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The Role of Renewable Energies on Energy Security in Iran (In three fields of resources, production and distribution of energy)

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ABSTRACT

Energy, as one of the most essential factors of production, plays a fundamental role in the economic growth and sustainable development of nations. It also serves as a cornerstone of modern civilization and technological progress. Therefore, maintaining and protecting energy resources, as well as ensuring the continuous availability of energy carriers, are vital for the continuation of economic and social development. National energy security in any country is directly linked to the extent and stability of its socio-economic development, where energy serves as a decisive element in both preservation and advancement. This study aims to examine the role of renewable energies across the domains of resource management, energy production, and distribution. Furthermore, the paper highlights how national security can be enhanced through the integration of political and security considerations in energy portfolio management. The development of an energy atlas, incorporating renewable energy sources and active as well as passive defense strategies, is also proposed as an effective approach to optimize national energy planning and achieve long-term sustainability.

1. INTRODUCTION

Today, fossil fuel provide the most of useable energy in the world. Therefore, major concerns has been raised for substitution of fossil fuel, because of its exhausting in near future. It is obvious that providing energy for future generations is a massive dilemma also very difficult, so that in 2030 year, the world's energy consumption will be double. Also, energy demand will be increase 1.8 % in each year between 2000 and 2030 years [1].

The exploited fossil fuel storage rate which were used to produce world and regions energy in at the end of 2015 can be viewed in figure 1.

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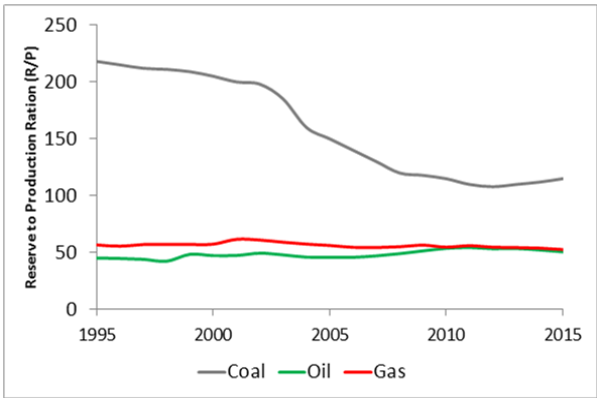

Fig. 1. Statistical Review of IEA, 2016

1.1. Importance of renewable energy

On the other hand, increase in living standards and advancing in various field and population growth lead to more energy use. The current population of the world is 7 billion people and annual growth rate is approximately between 2 and 3 percent, so that each 20 to 30 years population will be double.

As well, per capita consumption of energy in the world is 0.8 KW and economic indicators represent that GDP increases exponentially 2% to 5 % in year. Hence, global energy consumption increase 4 to 8 % annually if efficiency of energy conversion to national capital assume constant value. These are indicate that world's energy consumption will be high in recent century. Therefore, the question is fossil fuel are enough to respond global energy needs of human being in next century for survival, evolution and development or not?

the Researches shows that the average lifetime of underground resources (oil, coal and natural gas) will not exceed 100 years and such a growth needs alternative resources.

Renewable energy means any kind of energy that can be used without depletion of resources. In a country like Iran whit spread geographical extent, different kinds of physical conditions such as height, climate and social issues and etc., the necessity of diversification in energy portfolio in Iran and help out the electricity providers to diversify energy supply resources needs precise and scientific planning. Despite, the country's energy supply was based on oil and natural gas, such that over than 95% of energy portfolio of the country is oil and gas in recent years.

It is also noticeable that in recent years the only change in energy portfolio is substitution of gas instead of oil due to development of gas transmission network, so the share of gas reaches 62 % and continuously increases. Developed countries were aimed to diversify their energy portfolio by the approach to use of renewable energies. Negative consequences of policy of replacing gas instead of oil in the energy portfolio in Iran are following:

Considering the population and economic growth the energy consumption increases each year. On the other hand, the limited oil and gas reserves affect the exporting capabilities in these two fields.

Accordingly, planners need to consider the possibility of oil and gas negative balance and Iran's share reduction of petroleum export between oil-exporting countries. Increasing the share of gas in energy portfolio, decreases the share of exporting or converting to higher value added products of this important and strategic energy.

Lowering the level of energy security and rising social risk, despite the lack of asymmetric and optimization in the energy portfolio; the diversification of the energy portfolio increases national security.

Providing the most share of energy just by one or two resources, instead of diversifying resources, cause weakness of country versus high share energies. As an example, when over 64 percent of energy use depends on natural gas and this share provide just in two region of the country, it can be assumed that a disruption in gas producing system can be effect on total energy supply system.

Since energy play a direct role in social everyday life, the disruption in energy supplying system, even in short-time, can cause political and social crises.

Table 1. World ranking's diversification of energy consumption portfolio in 2016 [2]

	2015							2016						
Million tonnes oil equivalent	Oil	Natural gas	Coal	Nuclear energy	Hydro-electricity	Renew-ables	Total	Oil	Natural gas	Coal	Nuclear energy	Hydro-electricity	Renew-ables	Total
US	856.5	710.5	391.8	189.9	55.8	71.5	2275.9	863.1	716.3	358.4	191.8	59.2	83.8	2272.7
Canada	99.1	92.2	19.6	22.8	85.4	8.5	327.7	100.9	89.9	18.7	23.2	87.8	9.2	329.7
Mexico	84.4	78.4	12.7	2.6	7.0	3.7	188.8	82.8	80.6	9.8	2.4	6.8	4.1	186.5
Total North America	1040.0	881.2	424.2	215.3	148.2	83.6	2792.4	1046.9	886.8	386.9	217.4	153.9	97.1	2788.9
Argentina	32.2	43.4	1.4	1.6	9.6	0.6	88.7	31.9	44.6	1.1	1.9	8.7	0.7	88.9
Brazil	146.6	37.5	17.7	3.3	81.4	16.0	302.6	138.8	32.9	16.5	3.6	86.9	19.0	297.8
Chile	17.6	3.7	7.3	–	5.4	1.9	35.9	17.8	4.1	8.2	–	4.4	2.3	36.8
Colombia	15.6	9.6	5.3	–	10.1	0.4	41.0	15.9	9.5	4.6	–	10.6	0.5	41.1
Ecuador	11.8	0.6	–	–	3.0	0.1	15.5	11.0	0.6	–	–	3.5	0.1	15.3
Peru	10.7	6.4	0.8	–	5.4	0.4	23.7	11.4	7.1	0.8	–	5.4	0.6	25.3
Trinidad & Tobago	2.2	19.4	–	–	–	†	21.6	2.2	17.2	–	–	–	†	19.4
Venezuela	30.2	31.1	0.2	–	17.3	†	78.8	28.7	32.0	0.1	–	13.9	†	74.6
Other S. & Cent. America	67.5	6.6	3.2	–	20.8	4.5	102.6	68.5	6.7	3.4	–	22.5	5.1	106.2
Total S. & Cent. America	334.4	158.3	35.9	5.0	152.9	24.0	710.4	326.2	154.7	34.7	5.5	156.0	28.2	705.3
Austria	12.5	7.5	3.2	–	8.4	2.3	33.9	12.7	7.9	3.2	–	9.0	2.4	35.1
Azerbaijan	4.5	9.6	†	–	0.4	†	14.5	4.6	9.4	†	–	0.4	†	14.5
Belarus	7.7	14.0	0.7	–	†	†	22.4	7.5	15.3	0.8	–	†	0.1	23.7
Belgium	31.0	13.6	3.2	5.9	0.1	3.2	56.9	31.8	13.9	3.0	9.8	0.1	3.2	61.7
Bulgaria	4.4	2.6	6.6	3.5	1.3	0.7	19.0	4.5	2.7	5.7	3.6	0.9	0.7	18.1
Czech Republic	8.9	6.5	16.6	6.1	0.4	1.7	40.2	8.4	7.0	16.9	5.5	0.5	1.7	39.9
Denmark	8.0	2.8	1.7	–	†	4.3	16.9	8.0	2.9	2.1	–	†	4.1	17.1
Finland	8.7	2.0	3.8	5.3	3.8	3.1	26.7	9.0	1.8	4.1	5.3	3.6	3.4	27.1
France	76.8	35.1	8.4	99.0	12.3	7.9	239.4	76.4	38.3	8.3	91.2	13.5	8.2	235.9
Germany	110.0	66.2	78.5	20.8	4.3	38.1	317.8	113.0	72.4	75.3	19.1	4.8	37.9	322.5
Greece	14.9	2.5	5.6	–	1.4	2.0	26.4	15.4	2.6	4.7	–	1.2	2.1	25.9
Hungary	7.0	7.5	2.4	3.6	0.1	0.7	21.2	7.1	8.0	2.3	3.6	0.1	0.8	21.9
Ireland	6.8	3.8	2.2	–	0.2	1.6	14.5	7.0	4.3	2.2	–	0.2	1.5	15.2
Italy	57.6	55.3	12.3	–	10.3	14.3	149.9	58.1	58.1	10.9	–	9.3	15.0	151.3
Kazakhstan	13.2	11.6	35.8	–	2.1	†	62.7	13.2	12.0	35.6	–	2.1	0.1	63.0
Lithuania	2.8	2.1	0.2	–	0.1	0.3	5.4	3.0	1.8	0.2	–	0.1	0.4	5.5
Netherlands	38.7	28.3	11.0	0.9	†	3.1	82.1	39.9	30.2	10.3	0.9	†	3.1	84.5
Norway	10.3	4.4	0.8	–	31.1	0.6	47.2	10.4	4.4	0.8	–	32.4	0.5	48.6
Poland	24.9	14.7	48.7	–	0.4	4.7	93.4	27.2	15.6	48.8	–	0.5	4.6	96.7
Portugal	11.5	4.3	3.3	–	2.0	3.6	24.6	11.2	4.6	2.9	–	3.6	3.7	26.0
Romania	9.2	9.0	5.9	2.6	3.8	2.2	32.6	9.5	9.5	5.4	2.6	4.1	2.0	33.1
Russian Federation	144.2	362.5	92.2	44.2	38.5	0.2	681.7	148.0	351.8	87.3	44.5	42.2	0.2	673.9
Slovakia	3.7	3.9	3.3	3.4	0.9	0.5	15.7	4.0	4.0	3.1	3.3	1.0	0.5	15.9
Spain	61.2	24.6	13.7	13.0	6.3	15.6	134.4	62.5	25.2	10.4	13.3	8.1	15.5	135.0
Sweden	14.1	0.8	2.1	12.8	17.0	6.1	52.9	14.7	0.8	2.2	14.2	14.1	6.1	52.2
Switzerland	10.7	2.6	0.1	5.3	8.5	0.7	27.9	10.2	2.7	0.1	4.8	7.8	0.8	26.4
Turkey	38.9	39.2	34.7	–	15.2	3.9	131.9	41.2	37.9	38.4	–	15.2	5.2	137.9
Turkmenistan	6.6	26.5	–	–	–	†	33.1	6.7	26.6	–	–	–	†	33.2
Ukraine	9.2	25.9	27.3	19.8	1.2	0.4	83.9	9.1	26.1	31.5	18.3	1.6	0.3	87.0
United Kingdom	71.8	61.3	23.0	15.9	1.4	17.5	190.9	73.1	69.0	11.0	16.2	1.2	17.5	188.1
Uzbekistan	2.7	45.2	1.1	–	2.7	†	51.7	2.8	46.2	1.0	–	2.7	†	52.7
Other Europe & Eurasia	33.3	13.6	23.0	1.0	20.7	2.3	94.8	34.5	13.9	23.0	1.8	21.7	2.5	97.6
Total Europe & Eurasia	865.9	909.2	471.3	263.9	194.7	141.6	2846.6	884.6	926.9	451.6	258.2	201.8	144.0	2867.1
Iran	84.5	171.7	1.6	0.8	4.1	0.1	262.8	83.8	180.7	1.7	1.4	2.9	0.1	270.7
Israel	11.4	7.6	6.7	–	†	0.3	26.0	11.6	8.7	5.7	–	†	0.4	26.4
Kuwait	22.3	19.2	–	–	–	†	41.5	22.0	19.7	–	–	–	†	41.7
Qatar	10.7	39.5	–	–	–	†	50.2	11.7	37.5	–	–	–	†	49.2
Saudi Arabia	166.6	94.0	0.1	–	–	†	260.8	167.9	98.4	0.1	–	–	†	266.5
United Arab Emirates	40.9	66.4	1.3	–	–	0.1	108.6	43.5	69.0	1.3	–	–	0.1	113.8
Other Middle East	76.5	45.9	0.5	–	1.8	0.1	124.7	77.3	47.1	0.5	–	1.8	0.2	126.8
Total Middle East	412.8	444.3	10.2	0.8	5.9	0.5	874.6	417.8	461.1	9.3	1.4	4.7	0.7	895.1

1.2. Importance of renewable energy

Figure 2 shows the energy fluctuation in Iran in 2016.

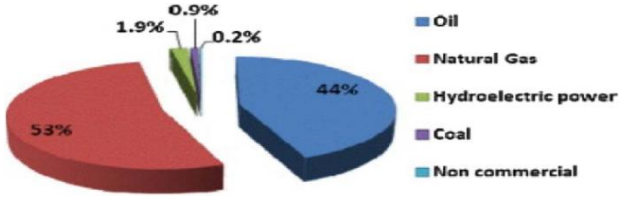

Fig. 2. Iran's energy portfolio changes in 2016 [3]

Fig.3. shows total energy fluctuation in the world between 2006 and 2016.

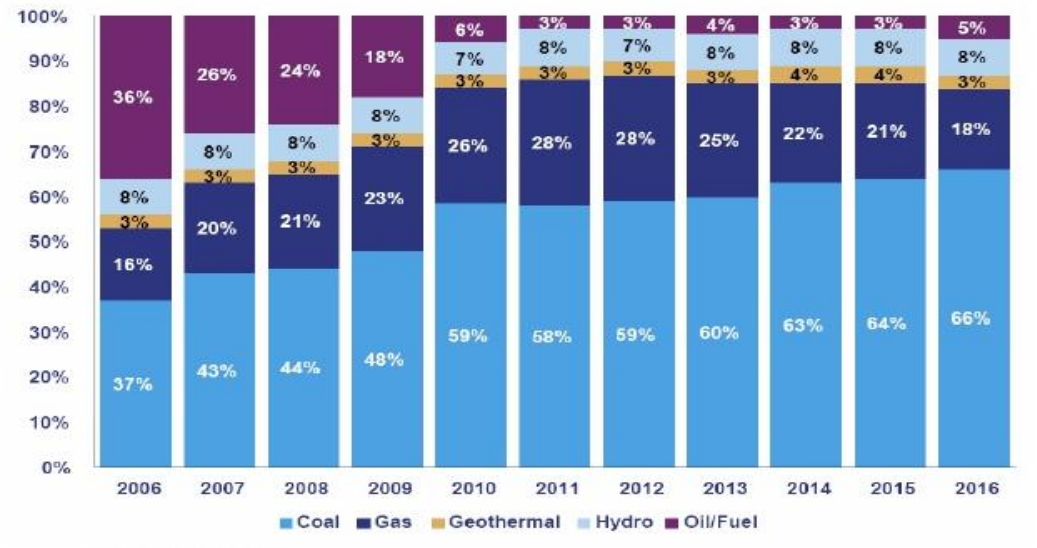

Fig. 3. Total energy fluctuation in the world between 2006 and 2016[4]

Figure 4 shows the variation in role of different primary energy carries in the world.

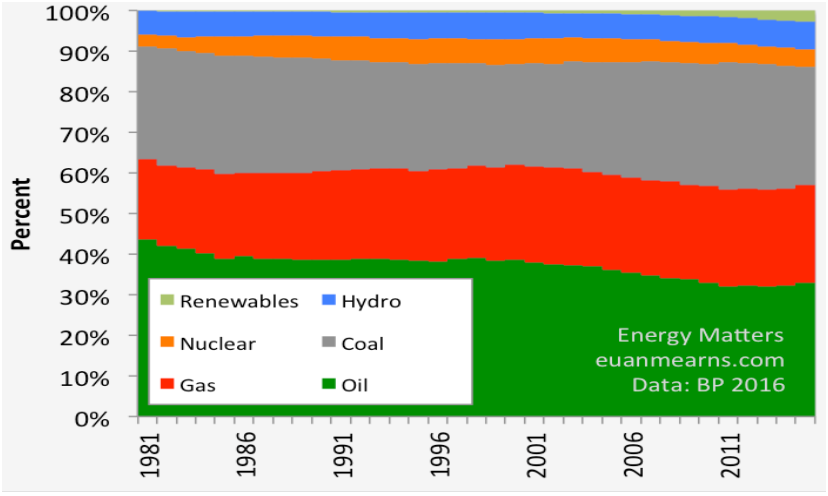

Fig. 4. Variation in role of different primary energy carries in the world between (1981 – 2011) [5]

In the perspective of global energy portfolio, renewable energies are more important and due to this, the global energy portfolio will have more diversification and the world utilize indigenous energy resources.

In this regard, European Union adopted a plan on 23 January 2008, which is planned to increase share of renewable energy to 20 percent in average energy portfolio of EU members in 2020.

Diversification of energy portfolio requires accurate knowledge of the potential of the country in existence of different carriers and analyzing the effects.

One of the most important issues to design a comprehensive energy portfolio is energy security. Energy security is important in designing a comprehensive energy portfolio. Energy security is a multi-dimensional concept which producers, consumers and investors cooperate with each other to achieve a sustainable security. Energy security for

importers is focus on base lines and secure providing resources. On the other hand, in exporters side the energy security define as sustainability in sales procedure.

As a result, Iran as a grand supplier and consumer in energy field, both security in providing and exporting energy has significant importance which shows the importance of energy portfolio management.

The diversity of energy sources in the energy portfolio of a country, is one of the factors that causes increasing in energy security. This diversity divides risks of energy into different resources so if a disruption occurs, vital threats do not threaten the security of country. Countries that have not this diversity, is at high security risk any time.

The three main features of a diversified energy portfolio are the multiplicity, balance and difference in available energy sources. Another important factors in energy security are geopolitical, political and strategic factors in supplying the energy portfolio. Current Iran's portfolio contains natural gas (approximately 62 percent), oil (approximately 35 percent) and about 3 percent of other energies.

In this portfolio, lack of multiplicity, balance and difference in energies causes decreases in security of portfolio.

In addition, most of this energy is exploited in South of the country and border area.

Consequently, if a major source of oil or gas in the country fails (such as the Asalouyeh region), the energy crisis is expected.

By define other sources of energy and diversifying portfolio in such a way that all relevant dimensions are included, Iran's energy security increases significantly.

Also, the national security can be increased by evaluating political and security issues in portfolio management and preparing energy Atlas, Decentralization from the energy supply regions (South and West of country) by using other energy resources such as renewables and defend active/passive in energy exploitation areas.

Considering these issues in designing an energy Atlas, helps to portfolio management.

1.3. Necessity to achieve goals in sustainable development in energy sector and prevention of international penalties

Sustainable development using renewable energies has been main stream in the world. Sustainable development is created by energy production and consumption systems which are more efficient, cost and pollution less. Considering energy use, sustainable development refers to development in technological and economic growth, also addresses other aspects such as the environment, culture and human specification.

Sustainable economy means sustainable development. Sustainable economy leads to an increase in cost-effective production and more people's participation in development, and the decrease limitation of short-term energy sources and long-term pollution. Considering high population growth, sustainable economic growth is achievable through access to non-limit and less drawbacks source of energy in todays of the world. Environmental and economic dimensions of fossil fuels, as the main source of energy, have been challenging for many years.

While the increase in energy consumption be along with ecological constrains, natural growth is limited; in this case, utilization of natural sources and economic growth are unsustainable. Manager and policymakers in all over the world believe that accessing to required clean and reliable energy resources is one of the most challenging issues in future in sustainable development. Therefore, dealing with the phenomenon that the growth of energy demand in the developed world without causing irreversible damage to the environment, and whether problems in the issue of free energy with a lack of energy will be problematic, is one of the important issues in the sustainable energy development is considered.

Based on what have been presented before in sustainable development and energy, it is required to know three other dimensions.

These three important dimensions of energy and sustainable development is illustrated in Figure 5. According to the dimensions, for sustainable development it is important to pay attention to other forms of energy in nature,

including the sun, wind, biomass and geothermal and their replacement. Figure 5 shows these three important dimensions.

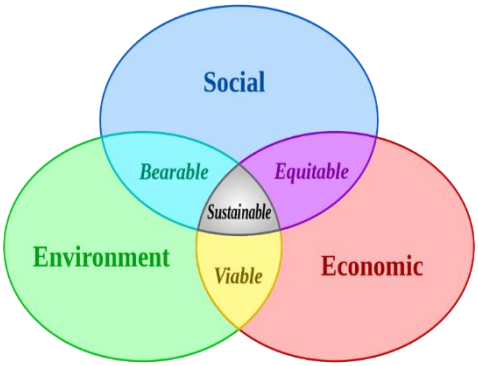

Fig. 5. Three Dimensions of the Importance's Energy in Sustainable Development [6]

1.4. Enhancing the security of energy supply and reliable sources of energy

Nowadays, energy as one of the most important production factors have a great share in countries economy growth and development, also play the most crucial role in recent development in human civilization. It is necessary for country to maintain and protect energy resources and continuity existence of energy carrier for continuation of economic and social developments. In other words, national energy security, in every country, depends on extension of socio-economic development which energy has decisive role in preservation and realization of socio-economic development. For example, failure of making secure electricity distribution network and ignoring country critical point of the network, causes power outage in spread region.

There are disadvantages such as, temporary cessation of industrial plants (which use domestic network), decrease in investing security in industry sector, and creating problems in electrical appliances at homes and business sector. Therefore, it can be concluded that electricity in economy and industry play a role as blood in body and absence of different organs in body collapse if the blood flow disrupt. Due to, this energy policymakers focus on energy security.

The improvement of the safety indexes of this system and the removal of the variables that are effective in increasing the risk and potential risks make positive effect on the performance of the energy system. In other words, increase in security of energy system, cause decrease in disadvantages of energy system that affect other sectors.

The current condition of Iran's energy system and its different effects on other sectors, also indicate necessity of increasing the level of energy security.

Some reasons which show the necessity of investment for developing energy security in energy system are illustrated below:

- Ease of covering domestic energy demand
- Preserving share of Iran in oil markets
- Maintaining and protecting energy resources and optimal utilization of them

Currently, developed countries use different methods to ensure the continuity of energy existence, including changing energy consumption patterns, increasing energy efficiency and using renewable energies.

Renewable energies are an endless energy source which are environmentally friendly and available in the most parts of the world. For instance, the sun radiation is more than 20 times the world's energy per day, and approximately 1 percent of its energy is absorbed and used by plants.

The geographical situation and radiation of 230 to 3330 hours of sunshine throughout the year have made our country one of the sunniest countries in the world, so that the sun radiation in about 250 days a year. This amount of radiation is equivalent to 6 million barrels of oil per day, equivalent to the country's maximum oil production.

2. ENERGY SECURITY CATEGORIZATION

The changes in energy system condition have significant effect on the economic and political status in each country. In other words, the most important indicators of domestic productivity are affected by changes in the status of the energy system.one of the factors affect this system is energy security.

Energy security is evaluated in different viewpoints and influences various factors. Since energy security depends on a variety of quantitative and qualitative variables, the energy security cannot be measured as a quantitative parameter and just be evaluated qualitatively.

Quantitative parameters such as natural energy reserves, and qualitative parameters such as political status of energy suppliers, and their diplomatic relationship through ensure the continuity of energy trade, can be illustrated. However, energy security is a function of all variables that affect the risk and probable hazards in energy system. The desired level of energy security is evaluated from different perspectives. For instance, the optimal level of energy security from the consumer's point of view is to achieve sustainable and safe energy by the lowest cost.

So, even if the consumer can achieve a higher level of energy security at a relatively high cost, and does not need this level of security, he will not do anything to achieve this level of security. Due to this fact that energy security exceeds the optimal utility level, hence, it is not appropriate. Figure 6 shows changes in the amount of energy security based on the cost.

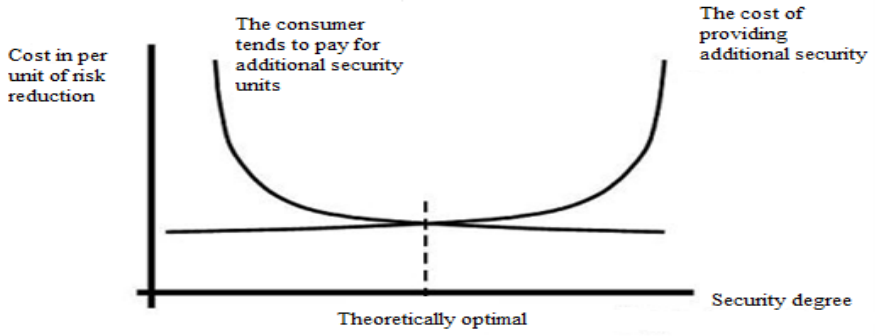

Fig. 6. The theoretical optimal security based on the required cost

Increase in the level of energy security from its optimal level for all energy carriers imposes a higher cost, because when security level increases, the cost rate for required security also increases. The determining the optimal utility level of energy security system is not a simple process, because the various hazards of the energy system cannot easily be calculated. One of the categorizing method used to better assess the security of the energy system, is based on their scope of effect. Based on this method, the security of energy system can be divided into three parts:

•Security of energy resources inside the country and other supplying countries

•The security of energy generators in terms of positioning and reliability technologies

•Security of the energy distribution network in terms of reliability and waste

Energy resources are primary energy carriers' reserves, mainly used as crude oil, natural gas, coal, and complementary energy sources (new and renewable energies). Primary energy carriers are not usually directly used, and they enter into process units to prepare for final consumption.

The most important units of energy production include oil refinery (converter of crude oil to petroleum products), fossil power plant (product from fossil fuel combustion to electricity), power plant and renewable energy plants such as wind power plants, solar cells and fuel cell (converting renewable energy sources to electricity).

To understand the importance of energy security, it can be noted that merely the economic losses caused by the disruption of electricity and gas delivery in the supply network and the problems associated with providing of energy carriers required, considering daily and seasonal changes, annually lead to great costs for public and private sectors.

2.1. Influencing factors on energy security in the three fields: resources, production and distribution of energy

The required security level for the energy system differs from the point of view of consumer, producer and, the most important, government perspective, which guarantees the survival of the connection between economic and political sectors with the energy sector, and approaches means to achieving optimal security for these sectors also has its own distinct differences However, the most important security of three fields of energy security are following parts:

A. The degree of variation in the system

B. Reliability of the system

Several factors are required to achieve the above two characteristics in the three fields, productive technologies and distribution network. Among the factors that affect the security of energy sources some of them are mentioned following:

- Creating diversity in energy supplies and moving towards new energy sources (renewable energies)
- Diversifying energy-consuming countries in terms of multiplicity of countries and new sources of energy
- Utilization the latest technology for extraction and exploitation resources
- Discover new sources and develop current resources
- Adjusting energy demand to the future reserves
- Adjusting current and future energy resources with environmental laws and obstacles (effective in changing the energy consumption pattern)

Among the factors influencing the creation of energy security in conversion technologies and energy production, we can mention the following:

- Diversifying fuel needed for conversion and production technologies
- Diversifying the nature of technology
- Diversifying the production of energy production Hubs
- Proper distribution of energy hubs in different regions
- Develop and improve the status of using technologies to produce final energy carriers
- Adjusting current and future energy production technologies with environmental laws and obstacles (effective in changing the energy consumption pattern)

Among the factors that influence the creation of more security in the field of energy distribution, it can be mentioned the following:

- Development of regional energy resources to reduce energy transmission
- Develop and improve the status of technologies using for distribute energy carriers
- Updating and maintaining the energy distribution equipment according to the growing need in different sectors.

- Optimal energy storage based on different regions
- Proper distribution of energy hubs in different regions
- Identification critical points in the network and removing them
- Reducing the dependence of large energy consumption centers on the global energy distribution network
- Adjusting the energy distribution methods in the future with environmental regulations and barriers

Achieving security of energy in different areas and using different methods is feasible, and in some cases, with the implementation of a policy or a combination of policies, security can be achieved ideally for the energy system.

2.2. Iran's energy security and the impact of renewable energies

Iran has vast resources of fossil fuels, but in terms of resources energy security, it has particular problems in comparison with many countries of the world.

In this section, by presenting quantitative information about variety of energy carriers used in Iran and other countries, it is trying to express the differences between Iran and other countries in energy supplies and necessity of diversification the resources. [7]

In 2014, the total final energy consumption of the Iran was to 212.5 million toe*, which 40.45 percent was attributed to oil products, 57.95 percent to natural gas, 1.03 percent to hydro-electric, 0.05 percent to renewable, and 0.52 percent to coal.

Figure 7 shows the contribution of each type of energy to the final energy consumption of the country.

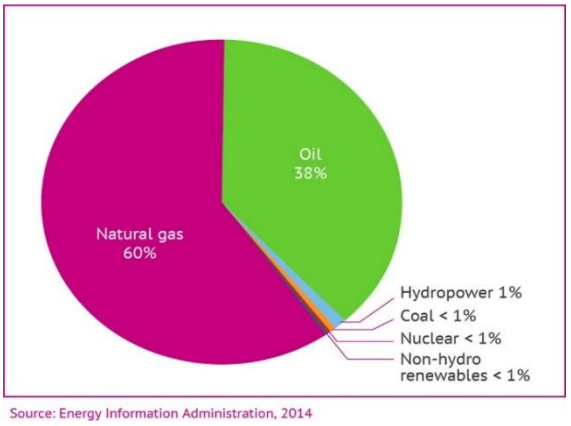

Fig. 7. Contribution of each type of energy to the final energy consumption of the Iran [8]

Comparing the statistics, the contribution of different energy carriers in final consumption of energy in Iran with other developed countries, it can be concluded that the energy sources used in Iran do not have the desired diversity.

Studying the contribution of different energy sources to the final energy consumption in the world, in 2010, shows that there are also three major energy carriers in the energy basket, indicating a relative diversity in energy supply sources. Considering the figure 8, the world total final energy consumption in 2010 was 33.56 percent of crude oil, 23.81 percent of natural gas, 29.63 percent of coal, 5.22 percent of nuclear power, 6.46 percent of hydroelectricity, and 1.32 percent of renewable energy.

*Ton of Oil Equivalent

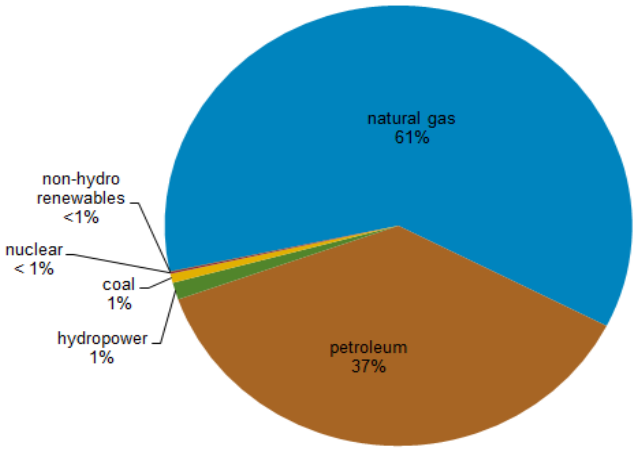

Fig. 8. Contribution of each type of energy to the final energy consumption of the World [9]

Comparing data of Iran with other countries, it is concluded that the sources of energy demand in different parts of the country are characterized by obviously diversifies weakly. Of course, this lack of diversification in energy supply sources can be find in most fossil fuel exporting countries. Therefore, Iran did not diversify energy resources and this parameter reduces energy security. Previous explanations shows the development of use of renewable energy sources in domestic energy consumption portfolio can effectively increase Iran security.

Another factor affecting energy security of resources, is the geographic location of current resources and new discovered resources. The geographic location of the crude oil and natural gas reserves of Iran and World is shown in Figure 9 and Figure 10. Situation of Iranian oil and gas reserves are shown in respectively.

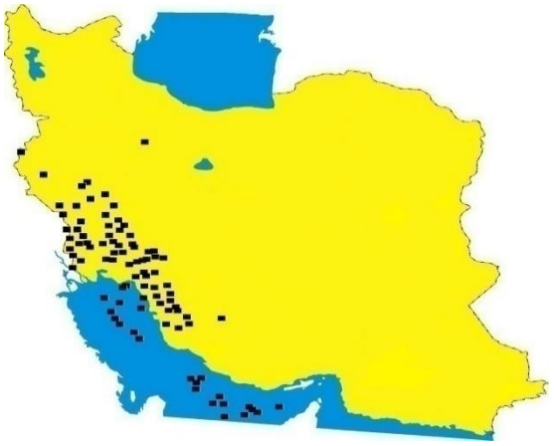

Fig. 9. Situation of Iranian oil and gas reserves [7]

Fig. 10. Situation of World oil and gas reserves [10]

Inappropriate geographic location of the Iran's oil fields in Iran-Iraq war, including the Nowrouz oil field, encouraged the enemies to bombard these areas. Since destruction of these oil fields, the primary energy production fell sharply. This has also happened in US and Iraq war, which the Iraq's oil wells was one of the first target had been attacked. Therefore, the development of regional and sporadic resources of renewable energy can increase the energy security and provide part of the energy needed.

2.3. Production energy security and impact of renewable energy in Iran

Various factors can reduce the energy security in technology of converting primary energy carriers into final energy sources. One of these factors is improper geographic distribution of energy production centers.

The geographic distribution of crude oil refineries and thermal power plants in Iran is shown in the Figure 11 and Figure 12. The refining of crude oil and the producing of various types of crude oil products is carried out by 9 domestic refineries in order to meet the needs of the country and export some of the surplus products abroad. High share of petroleum products in supply energy to different sectors, especially transport and households, and improper geographic distribution of crude oil refineries in the country, as well as not using small home power generators in remote locations and far distances between production and utilization centers in the country, causes spending a lot of money for transportation, and also cause a considerable loss of this energy and reduce the safety factor of electrical energy security for remote areas, which is sometimes also a sensitive area.

Fig. 11. Distribution of crude oil refineries in Iran [1]

Fig. 12. Distribution of thermal power plants in Iran [1]

Old refinery equipment will reduce the efficiency of fossil fuels and, consequently, increase the risk in the sources. Another problem in the country's refineries, demotion and lack of upgrading in refinery's products and the relatively high share of fuel oil in the portfolio of manufactured petroleum products. [7]

On the other hand, in 2009, the total electricity generated by the Ministry of Energy's power plants was 42255.3 MW, 34.5 percent by hydroelectric power plants, 27.2 percent by combined cycle power plants, 19.99 percent by gas plants, 17.41 percent by hydroelectric power plants, 0.68 percent by diesel power plants, 0.21 percent by wind power plants and less than 0.01 percent produced by solar and biomass power plants. Considering the fuel consumption of most power plants in the country, the amount of pollutants generated at a significant level, which is also reduces the security of energy system. The above information shows that use of renewable energy sources has a very high potential for increasing energy security.

2.4. Distribution energy security and the impact of renewable energies in Iran

Existence of a secure and integrated distribution network in each country requires for the development of a secure energy system. Distribution network of Final energy carrier in Iran is mainly divided into three parts:

- Petroleum products: transmission of oil products take place by pipelines, road and tankers, railways and petroleum product ships. Use of traditional technology in the aforementioned methods has prevented to reach desirable security of this part of the energy system. Also, the significant share of roads and improper quality of roads is one of the reasons causes the decline in the degree of energy distribution security.
- Natural gas: in the case of natural gas transmission and distribution, due to the wide network of gas pipelines, Iran is in a better position. It also shows that the natural gas distribution network is developing at a fast pace. However, open loop of gas pipelines in the country has reduced the security level of the gas distribution network. Figure 13 shows the main lines of natural gas transportation in Iran.

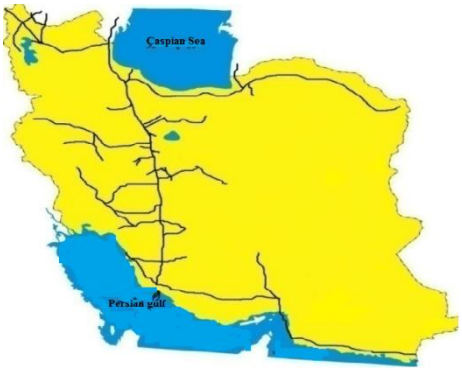

Fig. 13. The main lines of natural gas transportation in Iran [7]

Electricity: significant steps have been taken to transfer power lines and power stations. In 2010, the length of transmission and over-transmission lines, was 25150 km, and 3955.6 km of optical fiber length in Iran. One of the most important factors affecting the security of the electricity distribution network is the significant losses in the power distribution network of the country. The most important reasons for this are network exhaustion, connection of posts, faulty insulators, worn-out equipment and unauthorized use, which cause casualties, and makes the network vulnerable to natural disasters. Construction of alternative lines and the conversion of the air network cable into underground distribution sector are two solutions for reducing losses. In addition, using the underground cable network reduces energy losses, protects the distribution network from storms and floods.

Underground cable network in cities is more beneficiary than air cable. As a matter of fact, costly construction of this network, and the existence of gas and communication networks in the streets, makes the implementation of this project difficult. As can be concluded from this section, use of renewable energy sources has a very high potential for increasing the degree of energy security in Iran in the distribution sector, because using these resources, the importance of the distribution network in the energy system will be dramatically reduced.

3. IMPACT OF RENEWABLE ENERGY ON INCREASING ENERGY SECURITY IN IRAN

Studying current state of Iran's energy, shows the annual growth rate of energy consumption in the country is about 9%, which necessitates the development of the energy system. The high annual demand rate for energy consumption, the lack of diversification in energy sources, and the strong reliance on fossil fuels and the high share of energy exports in GDP, highlight the need to energy security.

On the other hand, energy and environment crisis can be happened due to play down the security of renewable energy. It can also have irreparable consequences economically.

By investigating the factors affect to increase energy security, it is obvious that the use of renewable energy in several cases can increase energy security. Some of them are illustrated in following:

- Diversification in energy sources
- Development of energy resources
- More adapting with environmental laws and regulations
- Diversify in energy technology
- Increase regional energy production and reduce energy transmission in the network (distribution security)
- Increase in energy storage requirements based on different regions and achieve optimal energy storage
- Proper geographic distribution of energy production and conversion centers (production security)
- Help to remove sensitive points in the transmission network
- Reduce the energy requirements of centers consumers to the domestic network energy using the decentralized generation capacity of supplementary energy

At the moment, the main focus is on the diversification of the electricity energy system and methods of producing. However, the most of produced energy from renewable energy sources is electricity. Energy security required for transportation and building sectors are next priority.

One of the biggest problems that cause problems in securing power generation is technical problems and costly of electricity storing. While by using renewable energy, electricity can be stored much easier than conventional methods, and it can increase the security of electrical energy.

4. CONCLUSION

Characteristics of Iran energy system shows that the lack of diversity of the system in three fields of resources, production technology, distribution network and high uncertainty in the energy system has led to reduce degree of

energy security. This becomes even more important for a country like the Islamic Republic of Iran, which is located in a specific economic, political, and military region like the Middle East and seeks to achieve its goals.

On the other hand, studying the factors of creation more security in the three fields of resources, production and distribution of energy, it can be well understood that the development of renewable energy applications can play a significant role in increasing the security of the energy system, because of the development of utilization of renewable energy sources can diversify energy sources, develop of current resources, adopt with environmental regulations and environmental barriers, diversify energy production technologies, and remove sensitive points in the network transmission.

On the other hand, the development of renewable energy applications can also help out the national security, because it is estimated by looking at the prospect for the next twenty years that a significant portion of the GDP is supplied through the export of fossil fuels.

Therefore, development of renewable energy applications, can be used to generate and maintain energy from fossil energy sources, and to preserve and protect fossil fuels for future generations.

CONFLICTS OF INTEREST

The authors declare no conflict of interest.

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