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Zero Energy Building in Iran

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Abstract

There is a feasible case study of constructing some buildings free from fossil fuel in Iran. The proposed guideline is replacing of solar energy with different types of energies in a building such as electrical energy for lightening and cooling, energy obtained out of combustion of fuels for heating of building and so on. Regarding the high rate of energy consumption in our country for supplying of required cases of residential buildings, if it is possible to supply this type of energy from among limitless energy sources such as solar energy it is possible to have a considerable economy in fossil fuels. Some of the results of this research are parallel improvement of solar energy with economic development of Iran through real economy in costs and providing new job opportunities. Finally it is resulted that with regard to high rate of primary costs, there will be no more request for benefiting from solar energy, provided that we consider suitable subsidies for applying the solar equipment.

Key words: Solar energy, solar heating and cooling, solar lightening, Energy economy

1. Introduction

In comparison with key goals of sustainable energy systems, there is a constructional shortage in energy system of Iran which may prevent from any modernization process and may cause further considerable economic, social and environmental costs for current and future generations. The mentioned shortage includes , quick development of transportation section in dense cities and its great share in energy consumption for personal transportation in civil environment, The high rate and non-suitable share of families in total electrical and heating energy consumption, increasing share of requests for Oil & gas which have considerable effects on export capacity and currency income of the country , subsidy system and superficial reduction of energy price which may encourage the consumers more , The severity of energy out of mentioned shortage and its higher amount than its average in industrial & under-development countries and so on [1].

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2. Solar energy in a building

There are different usages for energy in a building which is possible to be divided into two groups as follows:

First group is for electrical energy and second group for heating, cooling and supplying of warm water. Following there is an explanation about supplying these energies by the help of solar energy. Since the average world radiation of sun is about 19.23 MJ/m^2/day in Iran and with more than 7.7 hours /day in central areas , it is possible to say that solar radiation amount in Iran is one of the greatest around the world. For instance in Germany it is about 800-1000 MJ/m^2/year lower than half of the amount in Iran [2]. Regarding the area of Iran which is about 1,648,000 km^2, then the total radiation amount in Iran is about 3.3 million terawatt hour /year that is 13 times more than total energy consumption in Iran. In spite of natural suitable radiation, any applying of solar energy in Iran is so much little. There is no more need to an exchange, reserve resource and control system for simple systems. Figure (1) shows total energy radiation on horizontal level in summer on annual basis.

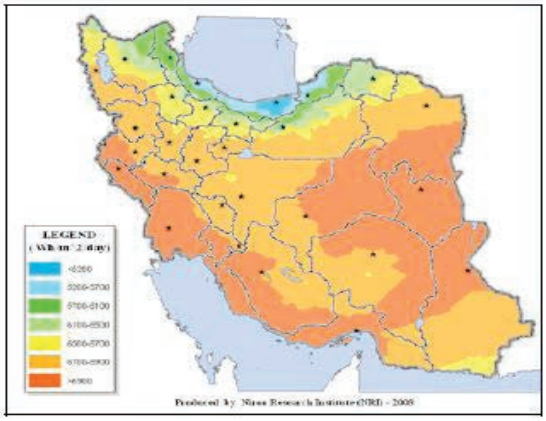

Fig. 1. Total solar energy in summer in Iran

According to the obtained information of this figure, percentage of high/low amounts in annual drawing of total solar energy radiation against the average rat is respectively equal to 0.14 and 0.28 that is a sign of little differences in average rate of this parameter with high rate in country. In other words it shows that there is a suitable solar energy potential in a wide area of Iran [3].

3. Solar electricity

One of the economic power bases of a country is electricity production. Therefore within recent decades there was so much attention to the increase of electricity production and its value added. By the way there is an increase in finding advanced technologies and applying of clean energies and renewable systems in supplying of required energy of human being.

4. How to use Photo-voltaic system

In order to supply electricity consumption in these buildings which mostly is used for lighting, it is possible to use photo-voltaic modules. Photovoltaic is a phenomena in which it is possible to change solar energy into electrical energy without any need to mechanic mechanisms. All photo-voltaic systems include three major parts as follows:

- Solar panels and/or modules as the exchangers of solar energy into electrical one
- Controlling charge circuit in which the obtained electrical energy out of photo-voltaic systems will be induced according to the performed designing and in compliance with consumer need
- Consumer and/or electrical charge

4.1. Application methods of solar electricity system

- Grid Connected: Electrical energy out of photo-voltaic system will be injected into electricity throughout network after deformation from DC into AC and after compliance of voltage & frequency levels out of this system with voltage level specifications, phase difference, frequency and so on. This means that any subscriber may act like a small producer by installing a connected to network system. Figure (2) shows the share of this method in electrical energy production.
- Stand Alone: This method is applicable for supplying of electrical energy for those places far from civil electricity network and/or with complete lack of electricity network. This method has a great share in solar electricity production systems.

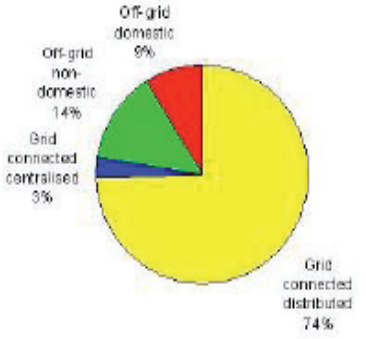

Fig. 2. share of variable method in electrical energy production

4.2. Production costs of solar electricity

Regarding all required equipments in photo-voltaic systems; it is possible to calculate any required costs for producing of special electrical power. It is possible to classify these costs into two types of fixed and variable costs in accordance with table (1).

Table 1. fixed and variable costs

Variable cost	fixed cost	
	P.V. Module	**1**
Change battery	Dry Battery	**2**
Chang inventor	Charge control and inventor circuit	**3**
	Structure of Module	**4**
Net	Installation cost	**5**

4.3. Economic reasoning of solar electricity

The most important problem on development and distribution of these systems is high rate of primary investing costs in solar electricity systems. It is anticipated that any production costs of solar electrical energy will be equal with fossil fuel energy in normal conditions in 2020. (Figure 3)[5] .

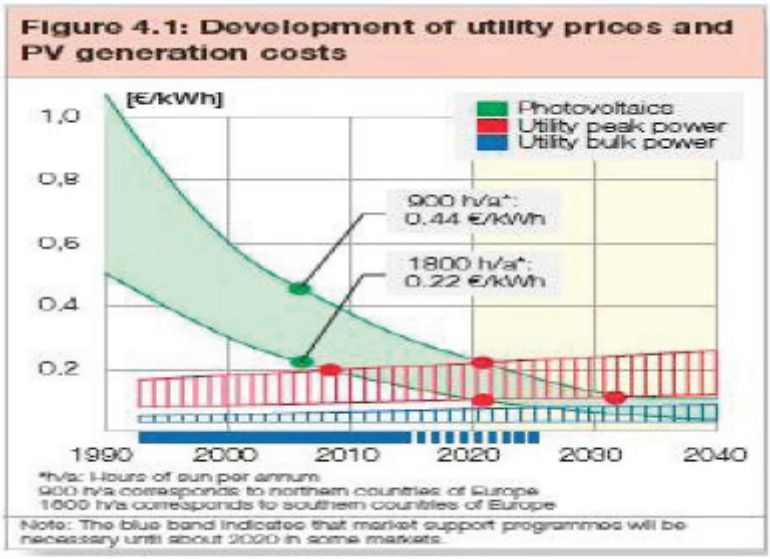

Fig. 3. Development of utility prices and P.V. generation costs

4.4. Solar share in ventilation

According to the considerations about %40 of total energy consumption of Europe has been allocated to commercial places and residential houses. There is an increase in the number of installed ventilation systems with more than 12kW through last 20 years while the number of floor spaces equipped with ventilation system has been increased from 30 million sqm in 1980 to 150 million sqm in 2000[6]. The annual energy consumption for ventilation in each house was 6TJ in 1990 and 40TJ in 1996 It has been anticipated that this digit will reach to 160TJ in 2010. This may in itself causes an increase in life costs

especially in urban places and green house gases as well [7]. One of the ways for reducing the costs is suitable benefiting from solar energy in ventilation system.

4.4.1 Function of solar chillers

Table (2) shows the efficiency of solar chillers for three different capacities of 50, 100 and 300 tons in accordance with required solar collector area, required ground area, supporting gas, economic amount in electricity consumption per year and any reduction of carbon dioxide rate.

Table 2 Efficiency of solar chillers

	Capacity:300t	Capacity:100t	Capacity:50t
Net solar area [1] m^2	2550	820	**410**
Ground area m^2	3000	1000	**500**
Require supported gas[2] terms	61000	20300	**10150**
Reduction of power pitch kW	325	117	**59**
Product hot water $34^0c/m^3$	155	52	**26**
Reduction of electrical energy kWh/yr	550000	90000	**45000**
Reduction of distribution co_2 ton/yr	1575	371	**185**

1- For Mediterranean moderate climate
2- For a cooling request of 9 hours per day in summer

Solar Thermal Rate (STR) coefficient is used for any calculation of heating output of solar ventilation systems which may obtain through multiplying of chiller function coefficient in solar collector output. Figure (4) shows the relation between these two parameters in different months [8].

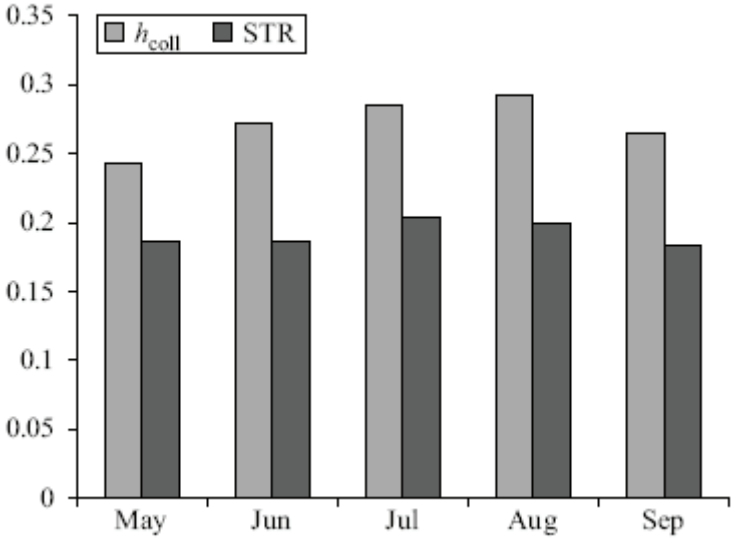

Fig. 4. Variation of collector efficiency VS, STR in different month

5. Estimation of costs & economy

Regarding table (3), it is possible to estimate any amounts of costs and economic saving in solar chillers with different capacities [9]. The mentioned amounts have been considered in accordance with current prices in market. The required amount for production of 1wat of electrical energy is sums of dollar, 0.4008 with a saving in electricity annual subsidy as a sum of dollar, 0.0407. Then the economy in annual subsidy of gas consumption in cubic meter is a sum of dollar, 0.0320. In addition, the environmental cost in each tone of carbon dioxide distribution is a sum of dollar, 19.2 as mentioned in table (3)[10] .

Table 3 Estimate any amounts of costs and economic saving in solar chillers

	Capacity:100t	Capacity:50t	Capacity:300t
Cost of absorption chiller ($)	50200	31100	**83100**
Cost of solar collector ($)	71800	35900	**223100**
Economy in electrical-compact chiller ($)	98300	49600	**957200**
Economy in electrical-absorption chiller ($)	3700	1800	**22400**
Economic in gas consumption ($)	5500	2800	**16500**
Economic in environmental costs ($)	7100	3600	**30200**

6. Economic consideration of Solar absorption chillers

According to all considerations under the title of Economic-Technical comparison of current cooling systems in the country, it is possible to conclude that absorption systems is the cheapest system in warm and humid areas from governmental and national attitudes against the most expensive system like gas coolers [11]. As a result and after comparing the solar absorption chiller system with current absorption chillers it is possible to show that there is an economic reasoning in any benefiting from solar absorption chiller system.

Obviously the customer does not consider it as an economic method with regard to primary start up costs; Table (4) shows a comparison between solar absorption chiller systems and general ones. It shows that any capital return period of solar absorption chiller systems is 5 years at state's major economic level and without any consideration of inflation.

Table 4- Considering the capital return period in solar absorption chiller

	surplus cost ($)	Economic ($)
Primary costs for solar system	1020000	
Electricity consumption costs		12500
Gas consumption costs		41500
Environmental costs		53500
Total costs of each column	102000	107500

7. Summary

Photo-voltaic and solar ventilation systems in current economic conditions are not economical from the investor point of view and for ordinary people due to the cheap price of fossil energy and electricity. According to what was described before, it is possible to conclude that benefiting from photo-voltaic

modules and solar absorption chillers have more advantages in the field of energy saving, economics and environment for which the primary investment in major level of country has just a return, only within first 5 years. As a result it is proposed that instead of any allocation of subsidies for non-renewable energies, any assistance for manufacturing of these systems may cause a reduction in environmental pollution and fossil fuel consumption. It has been estimated that growth of electricity consumption rate in Iran is between %6 to %8 for the next 10 years. The relevant costs of construction of new power stations and electricity transferring network is so much high but is possible to be reduced due to the lack of any needs for the transferring network in solar systems. Any promotion in Iran's movement towards sustainable energy has a lot of advantages for the country. World competition of renewable energies will increase through the next years. By providing quick suitable bases for benefiting from solar energy in Iran it is possible to increase the speed of mass production of installations and economic benefits. Any differences of costs for 1kw/hour of energy out of oil with 1kw/hour of solar energy will increase in the future from one side and there will be an increase in number of installations and saved energy amount on the other.

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