J Biochem Tech (2020) Special Issue (1): 35-44
ISSN: 0974-2328

The Role of Factors Influencing Non-Use of Solar Energy in Residential Regions Based on Roger's Diffusion of Innovation Theory (Case Study: Ardabil)

Maryam Jami Odolou, Mohammad Hasan Yazdani*

Received: 04 August 2019 / Received in revised form: 19 November 2019, Accepted: 26 November 2019, Published online: 25 January 2020

Abstract

Solar energy has drawn a lot of attentions more than ever before as an alternative to fossil fuels for its unique advantages as cheapness, creating no pollution, being unlimited and endless and its exertion of no negative effect on the environment. But, despite Iran's favorable geographical position, the use of this energy has been limited. Therefore, the present study aims at investigating the role of factors influencing non-use of solar energy in residential regions based on Roger's diffusion of innovation theory. The theoretical framework used is based on prior domestic and foreign research and a combination of sociological theories. The study method is qualitative based on grounded theory. The required data have been collected based on field method and the sampling was carried out through purposive sampling method so that 10 experts and specialists of solar energy were participated. All of the interviews were made based on a semi-structured method. Moreover, comparative analysis was the method of choice for analyzing the data. The results obtained from the interviews indicated that eight indicators, namely instructional, economic, social and cultural, technical, legal, managerial, policy-making and attitudinal barriers, are amongst the reasons for non-use of solar energy as pinpointed by the group of the experts and specialists. According to the present study's findings based on the experts' notions regarding non-use of solar energy in residential regions, it can be stated that the results of the current research paper are consistent with what has been found in research conducted by Abdousi, SANA experts, Cotler and UN's development program and also that the instructional, economic, social and cultural, technical, legal, managerial, policy-making and attitudinal subjects are the most important indicators of making non-use of solar energy in the society for the case study of Ardabil.

Key words: solar energy, innovation diffusion, barriers to the use of solar energy, grounded theory, Ardabil.

Introduction

During the recent centuries, the discovery and use of such resources as coal, oil and gas and the parallel increase in population and immethodical use of such non-renewable sources by human beings have caused a gradual decrease in the amount of these reservoirs and they are facing termination. The gradual reduction in the common energies (fossil fuels), population growth and rapid economic progresses have rendered it inescapable to bring about changes in production systems and transform the current energies. Due to the same reason, efforts have been made in line with saving fossil energies and preventing bioenvironmental pollutions for exploiting the resources that are renewable and harm the environment to a lesser degree. Amongst these resources, wind, solar, geothermal, biomass and water energies can be pointed out. Such energies are known as new energies and do not cause any pollution to air, water and soil and contribute to the stabilization of weather and preservation of the earth temperature (Abval Sheikhi, 2009).

In addition, one of the most primary indicators of the countries' national security is the access to the required energy. Any fault in the energy supply system would exert non-compensable effects on all of the economic and social sectors (Alimardani, 2010). Energy is one of the most important factors of the progress and development in the human communities; amongst the human-related factors, production, transmission and consumption of various energy types are the most important ones giving rise to the destruction and pollution of the environment (Azizi and Faryadi, 2012).

There is no doubt that only a few of the new energies would be usable by the mankind in the upcoming decades; among which, the sun's radiant energy can play an essential role in energy supply due to possession of such abundant advantages as being accompanied with no harmful bioenvironmental effects and its accessibility by the general public (Jahanbakhsh and Edalatdoust, 2009). In fact, solar energy is the most important renewable source of energy available to earth that, unlike fossil fuels, does not create pollution. The amount of energy

Maryam Jami Odolou
MA graduate, Department of Geography and Urban Planning, University of Mohaghegh Ardabili, Ardabil, Iran.

Mohammad Hasan Yazdani*
Associate professor, Department of Geography and Urban Planning, University of Mohaghegh Ardabili, Ardabil, Iran.

***Email :**yazdani.m51@gmail.com

reached earth every year is about 4×10 to the power of 24 joules; it means that it is ten thousand times larger than all of the energies consumed in the world (Hosseinzadeh and Afshar, 2006). Solar energy is one of the most common renewable energies. This type of energy can be converted into electrical energy by curbing the radiant and thermal energy of the sun to be finally used by the exploiters. Of course, the sun's thermal energy can be occasionally used directly. The substantial advantage of this type of energy lies in its stability and cost-effectiveness (Wee et al., 2012).

Iran is generally a very sunny country and it is enumerated amongst the best countries in terms of the amount of radiant energy it receives. The sun's abundant and endless energy has been spread all around the country without any need for huge and costly transmission and distribution networks (Haj Saqati, 2001). Moreover, Iran is situated between 25º to 40º of the northern latitude and in a region that is in the highest ranks amongst the various spots around the globe in terms of the amount of solar energy it can receive. The amount of the sun's energy irradiation in Iran ranges between 1800 to 2200 kilowatt hours per square meter per year and it is, of course, higher than the global average. There are reported over 280 sunny days for Iran on an average yearly basis and it is very notable but, in spite of such natural competencies, this energy has not been used in Iran except for a few cases and, as it is shown in the research literature, reactions are exhibited upon encountering a novel matter and its diffusion has to be carried out through certain mechanisms. According to the fact that there is no specific theory regarding such a topic as modern technology (solar energy) based on which a research model and the corresponding variables can be extracted, the current research paper uses the theoretical and sociological perspectives to come up with the following theoretical framework. "Everett Roger's diffusion theory" holds that five stages, named awareness, motivation, decision, implementation and acceptance, should be taken by the individuals (citizens) within a given period of time for the diffusion of a technology of a type (such as solar technology) and reaching a stage of acceptance and application.

The most essential theories related to diffusion and promulgation of a sort of technology amongst the members of a social system have been proposed by the diffusion theories. Amongst these innovation diffusion theoreticians, as well, Everett Rogers et al. (1990) have performed the most important and the most outstanding works. This diffusion theory investigates the social process of the innovations including the novel ideas and methods, use of instruments and the quality of their achievement and the method of their expansion in a social system. The diffusion theory pays a greater deal of attention to the idea that how individuals accept or reject innovation. As believed by Rogers et al., since the messages are new in diffusion process, there is always a degree of risk for the receivers meaning that the receiver acts differently in the face of innovation in comparison to the time that the messages are expressive of daily ideas. Rogers identified the following substantial elements in an analysis of innovation diffusion and/or promulgation of a novel idea: 1) innovation that is promulgated by means of 2) specific communication channels 3) inside the social system 4) in a gradual manner. The studies concentrated on innovation signify that there are substantial differences between the groups receiving the innovation in terms of individual characteristics, media behavior and position in social structure. Relatively, the receiver group is predominantly consisted of youngsters having better social and financial status and involved in specialized affairs and being more powerful in terms of their mental abilities as compared to the other receiver groups.

In communication terms, those who have accepted innovation earlier make more use of the global public media and information sources. Furthermore, the social relations of the individuals who have given up to the innovation earlier are more global than the late receivers and their intellectual trait and power is also higher compared to the late-receiving group (Shekarkhah, 2007, 50). The properties that innovation might have can influence the pace of innovation acceptance. These attributes generally are relative advantage, consistency, complexity, testability and visibility (Rogers and Shoemaker, 2000). Rogers believes that innovations that are perceived by the receivers to have more relative privilege, more consistency, more objectivity and lesser complexity would be accepted more readily and faster than the other ones. In Lionberger and Gewin's opinion, an innovation or a new idea should have better characteristics and condition in contrast to the common phenomenon and idea so that it can be readily accepted by the individuals (Lionberger and Gewin, 1995, 8).

Although Ardabil is situated in a cold climate and a mountainous region, the number of its sunny days is more than the European cities like Berlin; however, the solar energy used in Berlin is more than in Ardabil. So, in order to promote the use of solar energy in residential regions and reduce the pollution resulting from the fossil fuels, it is necessary to perform studies for identifying the factors influencing the citizens' willingness to use solar energy so that the barriers can be removed and the incentives of using solar energy can be corroborated to encourage people make more use of the solar resources.

Rogers and Shoemaker's diffusion of innovation (DOI) Theory: amongst the communication theories, Rogers and Shoemaker's diffusion of innovation theory is known as a theory having topics in common with rural sociology as well as communication and technology. Rogers and Shoemaker believe that people accept an innovation or a new thing when it is created based on their needs and conditions. The innovation can "be a new form of [past or in-use] technology, a novel thought or any other cultural feature" (Lauery and DeFlor, 2011, 260).

In Rogers and Shoemaker's idea, "promulgation of a novel technology, whether in a spontaneous or programmed manner, would be necessarily accompanied by a social change" (Rogers and Shoemaker, 1990, 27). In their idea, a researcher's job is finding out the reason why an innovation is accepted more readily than the other ones. In cooperation with them, he realizes communication as the essence of social change that is per se the result of diffusing novel ideas and innovations in the social system. Based on the theory of innovation

diffusion, acceptance or rejection of innovation depends on the users' awareness. Innovation is an idea, a method or a subject that is envisaged novel from the perspective of an individual or unit. On the contrary, diffusion is the process in the course of which an innovation is transferred to the members of social system through certain conduits within a specific period of time (Tung and Chang, 2008, 360). In this theory, it is assumed that the acceptance rate is determined according to the individuals' perception of the innovation's characteristics that are also known as the innovation's properties".

Study Background:

It was in 1615 (about 390 years ago) that solar energy was used for facilitating the daily works and put into practical use by the mankind for the first time. In this year, a French engineer used solar energy's heat to operate a water pump and transferred water from a place to another meaning that he used the device to practically transform solar energy to mechanical energy.

After that, between 1854 and 1873, an Australian person, named Gantener, used several mirrors to concentrate the sunlight on a long pipe wherein water was flowing and produced vapor that could generate mechanical energy via rotating a vane (Shadlou, 2010). Buildings can supply their thermal need from the sun in two forms, namely passive and active. The reception and storage of solar energy in passive state depends on the quality of the building's architecture but solar heating in active form entails the use of solar collectors and other means of transmitting heat to the building. The designing and construction of such buildings dates back to 2500 years ago. Ancient Iranians applied solar energy to reduce wood use for heating their houses in winter. They constructed the buildings in such a way that the sun light radiated into their sitting rooms during winters but the room space was shaded during hot summer days. Examples of such plans can also be observed in the majority of the other cultures in the world, as well. During the years between the two world wars in Europe and the United States, many plans were proposed and examined in the area of solar houses. Since then, no special change was made in this regard and it is now for a while that these factors have been investigated again by architects and engineers and such type of houses have been utilized in countries like Sweden and Switzerland; in the US, about 10 to 20 thousand solar houses were built only in 1890. It is attempted in such a type of houses to use solar energy for half of lighting, preparation of hot water and cooling and heating of the building and heat and energy wastage is prevented via applying useful constructional materials.

Researches have been conducted in the world and Iran regarding the use of solar energy. Some of them have been pointed out below:

Amongst the renewable energies, solar energy has the most important position under Iran's climatic conditions. Considering that Iran is positioned between 25º and 40º of the northern latitude, it is in the highest ranks in terms of receiving solar energy. All of these attributes are expressive of our country's features in terms of sun's irradiation and it possesses more auspicious conditions for the use of this energy as compared to the other countries (Zabihi, 1998).

Technical and economic investigation of using solar water heaters in tropical cities has shown that the use of solar water heaters can satisfy the consumers' needs and simultaneously be followed by a considerable amount of foreign currency saving as a result of reduction in the use of oil by-products (home sector's substantial fuel) (Akharati and Shirazi, 2001).

Shams Moghaddam (1998) studied the facilities of using solar energy in Iran in an academic dissertation in which numerous applications of solar energy has been investigated and power supply to Kish Island through taking advantage of photovoltaic cells has been found to be more cost-effective.

Terecl et al. (2009) conducted a research on the productivity and use of renewable solar energies with the objective of specifying, implementation and accomplishment of solar system projects in the urban park of Scharney Hauser neighborhood with a population of seven thousand residents in Germany. In this study, the static productivity and values and the required strategies in this regard were evaluated. Two applications were evaluated for it: the first one was pertained to the installation of photovoltaic panels the potential and usability of which was evaluated by means of GIS in residential regions. In the second part, the value and potential and the capital return period were taken into account. Novel energies such as the sun heat's use for heating and cooling the buildings were evaluated. Based on this study, 30% of the initial energy demand in Scharney Hauser Park can be covered by the strategies of storing solar energy. In a study called "the barriers, capacities and costs of renewable energies: conceptual topics", Verburggen et al. (2010) realize lack of paying attention to technical factors and marketing as the barriers to the development of renewable energies (Verbruggen et al., 2010).

In a study titled "renewable energy development in Queensland, Australia: case study of the barriers, goals and regulations", Martin and Rice believe that factors like investment barriers, commercial barriers, hindrances related to the rules and regulations as well as technological, informational and instructional impediments have negative effects on the development of renewable energies (Martin and Rice, 2012).

Eywazi investigated the application of solar energy for optimum use in district 24 of Tehran. He also paid attention to the amount of the pollutants' emission and the percentage savings and resultant costs and declared 10.4 as the initial capital return period for the application of solar energy (Eywazi, 2005).

Larijani et al. investigated the factors influencing the amount of solar energy systems' social acceptance in Tabriz. The results indicated that five variables, namely education, income, job, marital status and individuals' awareness, have the most important factors influencing the acceptance of solar energy systems (Larijani et al., 2014).

Shabiri and Bayati Malayeri concluded in an investigation of the amount of solar energy systems' social acceptance from the perspective of the people from Arak that there is a positive and significant relationship between the amount of the individuals' use of information sources and their awareness with the amount of the solar energy systems' acceptance (Shabiri and Bayati Malayeri, 2013).

Zyadin et al. found out in their study under the title of knowledge, perception and attitudes of the high school teachers regarding the use of renewable energy in Jordan that there is a positive and significant relationship between such variables as knowledge level and amount of the using information sources with the amount of using renewable energies and individuals' attitudes towards such energies while no significant effect was evidenced for social and demographic factors on the amount of using energy (Zyadin et al., 2014).

Khorasanizadeh et al. showed in a study named the investigation of the factors influencing the acceptance of clean energy technologies in developing countries (with an emphasis on Malaysia) that the usefulness, ease of use, social influence and offering of relevant information to the addressees are amongst the main factors influencing the acceptance of light-based diodes (Khorasanizadeh et al., 2016).

As it is seen, there is a scarcity of domestic research regarding the factors influencing the role and acceptance of solar energy use. So, the current research paper studies the factors influencing the Ardabil citizens' unwillingness to use solar energy based on a qualitative method and grounded theory. Conducting a qualitative research on the households in addition to quantitative research causes the researchers and planners gain a more subtle perception of the households' behaviors and motivations in using solar energy and such information can be contributive in officials' planning for improving the status of solar energy use. Therefore, according to the fact that there is a scarcity of qualitative research regarding the investigation of factors influencing the non-use of solar energy inside the country, the present study's author decided to make use of qualitative research methods for investigating the dissuasive factors and the reasons why the households are not willing to use solar energy.

Study Method:

The present study has been carried out based on a qualitative research and grounded theory. The study was commenced with purposive sampling and continued with theoretical sampling. The collecting and analyzing of the data were carried out simultaneously. Two methods were applied for collecting data: semi-structured interviews and note-taking. The data were collected through interviews with ten experts. The interviews were started with simple and general questions like "can you name the factors hindering the use of solar energy in houses in Ardabil?" and followed by more detailed questions like "can you explain more" and each interview lasted about 30 to 45 minutes. All of the interviews were recorded and transcribed after acquiring consent letters from the interviewees who were subsequently asked to endorse their sayings. The data extracted from every interview were transcribed for coding and analyzed based on constant comparative analysis.

Qualitative Data Collection:

1) Interview Guide: Three common interview plans in qualitative research are: informal conversation, guided general interview approach and standard interview using open-response questions. Open-response questions were utilized to perform an expanded exploration of the professors and specialists' perceptions and attitudes and the factors influencing the non-use of solar energy in residential regions. Since numerous individuals were interviewed, the questions were previously specified for preventing bias. Therefore, the interview plan falls within the format of open-response structured interview. However, in order for the interviewees to be able to freely express their attitudes and experiences, the questions had flexible structures.
2) Selecting the Interviewees: The participants were selected purposively or, in other words, theoretical sampling was conducted. Theoretical sampling is a sort of purposive sampling in which the researcher is assisted in creating or discovering theory or concepts the theoretical relationship of which with the evolving theory has been justified. In theoretical sampling, interview is made with individuals who are rich in terms of the study goals. In this method, sampling is terminated when each topic reaches theoretical saturation. To model the factors influencing the non-use of solar energy in residential regions of Ardabil, use was made of a purposive sampling to inquire ideas and notions from the experts and specialists in this area.

In the end, the data were collected following the interviews with ten experts and specialists within a three-month period.

Table (4-1): General specifications of the interviewed individuals in qualitative stage

Row	Interviewee's code	Organizational position	Service location	Interview duration
1	M1	Expert	Ardabil	44 minutes
2	M2	Expert	Ardabil	49 minutes
3	M3	Expert	Ardabil	57 minutes

4	M4	Expert	Ardabil	49 minutes
5	M5	Expert	Ardabil	53 minutes
6	M6	Expert	Ardabil	25 minutes
7	M7	Expert	Ardabil	37 minutes
8	M8	Expert	Ardabil	55 minutes
9	M9	Expert	Ardabil	41 minutes
10	M10	Expert	Ardabil	53 minutes

(Source: The author)

3) Interview Process: all of the interviews were conducted face-to-face and individually during the participants' work hour in their rooms from 8 a.m. till 2 p.m. within a three-month time. The mean interview duration was 45 minutes (between 25 to 57 minutes) and the interview was continued till reaching a rich description of the subjects related to the study. Tape recorder was used in all of the interviews for recording the experts' ideas. All of the interviews were carried out by the researcher.
Before starting the interview, the researcher seminally started conversation with informal subjects other than the study-related topics for creating a friendly relationship and subsequently explained the study goal, consent letter's content and interview questions in general.
Reaching Saturation: Simultaneous with interviews, the researcher investigated the recorded interviews and started determining the primary topics and secondary concepts. After eight interviews with the experts and specialists, all of the primary topics and majority of the secondary subjects were specified and the topics were found repetitive or, in other words, having reached saturation by which a stage is intended wherein no new data are added in regard of the interview topic and the subject is found having reached an appropriate expansion and the relationships between the topics are established. However, two extra individual interviews were made for more insurance.
4) Interview Transcription Process: To ensure the quality, each transcribed interview was reviewed at least four times and the participants' sentences were compared for investigating the coherence and consistency of the assertions. Moreover, a number of the interviews were sent to the interviewees as requested by them so that the transcribed materials can be also confirmed by them.

Study Region:

Ardabil is the provincial center and Ardabil County is located on a plain under the same name and, in terms of absolute position, it is situated between 48º 15' and 48º 19' of the eastern longitude and between 38º 11' and 38º 17' of the northern latitude. Although Ardabil has a cold climate and is located in a mountainous region, it has more sunny days than European cities like Berlin. However, the amount of solar energy used in Berlin exceeds that of Ardabil. There are various methods that can be used in Ardabil for using this clean energy for the city's enjoyment of a larger number of sunny hours and different measures, including 50% discount for the installation of panel to the households that want to use solar energy in 2012, government-guaranteed purchase of the power generated by the households and private sector in 2015 and obliging of various offices to the generation of at least 20% of their power energy through solar energy, were the interventions taken in Ardabil and other spots but no practical effect has been so far seen in the application of solar energy and, as stated by the person in charge of the new energies' department of the general office of Ardabil Province's electricity company, only five households are using solar energy in Ardabil for lighting and power generation.

Study Findings:

All of the interviewees were male. After analyzing the data regarding the barriers of using solar energy, seven primary grounds or themes were extracted and seven indicators have been investigated along with a sample of interviews. In the ending part of this section, Table (1) gives the primary classes along with subclasses each of which play roles in the selection of solar energy in residential regions.

Table 1: The responses of the experts to the study questions and identified concepts

Interview code	Interviewee's response	Identified concepts (codes)
M1	From the perspective of the interviewee no.1, the absence of technical equipment related to renewable energies is also amongst the barriers causing the non-development of the clean energies. Moreover, there is a shortage of equipment in this area and there is also a shortcoming or an absolute lack in terms of the experts and specialists as well as the installation and repair of the renewable energy instruments and if a panel or the other renewable energy instruments happen to break down, there is no versatile and specialized expert in this regard. Another of the most important problems in our region is that it rains in an inclined manner since there is a large deal of wind in Ardabil. When it rains, it is usually inclined and all of the panels are stained and this decreases the panel's output. As for the solar energy, we should know the methods of using electrical energy and see which cities have this potential;	1) Non-sustainability of solar energy during various seasons 2) Inaccessibility of the solar radiations under cloudy and rainy conditions 3) Absence of experts and specialists for the installation and repair of the solar tools 4) Inaccessibility of the technical and technological knowledge of solar instruments

	is it only a matter of sunny days. In this regard, the discussion related to the panels pertains to the cleanness of the panels' surfaces and no dust should be on the panels' surfaces. If a layer of dust sits on the panel, its output will be reduced by 30% to 40% and we are obliged to clean the panel's surface constantly every few hours and, according to the fact that Ardabil is situated in a dust-prone region, an important consideration would be panels' maintenance and keeping their surfaces constantly clean in which case we should try to make use of self-cleaning panels that are very costly.	5) The need for storage system 6) Difficulty in installing and maintaining solar technology
M2	From the perspective of the interviewee no.2, not holding meetings and seminars causes the people to have low awareness of the novel energies. Solar energy is not used due to the weakness in advertisement and politicians' unawareness and not being up-to-date regarding the country's culture and the people's following of fashions. If the use of solar energy is promoted in the programs and commercials of advertisement and television and radio, all of the households would procure such instruments. Furthermore, the absence and lack of holding instructional programs and installation of no banners and media's negligence of the issue in radio and television programs and commercials have also been pointed out for it has caused the people to remain uninformed of the solar energy.	1) Shortage of promotive and informative activities 2) Shortfall in the knowledge regarding the supportive regulations 3) Lack of general knowledge 4) Shortage in the specialized human workforce 5) Absence of statistics and information regarding the use of solar energy
M3	From the perspective of the interviewee no.3, not holding instructional seminars and not offering instructional programs and absence of commercial banners and no advertisement in the media such as in radio and television are also some important impediments to the use of solar energy for this causes the people to remain unaware and uninformed of the solar energy and its applications. There is not held any meeting in the area of new energies except one or two cases per year that are not of much use. It is due to the majority of the people's unawareness that holding meeting and seminar becomes necessary. There is not even one banner in the city so that the people can be informed of the fact that oil is endless and this new energy has to be put into use.	1) Shortage of written sources 2) Absence of long-term instructional programs 3) Researchers' non-participation 4) Governmental employees' lack of motivation 5) Absence of instructional content 6) Absence of plans by specialists
M4	From the perspective of the interviewee no.4, the existence of a strong policy in the area of supporting the advantages of solar energy causes the people to become more willing to use solar energy. For example, private organizations and sector can be encouraged to use solar energy and the politicians can devise supportive programs regarding solar energy. Furthermore, the national and local policies regarding the potential assessment and resource identification are very few and the government provides less support for the novel energies. Since politicians do not have sufficient knowledge of the ways of using solar energy, they cannot accordingly make use of it. In addition, inadequate commitment of the government to the support of new energy and shortcoming of the national and local policies in regard of potential assessment and resource identification bars the use of solar energy in residential regions.	1) Shortage of national and local policies regarding potential assessment and identification of resources 2) Lack of cooperation between the governmental and private organizations 3) Politicians' unawareness of solar energy's advantages 4) Government's inadequate commitment to the support of new energy 5) No supervision of the solar energy plans and projects
M5	From the perspective of the interviewee no.5, the cultural and social conditions governing the society are effective in accepting or rejecting innovations by households. Before implementing an idea, it is necessary to set the social grounds. Background studies and the information-provisioning plans in the society can accelerate it. Culture-building in regard of solar energy application is another factor that has to be promoted amongst the people. By infirming a culture, the people's ability in using this endless divine energy is intended and the expansion of culture and infixing a culture, the use of solar energy can be promoted. Considering the non-sustainable nature of the solar energy and the ease of using other energies, an Iranian family in our country finds it not reasonable to use solar energy due to its ready access to oil and gas energies and use of gas is far increasingly less costly. Therefore, an intensive culture-building work has to be widely performed. The main problem is culture-building and the people do not know what risk they are exposed to and the government does not show case examples to the people.	1) Weak acceptance culture 2) Sustainability problem of renewable energy sources 3) Little awareness of the advantages of the renewable energies
M6	From the perspective of the interviewee no.6, the executive managers are not so much willing in regard of new energies to make plans and perform projects and they are indifferent to it with the existence of such fossil resources as oil and gas. Additionally, in the developing countries, there is a shortage of experienced managers who can outperform others in the area of using new energies and also be capable of implementing the required instructions and operationalize the projects related to solar energy. Another of the managerial barriers is that the managers prefer the use of common energies like oil and gas	1) No cooperation between the country's executive managers for making plans and accomplishing projects 2) Managers' lack of competency in applying solar energy 3) Managers' preference in using

	to new energies. Managers' lack of awareness and their being not up-to-date have caused them to be totally negligent of the new energies' application. In some cases, as well, managers encourage people to the use of common energies in lieu of the solar energies and, in some other occasions, as well, the executive managers do not make the required collaborations for making plans and accomplishing projects. This interviewee also adds that the people's need for the use of solar energy is another issue that has to be taken into consideration by the managers. He states that if the power grid undergoes malfunction and the power outage occurs and the people cannot see their desired serials, they may say that let's buy a panel and store electricity so that we might not face outage again.	common energies 4) Managers' unawareness of the advantages of using solar energies
M7	From the perspective of the interviewee no.7, economic problems and barriers like short-term economic planning are amongst the largest impediments to the growth and development of new energies in the communities in favor of the citizens as envisioned by the experts. These can be removed by the facilitation of the private sector's presence as investor in renewable energy sector, national and international financial supplies, elimination of subsidy to the fossil fuels and investment of it in renewable energies' sector, correct pricing of fossil fuels and payment of subsidies to the households for making use of renewable energies' equipment. I think solar energy is costly. For instance, in one of the hard-to-reach villages of Tarom, several solar panels had been installed but they worked two or three years; of course, the power office installed those solar panels due to the region's being hard to reach and costliness of installing power poles and the villagers asserted that the panels did not work from 4PM on due to the depletion of the battery and that they could not use their refrigerators and cooling instruments and a battery for a solar panel costs 15 million and power use is more cost-effective.	1) Large costs of using solar energy 2) Government's lack of paying attention and granting of no loan 3) Falling short of supplying sufficient credits to the research projects and plans regarding the use of solar energy
M8	From the perspective of the interviewee no.8, the economic barriers are amongst the factors pointed out by the experts in regard of use of solar energy. In fact, one barrier to the use of solar energy is the expensiveness of the initial costs of the panel and the people are discouraged accordingly to use panel. Moreover, the problem resulting from the large costs of installing panel is amongst the other factors of making no use of solar energy. In addition, in economic terms, use of solar energy is not cost effective and fossil fuels are cheaper than the new energies and the people's short-term look at cheap fuel bars the application of solar energy. Moreover, because the methods of access to power are easy and power generation is costly but the people are given subsidy, they are found less willing to use new energies. Additionally, the cost of installing solar panels is also very high for the ordinary families.	1) No investment by the private sector 2) No use of solar energy in houses according to the country's richness in terms of fossil fuels 3) Large costs of solar technology purchase
M9	From the perspective of interviewee no.9, the existence of regulations in a specific area (like renewable energies) causes both the service providers and the applicants become more willing towards it with a larger deal of trust. The legal barriers directly influence the emergence and intensity of the instructional barriers. Embedding a curriculum on sustainable development with an emphasis on the conservation of fossil resources and expressing the importance of renewable sources, holding obligatory instructional courses and/or encouraging to the presence in the instructional courses on the investigation of the advantages and disadvantages of the various kinds of energy resources for the citizens, creation of academic courses related to new energies in art schools can fill the instructional gaps. Since the legal organs do not provide any support regarding new energies and even the textbooks do not care so much for them and there is no rule regarding the use of solar energy, the legal authorities and organs offer very low support in this area and even the executive branches cooperate very limitedly in this regard.	1) Non-transparency of the regulations related to the use of solar energy 2) Low cooperation between the executive organs 3) Non-transparency of the regulations supporting the investors
M10	From the perspective of the interviewee no.10, the existence of subsidy-assisted countrywide power grid and ready-to-use natural gas in comparison to solar technology for supplying heat to the houses bars the people's use of solar energy. Moreover, easy access to power through countrywide grid bars the use of solar energy. It is worth mentioning that the shortage of spaces for installing solar systems is another of the factors hindering solar energy application. Nowadays, the mass building construction has caused the installation of solar systems to be faced with some difficulties in residential regions. In people's mind, fossil fuels are cheaper than new energies and the use of fossil energies is a lot easier than solar energy and some people think that no pollution is created when they use gas.	1) Ease of using natural gas in contrast to solar technologies 2) Creation of no pollution when using natural gas for heating the houses 3) Easy access to home-based electricity through countrywide power grids 4) Existence of fossil fuels for installing solar systems 5) Shortage of the space for installing solar system

As it is demonstrated in Table (1), the experts have pointed to a vast spectrum of factors influencing the non-use of solar energy in the interviews. To sum and identify the primary components of factors influencing the non-use of solar energy, Table (2) gives the codes (topics).

Table 2: The identified codes (concepts) in the interviews with the experts based on the study questions

Main classes	Subclasses
Instructional barriers	Shortage of promotive and informative activiteis, shortage of knowledge regarding teh supportive regulations, lack of general knoweldge, shortcoming in the specialized human workforce, shortage of written sources, non-participation of the researchers and absence of instructional contents
Economic barriers	High cost of using solar energy, Government's lack of paying attention and granting of no loan to the users, supplying of insufficient credits to the plans, private sector's lack of making investment, richness of the country in terms of fossil fuels, technology purchase cost
Cultural and social barriers	Shortage of aan aceptance culture, sustainability problems of renewable energies, ease of using natural gas in contrast to the technology due to its lower costs
Technical barriers	Absence of specialized experts for the installation and repair of the solar tools, difficulty in installing and maintaining solar technology, nonexistence of an executive standard for the solar energy, identification of the companies supplying these equipment inside and outside the country, endorsement of commercial contracts with them, supply of the required spare parts, dust-proneness of the reegion, existence of inclined rains, non-sustainability of solar energy during various seasons, inaccessibility of radiant energy of the sun under cloudy and rainy conditions
Managerial barriers	Lack of cooperation from the country's executive managers for accomplishing projects and plans, managers' incompetency in energy application
Policy-making barriers	Shortage of national and local policies regarding potential assessment and identification of barriers, no copperation between the governmental and private organizations, politicians' lack of knowledge about advantages of the solar energy
Attitudinal barriers	Ease of using natural gas in contrast to solar technology, creation of no pollution when using natural gas for heating the houses, ease of access to the home-based electricity through countrywide power grids, existence of fossil sources for installing solar system, shortage of an appropruate space for installing solar system

Source: The authors' findings, 2017

Discussion:

In the present era, although the highest amount of energy used by countries is supplied through non-renewable energy resources and such fossil fuels as coal, oil and natural gas (Ntona et al., 2015), the use of these fuels causes emission of polluting gases and intensively leads to the environment polution (Ding and Somani, 2010). Based on the predictions, in case that the current trends are continued and energy consumption is left unmanaged and not reduced, all of the world's fossil fuel resources for the creation of which a time between 500 and 700 million years has elapsed would be depleted till the end of the present cetury (Kaviani, 2002). The selection of the experts is not a random behavior when there is made no use of solar energy, rather it is a behavior that has been acquired in the course of time and under the influence of various factors. The present study is aimed at the elaboration of the factors influencing the non-use of solar energy in Ardabil and the reasons expressed by the experts in not using solar energy were evaluated and seven primary topics were extracted. These factors are: instructional, economic, social and culture-building, technical, legal, managerial, policy-making and attitudinal barriers.

There are conducted sporadic research in the area of the barriers to the use of solar energy and the present study's findings are consistent with what has been obtained, including the results of a report by SANA experts (2011) who expressed the followings as the barriers to the use of solar energy likewise the current research paper: existence of cheap fuel, absence of a comprehensive national plan with certain legal quantitative scales, existence of structural problems regarding the activity of several governmental institutions in energy sector that causes scattering and parallel working, problems of the private sector's entry into the area of the development of renewable energies' development, shortage of credits for the completion of the projects, limitedness of the consultants and contractors and qualified supervisors in this area and costliness and time-consuming nature of creating the technical, scientific and industrial potentials required for implementing this set of projects in the country, newness and, in the meanwhile, advanced nature of some related technologies and lack of knoweldge in these grounds. In a study regarding the investigation of renewable technolgy application, Culter (2004) has mentioned high cost, inability to compete with other fuels, transmission cost, uncertainty in economic analysis and calculation of the environemntal effects and institutional factors, including lack of experience and information and technical and financial uncertainty, and legal and regulatory factors, including biased supervisory method and inappropriate conditions for bidding, and technical factors, including lack of planning instruments for the evaluation of the costs and utility and inaccessibility of entry; his findings are also in compliance with the present study's results (Culter, 2004). Furthermore, the UN's progress and development plan has pointed in its studies to such barriers as economic, instructional, cultural, social and technical hindrances in villages in regard of achievement of solar systems and these findings are also in accordance to what has been found.

Conclusion:

Enjoyment of solar energy similar to the other state-of-the-art technologies of the world has its own rise and fall and there are naturally barriers to its application. Although the economic barriers and costliness of using solar energy account for the largest quotient of the hindrances and are considered as the most effective barriers, the present study's results additionally indicated that the instructional, sociocultural, technical, managerial, policy-making and attitudinal factors are also amongst the other impediments that contribute to the non-use of solar energy in residential environment.

The majority of the households of the country are not informed of the advantages and benefits of the economic application of solar energy. Therefore, in order to make correct and optimal use of this huge energy resource, one should deal with the promulgation and diffusion of information and elevation of the users' awareness regarding the economic, bioenvironmental and social advantages of this technology because its application not only causes savings in power costs but also it is cost-effective in general and publicly in the long run. In between, the government's role should not be overlooked. In fact, the government shoulders a very critical responsibility in policy-making and organizing the resources and providing of such infrastructures as the suppply of the resources and financial loans, culture building and setting the required rules and regulations in line with modifying the energy consumption patterns.

References

Abval Sheikhi, M. (2009). A future towards new energy. Retrieved from http://www.jamejamonline.ir/papertext.aspx.

Akharati, R. & Shirazi, Z. (2001). Technical and economic investigation of the use of solar water heaters in tropical cities. the first international conference on the optimization of fuel consumption in buildings, Tehran.

Alimardani, K. (2010). Experimental study of the integrated water tanks. MA dissertation, advisor: Behrouz Mirza'eipour, Mohaqqeq Ardabili University, Ardabil, p.65.

Azizi, A. & Faryadi, Sh. (2011). Social-economic and bioenvironmental analysis of the advantages of using solar water heater (case study: Shiraz), *journal of solar energy, 15*(1): 3.

Culter, J. (2004). Renewable energy policies and barriers, forthcoming in encyclopedia of energy, *Academic press. Elsevier science, 173*(6), 90-92.

Ding, J., & Somani, A. (2010, April). A long-term investment planning model for mixed energy infrastructure integrated with renewable energy. In *2010 IEEE Green Technologies Conference* (pp. 1-10). IEEE.

Everett M., Rogers F. & Floyd Sh. (2000). Innovation diffusion, an intercultural approach, trs. Ezzatollah Karami and Abu Taleb Fana'ei, 3rd ed., Shiraz, Shiraz University Press.

Eywazi, Z. (2005). Residential/commercial use of solar energy in 22 municipality offices in Tehran and its effect on the environment improvement. the fourth conference on the optimization of fuel consumption in buildings, Tehran.

Haj Saqati, A. (2001). *Principles and application of solar energy*, 1st ed., Tehran, Iran's Science and Industry University Press.

Hosseinzadeh, M. & Afshar, R. (2006). Renewable energies (applications, advantages and limitations). *Journal of growth: geology instruction,* (47):45.

Jahanbakhsh, S. & Alidoust, M. (2009). Evaluating the use of solar energy in heating the buildings and residential regions of Azerbaijan, *journal of geographical research, .91*, 49-76.

Kaviani, M. (2002). Energy bottlenecks and evaluating the solar energy potential in Iran, *journal of studies and researches by literature and humanities departments*, (31): 15-38.

Khorasanizadeh, H., Honarpour, A., Sang-Ah Park, M., Parkkinen, J., & Parthiban, R. (2016). Adoption actors of cleaner production technology in a developing country: Energy efficient lighting in Malaysia. *Journal of Cleaner Production, 131*, 97-106.

Larijani, M.; Shabiri, M. & Abolhasani, A. (2014). Investigating the relationship between social acceptance of solar energy systems and the factors influencing it (case study: Tabriz). *journal of Iran's energy, 17*(4): 1-14.

Laury Sheron, E. & Melwin L. Deflor, (2011). *Turning points in communication researches (media effect)*, tr. Muhammad Gozar Abadi, Tehran, Danjeh.

Lionberger, H. & Pal H., Gewin, (1995). *Technlogy transfer from researchers to agricultural users*, tr. Muhammad Chizari, Tehran, Teacher Training University

Martin N.J., & Rice J.L. (2012). Developing renewable energy supply in Queensland, Australia: A study of the barriers, targets, policies and actions. *Renewable Energy, 44*, 119-127.

Ntona, E., Arabatzis, G., & Kyriakopoulos, G. (2015). Energy saving: Views and attitudes of students in secondary education. *Renewable and Sustainable Energy Reviews, 46*, 1-15.

Rogers, Everett M. & F., Floyd Shoemaker, (1990). *Innovation diffusion: an intercultural approach*. trs. Ezzatollah Karami and Abu Taleb Fana'ei, 2nd ed., Shiraz, Shiraz University Press.

Shabiri, M. & Bayati Malayeri, M. (2013). Investigating the amount of solar energy systems' social acceptance from the perspective of the people from Arak. the fifth scientific-specialized conference on the clean, efficient and renewable energies, Tehran, pp.1-9.

Shadlou. (2005). *Energies,* 2nd ed., Ettela'at Publication.

Shams Moqaddam, M. (1998). *Investigating the possibility of using solar energy in Iran (case study: Kish Island)*, MA dissertation, Tehran, Tehran University.

Shekarkhah, Y. (2008). Familiarization with the theory of innovation diffusion, *Journal of information-provisioning and book-keeping organization, 54,* available at www.noormags.org.

Tung, F. C. & Chang, S. C. (2008). Nursing Students Behavioral Intcntion ti Use Onlinc Courscs: A Qucstionnairc Survey. *International journal Nursing*.

Verbruggen A. Fischedick M. Moomaw W. Weir T. Nadai A. Nilsson L.J. ... & Sathaye J. (2010). Renewable energy costs, potentials, barriers: conceptual issues. *Energy Policy, 38*(2), 850-861.

Wee H.M., Yang W.H., Chou C.W., & Padilan M.V., (2012) Renewable energy supply chains, performance, application barriers, and strategies for further development. *Renewable and Sustainable Energy Reviews, 16*(8), 5451-5465.

Zabihi, A. (1998). Generation and application of electrical-solar photovoltaic in Iran, the first Iran-Germany common conference on the renewable energies, Tehran, pp.5-23.

Zyadin, A., Puhakka, A., Ahponen, P., & Pelkonen, P., (2014), Secondary school teacher's knowledge, perceptions, and attitudes toward renewable energy in Jordan, *Renewable Energy. 62*, 341-348.