

## Solar energy: Important Element of Economical Development

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**Abstract:** Producing electricity is one of the basic economical powers of a country, so increasing electricity production and its additional value has been the focus of attention in recent ten years. Meanwhile, by achieving the advanced technology, using of clean energy and reproducible systems in energy supply has had noticeable increase. Facility in access and use of solar energy are two factors that change it into a put it in a suitable source. Sun is the biggest and the only source of energy supply of the earth which is used to supply the energy in different ways, such as fossil and non-fossil fuels. In this article the role of improving efficiency of solar energy as a dynamic and constant source of economical development is studied. Also Iran situation in receiving and exploiting it in comparison with other countries have been reviewed. Fortunately, a huge number of solar projects in our country have been run in recent years. Generating solar power houses in Shiraz, Yazd and some other cities are some of the examples. Salient increase in electrification to rural areas of Iran by photo voltaic systems in recent ten years at industry and its effect on employment, private investment development and improvement of economy have been preceded.

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### 1. Introduction

Abundant of eternal solar energy, without any requirement to expensive transfer and distribution, is available all over the country.

Traditional Iranian architecture shows their specific attention to the correct and effective using of sun in ancient time.

Unfortunately, nowadays with existence of scientific and new technology in our country, using solar energy is so trivial.

It's generally known that the existing of huge oil and also gas resources, and weakness of scientific-technical grade of country is the reason for lack of improvement in using solar energy. However, it should be noticed that because of the economic value of these kinds of resources and their limitation, it is not logical to just use them for heating the water or buildings. Also in critical situations like war time or winter that lead to way blockade, some disorders will happen in extraction or distribution. So costumers will face lack of fuel. On the other hand, it can be mentioned that our country has a good potential in current scientific and industrial position. So if solar designs are defined and related sciences are introduced, solar industry can work as an independent industry here.

Especially after increasing of petroleum cost in 1973, developed countries had to start improving their technology in this field and till now they have done a lot of important progresses.

### 2. Iran and global or local energy changes

In global energy market, Iran stands in the focus of

attention and center of international exchange due to two reasons.

First: geopolitical situation of country, second: vital role of Iran in global security of energy. In fact in this frame it can be professed that the energy is one of the chain of connection between Iran and outside world. So Iran's energetic diplomacy and national development of country has mutual collaboration.

Meanwhile, energy and its security can change into one of the important confederacy of Iran relationship with powerful countries, particularly in Asia and Europe, and also it can have an effective help in realization of the country future development.

Making energy relationship with important countries is vital for the country since beside economical benefits it will have considerable security benefits and makes these countries dependent to Iran in providing principal commodities.

Our country produces 4 million barrels of petroleum in a day and 120 billion m<sup>2</sup> natural gas approximately. It equals 4 and 5 percent of oil and gas production respectively in all over the world.

Iran's situation is more important than other parts of the world, especially in gas section, because it finds specific position in security of Asians' energy consumer and on the other hand, it has the second place in natural gas resources across the world and better geographic location in western Asia.

Independent policy of Iran in management of its energy resources, its stable political behavior and its specific interest in creating adhesive relation with Asian

countries expand its capacities more than before.

Therefore, according to Iran's history in providing fossil fuel energy and receiving solar energy, it can also have one effective role in using solar energy in the region.

### 3. Key aims in stable energy policy

According to the current situation of international studies on stable energy policy, four stable strategic aims as a base of future energy diplomacy in Iran are: social acceptability, source efficiency, ecological impressments and economical efficiency.

**Social acceptability:** electricity for houses and industry, fuel for transportation, industry and also energy for heating water, and air conditioning in buildings should have fair prices.

**Source efficiency:** to prevent energy dissipation by having the best possible control on energy supply in order to provide maximum output energy from irreproducible fossil energy resources and reproducible

sources. Increase of energy efficiency causes decreasing of energy expenses for consumers.

Energy expenses which are saved in this way can be invested for accelerating the speed of presenting reproducible energy in the market.

**Ecological impressments:** to minimize making dopant diffusion such as (SO<sub>2</sub>, NO, CO<sub>2</sub>) which are dangerous for human health and to decrease the distribution of greenhouse gases like (CO<sub>2</sub>, CH<sub>4</sub>).

These kinds of gasses are the cause of instability of weather system and will influence the living conditions of human (current and future generations).

Distribution of these gases will be decreased noticeably by using the reproducible energies. The range of dopant greenhouse gases scattering in 1388 due to reproducible powerhouses is shown in chart 1. As the table illustrates using solar energy has the least pollution among the other reproducible energies.

The range of dopant greenhouse gasses diffusion in 2009  
(Source: energy balance sheet in 2009)

Type of energy	CO <sub>2</sub>	SO <sub>2</sub>	NO <sub>x</sub>
Water- electricity	54972	119	33
Windy	1814	12	9
Solar	10	0/02	0/02
Total	56796	132	42

**Economic efficiency:** it requires saving the expenses in energy supply in a long time. In this way we can decide about the specific technology and the profitable technological methods with a minimum time investment, ecological and economical expenses and to get welfare advantage based on business management view.

### 4. Iran condition in receiving solar energy

Iran is located between 25 to 40° on northern wide.

Also it stands in a region which receives a lot of solar energy, among the other areas in the world. The range of sunlight in Iran is estimated between 1800 to 2200 kwh/m<sup>2</sup> in a year which is upper than the universal average range. Sunny days in Iran are reported more than 280 days normally and this is so noticeable.

As it is shown in picture 1, Iran is member of those countries which have the highest amount of solar energy reception.

### 5. How to exploit solar energy

Solar energy is used by different systems in the current century which are:

- 1: Using the heating energy of the sun for houses, industries and powerhouses.
- 2: Changing the sun-rays into the electricity directly by some facilities called "photovoltaic".

Solar heat which produced electricity in powerhouses is divided into different parts itself which fascia parabola is one of them. In this powerhouse heating energy is produced as a result of focusing

sunbeams by some parabola mirrors.

In this method heat is created in a fluid. Then after passing through a converter, it gives its heat to the other fluid that surely is water. So it produces steam. Its temperature and pressure are so high that reach to the hot steam characteristics. It can produce variety of productions, for example it can be sent to turbine for electricity production or it can directly be sent to the heating systems of houses or a region or it can be used for ice and pure water production or even providing needed steam for production lines, like agricultural transforming industries... Such powerhouses can be used in a capacity of 20-30 megawatt to upper megawatts in producing electricity. In this way a country like US entered 354 megawatts electricity to circuit in 1984. And nowadays developmental projects are being performed in southern Spain & America.

There is other type of solar-heat powerhouses that is called centralizing tower. In this kind of powerhouse energy is produced from the mirrors which stand in a land. These mirrors are installed standing around the tower in a special position. There is a receiver on the top of the tower, that receives all of the sunbeams from the mirrors and the available energy carrier fluid makes the temperature up to 1200.

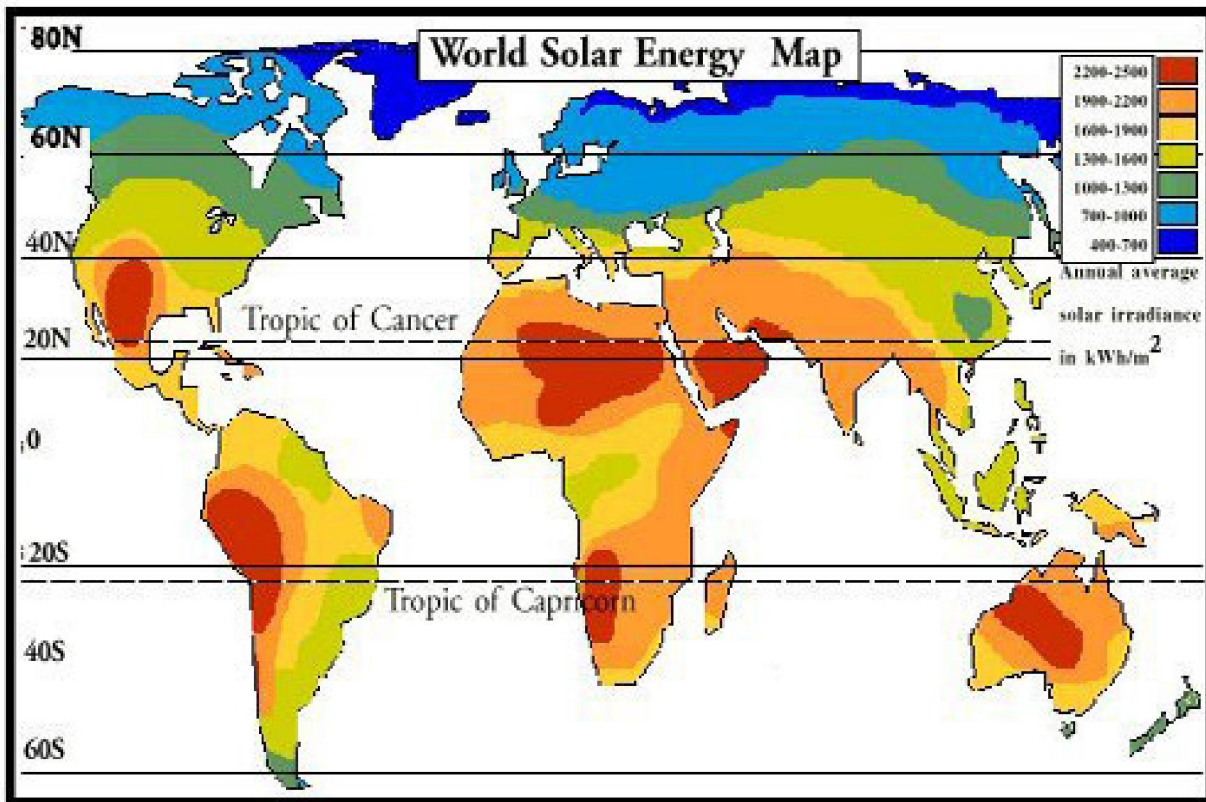
The other heat powerhouses are sun dishes with mirrors on their surfaces and a motor in their focus called Sterling. They start to produce electricity as a

result of focusing the sunbeam radiation on this motor and the phenomenon of sterling cycle. Production of these machines is 5 to 50 kW electricity and they can be used for the regions which are far from the web.

Photovoltaic systems that called solar electricity systems are the other examples of these systems which can be found in some parks above banquette lights. These pylons start to produce electricity without any inductor as soon as they receive sunbeam by their solar cell. When some of them are used together, they produce energy in range of W to kW. Certainly, type of this electricity is DC. In this type electricity is saved during the day and is used during the night. It can be

used for the house consumption directly or used in powerhouses or injected to the national electricity web which consequently improves the transportation of web through the lines.

The other application of solar energy is in producing heat, and this can be achieved by instruments like solar water heaters that installed on the roofs. In other words your needed hot water is provided just by sun and without using fossil fuels. Solar ovens, solar water purifiers and heating & cooling systems are other examples.



Picture 1, distribution of the range of receiving solar energy in the world.

## 6. Photo voltaic solar powerhouses across the world

Nowadays solar powerhouses are mainly photo voltaic & their capacity is just 0.1 percent of whole reproducible capacity of the country. But the rate of increasing of this in the world in 2008 was even faster than that of wind-electricity. And in comparison with the previous year it has been raised about 70.7 percent (from 7865.7 mW in 2007 to 13424.5 mW in 2008). In other word, in 2008 the capacity of photovoltaic powerhouses has increased to 5.56 GW; about 75 percent of this amount was belonged to Spain and Germany. The ratio of different

regions of the world regarding the whole installation capacity of photovoltaic is shown in picture (2). Meanwhile, Europe with 71.4 percent has the highest ratio and Middle East with 0.02 percent has the least ratio of photovoltaic installation. Now, Germany has the highest number of photovoltaic power stations in the world(5340 MW).

## 7. Completed project or under way project in the country

During recent years the energy ministry has completed some main projects and following project is under way:

### Generation of facia-pambola solar energy in

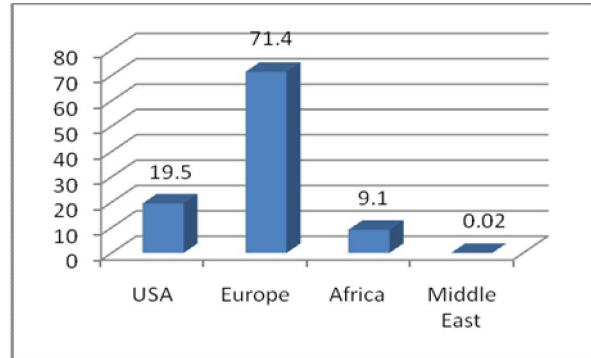
**Shiraz (250 KW capacities):** This solar powerhouse consists of 48 collectors. Now the first phase of steam production by solar energy is completed and its initiation steps have been completed successfully based on the first designing condition. Localizing the design of this powerhouse inside the country is one of the main advantages. Also making key elements such as collectors, parabola mirrors, controlling and acting systems, heating and mechanic systems of powerhouse are among other advantages of these kinds of projects.

**Solar Park:** Talaghan solar park has been installed & initiated in 2005 and now it is working. Solar heating technologies are divided into two categories: powerhouse and non-powerhouse and they have huge widespread systems, so creating a central place for installing solar non-powerhouse samples and their testing sounds necessary. Designing, producing, installation and initiation of Fernel collectors, parabola dish, solar Heliostats are some of the examples related to this project.

Also the other actions of these projects are designing & producing interior control room systems, designing, providing and installation of a part of

monitoring and controlling programs.

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Picture 2: the ratio of different regions of the world regarding the whole capacity of photo voltaic installation (2009)

Table (2): initiating and enforcing projects related to energy.  
(Source: energy balance sheet in 2009)

Name of project	Location of Project	Enforcing year	Initiation year	Capacity (KW)	Profitable age	Connection type to web
Development of powerhouses in Darbid of Yazd	Yazd	1999	2000	12	25	Out of web
Powerhouses improvement of Sar kavir	Semnan	1999	2000	15	25	Connected to web
30kw powerhouses	Tehran	2000	2002	30	25	Connected to web
6kw hydride system	Tehran. Energy .....	2006	2008	5+1	15	Connected to web
KW photo voltaic	Tehran Talaghan	2004	2008	10	25	Out of web
Solar power house- shiraz (steam phase)	Fars	1999	2008	250	20	Out of Web
Solar energy of Tabriz	Eastern Azarbayjan	2009	2009	24	25	Connected To web
Electrification To 634 villagers	All over the country	2008	2010	650	20	Out of web
KW photo voltaic	Tehran Talaghan	2004	2008	10	25	Out of web



Chart (3) electricity production in country during 2001-09  
(Source: energy balance sheet in 2009)

year	6 kw hybrid (wind- sun )	30 kw photovoltaic	Darbid power house	Sar kavir power house	Total (kwh)
2001			14100	96000	110100
2002	1500	22000	11100	14500	4910
2003	3000	45000	10800	63450	121450
2004		45000	8900	83300	140200
2005		10000	18000	25000	53000
2006		42000	17000	20000	79000
2007		32000	15000	24000	71000
2008		21000	19000	35000	75000
2009		21000	15000	31000	67000

**Hybrid and wind-sun 6kw system:** Now using photovoltaic technology in new and old buildings are considered. Using this system in coating the buildings are so various. This leads to many new ways of usage.

A set of windy 1 KW turbine installed with 5KW system was hydride in 2007. This turbine can produce electrical energy with the presence of the wind. In this way the power of photovoltaic system increases from 5 KW to 6 KW solar-windy hybrids. This system has 2 lines (182) both are used as a lightening resource of some parts of new energy organization.

**Rural electrification:** The purpose of electrification to 60 rural families started in Qazvin province in 2006. Totally 58 photovoltaic systems successfully used for electrification to villages which didn't have electricity as pilot samples in this project.

Being near to the center of the country and facilities in doing project, suitable climate and regional conditions, high numbers of rainy and cloudy days, and locating in windward passes are some of the reasons for doing this project in these villages. Therefore, electrification project has defined and started to 634 families in 2008.

**Solar water heaters and bathrooms:** Energy & petroleum ministries have done some actions in installation of solar water heaters and bathrooms. Before energy ministry installed 1041 solar water heaters in 2006, 2007 and 2008 years, it hadn't have any operation in this field. Petroleum ministry has installed totally 16854 solar water heaters and 419 solar bathrooms from 2001 to 2008. In 2008, 1924 solar water heaters and 87 public solar bathrooms were ready to use.

Also chart (3) shows the electricity production in country during 2000 -2010 years.

Solar electricity has produced in Darbid and Sarkavir powerhouses by 30 KW photovoltaic projects.

Also in 2009 solar powerhouse of Tabriz with 5000 KWh capacity has been added and the

production of solar electricity increased to 72000 in 2009 in sum.

## 8. Analyzing the economical aspect of solar energy phases

From economical perspective using solar energy can be analyzed differently. Here, two issues of employment and investment in private section have been focused:

### 8.1. Employment:

One of the advantages of using new energy is its importance in job creation opportunities in society. Also its effect on economical development, increasing energy supply and decreasing unemployment, are other reasons of increasing government investments in this section. Based on US energy ministry report, by 2030, 37 millions of new careers will be created as a result of new energy industry. Here share of US is 17%.

Nowadays there are 9 million persons working in this section and it produces 1040 billion \$ of the country gross production.

### 8.2. Private section investment:

One of the most important factors that prevent Iran from improvement in using solar energy is lack of private investors.

The most important reason of preventing private investment in solar energy is that they can't trust in its profit and they prefer to invest in well-paid markets which have a good security in turning back their investment.

Fortunately, government assistance can provide better situation for future of private investors in this industry.

Now analyses of economic possibilities under the title of Internal Returning Rate (IRR) have shown that, the amount of investment returning in new energy industry is 23 percent so that it is more than the profit of long time deposits in Iran bank with the interest rate of 19%.

## 9. Conclusion

Despite the positive advantages of using solar

energy, unfortunately this industry is neglected in Iran and also some other countries. Some factors like high expenses of solar system facilities, existence of oil and gas mines inside our country and paying no attention to replacement of fossil fuel are the reasons of neglecting this industry.

All in all, energy diplomacy has provided an optimized solution with the existence of fossil fuel in the country. Based on this, we can localize the use of reproducible energy technology. And later we can find the capacity of preparation of this energy in the presence of removing energy subsidies that are dedicated to paying the energy bills. In this way our country should be technologically ready to send this energy to different parts. Among supportive actions of government related to the solar energy projects, buying the produced electricity with guaranteed prices and paying loans can be mentioned.

So politicians should omit subsidies of fossil fuels slowly for improving the security of energy supply. On the other hand, they should consider a justifiable profit rate for reproducible projects. In this way, improvement of reproducible energies becomes stable and higher amount of oil and gas can be provided for export and this leads to getting higher related income.

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