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The requirement to motive the Jordanian citizens to use the solar heaters in Jordanian homes

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Abstract

Jordan's energy sector faces many challenges. The most important of these challenges is to rely on international energy markets through direct imports and to counter the high cost of importing crude oil and oil derivatives. As a result, there is a growing need to focus on renewable energy sources to enhance energy security. This has motived the Hashemite Kingdom of Jordan towards reliance on renewable energy projects as an alternative to traditional energy sources to meet its growing needs in various fields. Solar heaters have proved to be of great benefit as they reduce greenhouse gases, reduce costs and provide hot water for 24 hours in winter and summer. The current research depended on the descriptive approach to achieve the research objectives. The study found that the high prices of solar heaters and the lack of quality of materials used in the manufacture of heaters are the main obstacles that limit the level of citizens' use of solar heaters in homes. The Jordanian industry can increase the Jordanians dependence on solar heaters through providing the solar heater at affordable prices, reducing the initial cost of production, creating a system for installing solar heaters in large buildings, ensuring the efficiency and quality of raw materials used in manufacturing and supporting scientific research in the field of solar water heaters and linking them with individual needs and desires.

Key words: *renewable energy, the Jordanian citizens, solar heaters*

1. Introduction

The lack of local traditional energy resources is considered Jordan's main challenge, where Jordan relying mainly on imported sources of energy, which cover about 95% of its needs. Khaza'aleh (2014) pointed out that the energy sector in Jordan aims to provide energy in all its forms for all uses and at economical cost according to approved standards and specifications. Energy sector also aims to diversify sources and forms of energy and exploit them appropriately, in addition to improving the efficiency of the use and management of energy sources. In an attempt to promote the adoption of solar heaters by Jordanian households, the current research aimed to reveal the requirement to motive the Jordanian citizens to use the solar heaters in Jordanian homes.

It is estimated that the demand for primary energy sources in Jordan will increase by up to 4% per year by 2020, and electricity consumption will grow to 5% annually for the same period. The trend towards renewable energy sources as sources of local resources represents a real investment for the Jordanian environment, but according to the Energy Ministry's 2017 approval, Jordan still imports 94% of its energy despite its continuous efforts to self-reliance. Dependence on local sources of energy production is a global and local trend (Ministry of Energy and Mineral Resources, 2018). Ahmad (2011) stressed that it is possible, through reliance on renewable sources of energy, to affirm the principle of self-reliance.

Meeting the various challenges facing the energy sector in Jordan requires intensifying efforts to secure the supply of oil derivatives by diversifying sources and forms of imported energy, developing local sources of commercial energy, improving the efficiency of energy use in different sectors, and expanding the use of renewable energy. Rahim (2015) pointed out that Jordan, by its geographic location, is rich in solar radiation. The average daily radiation is estimated at about 5 kWh per square meter, and the number of solar clocks is estimated at 3000 hours per year (Report of the Ministry of Energy and Mineral Resources, 2012). If the total energy is calculated on the surface of the Arab world, it will reach 30 kilowatt hours per square meter.

This amount is equivalent to six times the amount of energy available from the estimated total reserves of oil worldwide (Report of the Ministry of Energy and Mineral Resources, 2012). Thus, the demand for renewable clean energy in various daily and industrial activities has recently been seen as the most appropriate alternative to fossil fuels that causes pollution. This demand has led many engineers and researchers to devise many alternative energy tools that can be invested in and benefit communities. These include solar heaters that heat water through solar energy without the need for any other energy sources.

Solar heaters have proved to be of great benefit as they reduce greenhouse gases, reduce costs and provide hot water for 24 hours in winter and summer. In an attempt to promote the adoption of solar heaters by Jordanian households, the current research aims to reveal the requirement to motive the Jordanian citizens to use the solar heaters in Jordanian homes.

1.1. Research problem

Jordan's energy sector faces many challenges. The most important of these challenges is to rely on international energy markets through direct imports and to counter the high cost of importing crude oil and oil derivatives. Steiner (2015) stated that continuing to meet the needs of citizens of oil derivatives, which is expected to exceed the annual growth rate of 3%, and continuing to meet the demand for electricity, and provide the necessary funding to invest in the development of the energy industry and its facilities within the time frames necessary to meet energy needs are from the most important challenges facing the Energy sector in Jordan (Naimat et al., 2008). On the other hand, the prices of crude oil and oil derivatives are increasing in the world markets, which resulted in the formation of a financial burden on the Government of Jordan, where the financial burden in 2013 reached to 4 billion dinars, accounting for about 17% of GDP (Khaza'aleh, 2014).

1.2 Research importance

Research importance highlights from the growing interest in renewable energy sources as an alternative to petroleum energy or fossil fuels in general.

Alternative energy sources are an important means of achieving energy security and many environmental considerations. These considerations led Jordan to rely on renewable energy projects as an alternative to traditional energy sources to meet the increasing energy needs in various fields.

It is hoped that the results of the current research will benefit the following parties:

1. The Jordanian government: through providing an idea of what the Jordanian government can do to encourage citizens to expand the use of solar heaters in a way that positively reflects on the national economy.
2. Jordanian families: by clarifying the ways to take advantage of solar energy in heating water in homes and to clarify the expected economic feasibility resulted from its use.
3. The private sector: In terms of clarifying ways to improve the quality of the products so that the Jordanian citizen is convinced of the importance of transition to the use of solar heaters as an alternative to the systems currently adopted, thus reducing dependence on imported energy sources.

2. Research methodology

The current research will depend on the descriptive approach by identifying the reality of the energy sector in Jordan, clarifying the role of renewable energy in meeting the energy needs in Jordan, as well as determining the requirements to encourage Jordanian citizens to use solar heaters in Jordanian homes.

3. Energy Sector in Jordan

The cost of imported energy for 2014 amounted to about 6 billion dollars, which accounts for 20 percent of the gross domestic product. This has affected on the state budget and the Jordanian economy. Jordan is exerting great efforts to exploit the available domestic sources of energy, renewable energy sources and oil shale to generate electricity or distillate for the production of oil.

Jordan is at the forefront of the Arab countries that have developed legal, legislative and regulatory frameworks to exploit renewable energy for electricity generation. In 2015, Jordan has signed many agreements of projects to generate electricity from solar and wind power with many international companies with a capacity of 500 MW.

The annual increase in population and the high rate of economic growth increase the level of demand for energy in Jordan. This can be noticed through increased demand for primary energy and electricity consumed. Primary energy demand in Jordan is expected to grow at an annual rate of 5.5%, bringing the demand for primary energy to 15 million tons by 2020 (Naimat et al., 2008). According to figures available to the electricity company, the maximum load increased from 1710 MW in 2005 to 2299 MW in 2010 and it is expected to increase to 3249 MW in 2020, at an annual rate of 4.4% (Naimat et al., 2008).

The energy sector strategy for the period 2015-2025 seeks to secure the supply of energy needed for sustainable development, increasing the contribution of domestic energy sources and reducing dependence on imports, as well as reducing the cost of energy on the national economy (Ministry of Energy and Mineral Resources, 2019). All this requires the need to find ways and strategies through which to increase the dependence on renewable sources of energy and maximize its exploitation.

4. Renewable Energy Sector in Jordan

Renewable energy is defined as the energy produced by non-desolate natural resources, including solar, wind, bioenergy and hydropower (Baniyounes, 2017). Renewable energy interest in Jordan dates back to the beginning of the 1970s with the rise in oil prices. An energy center was established at the Royal Scientific Society. The center specialized in introducing the solar heater to Jordan through the development of a prototype. After that, the use of solar heaters spread until the number of households owning solar heaters reached about 20% of the households in Jordan in the early 1980s (Khaza'aleh, 2014).

In 2007, the Royal Energy Commission worked on updating the National Energy Strategy, covering the years 2007-2020. This strategy aims to increase reliance on local energy sources, so that the proportion of renewable energy dependence in 2016 will reach 7% and in 2020 to 10%. In 2013, the real trend towards large-scale projects to produce renewable energy began. In 2015, the National Energy Strategy for the period 2007-2020 was updated, which included increasing reliance on renewable energy sources in 2025 to 9% (Khaza'aleh, 2014).

Water, solar and wind are among the most important sources of renewable and exploited energy in the world. Jordan has been trying to exploit these resources for decades. Jordan has been able to complete several small pilot projects in the fields of renewable energy. Moreover, Jordan has some of energy sources that can be used instead of oil if the appropriate technical and economic conditions are available to exploit them. Oily rocks are one of these sources. These rocks are considered sedimentary rocks containing a proportion of heavy organic hydrocarbons. The reserves of oily rocks in Jordan are estimated at 40-50 billion tons. These reserves are distributed among several sites, most notably the Al-Lujun, Suwaqah, Al-Sultani and Wadi Al-Maghar regions in the center of the Kingdom (Baniyounes, 2017).

Despite the difficult economic conditions experienced by the Jordanian economy, it remains committed to finding ways to diversify energy sources and make renewable energy and clean technologies a viable and complementary alternative to conventional energy. In Jordan, renewable energy faces a number of challenges, the most important of which are (Naimat et al., 2008):

a) Technology: This includes the level of possession of systems and materials to use the energy from the sun and wind effectively and distributed for use in homes, offices and commercial centers.
b) Weak localization of the renewable energy industry and linking it to the human and natural resources of wind and solar energy. Poppi (2017) pointed out that the modern technologies required for renewable energy are very limited.

Renewable energy represents 20% of the global energy market, where the bulk of it is related to hydropower, as solar, wind, biofuels and supply chains all face the challenge of its small size of market compared to various conventional fuels. This is in addition to the obstacles related to the investment needed to develop the infrastructure.

c) Policy constraints: The international community recognizes and is committed to working on solutions to global warming, resource depletion and energy security, but the biggest challenge is to find the best ways to use policy instruments such as incentives, taxes, legislation and laws to build technology development and reduce its negative effects (if any). This may take many years to find solutions to these various challenges. () argued that there are a number of important catalysts to be achieved, as achieving these catalysts means that Jordan is able to succeed in this area. The most important of these catalysts is the ability to store energy.

Thus, being able to meet Jordan's economic challenges in the renewable energy sector means being able to meet those fundamental challenges.

5. Solar heaters industry in Jordan

The solar heaters industry began in the mid-seventies; this indicates that the solar heaters industry is a medium-sized industry compared to other industries and not new industries in Jordan. Naimat et al. (2008) found that about 66% of the companies that manufacture solar collectors are in the category of small-sized companies with a capital of between 20,000 and 30 thousand Jordanian dinars. This confirms that the solar heaters industry in Jordan is considered a small industry in comparison with other industries.

Statistics show that 80% of the solar heaters factories have a production capacity of 50,000 to 80,000 heaters per year, which indicates the low productivity of the factories (Naimat et al., 2008).

In general, many production inputs are involved in the manufacture of solar heaters that may be primary or intermediate, including:

1. Galvanized sheet for outer box, where 10% of factories use aluminum for outer box.
2. Water pipes.
3. Thermal insulation
4. Paint.
5. The glass.

Since most of the factories are small, they do not import these resources directly, but they are obtained from the local market and from the traders who import them for this purpose, which makes it more difficult to separate the production inputs used in the manufacture of solar heaters and other uses. In general, factories in Jordan complain about a range of issues related to primary resources, including (Naimat et al., 2008):

1. The high cost of primary resources, especially the manufacture of galvanized sheets and water pipes, as high prices increase the final price of the solar heater and thus reduce the amount of purchase.
2. The fluctuation of the prices of raw materials, which affects the amount of production of solar heaters.
3. Imposing a sales tax on solar heaters which affects the final price of the solar heater and increases its price.
4. The use of raw materials of low quality, which affects the specifications of the solar heater, harms the local industry and reduces the proportion of demand for solar heater

On the other hand, solar heaters suffer from a range of technical problems associated with their manufacture, which are the problems of glass breakage, calcification, and rust.

These problems are caused by a range of errors committed during the manufacturing process, which include (Naimat et al., 2008):

1. Lack of special valves to empty the air.
2. Lack of sufficient space for heat absorption efficiency, as few tubes are used inside the solar heater in addition to increasing the distances between the pipes, which reduces the efficiency of heat absorption, especially in winter.
3. The lack of a pretreatment stage of cleaning and drying before the paint boiler.
4. The use of low-efficiency raw materials, such as glass with low thickness and bad types of galvanized sheets, which leads to the breakage of glass.
5. Lack of sealing or isolation of external elements during the manufacturing process, which leads to disruption in the manufacture of solar heaters and increases the possibility of leakage of pipes, thus reducing the efficiency of the heater.
6. The absence of a comprehensive study on the insulating materials used, where the use of approximate and inaccurate thicknesses reduces insulation efficiency.

Citizens are also engaged in various malpractice practices that lead to the destruction of solar heaters, which include:

1. The required number of mirrors is not specified when installing the solar water heater.
2. Place the hot water tank cylinder at a low level for the mirrors, which reduces the volume of hot water used.
3. Feeding the tank mirrors with cold water which affects the efficiency of the solar heater.
4. Lack of attention to barriers in the station that prevent the absorption of solar radiation as required.

   It is worth mentioning that The Institution for Standards and Metrology (GSO) provides a set of specifications for the inspection of solar water heaters. These specifications are not mandatory but optional for controlling the quality of solar heaters.

6. Motivating the Jordanian citizens to use the solar heaters in Jordanian homes

The domestic solar heaters industry in Jordan is exposed to many problems that hinder the production process and reduce the sale rate of solar heaters. It is worth mentioning that the Council of Ministers, in its resolution 898 at the session held in 2008, introduced wide exemptions on customs duties and subjected the general sales tax to zero on equipment, appliances and parts for energy conservation and renewable energy. In general, a range of suggestions could be made to encourage the solar heaters industry in Jordan, including:

1. Develop systems to control the quality of the manufacturing and give quality marks to factories that comply with Jordanian specifications and standards.
2. Create a fund to support solar water heaters, which works to give soft loans to buy solar heaters of quality conforming to Jordanian specifications.
3. Reduce the roofing tax for homes that are committed to placing solar heaters.
4. Exemption of solar heaters from sales taxes.
5. Conducting a national campaign to educate citizens about the importance of solar heaters and the amount of savings they provide to Jordanian families.

It is also important to present a set of proposals to the Jordanian industry through which Jordanians can increase their dependence on solar heaters and consider them as prerequisites to motivate the Jordanian people to use solar heaters in their homes, including:

1. Provision of solar heater at affordable prices.
2. Reduce the initial cost of production and pay attention to the quality of materials entering the manufacturing process.
3. Develop homemade solar heaters and reduce their size and raise their efficiency so as not to require much space on the roof of the house.
4. Creating a system for installing solar heaters in large buildings.
5. Creating effective solar heating systems especially in winter.

6. Looking for new marketing strategies for marketing solar heaters due to the loss of the link between citizens and factories for solar heaters.
7. Create a national fund to support the purchase of solar heaters according to the requirements of the Jordanian standard.
8. Supporting scientific research in the field of solar water heaters and linking them with individual needs and desires.

7. Conclusion

The results of the research showed an increase in the volume of consumption on all forms of energy in addition to increasing the volume of current and future demand and the growth rate of consumption. This confirms the problem of the lack of domestic energy or the inability of local production to bridge the large gap between domestic production and the volume of imports of oil and gas, thus increasing pressure on the Jordanian energy balance. As a result, there is a growing need to focus on renewable energy sources to enhance energy security. This has motived the Kingdom towards reliance on renewable energy projects as an alternative to traditional energy sources to meet its growing needs in various fields.

Water, solar and wind are among the most important sources of renewable and exploited energy in the world. Solar heaters have proved to be of great benefit as they reduce greenhouse gases, reduce costs and provide hot water for 24 hours in winter and summer. On the other hand, solar heaters suffer from a range of technical problems associated with their manufacture, which are the problems of glass breakage, calcification, and rust. Citizens are also engaged in various malpractice practices that lead to the destruction of solar heaters. The domestic solar heaters industry in Jordan is exposed to many problems that hinder the production process and reduce the sale rate of solar heaters. The high prices of solar heaters and the lack of quality of materials used in the manufacture of heaters are the main obstacles that limit the level of citizens' use of solar heaters in homes.

The Jordanian industry can increase the Jordanians dependence on solar heaters through providing the solar heater at affordable prices, reducing the initial cost of production, creating a system for installing solar heaters in large buildings, ensuring the efficiency and quality of raw materials used in manufacturing and supporting scientific research in the field of solar water heaters and linking them with individual needs and desires.

References

- Ahmad, A. (2011). Renewable and alternative energy and prospects for use in the Arab world. Oman Jordan.
- Baniyounes, A. (2017). Renewable energy potential in Jordan. International Journal of Applied Engineering Research 12(19):8323-8331.
- Khaza'aleh, H. (2014). Renewable Energy between the Strategic Option and the Jordanian Economic Reality. International Studies and Agreements Unit. Department of Studies and Training, Amman Chamber of Commerce.
- Ministry of Energy and Mineral Resources (2018). Energy Facts and Figures, http://www.memr.gov.jo/EchoBusV3.0/SystemAssets/PDFs/AR/BruchureA%202018.pdf
- Ministry of Energy and Mineral Resources (2019). Energy sector strategy for the period 2015-2025. Available at: https://www.memr.gov.jo/Pages/viewpage.aspx?pageID=276.
- Naimat, A., Al-Batayneh, N., Al-louzi, A. and Khreisat, A. (2008). MEANS TO ENCOURAGE THE EXPAND OF SOLAR HEATERS IN JORDAN. Royal Scientific Society Marketing and International Public Relations Department Industrial Studies Division.
- Poppi, S. (2017). Solar heat pump systems for heating applications Analysis of system performance and possible solutions for improving system performance. KTH Royal Institute of Technology School of Industrial Engineering and Management Department of Energy Technology.

- Rahim, N. (2015). THE ENERGY SECTOR IN JORDAN. Nada Abdul Rahim - Brussels Invest & Export Embassy of Belgium Beirut – Lebanon. Available at: http://invest-export.brussels/documents/16349/1140680/2015+-+Jordan%27s+energy+sector.pdf/920340a4-ee7d-4022-a386-947dd8bdbe96.
- Report of the Ministry of Energy and Mineral Resources on electricity consumption in Jordan (2012). Department of Energy Statistics.
- Steiner, J. (2015). ENERGY SECURITY IN JORDAN. Thesis, NAVAL POSTGRADUATE SCHOOL MONTEREY, CALIFORNIA.