SOLAR ENERGY APPLICATION IN MACEDONIA

POPOVSKA-VASILEVSKA. S.
University st.Kliment Ohridski, Faculty of Technical Sciences-Bitola
Ivo Lola Ribar bb, 7000 Bitola, MACEDONIA
sanja.popovska-vasilevska@tfb.uklo.edu.mk

Abstract - Macedonia has perfect geographical and climate conditions for solar energy application. But, despite these, the use of this energy source is at minimal level. The reasons for this situation are multiple and have political, economical, educational background; the level of public awareness has its role, too. Solar thermal systems are mainly used for sanitary warm water preparation, but also there are rare examples for space and swimming pools heating. So far, the generation of power from solar energy is limited to photovoltaic plants with capacities up to 1 MW. This paper gives general overview of the current state of the solar energy application in Macedonia, the perceived obstacles / barriers and the necessary conditions to be provided to achieve wider penetration.

Keywords: solar energy, state of application, Macedonia.

1. INTRODUCTION

Macedonia has rich solar radiation and large number of sunny days (more than 260).[8] Unfortunately, sun has weak application as an energy resource; it is not even mentioned in the state energy balance.

In the last thirty years we have witnessed rapid growth in solar energy application in many countries, but the most characteristic are the examples from China, Greece, Austria, Germany and recently France and Spain. Perhaps the solar application in Greece or Spain is not surprising – they have rich solar radiation, but the rapid growth in Germany and Austria is really interesting. Obviously climate predispositions are not the single important factor.

Leading countries in solar energy use have proven and still prove the possibility for fast, economically and energetically justified growth accompanied with great social benefits, when public support, long term and permanent positive policies are provided.

Solar thermal production technologies are already mature, i.e. the risks in their application are minimized. Moreover, developed countries have introduced standards and methods for their use and control in order to guarantee the quality of installed solar systems and energy gains.

Due to the difficult economic situation of the country and unrealistic price of electricity, interest in solar energy (and other RES) hardly exists. Nevertheless, the business sector, receiving information from abroad for renewable energy resources and their economic and social importance, makes initial efforts to penetrate the market. But the list of obstacles is long and unfortunately still preventing broader application.

2. SOLAR ENERGY APPLICATION IN MACEDONIA

Solar energy utilization can be summarized in the following applications:

- heat generation (warm water, space heating and cooling, cooking);
- power generation (photovoltaic, thermal systems);
- transport (solar vehicles);
- natural lighting;
- photosynthesis.

The most common application of the solar thermal technology is for sanitary warm water preparation in the households. Worldwide there are hundreds of thousands of solar systems for water heating, especially in regions where intensive solar radiation exists.

Solar energy is used to generate power as well, employing more complex technologies.

There is a big interest and potential for solar space cooling. It is expected that this technology will experience commercial level of development and huge application. Such forecasts are based on very simple fact – the largest cooling requirements match the most intensive solar radiation. When space heating is in question, the situation is opposite – the largest heating requirements match the lowest intensity of solar radiation. (fig.1)

In Macedonia, solar thermal energy is mainly used for sanitary warm water preparation with simple thermo-siphon or pumping systems. In tourist areas like Ohrid, Struga, Dojran, there are large size solar systems for sanitary water heating, placed on hotels and hotel complexes. Few years ago also individual solar combi systems appeared for combined space and sanitary water heating. Swimming pools heating with solar energy is not the practice in Macedonia (it is not even practice to heat the swimming pools out of the heating season), although recently there are a few examples derived.

ISSN 2067-5534

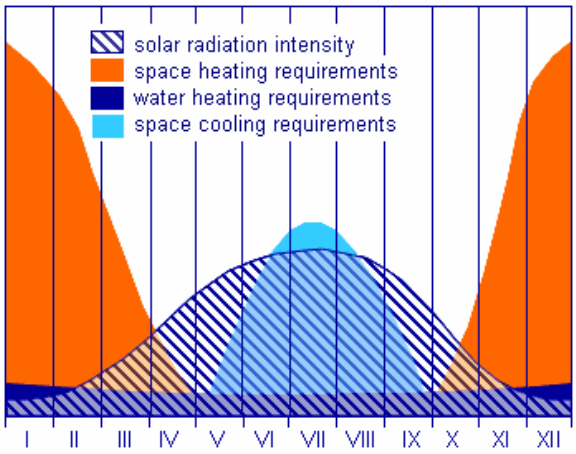

Fig. 1 - Annual energy needs of a household [10]

Considering the power generation with solar, currently there are nine grid connected photovoltaic power plants with total capacity of 2398 kW (2882 MWh planned annual production) having benefits from the preferential tariff. There is great interest for investments in such plants (larger capacities), but meanwhile the preferential tariff has undergone two changes and the process of gathering all the necessary permits and documents is very slow. In addition, maximum total capacity that can now be installed and connected to the grid is limited to 10 MW.

Annual daily average solar radiation in Macedonia is in the range between 3,4 kWh/m^2 in the northern part (Skopje) and 4,2 kWh/m^2 in the western part (Bitola). Therefore, the total annual average solar radiation ranges from 1250 kWh/m^2 to 1530 kWh/m^2 (fig.2) [1].

Despite the favorable geographical position and climate offering excellent solar energy potential, its utilization in Macedonia is at minimal level. The total installed operative capacity for heat energy production (flat plate and vacuum collectors) is 13,5 MW$_{th}$ or 6,6 kW$_{th}$ per thousand inhabitants (fig.3, fig.4).

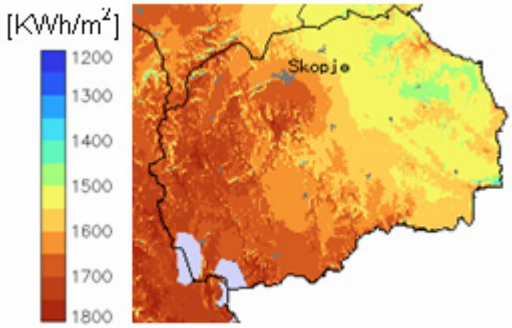

Fig. 2 - Map of average annual solar radiation in Macedonia [1]

The reasons for this situation are multiple, some of them are:

- long-year ignorant attitude of the state politics towards the RES, especially for heat production,
- years backwards unreal price of the electricity,
- low economy standard,
- lack of awareness of the decision makers and citizens,
- lack of appropriate legislative and regulative which would offer long-term support, strategic determination and devotion,
- lack of long-term financial support ,
- lack of regulations and mechanisms for maintenance and control of the installed solar systems quality.
- lack of mechanisms to register the newly installed capacities and their operability,
- incompetence in designing and installation of the solar systems,
- un-aesthetic integration of the solar systems [9],
- lack of good business practice (agreements for long-term regular maintenance and service, warranties, etc.).

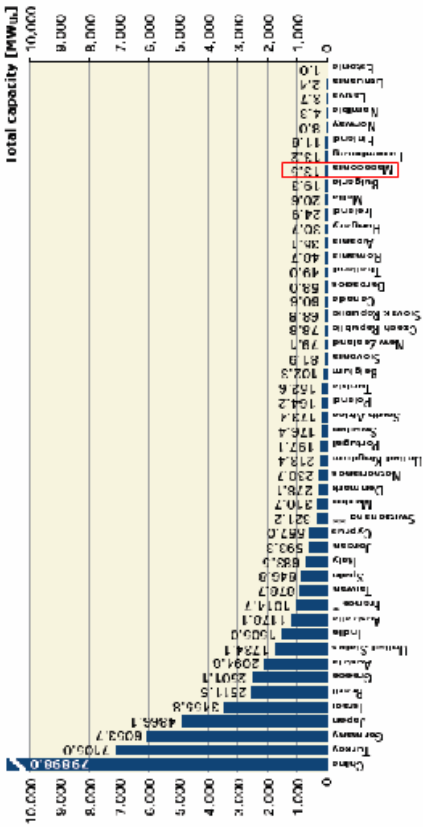

Fig. 3 - Total operative capacity in flat plate and vacuum solar collectors by the end of 2007 [5]

3. CONDITIONS FOR WIDER PENETRATION

Necessary conditions for wider penetration of the solar energy application are logical conclusion from the formerly listed reasons, and could be summarized in few important factors mutually related and dependent:

- ambitious targets
- research and development
- awareness raising
- obligations
- financial support
- demonstration projects
- trainings.

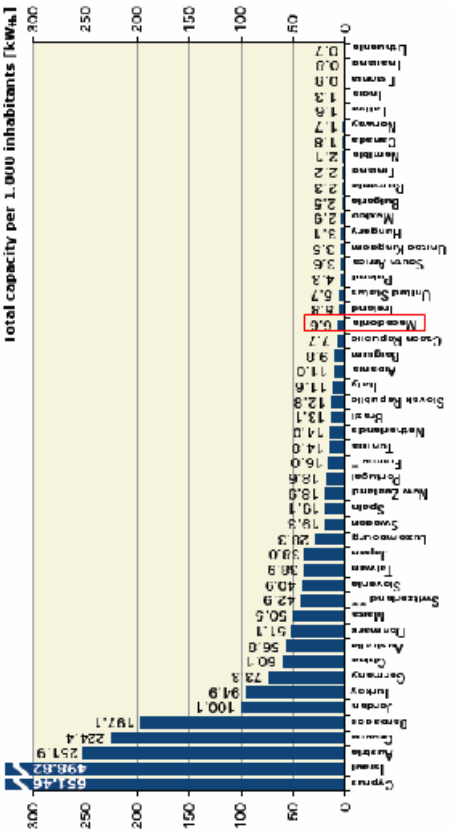

Fig. 4 - Total operative capacity in flat plate and vacuum solar collectors per 1000 inhabitants by the end of 2007 [7]

Ambitious targets – in Macedonia, considering the solar energy, it is obvious that priority is given to the power generation, i.e. the one is supported by preferential tariffs depending on the installed capacity. But due to high feed-in tariffs, and the power grid capacity, the maximum total installed capacity is limited to 10 MW, of which 2 MW are reserved for small capacities with max. nominal power of 50 kW (first preferential tariff 460 □/MWh, changed to 380 □/MWh, last change 300 □/MWh), and the rest is for larger capacities but up to 1 MW (first preferential tariff 410 □/MWh, changed to 340 □/MWh, last change 260 □/MWh). [7] Not anticipated limitations in terms of solar thermal power plants.

It is foreseen total installed capacity of 10-30 MW by 2020 with generation of 14-42 GWh per year, and 20-40 MW by 2030 with generation of 28-56 GWh per year. Upper limits are feasible in the case of considerably higher market price of electricity and development of cheaper solar technologies for power generation.[1,4]

Concerning the solar thermal energy, the one is treated as "hearsay" potential, where in the most recent document the following is stated:

The heat energy from the solar is foreseen to be used mainly in households. By 2020yr. 60,000 to 90,000 installations in households are planned, making the total utilization of solar energy (along with commercial and service sector and industry) about 60-90 GWh per year. By 2030 80,000 to 150,000 installations are planned in households. Thus, the utilization of solar energy as heat in all sectors would be 83-155 GWh per year.[1,4] In other words, the expected installed area by 2030 would be 160-300,000 m^2, which is going to be achieved even without support and additional efforts (current installed capacity is about 20.000 m^2). The EU target is 1m^2 per inhabitant by 2020 and 3 m^2 per capita by 2030.

In overall, there are no ambitious targets, neither there are intentions to be set; for the power generation due to real barriers – the targets are limited, while for heat production there are no limitations, but no support either (despite the fact that considerable power energy might be saved).

Research and development – In Macedonia there are already many technical faculties in the frame of the state or private universities. In the study programs of the first and second cycle at some faculties the RES, their technologies and plants are covered with appropriate subjects. There are also information for involvement in projects related to RES and solar energy, too, but most of them are dealing with transfer and dissemination of experiences, knowledge and technologies. At the Faculty for Electro and Informatics Technologies research is going on for producing low cost organic PV cells. In other words, as time has shown integral approach is necessary otherwise nothing can penetrate and be accepted successfully.

On the other hand, there have been initiatives from the business sector to develop its own products and optimization of system concepts. Such initiatives have resulted in several development projects financed by the Ministry of Science and Education of the Republic of Macedonia, organized in cooperation with the technical universities and the private sector.

Awareness raising - several times within a project funded by the EC or bilateral, campaigns have been conducted to raise public and administration awareness. In principle, positive results have been achieved expressed with increased interest in solar thermal systems, but it cannot be stated that larger application has been obtained. The reasons for this are the same as listed in section 1, of which nothing is done to mitigate or eliminate.

Financial support – as it has been previously said, the power generation from solar energy is supported by preferential tariffs, long-term, through 20-year contracts.

As for solar thermal energy (for households), from 2007 there have been four short-term programs for financial support in level of 30% of the installed system costs or a maximum 300 euros per system. Each program had available 150.000,00 euro or they were spent in less than month. The total result is approximately 2000 systems for domestic warm water with approx. 4000 m^2 installed collector area.

In 2007 a preferential VAT of 5% for solar thermal components has been introduced.[6]

Despite these recently introduced measures for financial support, not significant increase in the use of solar thermal systems can be observed. Obviously short-term programs for support (as is stressed in the global information literature and pointed out repeatedly) not only that are not positive but draw many negative consequences, such as opening of phantom companies which quickly benefit from the support; causing the stop-go effect to the solar thermal market – most of the people expect the next cycle of financial support to purchase a

ISSN 2067-5534 © 2012 JSE

solar system; no criteria applied to guarantee the minimum required quality of the installed systems, therefore, soon a wave of dissatisfaction is expected from the users or anti-campaign. Also, the preferential tax rate is not recommended supporting measure, because the results are not visible and principally interventions in tax liabilities are not encouraged. Notably, neither in Macedonia this measure resulted in greater use of solar thermal energy.

Demonstration projects – considerable numbers of demonstration projects have been realized mainly for sanitary warm water preparation, but the need for medium and large size demonstration is obvious (space heating and cooling, industrial applications, etc.). The ones should be open for the public to allow abstraction of experience.

Obligations - Obligations in relation to solar energy can be viewed from two aspects, namely:

1. Obligations of the state in terms of increasing the participation of RES in the energy balance. The goal of EC is 20% RES participation in the total energy needs by 2020.
2. Obligations in terms of providing a minimum quality that will provide guaranteed energy gains from the solar systems and their minimum durability of 25 years (it is estimated that it takes 12 to 13 years only to recover the energy invested in the system production).

Not long ago the RES in Macedonia had been treated as hearsay and non-worthwhile, especially for production of thermal energy. The relevance of joining the EC changed this treatment, but only declaratively because no any concrete steps are taken to increase the RES participation considerably. As previously explained, attention is paid only on power generation from wind, solar and small hydro facilities. But even here the results are negligible. Apparently it is not sufficient to have only legal background, but the ones should be based on extensive analyzes to determine the real and ambitious targets whose achievement requires legal background, and enforcement mechanisms, financial support, promotion etc. Also, the results of each measure should be carefully monitored to determine its success!

Countries that experienced tremendous growth in the use of solar energy, accepted responsibilities gradually achieved through:

- Obligations for mandatory coverage part of the total energy needs of new residential and commercial buildings with their own system employing RES (in principle among them solar energy is inevitable resource in urban areas).
- Prohibition to use power for heating sanitary water (China). Drastic but effective measure.
- Obligations for mandatory installation of solar thermal systems in the new residential buildings (Spain). At the beginning this measure had proved quite unsuccessful since the quality preservation and guaranteed energy gains had not been foreseen, but with the introduction of these aspects the result is tremendous growth.
- Attract financial support, i.e. for example 30-50% return of funds invested in solar thermal system (for natural and legal persons) or an exemption from paying property tax or income tax in the amount of 30-50% of the system costs. Of course, this support is tied to evidence of observed quality and energy gains of the system.

Concerning the obligations for minimal quality provision of the solar thermal components and systems, in Macedonia such mechanism doesn't exist. In the frame of a project financed by the Austrian Development Agency, a solar test laboratory has been provides for testing solar thermal collectors and tanks, with vision for future testing of solar thermal systems, too. The initial purpose of the test station has been to enable examination, improvement and optimisation of the Macedonian products, and at appropriate time to become accredited laboratory as indispensable part of the quality assessment and certification (e.g. – Solar Keymark). Unfortunately already forth year the solar laboratory is out of operation due to incompetence, lack of funds, lack of legal background etc.

4. CONCLUSIONS

Solar energy might be important energy resource for Macedonia. There is no doubt that the solar resource is plentiful, but dedicated work is required to ensure suitable conditions for its widespread use. The examples which can be followed are numerous, showing that it is worth investing in this ecological resource. Figure 5 shows the installed capacity of flat-plate and evacuated tube collectors from 2000 to 2008. At the same graph the economic growth rate can be observed. No other industrial sector can praise with such large growth rate. Therefore, there are no doubts that it is economically viable to develop the solar market.

Is the solar viable energy source? The assessed price for 1 kWh produced thermal energy is 0.017 euro [3]. No any thermal plant can even come close to such characteristics. Obviously solar thermal capacities are energy viable.

The ecological influence is definitely positive since the solar systems' operation is not connected with emission of dangerous gases.

However, probably the most important attribute is the social benefit since the development and growth of the solar market creates new jobs in different sectors. It can be estimated that if the necessary conditions are provided to install 700 MW capacity in solar thermal systems, minimum 3000 new employments will be opened in research and development, education, trainings, production, design, installation, service, maintenance, trade, etc.[10] This fact must not be neglected and will for sure contribute in decreasing the indigence, reviving of the economy and increasing of the life standard.

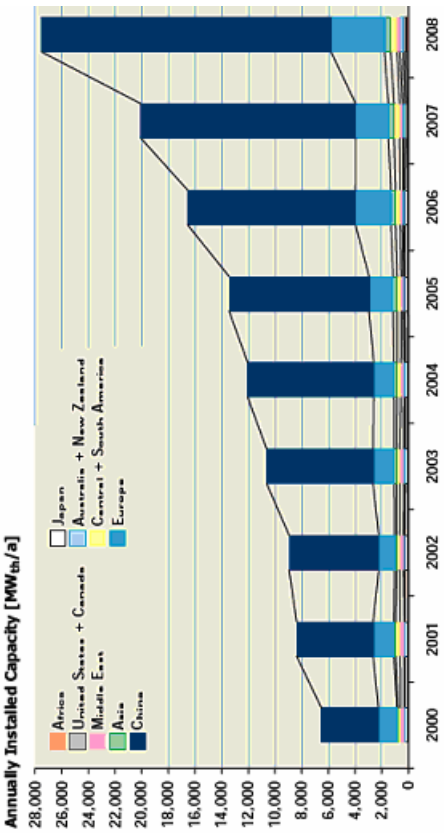

Fig. 5 - Annual installed capacity of flat-plate and evacuated tube collectors from 2000 to 2008 [2].

REFERENCES

[1]. Renewable Energy Sources in Republic of Macedonia, study, MANU, Skopje 2009

[2]. Renewables Global Status Report, Update 2009, REN21

[3]. SOLAR WATER HEATERS - Training of Experts & Professionals and Improvement of Technology & Production, Project Number: 8047-00/2004, financed by ADA, 2005-2008

[4]. Energy Development Strategy for Republic of Macedonia up to 2030, Skopje 2010, www.economy.gov.mk

[5]. Solar Heat Worldwide, Markets and contribution to the energy supply, Edition 2009, W.Weiss, I.Bergmann, R.Stelzer, AEE INTEC, IEA-SHC

[6]. Law for modification and amending the law for value added tax (Official Gazette of RM no.114/2007)

[7]. Ordinance for RES for production of power energy (Official Gazette of RM no.127/2008)

[8]. Slave Armenski, Solar Energy, 260 pg., Skopje, 2008

[9]. S.P-Vasilevska, I.Nasov, H.K-Boskova, V.Ristov, Solar Thermal Systems Integrated into Roofs and Facades, Solar Macedonia, Skopje, 2009

[10]. S.P-Vasilevska, K.Popovski, V.Gecevska, Solar Energy in Macedonia, edition by MAGA, Skopje 2010

ISSN 2067-5534 © 2012 JSE