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Survey Study for The Usage of Solar Energy at Household By The Employees of Al-Shifa Medical Complex in Gaza Strip

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Abstract. Providing residences of Gaza with electric power for 24 hours/day is one of the key problems that facing decision-making bodies in energy sector. Most recently, residence in Gaza started to adopt solar energy system as a replacement or as a complementary to the current energy sources. In this paper, we present a survey results that measures the success of using solar energy at homes in Gaza Strip. The study population is the employees of Al-Shifa Medical Complex (about 2000 employees). The questionnaires are distributed to a sample of 10% of the total population. Collected data is analyzed using SPSS. Results show that gender and job titles have no effect of the decision of adopting solar energy systems. However, income has a direct effect on the decision of adopting solar energy systems.

1. Introduction:

Photovoltaic, PV, is a device that converts light from into electrical energy. The main components of solar energy system are Solar Panels, Inverter, Battery Pack, and Charge Controller [1]. For residential use, there are several types of solar systems available in the market to consider. While these are based on different factors like grid connection, material type, battery, and placement, there are three main types of solar power systems: stand- alone systems, grid-connected systems and solar PV hybrid system [2]. Gaza Strip has been suffering from a chronic deficit in electricity since 2006. Around two million people are living on less than 4 hours of electricity a day because of the 61% electricity deficit. Several alternatives, including the use of electric generators, solar panels and uninterruptible power supply units were initiated to overcome electricity shortages, particularly in houses, hospitals and schools. That problem started in 2006, when Israeli forces occupation bombed electricity-generating station located in the central Gaza Strip [3]. The problem is increased due to the tensions between Hamas and Fatah, over custom tax revenue, funding of Gaza, and political authority. Gaza is supplied by three primary sources: Israeli power line (120 MW), Egypt power line (37MW if all lines worked) and the Palestine Electric Company (PEC) power line, and the said quantity depends on the amount of fuel available for the production of electricity [3]. On average, the PEC provides approximately 80 MW or more than 50% of its full capacity of 120 MW. However, PEC currently can provide Gaza only by 54MW.In addition; Israeli line is reduced to 70MW out of its full capacity due to the above-mentioned reasons.

Thus, Gaza Strip receives only 161 MW from all the aforementioned sources. Moreover, Gaza's electricity demands vary seasonally. During the summer and winter months it requires 440 MW. During the rest of the year, it requires 380 MW. Then, irrespective of the seasonal needs, there is a significant deficit between 220 to 280 MW through the course of the year, and this deficit causes recurring interruption of electrical supply to homes and economic and service facilities [3].

In this way, the electricity crisis in Gaza has become one of the outstanding problems that affect various aspects of the lives of the Palestinian citizens. This crisis is also considered as particularly acute due to its impact on the economic and social welfare in the Gaza Strip. In 2012, Ministry of Health started to use solar energy system in several clinics and hospitals, e.g., Children's incubator in ALNASER Hospital, and as a backup electrical source in intensive care unit and operations rooms [4]. Ministry of Education and Higher Education also started to equipped several schools with solar systems, e.g., Bashir Al Rais secondary school for girls and then rolled similar projects to this day. Recently, the Ministry of Education and Higher Education and the Palestine Investment Fund (PIF) signed an agreement to develop and install solar power systems on 500 public schools in west bank and Gaza strip with a total capacity of 35 MW and an investment volume of 35 million dollar [5]. Ministry of Agriculture and the Ministry of the Interior, the local municipalities, universities, factories, stores, and private companies are following the same steps. Most recently, people started to use the system to provide electricity to their private homes or apartments. Gaza Electricity Distribution Corporation (GEDCO) started to encourage people to install their own solar system at their houses by providing solar systems to their customers with installment system to be collected with the monthly bill [6]. In the last few years, little research have been established to study the implementation of solar energy in Palestine and in Gaza Strip in particular. Some studies [7 -13] proposed alternative sources of renewable energy such as solar, wind and sea wave energy. Other researchers (e.g. [14]) developed plans for the construction of solar power plants in the Gaza Strip. In 2016, Adel Juaidi [9] and others analyzed the current energy sector situation in Palestine and highlighted the status of the potential renewable energy (RE) as an essential future energy source in Palestine.

In a previous work by the authors, the motivation for the local institutions to install solar energy is studied [15]. The results of analyzing the collected data show that the local institutions chose to use solar energy regardless to the price due to its environmental value. The results did not depend on the attributes of the institutions and the authors recommend using solar energy as another source of energy [15]. However, this study does not include other sectors in the local society, e.g., household, small shops, and hotels. In this work, authors expand their work to include households. Authors could not find a good reference to the list of people of install solar system at their houses, they decided to choose a close society consists of the workers in Al-Shifa Medical Complex to study the usage of solar system at houses in Gaza strip.

2. Research Problem

The people in Gaza are suffering from power outage. Students at schools and universities have to do their homeworks in 3 hours per day period when electricity is on. Similarly, professors and teachers should use these 3 hours to do all their work duties. As it obvious, this is impossible. Thus, people in Gaza started to adopt solar systems at their houses. The focus of this work is to study the implementation of solar systems by households in Gaza Strip. This research attempts to answer the following main question: "Can solar energy be an alternative to conventional energy for domestic use in Gaza Strip?" In specific, the research problem will answer the following questions: (1) Is the environmental value affects the domestic user's decision to adopt solar energy system?; (2) Is the cost of energy affects the domestic user's decision to adopt solar energy system?; (3) Is solar energy market affects the domestic user's decision to adopt solar energy system?; (4) Are the attributes of domestic users (gender, job title, and income) affect the decision to adopt solar energy system?

Importance of Research: The importance of research stems by providing an accurate information about the use of solar energy at houses by surveying people working at Al-Shifa Medical Complex in Gaza Strip.

Research Objectives: The main objectives of this research are to find out the useful of implementing solar energy system for domestic use in Gaza Strip. The specific objectives of the research can be summarized in the following points; (1) Shine the light on the domestic use of solar energy systems in Gaza Strip, (2) Examine the role of the available solar energy environmental value in the decision of domestic users to adopt this technology, (3) Examine the impact of solar energy marketing in Gaza Strip and its effect on domestic users' decision to adopt solar technology, (4) Find out the effect of the price of the solar energy system on the decision of domestic users to adopt the solar energy system, (5) Find out the effect of different attributes of domestic users (age, sex, income, geographic region, type of house, and house ownership) on adopting solar technology, and (6) Propose solutions and recommendations to avoid most of the gaps and obstacles that affect the willingness of local inhabitants to adopt solar technology.

Variables of Research: Figure 1 defines the independent variables and dependent variable.

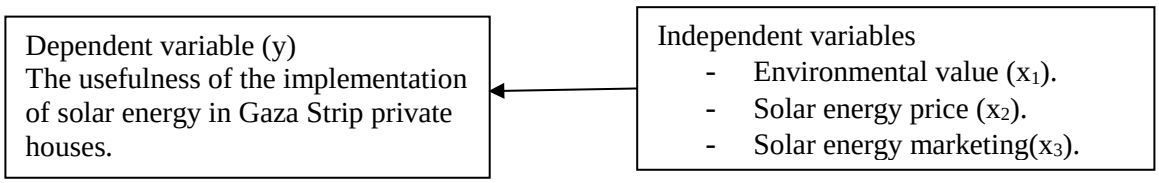

Figure 1. The relation between dependent and independent variables.

Hypothesis: The significance level is measured at $\alpha \leq 0.05$ [16]. (1) There is statistically significant differences in the attitudes of the employees of Al-Shifa Medical Complex in Gaza regarding the success of applying the solar energy technology (environmental benefit, solar energy, market value, total) due to gender variable; (2) There is statistically significant differences in the attitudes of the employees of Al-Shifa Medical Complex in Gaza regarding the success of applying the solar energy technology (environmental benefit, solar energy, market value, total) due to the variable of the job title., (3) There is statistically significant differences in the attitudes of the employees of Al-Shifa Medical Complex in Gaza regarding the success of applying the solar energy technology (environmental benefit, solar energy, market value) due to the variable income level.

3. Methodology

In this section, we present the actions and steps taken in the field study, which addresses the methodology, the community of the study, and the sample of the study. Moreover, we clarify the tools used in the study, their steps, and statistical methods used to analyze the data to reach results and achieve the objectives of the study.

3.1 Study Approach

The researchers followed the analytical descriptive approach that tries to answer the basic question in the science and nature of the phenomenon discussed, including analysis of the phenomenon, its environment, and the relationship between its components.

3.2 The study population

All employees at Al-Shifa Medical Complex, which is 1819 employees (549 doctors, 650 nurses, 370 administrators, 250 technicians)

3.3 The study sample

The sample of the study was about 10% of the total population. 200 employees of Al-Shifa Medical Complex is randomly chosen to fill the questionnaire. 58% of the study sample are male and 42% are

female. Regarding the job title, the sample has the following distribution: 29.5% of the sample works as administrators, 28.5% of the sample are nurses, 15.5% of the sample are programmers or accountants, 13% of the sample are doctors, 8.5% of the sample are technicians and 5% of the sample are engineers.

3.4 The study Tools

The researchers used the questionnaire titled "usefulness of implementing solar energy at Gaza Strip houses". The questionnaire has two main sections. The first section includes personal data for each participant. The second part has 22 items of the questionnaire on a five-point scale: strongly agree, agree, not certain, disagree, and strongly disagree. The second part is divided to three main parts; (1) The First part: Environmental benefit and included 8 items, (2) The second part: The adoption of solar energy and included 9 items, and (3) The third part: The market value of solar energy and included 5 items.

3.4.1 Statistical Analysis. The researchers used the statistical methods of statistical analysis for the Social Sciences (SPSS).The following statistical methods have been used; (1) Descriptive statistics, including the percentage, arithmetic mean, standard deviation and relative arithmetic weight. This is mainly used to determine the frequency of categories of a variable and to describe the variables of the study, (2) Pearson correlation coefficient is to verify the reliability of internal consistency between the items of the questionnaire and the total score of the questionnaire, (3) Cronbach's Alpha coefficient is to determine the stability of the scales, (4) Spearman Brown Split Half is to determine the reliability of the test after changing test length, and (5) One Samples T test is to determine whether the average response level has reached a specific mean of 2 or not.

3.4.2 Research limits. The study identified the following limits; (1) Objective limit: This study is limited to studying the implementation of solar power in the Gaza Strip houses, (2) Spatial limit: study confined in Gaza Strip, (3) Sample limit: The study included only employers at Al-Shifa Medical Complex, and (4) Time limits: This study has conducted in the last quarter of 2017.

4. Research Results and analysis

Results on the main question: Can solar energy be an alternative to conventional energy for domestic use in Gaza Strip? In order to answer this question, the percentage, mean and relative weight of the items of the questionnaire are calculated. The results are exhibited in tables 1, 2 and 3 for the three main parts.

Environmental benefit: After calculating the arithmetic mean, standard deviation and relative weight for environmental benefit, we found that the highest ranked item is item 8: "If the cost of energy is equal to solar and conventional energy, you will choose solar energy" ranked first with a relative weight of 73.10%. and The lowest ranked item is item 6: "You are aware of the environmental risks resulting from the use of traditional energy sources" ranked sixth with a relative weight of 67.60%. The relative weight of the environmental benefit of applying solar technology by the employees of Al-Shifa Medical Complex in Gaza is 69.43%.

The adoption of solar energy: After calculating the arithmetic mean, standard deviation and relative weight of the adoption of solar energy, we realized that the top ranked item is item 11: "The government subsidy, if any, for the prices of solar energy that drives you to adopt it" ranked first with a relative weight of 74.20%. while the lowest ranked item is: item12: "The cost of solar energy is less than the cost of conventional energy in the long term" ranked seventh with a relative weight of 67%. The relative weight of the adoption of solar energy technology in Al-Shifa Medical Complex in Gaza is 67.93%.

Market Value: After calculating arithmetic mean, standard deviation and relative weight, we found that the top ranked item is item 20: "You see the need for specialized governmental centers to research renewable green energy" ranked first with a relative weight of 77%. While the lowest ranked item is item 18: "You see the future of solar energy to replace the place of traditional energy" ranked fourth

with a relative weight of 68.70%. The relative weight of the success of applying the solar energy technology (market value) of the employees of Al-Shifa Medical Complex in Gaza is 72.04%.

Results related to the first hypothesis: To validate the hypothesis, the independent sample t test was used to determine the differences between the two variables. Results of the analysis show that there are no statistically significant differences in the application of solar energy technology (environmental benefit, solar energy, market value, total) by Al-Shifa Medical Complex employees in Gaza due to gender variable.

Results related to the second hypothesis: To validate the hypothesis, the One Way ANOVA test was used to determine the differences between the two variables. The results of the analysis indicates that there are no statistically significant differences at the level of significance of 0.05 in the success of applying solar energy technology (environmental benefit, solar energy, market value, total) in the employees of Al-Shifa Medical Complex in Gaza due to the variable of the job title.

Results related to the third hypothesis: To validate the hypothesis, the One Way ANOVA test was used to determine the differences between the two variables. Results exhibits that there are statistically significant differences in the degree of significance of the application of solar energy technology (environmental benefit, solar energy, market value, total) byAl-Shifa Medical Complex employees in Gaza due to variable income level. To illustrate the differences, the Scheffe' Test and the following results are obtained:

For Environmental benefit, Scheffe' Test presents that there are statistically significant differences at the level of significance of 0.05 among the categories of income level (2000 - 4000, less than 2000) for the category of income level from 2000 NIS to 4000 NIS.

Regarding Adoption Solar Energy, Scheffe' Test shows that there are statistically significant differences at the level of significance of 0.05 among the categories of income level (2000 - 4000, less than 2000) for the category of income level from 2000 NIS to 4000 NIS.

And for Market value, Scheffe' Test presents that there are statistically significant differences at the level of significance of 0.05 among the categories of income level (2000 - 4000, less than 2000) for the category of income level from 2000 NIS to 4000 NIS.

6. Conclusion

In this work, authors studied the reasons behind adopting solar energy systems as an alternative source of energy at households in Gaza Strip. The study conducted on a sample of 200 employees at Al-Shifa medical complex. Different factors are considered in the study including gender, income and job titles. In addition, the study addresses different reasons, which might be the motivation for the households to use solar energy. These reasons are the environmental factor, marketing and prices. The sample members do not use solar energy as a full replacement for traditional energy. The results of analyzing the collected data from the questionnaire using SPSS show that the gender and job titles have no effects on the decision of adopting solar energy. However, income level has impact on the decision of adopting solar energy system. This make sense because the adoption of solar energy needs enough budget no matter what job title or sex a person have.

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