

*European Commission  
Directorate General for Energy and Transport*

*Contract NoNNE5/2002/00086*

**“WIDENING THE USE OF EUROPEAN SOLAR  
THERMAL TECHNOLOGIES IN MEDITERRANEAN COUNTRIES  
FOLLOWING THE SUCCESSFUL  
MODEL OF GREECE AND CYPRUS.  
PART B: I, F, RO, BG, TR”**

**Bulgarian Solar Thermal Market  
Development Plan**

Prepared by:



## Table of contents:

<b>1. Solar Thermal Systems Technology and Application .....</b>	<b>3</b>
<b>2. Objectives.....</b>	<b>5</b>
<b>3. Market Overview and Forecast.....</b>	<b>5</b>
<b>3.1. Market Overview.....</b>	<b>5</b>
<b>3.2. Market Forecast .....</b>	<b>7</b>
<b>4. Measures for Development of the Solar Thermal Market .....</b>	<b>8</b>
<b>4.1. State Measures.....</b>	<b>8</b>
<b>4.2. Regional Measures .....</b>	<b>9</b>
<b>4.3. Economic Measures .....</b>	<b>9</b>
<b>4.4. Third Party Financing .....</b>	<b>10</b>
<b>4.5. Guaranteed Solar Results .....</b>	<b>10</b>
<b>4.6. Legal Framework .....</b>	<b>11</b>
<b>4.7. Integration of Solar Thermal Systems in Buildings.....</b>	<b>12</b>
<b>4.8. Implementation of Solar Thermal Systems in Tourist Sector .....</b>	<b>12</b>
<b>4.9. Implementation of Solar Thermal Systems in Industrial Sector .....</b>	<b>13</b>
<b>5. Promotion and Dissemination Actions .....</b>	<b>13</b>
<b>6. Closing Comments .....</b>	<b>14</b>
<b>6.1. The state with its regulatory functions .....</b>	<b>14</b>
<b>6.2. Establishment of an Association in Bulgaria for Solar Thermal Systems with its Solar Market functions .....</b>	<b>14</b>
<b>7. References .....</b>	<b>16</b>

# **BULGARIAN SOLAR THERMAL MARKET DEVELOPMENT PLAN**

Bulgaria enjoys a significant solar energy potential which unfortunately, up to the present moment, is almost not utilized. The greatest part 66% of the technical solar potential in Bulgaria belongs to the active solar thermal energy systems. Solar thermal collectors for hot water production could be utilized almost everywhere in the villages and the towns, in the hotels, holiday houses, camping, industry etc., particularly in the period between April and October when the solar radiation is higher.

In Bulgaria the average annual period of sunshine is about 2 100 hours and in some of its regions it may reach 2 500 hours (i.e. the range is from 1 450 to 1 600 kWh/m<sup>2</sup> annually).

During the period 1977 – 1990 in Bulgaria was implemented a state large-scale program for research, design, production and implementation of 50.000 m<sup>2</sup> of solar collectors.

However, the low quality of the equipment and the installations made in Bulgaria, and the lack of maintenance in many of the early installations, resulted in a dissatisfaction, creating for a moment an additional barrier to further solar energy utilization.

For the last 15 years many demonstration programs for solar thermal systems have been developed and implemented.

The market of solar thermal systems in Bulgaria, at this moment, started to develop at good rates. Of great importance, at this still early stage on this market, is the good quality of the equipment and its correct and professional sizing, implementation and maintenance.

## **1. Solar Thermal Systems Technology and Application**

Generally, solar thermal systems could be classified according to three criterion:

- Type of transportation of working fluid from collectors to accumulators: gravity collectors and circulation pump collectors;
- Manner of heat conversion from the working fluid to accumulators: direct collectors and indirect collectors (through a heat exchanger) by giving out heat to the accumulator;
- Number and type of consumers: individual and multiple-consumer collectors.

It should be mentioned that in Bulgaria are utilized all types of systems, depending on the consumer and his requirements.

The solar part of a system consists of two main units – a solar collector and a heat accumulator.

Three types of solar collectors exist for heating of hot water, and namely:

- **Flat plate collectors** could be manufactured from different materials like copper, aluminum, iron or plastic. They usually have black surface, painted or selective, laid on via galvanization or evaporation in vacuum;
- **Vacuum tube collectors** have absorbers, which are mounted in a glass tube from which the air is evacuated and vacuum is created. The solar energy heats up the liquid in the absorber and it is transferred to the domestic water.
- **Concentrating collectors** concentrate optically the solar radiation to a small target or receiver where it is transformed into heat. Concentrating collectors are associated with high temperatures.

In Bulgaria the flat solar collectors are the most common. This is due to their lower price and simpler manufacturing technology. They require also simple and little maintenance.

The most common application of solar thermal systems is **to produce domestic hot water**, for hotel services and in households, hospitals, nursing homes, campsites, sports facilities, etc. Despite their large potential and the many projects demonstrating their feasibility, systems specifically for heating swimming pools are not yet in widespread use. Similarly, solar energy is not widely used to produce space heating in Bulgaria. This is because the period when most heating is needed is when weather conditions are least favorable.

Looking to the future, certain improvements need to be made to the existing technological bases for solar thermal systems using glazed collectors, enhancing basic design features, increasing the quality of selective surfaces by incorporating glass with low iron content and improving component manufacture and systems integration. The bases need to be provided for extending the life of equipment and systems even more, from the present average of around 20 years to at least 30 years, whilst also maintaining the simplicity of the technology.

All this necessary technological development should go hand-in-hand with decreasing investment costs for users thanks to mass production, improved production processes and better marketing.

As regards applications, the great need and challenge for the coming years is to widen the range of possible solar thermal energy uses. The potential fields of application are as follows:

- **Domestic Hot Water (DHW):** The obtaining of hot water in Bulgaria is mainly done with electrical boilers, i.e. their replacement with solar collectors means replacement of the electrical energy. The country disposes of very large potential for application of solar collectors for DHW in the households, hotels and other consumers. For its utilization, however, are necessary financial incentives, as well as wide information campaigns;
- **Space heating:** The application of solar thermal systems for space heating is at its initial stage. In Bulgaria, the heating season begins in the second half of October and ends at the beginning of April. This is a period in which the quantity of sunshine is lowest. This kind of heating, to the present moment, is applied in hotel and sports facilities, where in the summer the water of the swimming pools is heated, and in the winter the premises are heated;
- **Cooling:** Recent testing of the combination of a solar energy system with an absorption machine has produced satisfactory results, opening up the possibility of serving the market. Nevertheless, solar and absorption technologies require further development in order to reduce costs. This new technology has not yet found an application in Bulgaria;
- **Agriculture and industry:** There are opportunities to apply solar thermal systems in agriculture and industry for processes requiring hot water and in drying processes. In such applications, systems can be optimized by using forced hot air collectors.

The current technology and the prospects for short-term development are enabling Bulgaria to overcome the initial delay and promote the widespread use of low temperature solar thermal energy. This will enable consumers to use solar energy for their energy requirements, contributing in this way to the environment, reducing energy dependence and helping the local industry to create jobs.

## **2. Objectives**

The objectives of the Bulgarian Solar Thermal Market Development Plan are to:

- Promote installation of solar thermal collectors, corresponding to the objectives of the National Program on Renewable Energy Sources 2002-2010. The National Program on RES 2002-2010 foresees in this period to be implemented solar thermal installations with total heating capacity of 183,2 MW, while annually the saved heat energy is foreseen to come up to 641.200 MWh/year.
- Raise social awareness of the benefits of using solar energy.
- Support the establishment of an Association in Bulgaria for application of solar thermal systems.
- Assist the establishment in Bulgaria of joint venture companies for implementation of the newest technologies for production of elements for solar thermal systems.

## **3. Market Overview and Forecast**

### **3.1. Market Overview**

The main factors influencing the solar thermal market in Bulgaria are as follows:

- The installation of 50.000 m<sup>2</sup> solar collectors during the period 1977-90 was made in the framework of a governmental program and was financed by the government, local authorities, etc. These solar collectors were installed in hotels, tourist and sport facilities and in the industrial sector.
- This policy was not related with the market penetration of solar thermal installations for households, small hotels, industry, etc.;
- The low energy prices of the fuels and electricity at that time and incompetiveness of the price of a solar energy were the main barrier to the development of the solar thermal market;
- Since 1990, Bulgaria is in transition and major part of the tourism facilities and industrial enterprises have been privatized or undergoing this procedure. This is one of the reasons for the poor maintenance, leading to the present bad status of the installations of the above-mentioned 50.000 m<sup>2</sup> solar collectors;

In the tourist facilities, 54% of the installations are still operational, but for the industrial sector only 8% are still in operation.

- Major part of the existing installations requires repair. The main problems are the corrosion of steel collector frame and the absorber coatings, lack of frost protection, broken glasses, etc.

To get a complete market overview, the following main reasons should be mentioned:

- For domestic system ensuring the needs of hot water is assumed that the necessary volume of hot water per day for one person is around 60 liters with temperature 45°C. In accordance with the type of the used collector this is achieved with 1 to 2 m<sup>2</sup> of collector surface. When it concerns big systems like hotel, restaurant and others, calculations are made evaluating more factors like coefficient of filling in, season and etc.

- With the choice of a system and components, the geographical region is also taken into account and whether the system will be used all the year around (the utilization of vacuum tube collectors is recommended) or only during the period April - October.
- The monthly savings depend on the quantity of hot water, which will be used, the volume of the boiler and the price of the conventional energy, which is used for additional heating of the water.

A well-designed system should ensure between 50% and 85% “solar contribution” or saving from the traditional bill.

- Solar water heating systems are always installed with an additional source of heating. It supplies hot water in case of exhaustion, a bad day, so that there is always water in the boiler ready for use. In any case, for optimal utilization of the solar system and for more savings, the consumption of hot water should be evenly distributed in the days of the week. This would decrease the utilization of a source for additional heating.

The price of a mounted solar installation depends on the type of collectors, the type of the system and the concrete conditions of the site, but in general it is between 1.500 lv and 5.000 lv. for a four-member family installation (240 liters/day). Why is the difference so big? The price and the effectiveness of the system depend on some variables:

- Number of months, during which solar heated water will be used;
- Size and type of the system – thermosiphon does not require specialized automation;
- Type of collectors – the flat plate collectors operate from April till October, in comparison to the “all-the-year-around” vacuum tube collectors;
- Type of roof on which the collectors will be installed – are there any additional stands needed;
- Professional or “do it yourself” system.

Before taking the decision what type of collectors to be bought, an answer to the following main question should be given: What is the purpose of the system and how much time will it be used during the year?

With seasonal use, like bungalow, villa at the seaside or in the mountain, a not expensive and efficient in the summer collector should be chosen. Such are the flat plate collectors with black painted absorbers.

If the necessities are in a greater time period, for example they include also the transitional seasons (spring, autumn), a good choice is investment in selective flat plate collectors. In Bulgaria there is no technology and capacity for production of selective absorbers, yet. There are two importers of selective absorbers in Bulgaria.

For the winter, the only collectors, which could operate in an extreme climate, even in cloudy weather, are vacuum tube collectors with heating tubes.

For Bulgaria, of special importance is the way of protection of the systems against freezing. The most popular way is the utilization of propylene-glycol mixture with water. The system as a type should be executed in a way that it implements an indirect contact between the working (solar) fluid with the domestic water through heat-exchanger.

The Solar Thermal Equipment market in Bulgaria is rapidly developing, but it is still in an initial phase. Apart from the professional producers in Bulgaria and the professional distributors, as well, there are a number of producers and suppliers who work unprofessionally. Of particular importance is that the clients contact an engineering company, which will not only offer delivery of the components of a Solar Thermal System, but will also design it, install it and will maintain the installations. Otherwise, the system could be not accurately sized or mounted unprofessionally and the expected effect will not be achieved.

### **3.2. Market Forecast**

The forecast evolution of the solar thermal market in Bulgaria is determined by some main indicators like:

✓ **Very large solar potential** (1.450 to 1.600 kWh/m<sup>2</sup> annually)

The utilization of solar energy in Bulgaria dates back to the ancient times. At present, the Bulgarian is open to its utilization, but it is necessary to overcome the respective barriers.

✓ **Investments and energy prices**

On the Bulgarian market, the cost of solar thermal systems varies in a wide range. The cost depends mainly on the type of collectors, whether it is plate or vacuum-tube, and in which country it is manufactured. The cost of the Bulgarian solar collectors is only 100-150 EUR/m<sup>2</sup> and 250-290 EUR/m<sup>2</sup> for the entire system, depending on the technology used and the installations applied. The obtaining of domestic hot water in Bulgaria is mainly done with electrical boilers. Therefore the price for obtaining of hot water from solar thermal systems is compared to that for obtaining of hot water from electrical energy. The price of the electrical energy in Bulgaria has increased several times for the last years and while the estimations made 5 years ago for the simple pay-back period of solar thermal systems showed 15 years, with the current average prices of the electrical energy 0,07 EUR/kWh this pay-back period is 2 to 6 years. It is foreseen in 2004 the price of the electrical energy to rise with another 10 %, and from 2007 it will be liberated from state regulation. Therefore it is considered that the solar thermal systems will be more competitive.

✓ **State supporting policy**

The project for a new Energy Law foresees “Sustainable development of electrical and thermal energy generation from RES in the interest of environmental protection”.

✓ **Establishment of an Association for Solar Thermal Systems** This Association will help the development of commercial network and corresponding activities like qualified information and services.

According to the PHARE Project BG 9307-03-010-2001 in Bulgaria there are about 112.000 m<sup>2</sup> of solar thermal systems for DHW. With population of Bulgaria of 7.929 thousands people, this equals 14,1 m<sup>2</sup> of solar collectors per 1.000 inhabitants. In comparison to the average level for Europe, which is 19,9 m<sup>2</sup> per 1.000 inhabitants, it is seen that the level for Bulgaria is 30 % less, despite the large solar potential that the country possess.

According to a general assessment, in 2002 in the country have been installed about 5.000 m<sup>2</sup> of solar collectors. In the present year 2003, this figure is as twice as much.

The National Program for Development of RES in Bulgaria foresees in the period 2002-2010 to be installed solar collectors, from which 641.200 MWh/year of heat energy to be obtained. With average 1.500 kWh/year per 1 m<sup>2</sup> of solar collector, this results in 427.445 m<sup>2</sup> of solar collectors to be installed or for 8 years this makes 53.000 m<sup>2</sup>/year. With the present market development this presents 5 times more installed collectors for a year. The achievement of this goal requires all measures to be undertaken and applied.

#### **4. Measures for Development of the Solar Thermal Market**

The climatic conditions and the high rates of solar radiation in Bulgaria are ideal for the exploitation of solar energy for thermal energy production. Unfortunately, this significant solar energy potential is almost unutilized to the present moment.

A series of measures and incentives should therefore be adopted to take advantage of the opportunities offered by the solar energy.

The most important thing to be done is to convince the population and the public to perceive and assimilate the idea of utilization the solar energy for obtaining of heat energy as something ordinary and normal in the everyday life. It is very important to insure public support in the face of the local and municipal authorities.

#### **4.1. State Measures**

The Energy and Energy Efficiency Law (adopted in 1999) treats only generally RES. Renewables are still not considered a priority in legislation and there are no incentives for their utilization, including solar thermal installations, as well.

The new Energy Law and the new Energy Efficiency Act have been discussed in details for the last months. It is foreseen that they are adopted by the Parliament till the end of 2003. The project for new Energy Law foresees “Sustainable development of electrical and thermal energy generation from RES in the interest of environmental protection”.

The Ministry of Energy and Energy Resources is responsible for the sustainable development of the electrical and heat energy generation from renewable energy sources in the interest of environmental protection.

The solar thermal energy is a sustainable and clean source of energy and can provide in Bulgaria a significant share of environmentally friendly energy. This is due to the fact that in the country domestic hot water is obtained mainly through electric boilers, i.e. the solar thermal energy substitutes the electrical energy. The comparison should not be measured only by the price, but also by the fact that for obtaining of 1 kWh electrical energy from conventional energy and according to the total coefficient of efficiency of the electrical energy system, about twice as much primary energy sources are necessary. The specific CO<sub>2</sub> emissions for the Bulgarian electrical system are about 1.250 g/kWh.

For example, a solar installation in an individual private house, with obtained, annually, 2.080 kWh, the CO<sub>2</sub> emissions are reduced with 2.600 kg. Therefore, the installation of solar collectors, and especially big solar thermal systems, could be connected with the principle of the green certificates. That is why the state could support the introduction of the green certificates, in case of big solar thermal systems.

In conclusion could be said that the utilization of RES in Bulgaria is constantly growing, but the price of the energy generated is higher than the market price. In many EU member states this activity is stimulated through various economical mechanisms (tax alleviations and state

subsidies). These mechanisms, however, are difficult to be applied in Bulgaria, at the present moment, as the country is in bad financial state. That is why the state foresees a wide practical application of “Tradable Green Certificates” and there should therefore be found their application in the case of solar thermal systems.

## **4.2. Regional Measures**

Republic of Bulgaria is in transitional period from centralized planned economy to market economy, which requires decentralization of the state regulation and larger autonomy of the local and regional authorities, which in the moment is in the process of realization. There should, however, be mentioned that, at the present moment, there are no regional and municipal structures, dealing with energy planning and utilization of renewable energy sources.

The decentralization of the state regulation and management, and the greater autonomy of the local and regional authorities will lead to development of their resources, as in the process of utilization of solar thermal energy, three objectives are achieved: improvement of the environment, economic development and raising the number of local jobs. There should, however, be mentioned that at the local level there are no financial stimuli for implementation of solar thermal systems like reduction of specific taxes on construction, installation and works. Non-returnable grants are not provided by local authorities, either. Regardless of the fact that the local and regional authorities has no financial possibilities for support of the introduction of solar thermal systems, they realize and appreciate their importance. The National Program on RES 2002-2010 foresees the construction of 439 sites with solar thermal installations with total heating capacity of 183,2 MW. From them, 377 sites with total capacity of 157,9 MW are proposed by the local authorities for realization.

## **4.3. Economic Measures**

One of the main reasons for Bulgaria to possess a substantial solar potential and a limited scope for its utilization is an economic reason. For a long period, from 1944 to 1990, the state applied symbolic prices of the energy sources (electricity, heat, etc.) and the development of the RES market, could be said, remained in an initial phase. The demonstration projects implemented during the last years, undoubtedly, contribute to the solar thermal applications development.

Each new initiative, including solar thermal systems market development, requires in the beginning a financial support. Bulgaria, at present, is in transitional period and in a very bad financial state, due to:

- There are no state funds in Bulgaria for development of RES utilization and technologies. Such a fund would support to a greater extent the implementation of various RES projects, including solar thermal installations;
- The Bulgarian commercial banks have very prudent crediting policy – high interest rate (usually about 15%) and credit guarantee more than 125%. They abstain from granting long-term credits. Currently, this burdens the small and medium size enterprises in producing solar collectors and solar thermal installations;
- In some cases, the renewable energy is still more expensive than the consumer price of heat and electricity. The pay-back period for solar thermal installations, in most of the cases, is more than 5 years.

From the above stated follows that the state should offer opportunity at utilization of RES, including solar thermal systems, to be used the state funds for energy efficiency and for the environment.

The state should also support the crediting policy for RES, including establishment of a special crediting line, with which there will be possibilities for small credits for separate installations, and also for credits for development of enterprises for production of elements for solar thermal installations. The credits should be granted at preferential interest rate, and the credit guarantee should be reduced.

#### **4.4. Third Party Financing**

Third party financing could be successfully implemented at application of solar thermal installations.

Solar thermal systems typically have a high initial capital cost, but low running costs. Third party financing (TPF) aims at overcoming this obstacle. The high capital cost of renewable energy systems in general can be met by someone other than the user (or seller) of the energy, i.e. the third party. The user pays for each unit of energy delivered, but not for the equipment. The cost of the energy delivered to the user is set using a combination of factors including:

- The cost of energy delivered by other fuels for heating water;
- The payment required to pay off the investment by the third party (and produce profit);
- The estimated cost of maintenance and repairs over the lifetime of the contract.

As an example for third party financing could be mentioned the completed solar thermal system for hot water in a panel block of flats No 25 in housing estate “Levski” in Sofia. Investor is the company “Techem Services” Ltd. The total number of inhabitants is 130 people. The necessary total quantity of hot water is 6.500 liters. The solar thermal installation is mounted with collectors from the company “Ecohand” – Austria.

The total area of the collectors is 126 m<sup>2</sup> and they are mounted on the flat roof of the block. The accumulating vessels have in-built electrical heater for additional heating, when necessary.

The consumed hot water is paid for by the consumers – the inhabitants of the building. For this purpose, in every dwelling is mounted a hot water-meter.

In conclusion could be said that this way of financing of solar thermal systems could find a wide application in Bulgaria.

#### **4.5. Guaranteed Solar Results**

Guaranteed Solar Results is another financing technique. This technique removes any doubts customers may have that a solar water heating system may not perform well by guaranteeing that over an agreed period they will receive a given amount of heated water from the solar installation. If the installation does not perform to the standard set out in the guarantee, the customer is financially compensated. According to a contract, the provider also maintains the system so that it will perform to the agreed standard.

The success of Guaranteed Solar Results depends on:

- A clear contract between the customer and a partnership of project developers, managers, equipment installers, and financiers;
- Accurate predictions of system performance;
- Accurate estimation of hot water demand profile;
- Metering and data logging systems.

The application of Guaranteed Solar Results clearly brings advantages to the solar thermal market. The following are the most important of these:

- Greater awareness about the service provided;
- Increased users confidence;
- Minimized risks for users;
- Increased facility reliability;
- Greater dissemination of results;
- Proximity between the solar facility and the user.

This financing method can also contribute to the development of the solar market and, combined with financial instruments such as Third Party Financing, leasing, low interest loans, etc., should lead the trends over the coming years in the solar energy sector in Bulgaria.

This financial technique already finds application in the country, although these are only the first steps.

#### **4.6. Legal Framework**

Some of the main barriers to implementation of solar thermal installations are:

- Lack of related codes and standards covering the technical requirements to the equipment and installations;
- There are no authorized laboratories for quality control of the solar collectors;
- Solar thermal installation regulations should be implemented for ensuring correct design and appropriate system assembly and maintenance criteria.

From the above could be concluded that for solar thermal market development in Bulgaria is also necessary establishment of the respective legal framework.

For the correct completion of solar thermal systems, besides the respective equipment standards and installation regulations, is necessary also a procedure for obtaining of a license as an official solar thermal energy installation agent. Similarly, regulations should be implemented for appointing official installation and solar thermal maintenance companies.

For security of stable growth of the solar thermal market in Bulgaria, it is essential to increase the number of the companies, which dispose of sufficient technical capacity to design and install solar energy systems. We are confident that for achievement of that condition will contribute a good legal framework.

#### **4.7. Integration of Solar Thermal Systems in Buildings**

The development of the solar thermal market depends also to a great extent on the way of thinking and the practice in designing of solar energy systems in buildings. It is necessary to establish solar thermal installations as a habitual element in new buildings. Taking into consideration the above-stated, Sofia Energy Centre, supported by the European Commission, issued the guide – “Solar Energy in Buildings”.

This guide is targeted to architects, engineers, administration and management staff, lecturers, urban planners and interested individuals. It gives indications for the application of active and passive solar systems, while designing and using them in existing buildings under the climatic conditions of South Eastern Europe. The aim is to stimulate designers and citizens to make the best use of direct solar energy; not only to take advantage of saving conventional energy, but to achieve an aesthetic effect for the urban environment as well.

Another main direction for solar thermal market development is the application of solar systems in public buildings. In Bulgaria, due to the long transition period (already 13 years) in which no means have been invested for maintenance of public buildings, most of them are in bad state and need refurbishment. At refurbishment of public buildings (schools, hospitals, social housing, sport facilities, etc.) should be foreseen also measures for increasing of the energy efficiency, as well as measures for utilization of RES, including solar thermal systems.

Public buildings with high hot water consumption represent an important part of the potential solar thermal market.

The implementation of solar thermal systems in public buildings can serve also as demonstration projects. It should be underlined that at the initial development stage of the solar thermal market, the good demonstration projects are of great importance.

#### **4.8. Implementation of Solar Thermal Systems in Tourist Sector**

Bulgaria disposes of all natural historical and cultural prerequisites for wide development of the tourism and therefore of the hotel sector. The application of solar technologies in the hotel industry in Bulgaria, at present, still remains modest.

The capacity of accommodation facilities in Bulgaria in 1999 was about 117.000 beds. A great part from the hotels, and especially those at the Black Sea coast, have no heating. The climate is moderate in this region and most of the hotels are closed in the winter or operate at a very low level only.

The lack of heating, air conditioning and heated swimming pools in most of the hotels limits the total energy consumption to only half of the Western expected levels. Domestic Hot Water (DHW) is the most important energy consuming sector in the hotels. Usually, domestic hot water is heated by means of electricity and occupies the greatest share of a hotel’s electricity consumption.

With the opening of the Bulgarian market to the EU member states, the requirements of the tourists increased. In more and more hotels were installed air-conditioning and heating, and heated swimming pools, as well. The increase needs of hot water and at the same time the increased price of the electrical energy leads to increased demand and implementation of solar thermal systems. It should be mentioned that the demand for solar thermal systems is divided in two types. Solar thermal systems which operate only during the period April-October and solar thermal systems which operate all-the-year. It is characteristic that combi-solar systems are calculated and implemented, which in the summer satisfy about 80 % of the needs of DHW, and

in the winter, at reduced working capacity, besides DHW, they supply a certain part of the necessary heating for the operating part of the hotel.

The key challenge for the engineer creating combi-system is how to combine the different requirements of heat suppliers and heat consumers into one single cost-effective, durable and reliable heating system, achieving the greatest benefit from each installed square meter of collectors.

#### **4.9. Implementation of Solar Thermal Systems in Industrial Sector**

There is certain experience in Bulgaria in introduction of solar thermal systems in the industry. According to the State Program on installation of 50.000 m<sup>2</sup> of solar collectors in the period 1977-1990, the majority of installations (44%) in Plovdiv and Sofia regions are installed in industrial enterprises for sanitary needs. Besides for DHW, the solar thermal energy is utilized in the production process, for example as solar dryers in the wood processing and agricultural products industries.

In the development plan of solar thermal systems for the industrial sector should be included:

- Identification of the most suitable production processes;
- Information campaign for the possibilities and the advantages of solar thermal systems for the production processes, as well as for the necessary DHW.

#### **5. Promotion and Dissemination Actions**

As the Solar Thermal Market in Bulgaria is at initial stage, large-scale awareness-raising campaign should be carried out, aimed at the public in general, as well as campaigns aimed at professional groups concerned (architects, engineers, developers, construction companies) and at potentially important clients (hotels, industry, municipalities). The purpose of these campaigns should be to create a positive attitude to solar energy in view of the environmental benefits obtained from using this energy source compared to conventional energy forms. Information and awareness campaigns in the mass media and at special trade shows should focus particularly on applications of outstanding interest, such as the centralization of individual systems and the use of solar thermal systems to heat swimming pools. Awareness-raising campaigns should also be carried out aimed at the industry.

One of the most important measures required is promotion aimed at local authorities. The objective should be for solar thermal systems to be installed in public buildings (schools, nursing homes, sports complexes, etc.).

Another objective concerning local authorities, perhaps larger in scope, is to promote citizen use of solar energy through municipal plans and ordinances and town planning and building regulations that establish the necessary parameters for installing solar systems in new buildings. At the very least, new buildings should be fitted with pre-installation facilities.

## **6. Closing Comments**

Taking into consideration the above-stated in the Bulgarian Solar Thermal Market Development Plan, the following elements should be included:

### **6.1. The state with its regulatory functions**

6.1.1. Adoption and realization of a National Strategy and a Program for Development of the Renewable Energy Sources (RES), including solar thermal systems, with view to supporting the investment process.

6.1.2. Legislation and normative acts:

- In the project for Energy Law and in the project for Energy Efficiency Law solar thermal systems should also be included as: local energy source, energy-environmentally friendly and energy effective.
- Establishment and adoption of related standards and regulations covering the technical requirements to the equipment and installations.

6.1.3. Financial stimuli, to the consumers, as well as to the producers of elements for solar thermal systems:

- Reduction of the taxes. Granting preferential loans (gratis period, low interest rates);
- Offering an opportunity for utilization of the respective funds (for example Energy Efficiency Fund).
- Application of “Tradable Green Certificates” in case of big solar thermal systems.

6.1.4. Decentralization of management.

Establishment of units, at regional and municipal levels, responsible for the development and the utilization of RES.

6.1.5. National and regional campaigns, which are aimed at stressing on the advantages of the utilization of RES, including solar thermal products.

6.1.6. Standards for the main solar thermal elements.

6.1.7. Support for establishment and operation of laboratories for testing of elements of solar thermal systems.

### **6.2. Establishment of an Association in Bulgaria for Solar Thermal Systems with its Solar Market functions**

6.2.1. Members of the association could be producers and importers of elements of solar thermal systems; companies, which design, install and maintain these systems; scientific and testing laboratories and others.

6.2.2. Research on the solar thermal systems market in Bulgaria for different sectors (dwelling buildings, public buildings, hotels, sports complex, industry and etc.), as well as for the different type of collectors (seasonal and all year utilization);

- 6.2.3. Assistance to implementation of Third Party Financing and also of Guaranteed Solar Results;
- 6.2.4. Organization of acquainting tours for members of the association, for example in Greece or in other country. Visits to producers of elements for solar thermal systems (absorbers, collectors, boilers), solar laboratories. This will contribute to the better acquaintance with the products and will create conditions for future collaborations.
- 6.2.5. Organization of information campaigns, aimed mainly at the potential users.
- 6.2.6. Assistance to local producers of elements for solar thermal systems for testing of their products in respective laboratories.
- 6.2.7. Assistance for establishment in Bulgaria of joint venture companies for implementation of the newest technologies for production of elements for the solar thermal systems.

## **7. References**

1. Balkan OPET, “Sustainable Building”, 2002
2. Balkan OPET, “Information Package on Solar Thermal Technologies for Application in the Tourist Sector”, 2001
3. European Solar Industry Federation – ESIF, European Commission – Altener Program, “Sun in Action. The Solar Thermal Market. A Strategic Plan for Action in Europe”
4. “National Program on RES in Republic of Bulgaria 2002 – 2010”
5. European Commission, “Energy for the Future: Renewable Source of Energy. White Paper Laying Down a Community Strategy and Action Plan”, 1997
6. European Commission, “Energy for the Future: Renewable Source of Energy. Community Strategy and Action Plan. Campaign for Take-Off”, 1999
7. FEMOPET Bulgaria, “Solar Energy in Buildings”, 1999
8. Arbeitsgemeinschaft ERNEUBARE ENERGIE (AEE), “Statistica Evaluation and Analyses of Large-Scale Bulgarian Solar Installation”, 1999
9. Freidemann & Johnson Consultants GmbH, “Solar Thermal Equipment for Hotels and Holiday Facilities in Bulgaria”, 1995
10. Natsionalna Elektricheska Kompania EAD, Annual Report 2002
11. ESD UK, “Technical and Economic Assessment of Bulgarian Renewable Energy Resources”, 1997
12. Solar 2000, International Symposium, Gleisdorf, 2000
13. “Widening the Use of European Solar Thermal Technologies”, Proceedings of the Workshop, Sofia, 2003