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Research Article

Energy Conservation and Management for Houses and Building in Oman-Case study

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Abstract: The interest in energy conservation and management comes from the increased demand on energy in the present day. This issue has become necessary to achieve sustainable development of the society. Energy conservation means the change in the pattern of energy consumption and pursued to reduce the increasing growth in energy consumption. The case of rationalization of energy consumption needs clear mechanisms to address the problem of high consumption rates. Also, the attention should be paid to the transition to a sustainable energy sources that can save energy through natural sources rather than fossil fuels. The energy conservation enlightenment should be promoted among segments of society, whether individuals, families, institutions, and companies to ensure continuity for future generations. The goal of reducing energy consumption can be done in several ways, starting from the design of the building that gets use of the natural energy resources. The employment of thermal insulations at the outer wall is another type of energy conservation. Also, the replacement of bulbs with lamps that consume low power is one of methods of reducing energy consumption. In this paper, the focus was on electrical devices usually used in homes in Oman. Also, the number and types of the used lighting devices were measured, the energy consumed, the number of air conditioners, the number of working hours, and the monthly bill were followed up and recorded. We also conducted a questionnaire to measure the extent of people's knowledge of the importance of energy conservation and ways to preserve it.
Keywords: Energy, management, conservation, rationalization, electricity consumption.

INTRODUCTION

Energy plays a vital and essential role in economic and social development necessary to meet the aspirations of the peoples in achieving a better standard of living. It confirms expectations continuation of the current growth in global energy demand, but the steady increase in consumption in developing countries quickly makes these countries as the largest energy markets countries, as these countries will need massive amounts of them to achieve the continuous development of their peoples.

The rationalization of electric power is one of the most fundamental pillars for optimal utilization of fossil energy sources such as petroleum and its derivatives which are used in power plants which helps in preserving these resources for future generations.

The following two aspects have particular importance of Energy Conservation [2]:
1. Economic factors
2. Environmental impacts

Although the power management has been known over an extended period in the big buildings, it has recently begun in the application at the household level. Most homeowners are not familiar with this term already and follow random and not- thought-out measures to reduce energy consumption. The power management in any building is the core technology that concerned with energy depending on the interactions between the components and parts of the building. As an example of those parts: construction site, walls, windows, doors, the roof of the building; and heating, ventilation, and air conditioning system; and the lighting, and equipment control [3].

As Oman is facing a problem of increasing energy demand and cost and severe environmental results from fossil fuels combustion, the thinking in finding out more solutions that developed as techniques for power management for the sake of saving more

energy. The scientists have focused first on spare parts, materials and locations of homes and ways to be selected for both green energy and fossil energy saving items [4].

The building supposed to be constructed not randomly, so that it is built in a manner to be able to provide services to owners and provide comfort by providing heating, cooling and proper lighting [5]. It should also take into account the saved energy cost, which means that the cost of obtaining the necessary energy for lighting, heating, and cooling. The power consumption can be reduced by a proper design of the windows and the employment of the suitable thermal insulation and the use of low consumption energy resources [6].

The problem in Sultanate of Oman is that a large number of people in it have little knowledge about the importance of energy conservation and the methods to reduce power consumption. Also, they lack to the importance of using the power of nature to limit the damage caused by the increased abnormal use of energy [7 & 8].

The Omani authorities put several projects and plans for the rationalization of energy consumption, for example:

1. A master plan for energy conservation and rationalization of electricity consumption [9].
2. A project evaluation of the readiness of the Sultanate of renewable energy [10].
3. Project of installing solar cells on the roofs of buildings [11].

Also, there were many local initiative studies as:

1. Study the feasibility of producing electricity from solar energy [12 & 13]
2. National Strategy for Energy Project.
3. Study Wind Atlas [14].
4. Electric power generation from the wind project [14].
5. Study the optimal rationalization of energy consumption in the assets of the Authority.

The aim of this study is to provide convenient ways to know how to preserve the energy and its management in the Omani building, thus reducing power consumption. This work is a continuous effort of the Renewable Energy team at Sohar University to increase the education knowledge in renewable energies and saving the Omani, Gulf, and Iraqi environment [15-58].

METHODOLOGY

This study was conducted to reach its aim based on the following methods:

1. **Data Collection From home based**

The investigation of the house design of the house and it is orientation as well as the type of lighting and air condition used in this house. A house was taken as a sample, as it has been communicating with its residents to collect their valuable data.

2. **A comparison between used equipment and saving equipment**

A comparison was conducted between the lighting types used in the home-based concerning energy consumption with the types of lighting portfolio of energy.

SURVEY STUDY

A survey study was prepared as shown in the appendix, which helps us to see under which condition the house owners choose the lighting and air condition. Also, it helps to assess their knowledge about the usefulness of heat insulation.

RESULTS AND DISCUSSIONS

Table 1 represents a comparison between the lightening locally available in Omani markets. The table clarifies that the light-emitting diodes give longer lifetime and approach efficiency for the Incandescent and Fluorescent types. The relatively higher prices make the turnout on it had been lower than other species, although of its longer lifetime. This result indicates a decrease in the citizen consciousness and awareness.

A house in the Al-Hambar village in Sohar was investigated and it was taken as a sample and case study of Omani houses depending on its general design drawings and electrical distribution as illustrated in Table 2. Also, the survey we conducted to identify the prices and features of the electrical bulbs in the market based on the number of lamps, fans, air conditioners and hours of working. In addition to that, we focused on rates of annual consumption in Omani Rial(RO). The RO is equivalent to 1000 Biza (BZ) and 2.57 US Dollar. The electricity sector assigned the Sultanate massive amounts of money each year to cover peak loads, which take only a limited number of hours during the summer. So, it is necessary for citizens to define the importance of rationalization and benefits to deport loads of additional off-peak time, as well as, to follow the rationalization guidance in the use of lighting and electrical appliances, which is beneficial to the citizen and the state.

Table 1: Lighting Comparison

Lighting Type	Efficacy (lumens/ watt)	Lifetime (hours)	Color Rendition Index (CRI)	Color Temperature (K)	Indoors/ Outdoors
Incandescent					
Standard "A" bulb	10–17	750–2500	98–100 (excellent)	2700–2800 (warm)	Indoors/ Outdoors
Energy-Saving Incandescent (or Halogen)	12–22	1,000–4,000	98–100 (excellent)	2900–3200 (warm to neutral)	Indoors/ outdoors
Reflector	12–19	2000–3000	98–100 (excellent)	2800 (warm)	Indoors/ outdoors
Fluorescent					
Straight tube	30–110	7000–24,000	50–90 (fair to good)	2700–6500 (warm to cold)	Indoors/ outdoors
Compact fluorescent lamp (CFL)	50–70	10,000	65–88 (good)	2700–6500 (warm to cold)	Indoors/ outdoors
Circline	40–50	12,000			Indoors
Light-Emitting Diodes					
Cool White LEDs	60–92	25,000–50,000	70–90 (fair to good)	5000 (cold)	Indoors/ outdoors
Warm White LEDs	27–54	25,000–50,000	70–90 (fair to good)	3300 (neutral)	Indoors/ outdoors

Table 2: Electrical distribution

Electric equipment	Number	Energy (KW)	Consume (Hour)	Price (BZ)	Price Consume Daily (BZ)	Price Consume Daily (RO)	Price Consume Monthly (RO)	Price Consume Yearly Yearly (RO)	Price Equipment (RO)	Total Price Consume Yearly For lighting (RO)
Fan	9	0.07	10	10	99	0.099	2.97	35.64		
Air condition	7	1.5	12	10	1820	1.82	54.6	655.2		
Incandescent Lighting	66	0.05	12	10	444.5	0.4445	13.335	160.02	0.2	173.22
Fluorescent double tube Light	2	0.07	12	10	16.5	0.0165	0.495	5.94	1	7.94
Total Price Consume Yearly (RO)								856.8		181.16

Table 3 shows low rates of annual consumption that can be gained through the replacement of bulbs qualities with lower power consumption. Power Management process is an ongoing effort to find better ways to reach the goal, and begin to implement these methods, the follow-up process and the progress made in energy conservation. The power consumption management does not need a long time but needs constant follow-up can get better results in the event of making energy management is part of the daily routine.

Survey Results

A questionnaire was conducted involved ten questions; its output was the following:68% of interviewed people are aware of the amount of energy consumed by lamps, and 12% of them are not. A high proportion of people chose the bulbs types due to its low price, but 6 % of them are looking to save energy. Also, 40% of the respondents used white LEDs (Light Tube).

Regarding the air conditioning, it has been observed that 31% of people use less than six conditioners at home while using 49% more than six conditioners. Some people use a wall air conditioner, but 35% of individuals use the central conditioning and found that 21% of people use both types. Concerning the use of isolation, and a 60% responded that they did not use in their homes, while 10 % think it is critical to use as Table 4 and Fig. 1 reveal.

Table 3: Electrical distribution after reducing the energy

Electric equipment	Number	Energy (KW)	Consume (Hour)	Price (BZ)	Price Consume Daily (BZ)	Price Consume Daily (RO)	Price Consume Monthly (RO)	Price Consume Yearly (RO)	Price Equipment (RO)	Total Price Consume Yearly For lighting (RO)
Fan	9	0.07	8	10	47	0.047	1.41	16.92		
Air condition	7	1.5	9	10	897	0.897	26.91	322.92		
Incandescent Lighting	66	0.012	12	10	100.63	0.10063	3.0189	36.2268	1	102.2268
Fluorescent double tube Light	2	0.012	12	10	2.5	0.0025	0.075	0.9	1	2.9
Total Price Consume Yearly (RO)								376.9668		105.1268

Table 4: The questionnaire results

Question number	Answer 1	Answer 2	Answer 3	Answer 4
Q1	20	50	10	
Q2	22	10	40	8
Q3	41	6	33	
Q4	68	12		
Q5	31	49		
Q6	24	35	21	
Q7	22	45	13	
Q8	12	68		
Q9	10	70		
Q10	20	60		

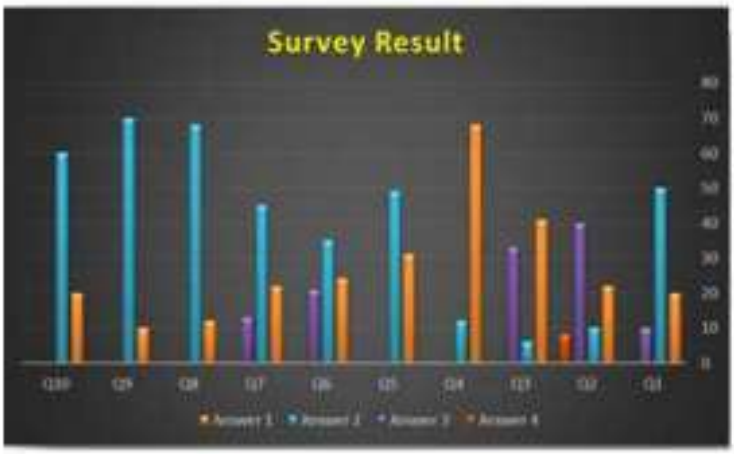

Fig-1: the questionnaire results

CONCLUSIONS

Energy is essential to our daily lives. However, most of us don't use energy as efficiently as we could. By assisting those who use energy (householders, mainly industry and businesses) to be more energy efficient, we can help to reduce the amount of energy we use overall.

In this study and from the site visit to a house in Al-Hambar village we found out that people should take into account the importance of the appropriate design of a house for better energy conservation and management. To achieve that, consideration of a suitable lighting, efficient ventilation, insulation, and usage of GRC can lead to a better level of saving energy.

Besides, the questionnaire survey showed that people need more awareness about the importance of using materials and apparatus that saves energy. For example, if each household in Oman replaced just four 100 watt incandescent light bulbs with 23 watt CFLs, over 292000-kilowatt hours of electricity could be saved each year enough to power more than 60000 homes for a year.

APENDEX I

Questionnaire

Energy Conservation & management in the home

Q1) How many light bulbs used in your home?
- 10 to 15 lamps
- 15 to 25 lamps
- More than 35 lamps

Q2) What type of these bulbs?
- CFL lamps, discount Energy
- Yellow lamps
- White lamps (Tube Light)
- All of the above

Q3) Why is your choice of these types of bulbs?
- Price
- energy saving
- Quality

Q4) Are you familiar with the amount of energy consumed this quality of bulbs?
- Yes
- No

Q5) How many air conditioners in your home?
- Less than 6 conditioners
- More than 6 conditioners

Q6) What kind of air conditioners?
- Conditioner wall
- Central conditioner
- Both

Q7) Why is your choice of this type of air conditioners?
- Price
- Quality
- Energy saving

Q8) Are you familiar with the amount of energy consumed this quality of air conditioners?
- Yes
- No

Q9) Do you think that the use of a thermal insulation important?
- Yes
- No

Q10) Have you ever been used of a thermal insulation during build your home?
- Yes
- No

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