EFFECT OF A FOUR-WAY ROTATING DEVICE TO THE ELECTRIC ENERGY PRODUCTION WITH SOLAR CELL

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Abstract: Nowadays on the other hand the decrease of the energy store of the Earth is getting people on one hand to utilize energy consciously and to environmental protection and on the other hand experts are attempting to introduce new alternative energy sources. There are more and more wind power plants and plants used for producing bio-fuel are cultivated in a permanently increasing area. The healing effect and respect of the sun have been known for a long time, but the lining of its energy industry and households used to require such a technical development which was realized only in the last decades.

The European Union has hardly conventional energy sources: both natural gas and crude oil are mostly imported. According to the essay [1] concerning energy needs , resp. different kinds of fuel the energy import dependency is presumably increasing until 2030. Therefore shall be examined what kind of energy or energy source can be used for different purposes and where an energy source of lower quality can also satisfy energy needs, alternative energy sources shall be used in the future. For preparing this concrete measurements shall be carried out k [2.].

The University of Debrecen, Engineering faculty, Electric Engineering and Mechatronic Institute and Proker-Plusz Bt. has begun a research for developing a cheap solar cell, resp solar collector scaffolding being able to rotate and tilt on the basis of an innovation contract (Fig. 1). According to the cooperation agreement of these two organizations solar cell rotating system has been put up in the court of the Engineering Faculty. The Electric Engineering and Mechatronic Institute has designed and installed the electronics following the position of the sun both vertically and horizontally in the case of sun-shine.

Figure 1. Last phases of the installation

The research began on July 15, 2010 when the rotating electronics had just been rectified and 7 pcs KS 180 mono-crystal solar cells had been installed. The theoretically

achievable maximum capacity is 1260 Wp, the available inverter is SB 1100 (P_{ki}=1100 W) and so the whole capacity can not be achieved at all or can only be achieved in certain cases (appropriate sun-shine at a low exterior temperature). The research was finished on February 25, 2011 The rotating system's period following the position of the sun alternated with present settings and according to the changes of seasons vertically between 20 and 30 minutes and horizontally between 15 and 20 minutes. The different frontal passages took place as a result of changes of the radiation energy and falling angle of the sun according to the change of seasons. The time of following the position of the sun can be decreased, but this has no positive effect to electric energy production. The quantity of electric energy used for rotation can be measured, but it is not a relevant value for energy production (table 1.).

The measurement of consumed energy showed appreciable data on in the case pof sunny weather.

Date	Starting of production.	Finishing of production	Sunny weather	Cloudy	kWh	Used. Wh	Wp
28-07-2010	05h.51min.	19h.31min.		13h.40min.	1.341	13	638
31-07-2010	05h.48min.	19h.40min.	13h.52min.	0	6.125	112	1004
12-08-2010	05h37min.	19h.19min.	13h.42min.		7.283	114	926
12-10-2010	07h.10min.	17h.42min.	10h32min.		6.210	81	938
18-11-2010	08h.06min.	15h.10min.		7h.04min.	0.033	0	11
24-01-2011	07h.44min.	16h.09min.	08h.25min.		3.379	45	951
23-02-2011	07h.02min	16h.49min.	09h.47min.		4.431	54	758

Chart 1. Data measured during the rotation of the rotating device

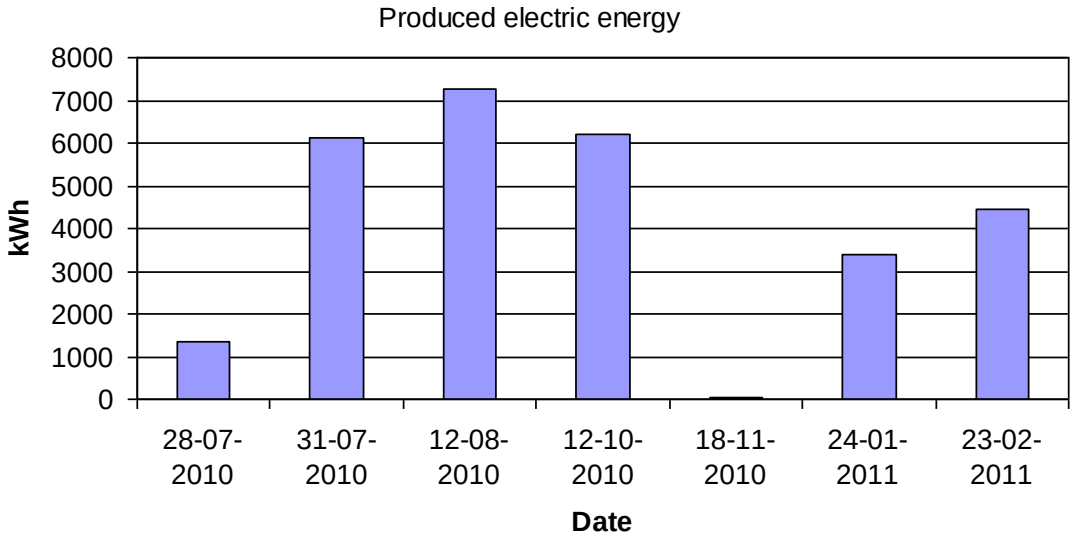

Figure 2. Produced electric energy

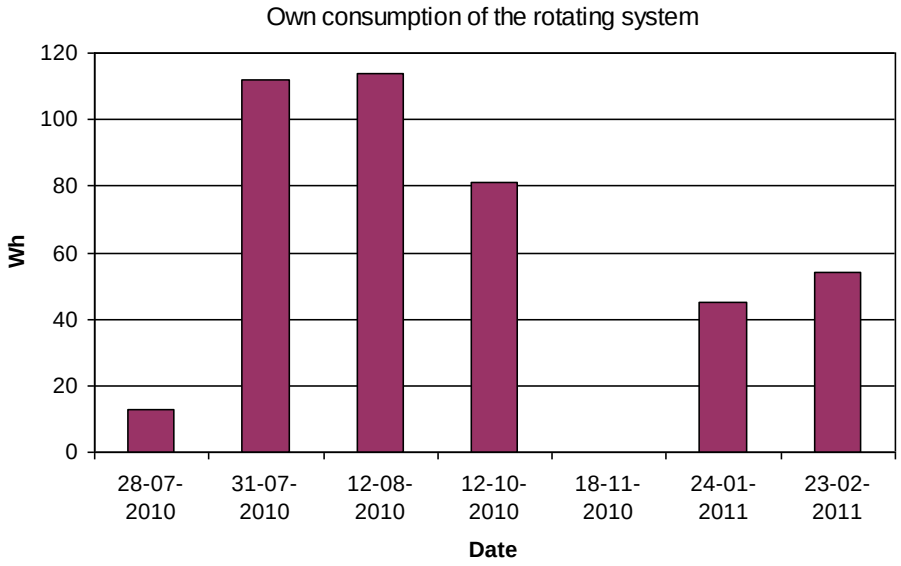

Figure 3. Own consumption of the rotating system

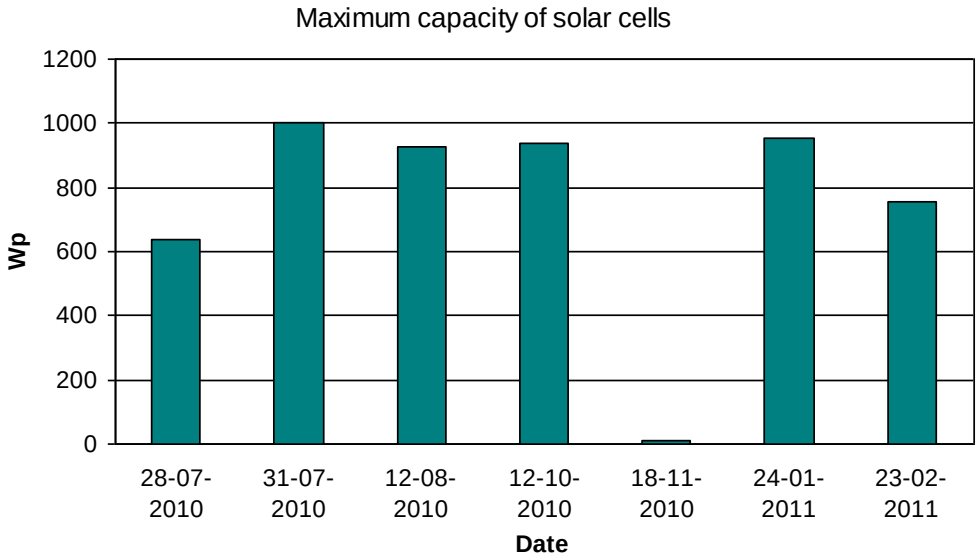

Figure 4. Maximum capacity of solar cells

The comparison of the daily produced electric energy quantity was carried out with two different methods. First method: on consecutive days in automatic plant, while in the second method the production was measured in an optimum angle.

The research has proved that there was no difference of daily produced electric energy quantities if on consecutive days the weather did not significantly changed (as far as average temperature, maximum temperature, steam content of air and cloud formation preventing sun.-shine (table 2.).

Date	Starting of production.	Starting of measurement.	End of production	End of measurement	kWh	Used. Wh
05-08-2010	05h.38min.	161.690 KWh	19h.01min.	166.935 KWh	5.245	111
07-08-2010	05h.48min.	171.275 KWh	19h.50min.	176.634 KWh	5.339	104

Chart 2. Electric energy produced during the operation of the rotating device

Electric energy production measured during the fix (optimal) operation of the rotating device in an angle of 35° (table 3.)

Date	Starting production	Starting measurement	End of production	End of measurement	kWh	Used. Wh
04-08-2010	05h.33min.	157.310 KWh	19h.21min.	161.690 KWh	4.380	0
08-08-2010	05h.40 min.	176.634 KWh	19h.34min.	181.344 KWh	4.610	0

Chart 3. Electric energy quantity produced in the case of optimum setting of the rotating device

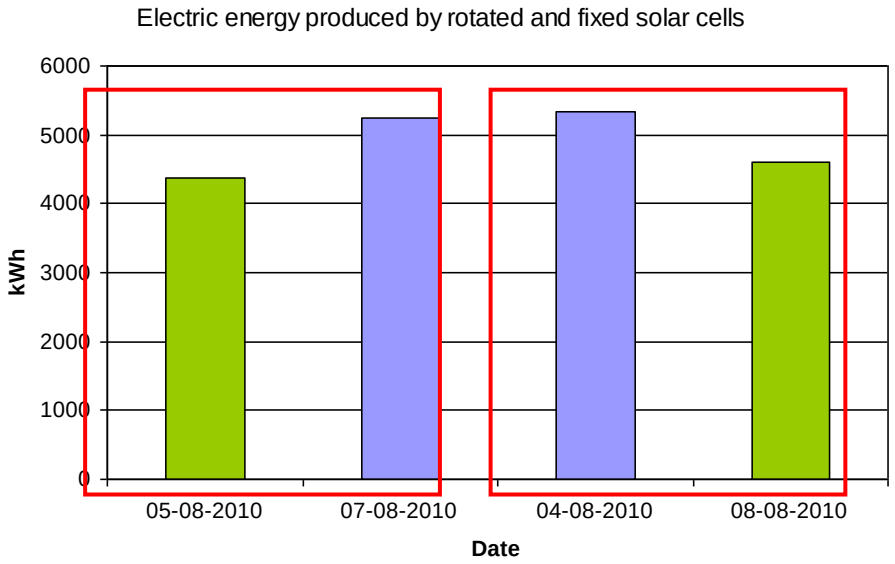

Figure 5. Electric energy produced by rotated and fixed solar cells -1

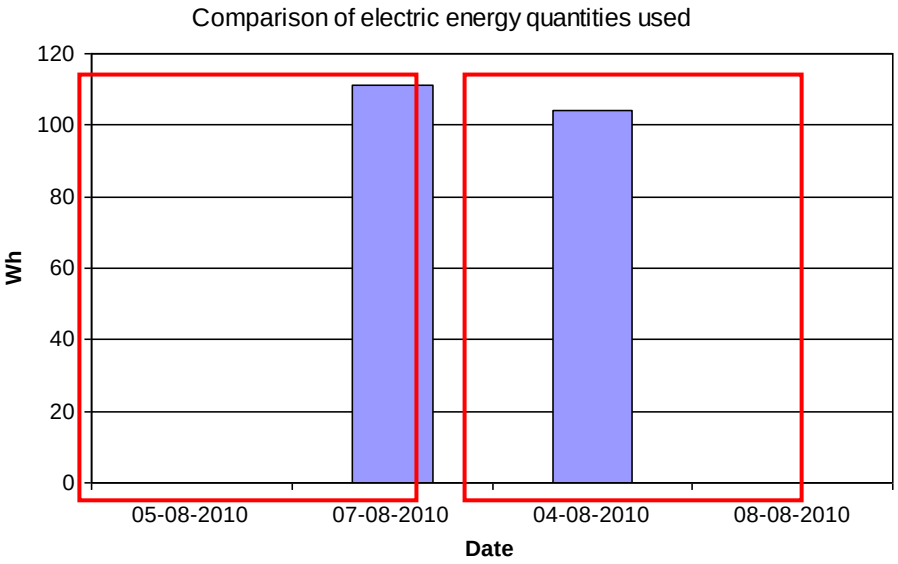

Figure 6. Comparison of electric energy quantities used by different measurement methods -1

Ut8ilizing the results of the double and triple table the difference between the electric energy quantity produced by modules set in a falling angle regarded ideal in Hungary and sun position following system.

Date	Rotated	Fix	Produced kWh	Consumption kWh	Difference kWh	percent
04-05-2010	no	yes	4.680	0	4.680	87.47%
05-08-2010	yes	no	5.145	111	5.034	100%
07-08-2010	yes	no	5.439	104	5.335	100%
08-08-2010	no	yes	4.610	0	4.610	86,41%
22-09-2010	yes	no	7.364	121	7.243	100%
23-09-2010	no	yes	6.121	0	6.121	84.5%
16-01-2011	no	yes	2.123	0	2.123	88,40%
17-01-2011	yes	no	2.482	72	2.410	100%

Chart 4. Comparison of energy quantities

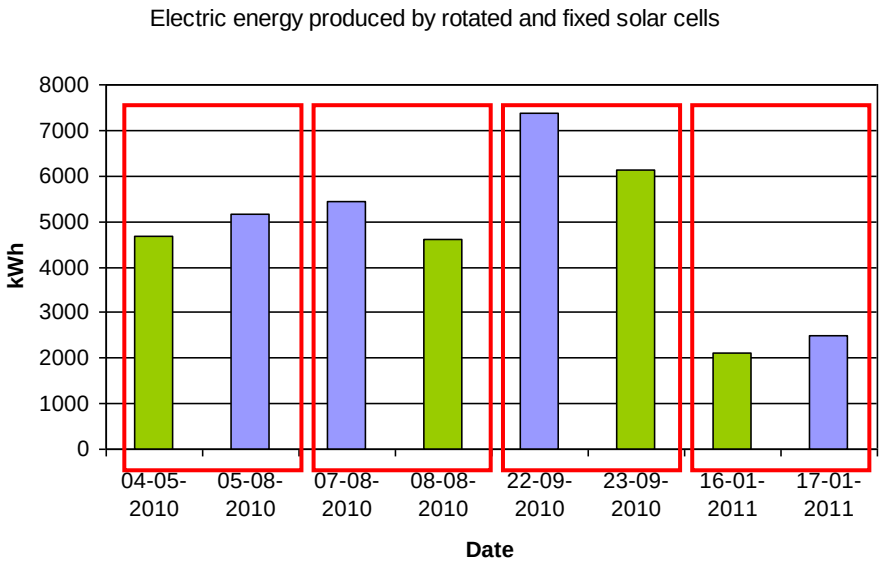

Figure 7. Electric energy produced by rotated and fixed solar cells -2

The calculated difference altered between 84.5 and 88.4 % according to the appreciable results of measurements in the case of fixed setting, if I regard the electric energy quantity produced during the operation of the rotating system 100 % .
The presented data are the result of individual selections, on the basis of which only data acquired under personal supervision have been utilized for calculations. However, this does not mean that measurements conditions (official meteorological measurements) are the same.

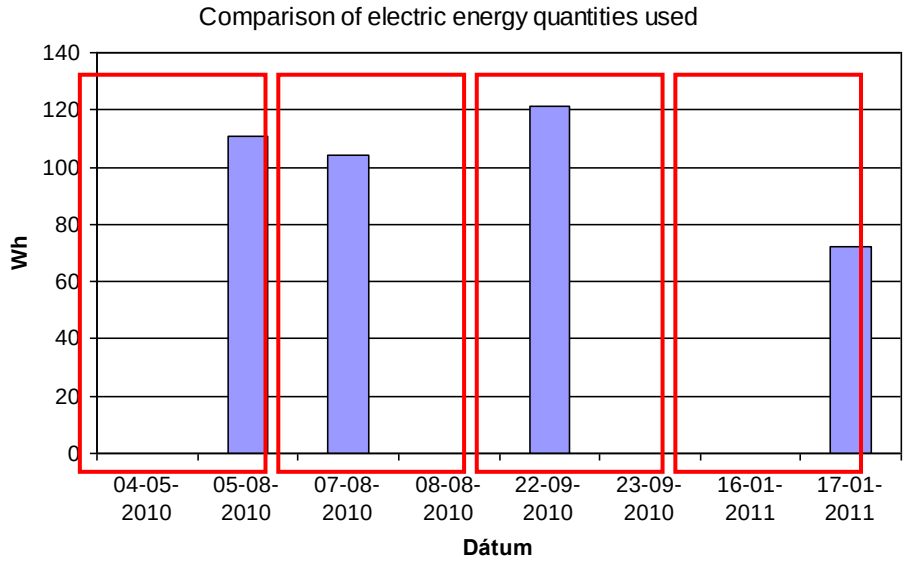

Figure 8. Comparison of electric energy quantities used by different measurement methods -2

In another possible measurement method the position of solar cell modules has been changed in certain periods between the fixed position and the other one the following the position of the sun [3.]. The measurements were carried out on two cloudless day in February between 8 o'clock in the morning and 16 every hours. From these data could only be concluded to differences between maximum capacities (table 5.).

Date/measurement	8 hour	9 hour	10 hour	11 hour	12 hour	13 hour	14 hour
07-02-2011 fix	35 Wp	112 Wp	476 Wp	860 Wp	931 Wp	832 Wp	342 Wp
07-02-2011 rotated	35 Wp	548 Wp	770 Wp	890 Wp	931 Wp	888 Wp	724 Wp
15-02-2011 rotated	19 Wp	675 Wp	982 Wp	1017 Wp	1103 Wp	1004 Wp	945 Wp
15-02-2011 fix	19 Wp	201 Wp	543 Wp	934 Wp	1113 Wp	956 Wp	543 Wp

Date/measurements	15 hour	16 hour
07-02-2011 fix	116 Wp	33 Wp
07-02-2011 rotated	346 Wp	34 Wp
15-02-2011 rotated	667 Wp	266 Wp
15-02-2011 fix	287 Wp	54 Wp

Chart 5. Comparison of momentary capacities

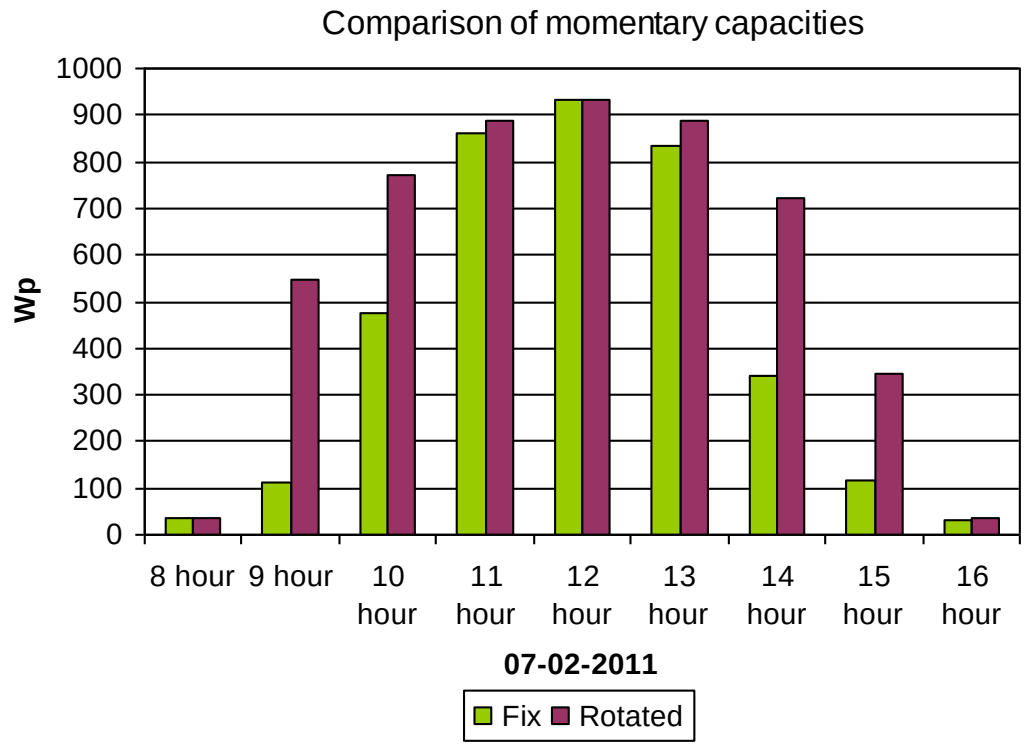

Figure 9. February 07, 2011 Comparison of momentary capacities

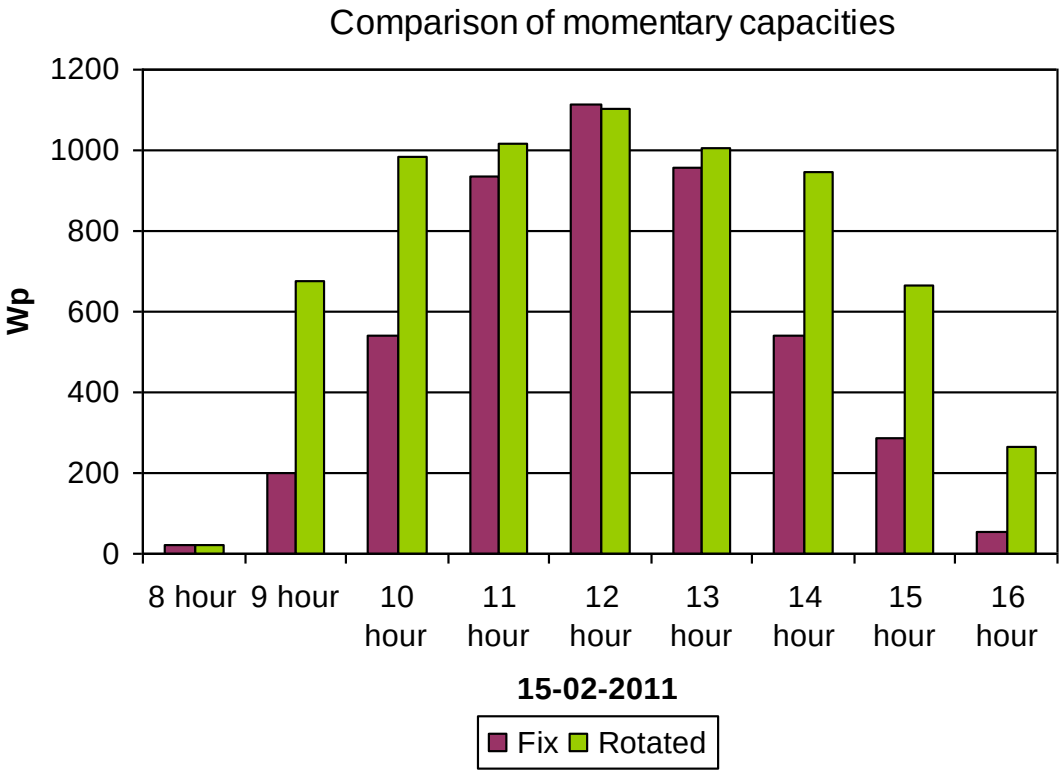

Figure 10. February 15, 2011 Comparison of momentary capacities

Summary

These are the results of researches taking six months. The geographical position of the rotating device placed in the court of the University did not correspond to ideal circumstances, because the shadow surrounding buildings influenced the results of measurements in any period of the day. This influence is mainly characteristic in the morning and afternoon. Because of these influential factors such aspects were taken into account during the research of the electric energy quantity produced or to be produced, in which there were no changeable exterior circumstances distorting the measured data.

On the basis of measurements and calculations carried out before can be established that solar cells mounted onto a rotating system can produce 20 to 25 % more electric energy than ones in fixed position.

The results of measurements acquired in a whole year are needed for carrying out final and authentic measurements as well as it is worth positioning the device rotating solar cells at an environment without shadow. For evaluating comparable data precise and authentic data (humidity, temperature, solar radiation parameters) shall be taken into account.

As a result of the research the Soltesk system was put on the market some days ago and it can already be ordered. The product was put on the market shortly after the finishing of the research.

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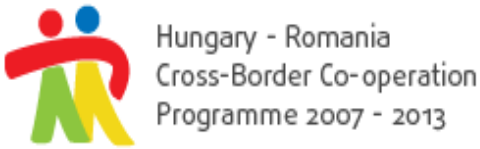

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