THE CHARACTERISTICS OF SOLAR ENERGY UTILISABLE IN HUNGARY

CARACTERISTICILE ENERGIEI SOLARE UTILIZABILE IN UNGARIA

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Abstract: *One possible method to reduce the energy dependence is to increase the role of renewable energy sources at our disposal. Solar energy utilisation with technical equipment is called active utilisation. The direct heat utilisation can be considered as an economically exploitable renewable energy source. We carried out our examinations in Hódmezővásárhely between the 1st of January and the 31st of December in 2008. The insolation measurements typical for the exploitable radiance energy values were done daily, every hour from 8.00 am to 4.00 pm in June, July, August and October. Consequently in the period from April to October in Hungary it is absolutely advisable to utilise the solar energy, the available quantity of which enables us to compensate the smaller energy yield of the winter period with applying adequate energy-storage solutions*.

Keywords*: renewable energy, solar energy, active thermal heat utilisation*

INTRODUCTION

The debate between Russia and the Ukraine starting in January 2009 resulted in an energy crises, which again was a warning for several countries in the European Union, among them Hungary as well, how dependant and defenceless they are in such a situation. The energy supply of Hungary depends 80% on Russian gas therefore a lengthy dropout in gas transportation means an inextricable situation for the energy management of the country. Geothermal energy and solar energy are renewable energy sources, which can be found in the largest quantity in Hungary and can be exploited economically. Active utilisation can be carried out by utilising electricity or heat gained by photo-electric and photo-thermal methods.

Nowadays besides the geothermic energy it is the active thermal to decrease gas import.

The objective of my examinations is to acquire direct experiences about the active thermal heat utilisation, while comparing the results of the relevant literature and my own measurements primarily regarding the South Plain of Hungary and the neighbouring countries.

MATERIAL AND METHODS

Solar energy utilisation is the most environment-conscious solution for the energy problem of mankind. Unlike fossil fuels it is always available, never pollutes the environment and its use decreases the use of traditional energy sources considerably. (DOMONKOS, 2009) In the spring of 2007 the leaders of the European countries agreed to cover 20 % of the energy needs from renewable energy sources by 2020. The European Commission worked out an interactive solar energy map to show the amount of utilisable solar energy in any geographical part of Europe. HTTP://WWW.ZOLDTECH.HU)

The electromagnetic radiation from the Sun equals a blackbody radiation of approximately 6000 K temperature and contains ultraviolet and infrared spectrum in addition to the visible light spectrum. (HTTP://EN.WIKIPEDIA.ORG)

Spectral radiation can be seen in Figure 1.

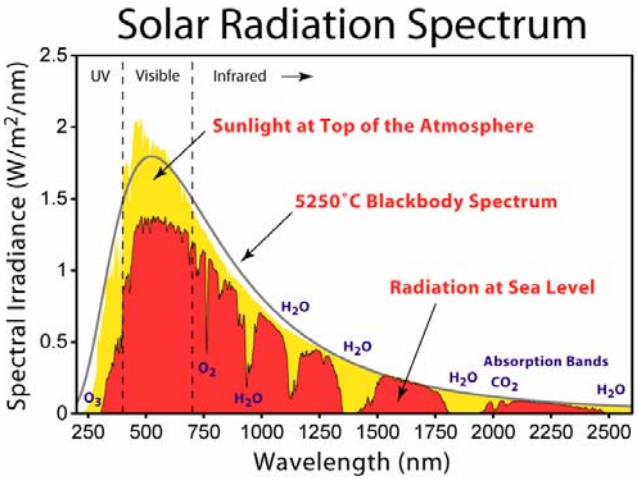


Figure 1: Blackbody spectrum and solar radiation spectrum

There is $176x10^9$ MW power arriving from the Sun to the Earth. The utilisable energy-quantity at certain geographical places is significantly influenced by their distance from the Equator. Potential solar-energy utilisation areas can be those where the average daily energy yield is at least 5 kWh/m^2 within a year. (WWW.KEKENERGIA.HU)
These values are shown in Figure 2.

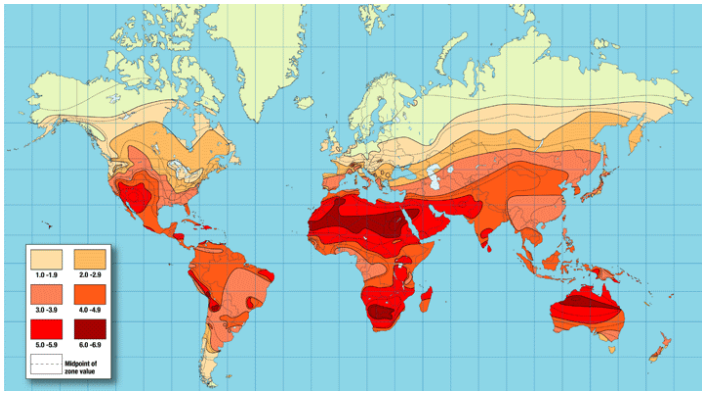


Figure 2: World solar insolation values

As it can be read from the map, Hungary is situated in the range of 2-2.9 values. The value of solar irradiation on the territory of Hungary is varied a little by the geographical location of the region. The annual average values are shown in Figure 3. The average values are between 1250-1550 kWh/m^2, while the higher values can be measure on the south-eastern part of the Hungarian Plain, in the Szeged-Debrecen region. (HTTP://RE.JRC.EC.EUROPA.EU) The daily average values are between 3.28 kWh/m^2 day and 4.1 kWh/m^2. The time distribution of the annual solar irradiation arriving at the surface of the Earth is varied by the lengths of the days within a year and also by the different extent of clouds depending on the seasons.

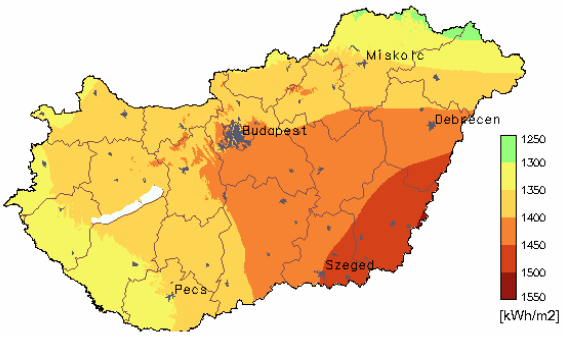


Figure 3: Annual quantity of solar irradiation in Hungary

The annual average time distribution values of solar insolation in Hungary between 1961 and 1990 are shown in Figure 4.

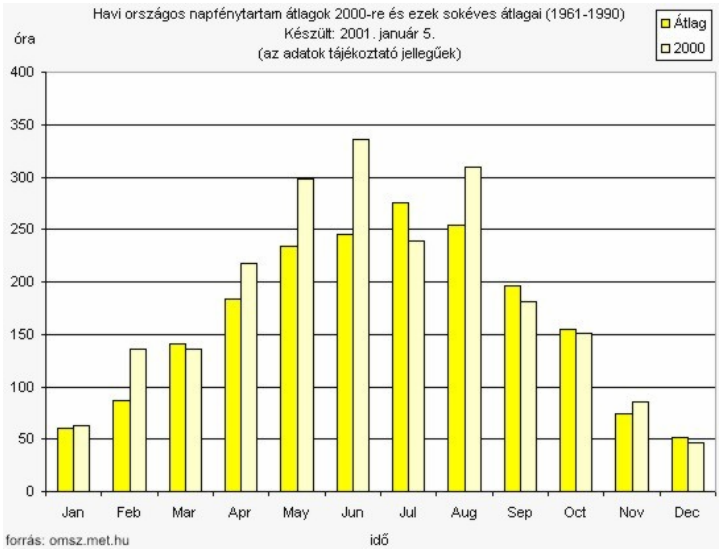


Figure 4: Annual sum of sunny hours in Hungary.

Based on the 20-year examinations of the Szarvas Agro-meteorological Observatory of the Hungarian Meteorological Service between 1975 and 1995 the average annual values of global irradiation in the middle part of the Hungarian Plain is shown in Figure 5. (PATAY, 2006)

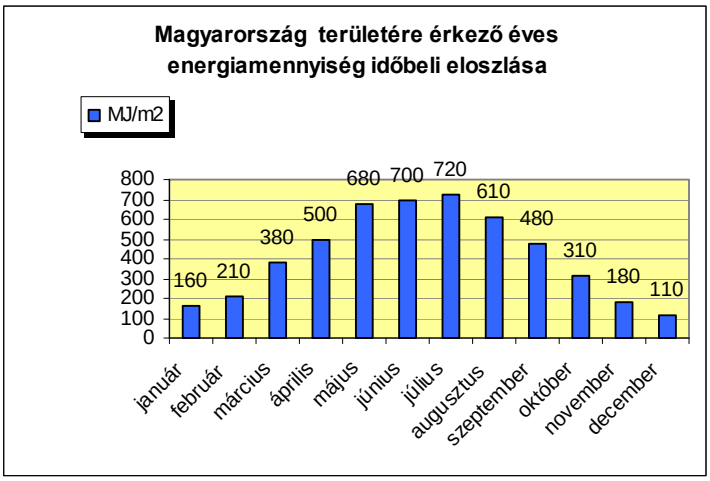


Figure 5: Annual quantity of global irradiation in Hungary

The data indicate that the annual energy yield is 5040 MJ/m^2 , which equals 1400 kWh/m^2 value, from this the daily average in this 20-year period is 3.8 kWh/m^2.

We registered the number of the sunny hours and their percentage compared to the days of the month as well as the insolation values expressed in lumen/M2 in a measurement register book. I defined the performance density values typical for the radiation intensity by calculation.

RESULTS

The number of sunny days suitable for solar energy utilisation in Hódmezővásárhely in 2008 was as follows: out of the 366 there were 172 days suitable for solar energy utilisation in 2008, which means a 475 rate. The difference between the months of the year was significant.

The distribution of sunny days by months can be seen in Figure 6.

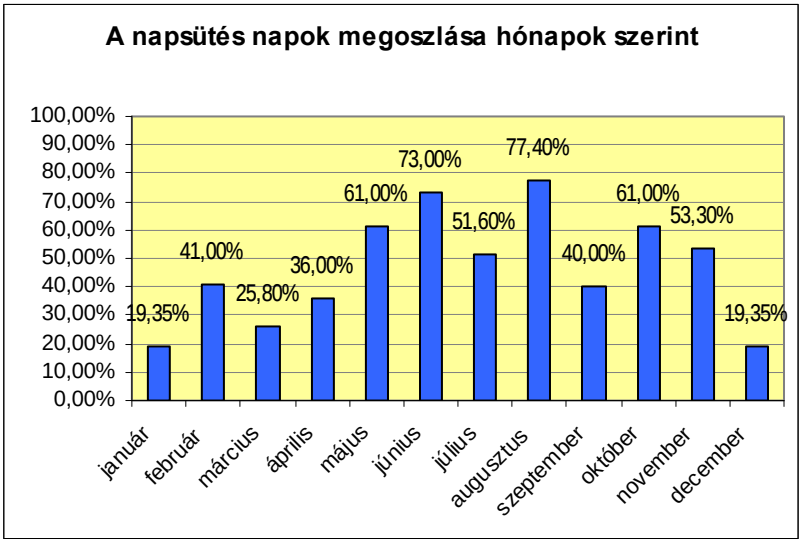


Figure 6: The rate of sunny days suitable for utilisation

In case of a solar radiation equalling an absolute blackbody with 6000 K^o surface temperature the illuminance value was 90 lumen/watt. (SZALAI, 1970)

The measured illuminance values can be seen below in Figures 7-9.

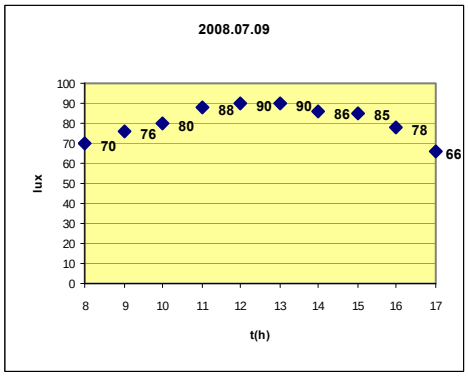


Figure 7: Illuminance values in July

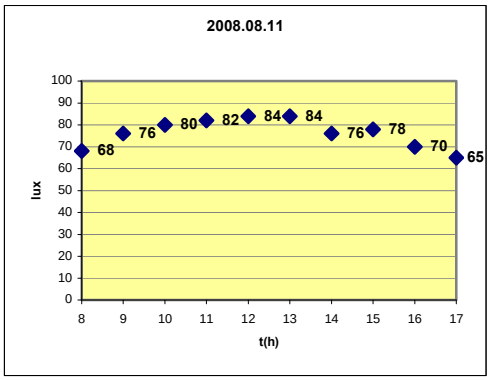


Figure 8: Illuminance values in August

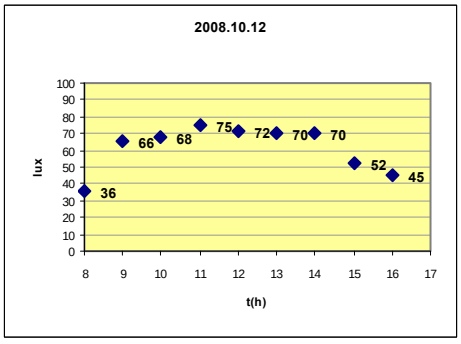


Figure 9: Illuminance values in October

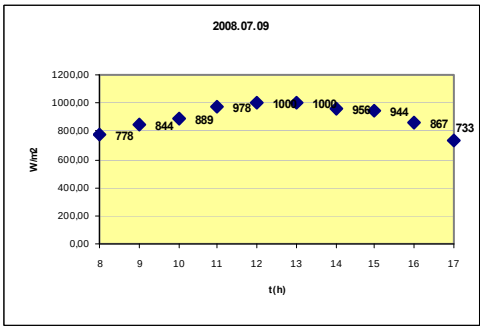
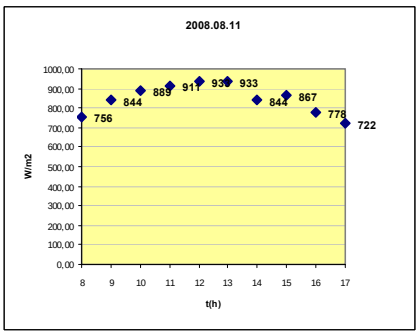


Figure 10: Insolation values in July



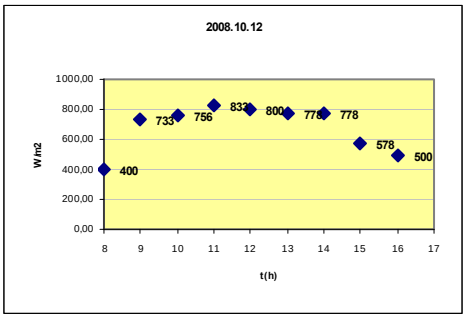


Figure 11: Insolation values in August **Figure 12: Insolation values in October**

CONCLUSIONS

Based on the professional literature we can conclude that the 3.8 kWh/m^2 daily average energy yield does not meet the required 5 kWh/m^2. The average energy yield of the summer months (April – October period) is 3690 MJ/m^2, which equals a total value of 1025 kWh/m^2 meaning a monthly value of 170.83 kWh/m^2 and a daily value of 5,69 kWh/m^2 . This meets the above mentioned demand. Consequently in the period from April to October in Hungary it is absolutely advisable to utilise the solar energy, the available quantity of which enables us to compensate the smaller energy yield of the winter period with applying adequate energy-storage solutions. As a result of the above mentioned facts the objective of the future development should be the improvement of the technical condition system of economical energy storage on the large scale. Based on the data in the literature and the examinations we can conclude that in the south-eastern part of Hungary and in the surrounding areas over our borders there are favourable possibilities for the utilisation of solar energy primarily in the field of thermal use.
The potential solar energy enables a significantly more intensive utilisation primarily in those areas where the energy demand coincides with the summer maximum values of the radiance energy, such as fodder drying or solar cooling – air-conditioning.

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