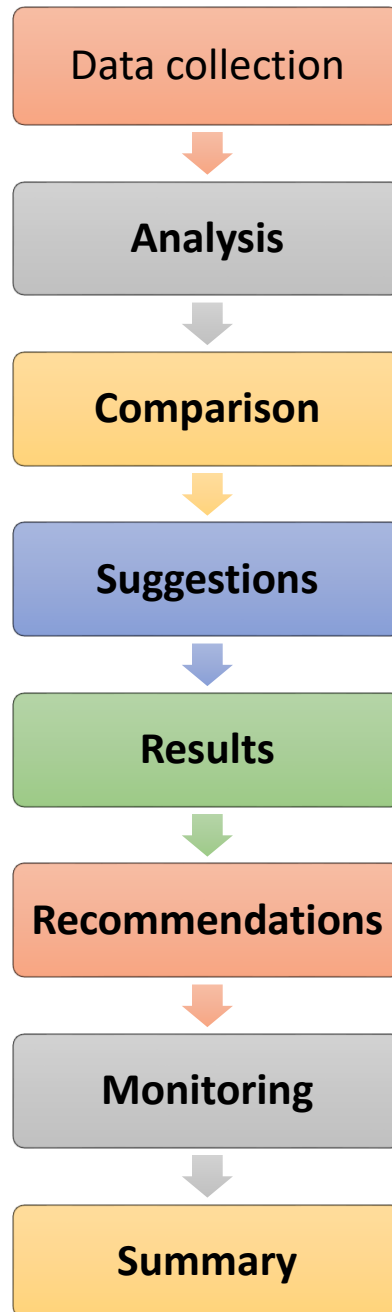


Figure 15: Future Studies Algorithm

✚ Firstly

The researcher takes the facility and records general information about the facility (location, area, hours of operation, etc.).

Each system takes and records its information (working hours, quality, efficiency, nature of use..)

✚ Secondly: Data collection

Systems data are collected in different ways, with an appropriate method for each system

Measuring and recording devices (manually) (temperature, emissions, leaks, light intensity, sound, pressure, output quality ...)

(Theoretically) numbers and values written on the system data sheet

✚ Thirdly: analysis

The researcher begins by analysing the values he collected and using the equations needed to show the results

✚ Fourthly: Comparison

The researcher compares the results of his research with the actual results, indicating the percentage of loss between the available system and the model system.

✚ Fifthly: Suggestions

After comparing the systems and examining the causes of loss, the researcher moves to choosing one of the two methods

Available system maintenance (if the system encounters a minor defect that can be remedied with maintenance and follow-up)

System replacement (when system maintenance stops or system expires)

✚ Sixthly: Results

The researcher records the results and any other suggestions the researcher wishes to add

✚ Seventhly: Recommendations

Developing recommendations for facilities to raise the efficiency of the study

✚ Eighthly: After implementation

Monitoring takes place after the proposed recommendations have been implemented

✚ Ninthly: Summary

Here a summary is recorded that summarizes the status of the originator before and after the study and the challenges that the researcher faced, and this also would enhance and support research and other future research.

Support tools

The researcher can rely on several programs and books that will enhance his study and achieve better results, such as (Plant Energy Profiler Excel), or make an economic feasibility study to show the extent of his success.

Chapter IX: Results & Discussion

When looking at the energy situation in Palestine in general, we see the lack of energy efficiency and the limited resources and what the occupation does in terms of controlling the resources and quantities entering and leaving the Palestinian lands, and on the other hand, we see the increasing population and the increase in energy demand significantly over the past years. Palestine energy consumption and finding effective alternatives

Many researchers interested in energy matters have carried out studies to assess and manage energy consumption in different sectors, including the good and the weak, which need support. Given the effectiveness of these studies in determining the level of energy and consumption rates in different facilities and what can be modified to achieve higher energy efficiency, previous studies had to be reviewed.

The project is based on conducting comprehensive reviews of sectors (education, factories, commercial, and hospitals). Where more than one sample was taken on each sector after increasing knowledge and experience in energy matters, rationalizing consumption and effective activities in this matter. After taking these studies and analyzing them, key points were set that would improve these studies. A scheme was drawn up to help future researchers conduct effective studies on scientific grounds.

The most important results of the review of previous studies

Previous energy consumption assessment studies lack quality and actual work on the ground, as they did not depend on the actual values, numbers and measurements of the systems that were worked on.

After analyzing the reports and re-working on them, it was found that the studies of rationalizing consumption and assessing the general energy situation in the various sectors must include 3 stages

❖ Initial stage (beginning of research and information gathering)

So that the information is collected properly by relying on the measuring devices and the data recorded on the systems

❖ Intermediate stage (analysis and results recording)

This stage includes analyzing and reviewing the collected data, conducting an economic feasibility process that demonstrates the success of each part of the system, comparing available measurements with typical measurements, and recording results and suggestions.

❖ Final stage (submission and follow-up)

The recommendations mentioned here are applied to raise the facility's efficiency, then the study that has been implemented on the ground is followed up and monitoring tours are conducted in the facility to record the extent of compliance. Then the most important points and challenges are recorded to aid in future studies

It is certain that if good work is done on such a review, the efficiency of energy audit projects will increase. These studies constitute reference studies for researchers to know the challenges that they may face, how the researcher should avoid them, and the points that the researcher should focus on.

Perhaps the most important thing that can be applied in these studies, which is still increasing, is to conduct a periodic review of these studies, take advantage of the good points and highlight weaknesses, and how they can be fixed by those with experience. In these matters

Chapter X: Recommendations

After completing the research, it was necessary to develop recommendations for recommendations that would enhance energy efficiency in general in all sectors, as they were:

1. Promote the existence of laws and policies that support projects for rationalizing energy consumption and relying on clean energy
2. Imposing financial fines for establishments with high consumption that do not rely on scientific foundations for their energy consumption and there is great waste
3. Imposing subsidies for energy projects, whether on the scale of studies or the application of feasible studies
4. Conducting monitoring tours on various establishments and assessing their energy efficiency
5. Disseminating awareness campaigns about energy matters and the importance of preserving it
6. Support energy-saving equipment
7. The introduction of control and sensor systems in the power systems to reduce excessive consumption
8. Supporting centres and institutions concerned with raising energy efficiency and clean energy
9. Publishing pictures that raise awareness of energy matters and rationalize consumption in public places
10. Conducting research to review and evaluate energy consumption in different facilities, as well as evaluate such motors to increase efficiency as much as possible

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