

# Social Acceptance of Renewable Energy in Developing Countries: Challenges and Opportunities

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## ABSTRACT

Utilization of renewable energy technologies has short-term, middle-term and long term interests. Since the portion of renewable energies have to increase 10% till 2025, legislating relevant policies for increasing the portion of these energies is essential. This article reports studies about the social acceptance level of renewable energies in a selected developing country by using social acceptance pyramid. First, the identified indicators are weighted based on the circumstances of renewable energies. After that, the selected renewable sources, wind, solar, and geothermal, are ranked based on the indicators and analytical hierarchy process. The research results indicate that wind energy has the better social acceptance position than solar and geothermal energies. Finally, some polices are suggested for increasing the acceptance level of all renewable energies in developing countries.

**Key words:** social acceptance, renewable energies, developing countries

## INTRODUCTION

Fossil sources limitations, developing the security of energy supplies, decreasing reliability on the global transmission network, and decrease in petrol incomes according to reduction of oil reserves, preserving the environment and improving Iran's position in international strategic environment are the core reasons of using renewable energies in Iran. Based on the energy balance sheet of Iran in 2012(Iran's Ministry of Energy, 2012) the portion of fossil energies in electrical gross genera-

tion is 93% and the portion of renewable energies (hydropower, wind, solar and biogas) is less than 7%. As respect to this point that the portion of renewable energies have to increase to 10% till 2025 [1] therefore, proper policy making for increasing the share of these energies seems to be essential.

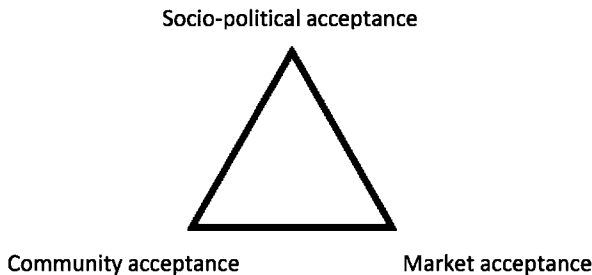
Nowadays, policy makers all around the world have especial attention to the development of renewable energies and according to the increase in process of the fossil fuels, they resorted using these energies. In recent years, using renewable energies have been increased quickly, especially in industrial countries and Iran despite of having plenty of fossil sources is not an exception, according to possessing great potential of proper renewable energies, logical development of these valuable sources looks appropriate [1].

However, despite the crucial role of public acceptance in developing of new technology, social acceptance as a part of the procedure of using renewable energies has been neglected. Therefore in this research the importance of social acceptance in developing renewable energies in Iran will be studied.

First, the existing literature in the Renewable Energy domain is reviewed. After that, conceptual model of research is presented based on indicators and sub-indicators. Finally, the results show the effective indicators of social acceptance in developing country for a case study, Iran.

### **Theoretical Framework**

Wustenhagen helped clarifying the concept of social acceptance by introduction of three dimension, social acceptance model. These three dimensions include: socio-political acceptance, community acceptance and market acceptance [2]. Figure 1 shows the social acceptance pyramid developed by Watenhagen.



**Figure 1. Triangle of social acceptance of Renewable energies [2]**

Table 1 shows the comments on indicators and sub-indicators.

**Table 1. Indicators of the social acceptance**

Indicators	Sub indicators	resources
<p><b>Socio-political acceptance:</b>                      Socio-political acceptance is the most general dimension of social acceptance that includes how actors( people and organizations) make decisions, resolve conflicts, form partnership ,respond governmental policies and accompany with social problem.                      Several indicators shows that policies and renewable technologies in lots of countries have high social acceptance. This issue indicates that in public poll in which people accepted supporting of developing such technologies, even in countries that governments poorly supported such energies, this positive public image of renewable energies ended in misleading policy makers and distracted them from their social acceptance</p>	<p><b>Public acceptance:</b>                      It's the public support of changes associated with the development of a technology. personal factors, psychological and contextual factors have critical role in social acceptance. Personal factors includes, age ,gender, educational level, income level and social class, psychological level includes level of knowledge about the technology and context factors like technological factors including range and type of a new technology. Also institutional factors like ownership of the project, cost's distributions, and institutional public participations in new technologies could be effective.                      Social behavior is different toward public projects and private ones. Society supports better in interaction with projects which have public ownership and have distribution of benefits at the community level.</p> <p><b>Key stakeholder's acceptance:</b>                      Stakeholders include each of people or groups who are affected by technology developments or can affect that. Many of the barriers to access a successful performance of the projects could be the result of lack of public acceptance of such projects by this group.</p> <p><b>Policy maker's acceptance:</b>                      From socio-political point of view, acceptance of projects by core stakeholders and political actors have critical importance. When challenge is programming and increasing public participation incentive, cooperation with stakeholders and policy makers and analyzing the acceptance level is important.</p>	<p>[2],[3],                      [4],[5],                      [6]</p>
<p><b>Community acceptance:</b>                      Means acceptance of decisions related to locating and establishment of power plants and renewable energy projects by public stakeholder's especially local residents, this is where a phenomenon called "NIMBY"<sup>1</sup> is shown. The phenomenon which indicates that people support renewable energies till these installations are not close to their locations. Also some other believe this ideology is oversimplification of public motivations and is not accurate. Some researchers believe the opposite effect of "NIMBY" and claim that neighborhood with power plant will decrease the resistances. One of the characteristics of community acceptance is it's time dimension. Acceptance pattern of community acceptance has U shape which starts from high acceptance before starting the project, during the projects decreases to its least level( but the mean id acceptance is still positive) and increase after the project and utilization.</p>	<p><b>Distributional justice:</b>                      It is The method of cost and profit division. Common vision of the society toward the energy projects is profit seeking of its investors. So justice in distribution of positive and negative effects is one of the community acceptance aspects. Lack of attention to this issue by planners and developers of the project will cause conflicts and opposition with relating energy.</p> <p><b>Procedural justice:</b>                      It is related to the justice in decision making process and equal opportunity of participation for all stakeholders. An uninterrupted and perdurable engagement with local residents during project development is one of the key elements of procedural justice. Lots of community oppositions occurs when people feels their participation is useless.</p> <p><b>Trust:</b>                      It refers to the level of community trust in the outside investors. The role of trust in</p>	<p>[2], [7],                      [8],[6],                      [9], [10]</p>

(Continued)

**Table 1. Indicators of the social acceptance (Concluded)**

	<p>increasing the social acceptance level is explicit. Trust is defined as the element which simplify the legislation and its practicing, different researches shows that lots of oppositions with renewable energies developments causes from lack of trust in society and investors. This distrust in some cases , come from politicians efforts for restricting people's role and increasing programming speed despite of public oppositions. Distrust is one of the most important barriers of developing the renewable energies projects. In lots of cases when people choose between different energies and the atmosphere between community and policy makers is distrust or people has limited knowledge of renewable energy, acceptance among people of one region for the implementation of the project does not exist.</p>	
<p><b>Market acceptance :</b> This kind of acceptance, refers to accepting a new technology in market or processes by which actors accepts and supports new innovation. By moving from bigger renewable energies like wind energy to smaller ones, the problem of market acceptance become more important. In market acceptance besides users, it focuses on investors and intra-firm acceptance of new technology. In fact, ,market acceptance relates to socio-political acceptance because most of investors and companies are part of stakeholders and play important role in policy making and financing energy systems.</p>	<p><b>Consumers acceptance:</b> This kind of acceptance, refers to accepting a product or technology by the target group. Consumer's acceptance have five steps: *awareness: in this step consumer will be informed of new energy but doesn't have exact information about it. *Tendency: in this step consumers will look for some information about new energy. * Assessment: this step refers to consumer's decision of using this energy. *Test: consumer will use and test the energy limitedly. * Total utilization: consumer decides permanent use of the energy.</p> <p><b>Investors acceptance:</b> Includes the tendency of capital owners to participate in the process of technology development, investors' interests in renewable energies projects has important role in process of their development. Most important barriers according to investing in such projects are: *uncertainty according to new technologies which has not been tested yet. * Uncertainty according to political issues and their impact on market competitiveness. * Risks related to the markets with established actors.</p> <p><b>Intra-firm acceptance:</b> It is the manner of accepting new technologies in energy producing firms. Evidences show acceptance of new technology by large firms acting in the relating area, is hard.</p>	<p>[2], [4]</p>

By specifying indicators and sub indicators of social acceptance, they can be weighted and three energies of wind, solar and geothermal could be measured. The conceptual model of social acceptance of renewable energies that derives from social acceptance pyramid is shown in the Figure 2.

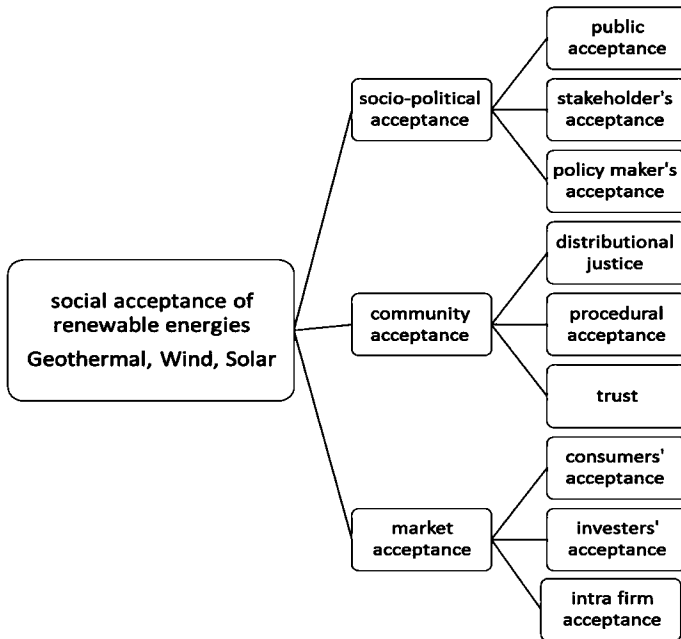


Figure 2. Conceptual model of social acceptance of renewable energies

## LITERATURE REVIEW

The literature in this area indicates that social acceptance includes different aspects which have to be considered in programming of renewable energies' development. First, renewable power plants have less capacity than traditional power plants which increase the importance of decisions about locating and deployment of power plants [2]. Second, renewable energies in the conversion process has congestion and as a result have more final effect (per MWh) and in the end extraction of fossil or nuclear energies is done out of society's sight and in some cases under the ground. But renewable power plants like wind power is more disposable to everyday life of society, in fact using such energies compared to fossil energies are located closer to consumers and as a result, its environmental effects are in the vicinity of residential areas and will be paid more attention [2].

Shackley, S., et al. [11] have done a research on the containment and storage of carbon dioxide in Europe and came to this conclusion that most of respondents were adherent of entering this problem to the

national plan of decreasing carbon dioxide [12]. Wolsink [13] stress that engaging local residents into the policy making process would help to improve the social acceptance policies [12]. Wüstenhagen, Wolsink [2] point that it's hardly possible to achieve all purposes of renewable energies without social acceptance. So, social acceptance have to be considered during policy making. Rogers et al. (2008) mentioned [14] three reasons for public opposition against renewable energies' development: inappropriate scale of development, an acceptable relation of costs to public profits and lack of enough relation between residents of a region and their views [14].

Jobert, Laborgne [15] studied affecting factors of wind energies development and mentioned some factors. One of these factors is the visual effect of turbine on environment. They mentioned that society prefers areas with less extent and larger turbines than extended areas with smaller turbines. Types of landscapes seems to be important as well, and he mentioned that the movement of turbines blades has positive effect on its acceptance because it inducts the utility of power plant. One of other important factors is economic interests of projects which will be followed by partnership of stakeholders, land owners and investors. They point out fact if informing people about specific energy, quality of relations with society and public partnership in the programming process as the effective factors of social acceptance [15].

Moula, Maula [16] had provided a conclusion of indicators on social acceptance which includes: partners, socio-economic context, group age, political beliefs, behaviors, perceived performance, facilitating conditions. Costs, trust, location and position of partners toward renewable energies.

Jobert, Laborgne [15] studied experiences of France and Germany and divided eight effective factors on wind energy development into two groups of location establishment factors and project management factors.

#### **Factors of Location of Establishment:**

- Areas geography and effects on environmental views: how turbines placed in the region and how much they are in the sight of residents.
- Former use of the region: has the region have other uses before, and how turbines' installation would affect this use.
- Ownership of desired area; public or private
- Economy of the area; role of tourism and economic situation

### **Factors of Project Management**

- Managers and developers of the project's social integration; are managers from inside of the region or out of it?
- Accessibility to information and partnership; when and how people will be informed and enter the programming process.
- Create a support network of a project; can managers create a network for supporting (local) residential actors of projects.
- Economic partnership; are residents offered an economic partnership proposal.

Devine-Wright [5] concluded researches about adaptation of renewable energies and provided a classification which included personal factors (age, gender, social class, income), psychological factors (degree of awareness and understanding, political beliefs, environmental beliefs and concern, place attachment and perceived fairness and levels of trust) and contextual factors (technological and spatial factors).

Alasti stated the characteristics of social acceptance of a new technology as follows [4]:

- support of a new technology from policy makers and experts
- information accessibility and positive views of a new technology in society
- social enthusiasm for utilization of new technology
- not being any obstacle from social groups, policy makers and other members of society

From her point of view, three factors stated below have important roles in formation of social acceptance:

- knowledge; public knowledge of different aspects of new technology
- fears; undesirable feeling according to understanding of existing risks in utilization of new systems.
- perception; the society's mindset about physical and mental healthiness of new technology

Table 2 shows summary of researches in the social acceptance of renewable energies has been provided.

### **Ranking of Renewable Energies**

Even though most of researches in this area are about comparison

**Table 2. Summary of researches in the social acceptance of renewable energies**

<b>Author</b>	<b>View point</b>
<b>Rogers and et al. [14]</b>	Three reasons of public opposition with developing renewable energies include: Inappropriate scale of development, unacceptable ratio of the society's interests and inexistence of adequate relation with residents and their views
<b>Jobert and et al. [15]</b>	Effective factors on development of wind energy are divided into two groups of factors relating to the location establishment and factors relating to project management: Factors of location establishment: * Areas geography and effects on environmental views * former use of the region * ownership of desired area * Economy of the area Factors of project management * managers and developers of the project's social integration * accessibility to information and partnership *create a support network of a project *economic partnership
<b>Devine-Wright [5]</b>	Classification which included personal factors (age, gender, social class, income), psychological factors (degree of awareness and understanding, political beliefs, environmental beliefs and concern, place attachment and perceived fairness and levels of trust) and contextual factors (technological and spatial factors).
<b>Alasti [4]</b>	Alasti stated the characteristics of social acceptance of a new technology as follows: *support of a new technology from policy makers and experts *information accessibility and positive views of a new technology in society *social enthusiasm for utilization of new technology *not being any obstacle from social groups, policy makers and other members of society From his point of view, three factors that states in below has important role in formation of social acceptance: *knowledge; public knowledge of different aspects of new technology *fears; undesirable feeling according to understanding of existing risks in utilization of new systems. *perception; the society's mindset about physical and mental healthiness of new technology
<b>Wüstenhagen and et al. [2]</b>	He introduced three aspects of social acceptance in his research which helped clarifying its definition. This three aspects includes: socio-political acceptance, community acceptance and market acceptance

and ranking of fossil energies and renewable energies, some of them have examined public knowledge of renewable energies in their researches as well. Erbil [17] studied social acceptance of clean energies among Istanbul residents. In the part of this research interviewees have been asked to rank these energies. Results indicates top five energies



from their point of view were: solar, wind, geothermal, hydro power, and natural gas.

Yiridoe [18] state that 73% of Australian interviewees know solar energy as the best option for electricity generation. Wind had the second place and its reason was incentive programs and governmental facilities for developing solar energies. The findings of Brochers et al confirms this issue [19].

Results of assessing energies in small scale in England shows that solar and wind and hydropower in small scales are more acceptable than large scales and other energies among residents of one part of England [20].

Kaenzig, Heinzle [21] studies the preferences of German residents in utilization of needed energy for Electronic instruments. Interviewees pointed solar energy, biomass, geothermal. Zografakis, Sifaki [22] research results indicates that for developing the renewable energies in the region of Greece. Increasing knowledge level of residents is essential. He claims that residents' knowledge about wind and solar energies are more than others. A research in Finland confirms same results [23]. In Greece most popular renewable energy among people are solar, wind and geothermal energies in a row [24]. A study in Jordan confirms the results [25]. A summary of the researches provided in the Table 3.

**Table 3. Some related researches**

Five best energy sources from the Istanbul resident's point of view are: solar, wind, geothermal, hydropower and natural gas	[17]
73% of Australian interviewees believe solar energy is the best source of energy and wind energy has the second place	[18]
Solar, wind and hydropower in small scale are preferred than other sources of energies in the region of England	[20]
German's residents prefer using solar, wind, biomass and geothermal as the source of their electronic devices	[21]
Knowledge of Greece residents are more about solar and wind than other sources of energies.	[22]
Most known renewable energies in Greece are solar, wind and geothermal energies	[24]
American consumers tend to pay for solar, wind and biomass for power generation	[19]
Level of knowledge is classified as wind, solar, hydropower and biomass in a region of Finland	[23]
Level of knowledge about solar energy in higher than solar and geothermal energy in Jordan	[25]

## RESEARCH METHOD

The data for this research have been collected through survey. The statistical society of this research are experts of Tehran university professors and managers and experts of Iran Renewable Energies Organization (IREO). Number of people having necessary characteristics in the field of social acceptance of each one of these three energies have been limited. Therefore, purposive convenient method is used and 16 questionnaire have been distinguished. The inconsistency rate of all questionnaires were less than 0.1 and were acceptable. Then for using analytic hierarchy method, the data were entered in Expert Choice software and combined and final results were extracted.

The analytic hierarchical process is one of the multi criteria decision making methods which is used for making decisions and choosing one option among different ones based on determinant indicators [26].

Three critical phase in this process includes [27]:

1) **Drawing a hierarchical tree**

Constructing the hierarchical structure of problem, the first step in studying an AHP problem in which levels of problem come together logical and in good order and complicated systems become understandable by constructing these levels and analyzing to the elements [16].

2) **Determining the priorities**

The purpose of this step is bigeminal comparison of elements and linking them based on their characteristics. For prioritization, elements are compared as a couple based on criterion. For bigeminal comparison using matrix is the best way. Matrix is a simple and useful instrument which is a framework for examining compatibility, gathering more information through all possible comparisons and sensitivity analysis of overall priorities by enhancing the judgments.

3) **Integrating judgments**

For determining a collection of priorities about a problem, the judgments extracted from bigeminal comparison must be combined in order to achieve a number which indicate a priority.

## DISCUSSION

Indicators which were used for ranking renewable energies were socio-political acceptance, community acceptance and market acceptance. Based on extracted data from expert's responses, weights of indicators and sub-indicators calculated as shown in the Table 4.

**Table 4. Weights of indicators and sub-indicators of the research**

Indicators	Sub-indicators		Relative value of indicator
Socio-political acceptance	Public acceptance	0.113	0.458
	Stakeholders acceptance	0.379	
	Policymakers acceptance	0.508	
Community acceptance	Distributional acceptance	0.349	0.172
	Procedural acceptance	0.269	
	Trust	0.382	
Market acceptance	Consumers acceptance	0.167	0.370
	Investors acceptance	0.625	
	Intra-firm acceptance	0.208	

As is shown from the table's results among three aspects of social acceptance, the expert's socio-political point of view is the most important one in renewable energy's development process. Also in this process, sub-indicators of policymakers' acceptance and investors' acceptance are effective factors. The reason of this fact is how energy supplies are offered in Iran and introduction and development of new energy is totally governmental and based on policies made by policy makers. From other point of view investors in implementation and exploitation phases, have the accelerator role. In the following, after prioritizing indicators and combining them with other options, Table 5 shows the final ranking of renewable energy options provided.

- 1) Wind energy with relative value of 0.522
- 2) Solar energy with relative value of 0.357
- 3) Geothermal energy with relative value of 0.121

Since emphasis is on offering guidance for proper policy making about the alternatives, therefore, in their ranking the relative value of distribution is intended. According to the results of ranking, wind energy has most social acceptance, and that means the development pro-

**Table 5. Final ranking of renewable energy options**

<b>Energy</b>	<b>Indicators</b>	<b>Total sum</b>
Wind	Socio-political acceptance	0.0551
	Community acceptance	0.417
	Market acceptance	0.549
Total weight of wind energy	0.522	
solar	Socio-political acceptance	0.337
	Community acceptance	0.421
	Market acceptance	0.343
Total weight of solar energy	0.357	
geothermal	Socio-political acceptance	0.112
	Community acceptance	0.163
	Market acceptance	0.108
Total weight of geothermal energy	0.121	

cess of this energy would probably have most cooperation from society. Figure 3 shows final options.

It is obvious is that all three kinds of adaptations need more citizens' awareness. The lack of awareness is not only in general issues like global climate change, but also in special positions like developing tourism and providing regional energy security. For social acceptance of wind energy, Socio-political and market have good condition, but community acceptance has earned less score. Wind energy confronts difficulties like locating the power plants, negative effects on natural views, inappropriate use of land and environmental effects costs and benefits. Also, based on results solar energy have better community acceptance and for developing this technology socio-political and market acceptance should be considered. From this aspect the process of development confronts difficulties like high costs of using solar energies, lack of adequate technical capability maintenance and repairing units and problems of achieving economy of scale. Geothermal energy comparing to two other energies have worse social acceptance condition. It sees lack of adequate knowledge among policy makers and people is the most important challenge of developing geothermal energy. According to the features resulted from studies it seems that present condition from the social, cultural, economical, and political infrastructures for implementation of this kind of technology is not proper.

In Iran major decisions like development and exploitation of energy depends on decisions of policy makers of energy area. So most impor-

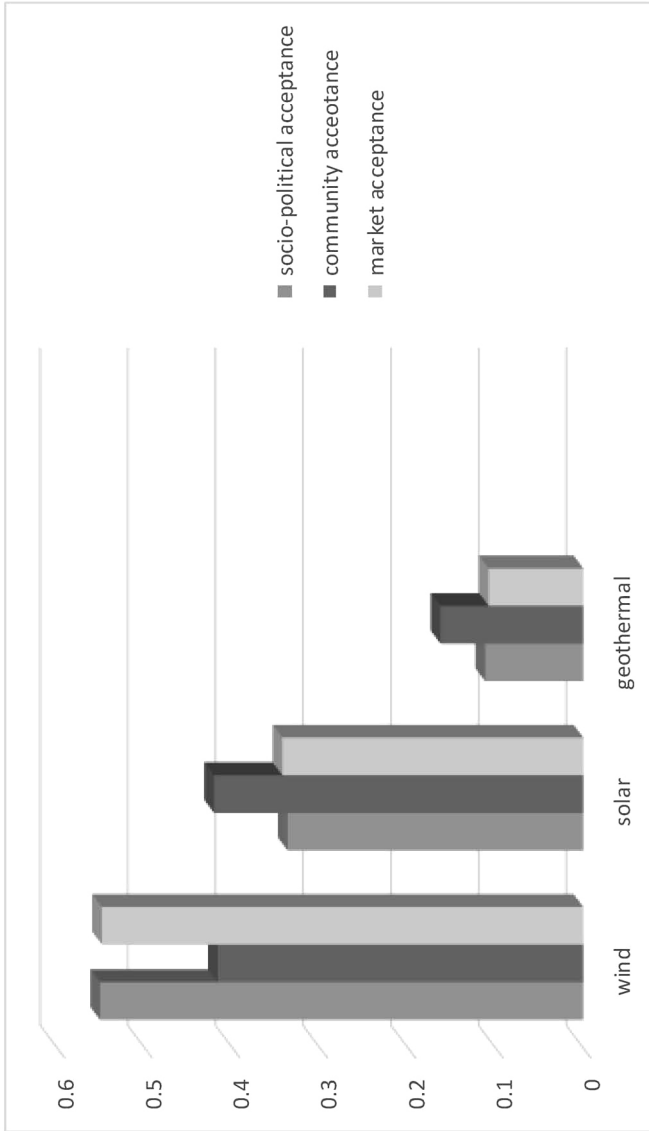


Figure 3. Final ranking

tant factor in ranking of these three energies is acceptance of policymakers or in general socio-political acceptance. On the other hand positive point of view of policy makers about one kind of energy can accompany community acceptance, however, the trust factor have important role in community acceptance. Trust is the element which facilitates legislation and its implementation. Results of analyzing questionnaires show the importance of community acceptance as well. Other important factors in social acceptance of renewable energies is the market and private investors. Principle 44 of constitutional law and law of supporting private sector investment in renewable energy resources approved in 2001, confirms movement to reinforcement of private sector and fundraising. In process of developing renewable energy development besides policy makers' acceptance, investors' acceptance have importance as well. As shown in table 4 this factors have higher scores in wind energy in comparison with other energies. Based on the opinion of one of the experts, community acceptance is the most important factor in social acceptance of renewable energies. In supplementary interview with him. The reason of choosing this factor as the most important one was introduced effectiveness of community acceptance with companionship of investors and policy makers.

## CONCLUSION

Utilization of renewable energies have substantial short term, midterm and long term interests. Security of energy supply, sustainable development of local industries, job offering and environmental sustainability are some of these profits. This is when fossil energy supplies are nonrenewable and due to greenhouse gases emissions like carbon dioxide has lots of negative effect on health and environment. Renewable energies with potential of job offering and wealth creation, causes empowerment and strengthen self-reliance of local communities and helps poverty alleviation goal. These energies are less effected by fluctuations in world market prices and helps the country's economic stability [1]. Based on what is shown in Figure 3 for increase in social acceptance of wind energy needs improvement in community acceptance also for enhancing social acceptance of solar energy, socio-political acceptance and market acceptance are important and all three factors are essential for geothermal energy enhancing. In the following we try to

five solutions in order to achieve the social acceptance goal for each of these three energies:

**Wind energy:**

For enhancing community acceptance of wind energy we can cite policy factors as below:

- 1) Efforts to attract local residents to participate in the establishment and operation.
- 2) Proper distribution of costs and interests and creating the public perception of justice.
- 3) Public awareness of the benefits through lectures, seminars and television programs.
- 4) Using local residents from the benefits of using wind turbines
- 5) Introduction of a cost difference of using wind energy instead of available energies could make society more eager to accept this energy

**Solar energy:**

For enhancing socio-political acceptance and market acceptance of solar energy these solutions are suggested:

- 1) Efforts for gaining supports of key policy makers by showing long term benefits for society
- 2) The state of facilities and financial incentives for participation of investors
- 3) Providing advanced technical training to raise awareness of active companies in this area
- 4) Developing appropriate business models to attract foreign investments
- 5) Developing R&D sectors in order to identify deeper aspects of technology
- 6) Expressing the effective role of solar energy in achieving the goals of sustainable development compared with other energies
- 7) Identifying potential areas in the use of solar energy spatial planning model.

**Geothermal energy:**

For developing this technology these solutions can be cited:

- 1) Due to low price energy and consequently improper use of them in the country, it seems increasing the price of fossil fuels can encour-

- age energy producing organizations and investors in this sector more and more toward using renewable energy (e.g. wind energy)
- 2) Focus in increasing the awareness of policy makers, investors and people by meetings and justification conferences.
  - 3) Implementation of practical samples and items in order to identify the characteristics of this type of technology to politicians and investors of the relevant organizations.
  - 4) Cooperation agreements between foreign firms and domestic companies in order to use expertise and investment
  - 5) Identifying potential areas for using geothermal energy by relying on allocation model.

In conclusion, this research presents a model for aspects of social acceptance of renewable energy and testing wind, solar and geothermal energies in Iran.

In this model indicators and sub indicators of social acceptance of renewable energies are provided. The research can be continued by developing indicators more detailed and defining operating sub-indicators for each defined indicator in this research. How to accelerate the process of developing wind and solar energies by using provided approaches and challenges of social acceptance of geothermal energy according to high potential of this energy in Iran can be a topic of another research which can definitely help developing renewable energies in Iran.

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