EAST-GSR
Solar Thermal applications in EASTern Europe with Guaranteed Solar Results

WP 2

Summary report

"Analysis of the local situations in the Eastern European partner countries"

Sašo Medved, Ph.D.
Jure Vetršek
University of Ljubljana
Faculty of Mechanical Engineering

Table of content

0. Introduction – the GSR concept

Renewable energy development is a key issue to act against global warming as well as to ensure the energy independence of European countries in a context of increasing energy consumption and prices. That is why the European Union Head of States have fixed in 2007 an objective of 20% of renewables in the energy mix at the horizon 2020. In order to comply with this commitment and, as heating represents 48% of the EU consumption, a directive on renewable energy sources for heating and cooling is to be issued. It will provide a framework for the adoption of national objectives and action plans. The development of solar thermal for domestic hot water production is one of the fields to be developed in order to reach those objectives.
The EAST-GSR project, cofinanced by the Energy Intelligent Europe programme aims at encouraging the development of a sustainable large solar thermal market by promoting a quality approach and transposing the Guaranteed Solar Result (GSR) procedure which guarantee a system yearly solar production. This approach has been first developed in France during the 1990's and then disseminated throughout EU15 with the support of Thermie and ALTENER programmes.

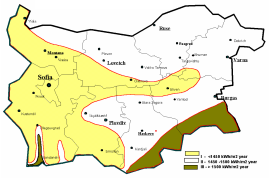
Expected results of the EAST-GSR project are:

- Transfer the GSR charter; improve solar thermal equipment quality and installation.
- Train professionals to increase know-how about design and operation of collective solar thermal heating systems.
- Encourage the integration of solar thermal systems in the building construction process.
- Implement one complete telemonitoring system per country on an existing collective solar thermal installation with theoretical GSR contract and assess performances to demonstrate reliability and increase professional confidence.
- Realize feasibility studies for solar systems for which the GSR contract would apply on new potential sites and present the results and potential projects to investors, financial institutions and promoters.
- Network and disseminate project results to encourage potential clients and investors to consider thermal solar technology as a mature and trustworthy option.
- Promote this quality approach at EU25 level.

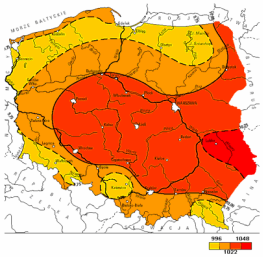
The objective of this summary report is to present the status and prospects of solar thermal market in 5 Eastern EU countries - Bulgaria, Poland, Romania, Slovak Republic and Slovenia - and especially the potential of large solar systems using the GSR (Guaranteed Solar Results) quality approach. The summary is based on analyses and conclusions of five national market prepared by **Sofija Energy Center** (SEC) from Bulgaria, **Krajowa Agencija Poszanowania Energii S.A** (KAPE) from Poland, **Oskar Von Miller Institute (OVM-ICCPET)** from Romania, **Slovenska Energeticka Agentura** (SIEA) from Slovak Republic and **University of Ljubljana** (UL-FME) from Slovenia. The project is coordinated by **ADEME** from France and the consortium also involves **Arsenal Research** (Austria), **DENA** (Germany, CRES (Greece) and **TECSOL** (France).

Energy demand and role of renewable energy sources differ significantly between analyzed East and Central EU countries. However, a common fact is the high potential of solar energy.

1. Partner countries

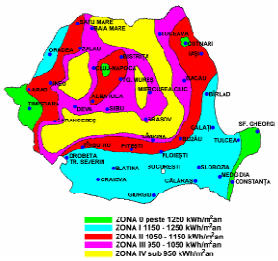


The Republic of Bulgaria is located in the south-eastern part of Europe on the Balkan Peninsula. The country has a population of around 7.9 million and covers a territory of 110.912 km^2. From 1996 population decreases by almost 5% per year. GDP in 2005 was 2250 € per capita. The country lies between the strongly contrasting continental and Mediterranean climatic zones. Bulgarian mountains and valleys act as barriers or channels for air masses, causing sharp contrasts in weather over relatively short distances. The average annual period of sunshine is about 2.100 hours and reaches 2.500 hours in some of its regions. Solar radiation is from 1.450 to 1.600 kWh/m² per year on horizontal plane.



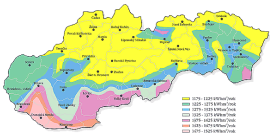
Poland has area of 312.683 km^2 and over 38.2 million inhabitants. They are concentrated mainly in large cities, including the historical capital of Poland - Krakow, and the present capital, Warsaw. Population decreases and is getting older. GDP increased from 2274 €/capita in 1995 to 5155 €/capita in 2005.

Maritime and continental types of climate prevail. More than a fourth of the country is covered by forests. Annual solar radiation on horizontal plane is between 950 and 1250 kWh/m^2 with 1600 sunshine hours per year.



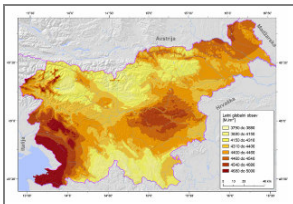
Romania has the seventh largest population within the Europe Union with an estimated 22.3 million inhabitants and the ninth largest territory with 238.391 km^2. GDP increased from 1900 € per capita in 1999 to 3800 € per capita in 2005. Romania has significant domestic crude oil and natural gas reserves.

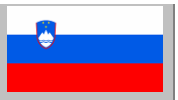
Romania's terrain is distributed roughly equally between mountainous, hilly and lowland territories. Climate varies between temperate and continental. The hottest regions are in the southern part of country. The average solar radiation on horizontal plane is between 1.100 too 1.300 kWh/m^2 per year.



Slovak Republic is Central European country bordered with Austria, Hungary, Ukraine, Poland and Czech Republic. It's area is 49.034 km^2 and it has a population of 5,4 million inhabitants. In the last decade population and life expectancy have grown continuously. GDP in 2005 was 4700 € per capita.

The climate in Slovakia shows considerable variations, mainly due to the great land elevation differences. Climate in lowlands greatly depends on their elevation and on the mountains that encircle them. The solar radiation is in range from 1.100 up to 1.500 kWh/m^2 on a horizontal plan.

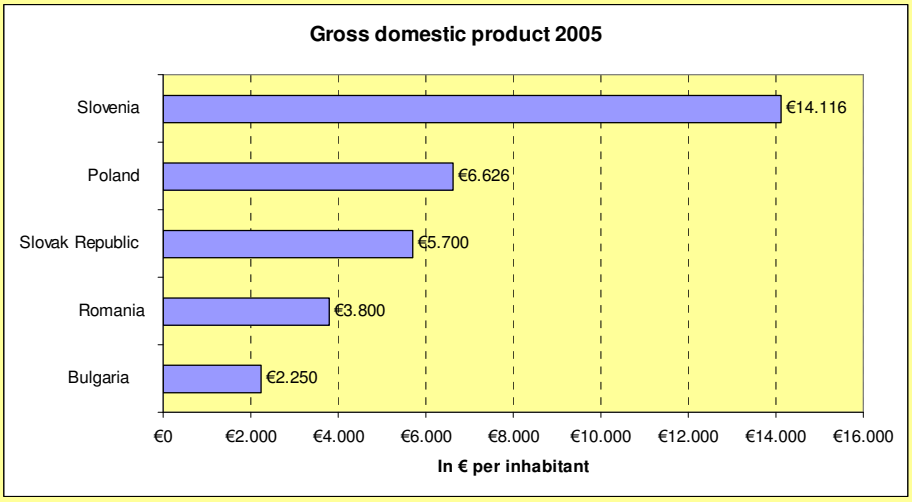


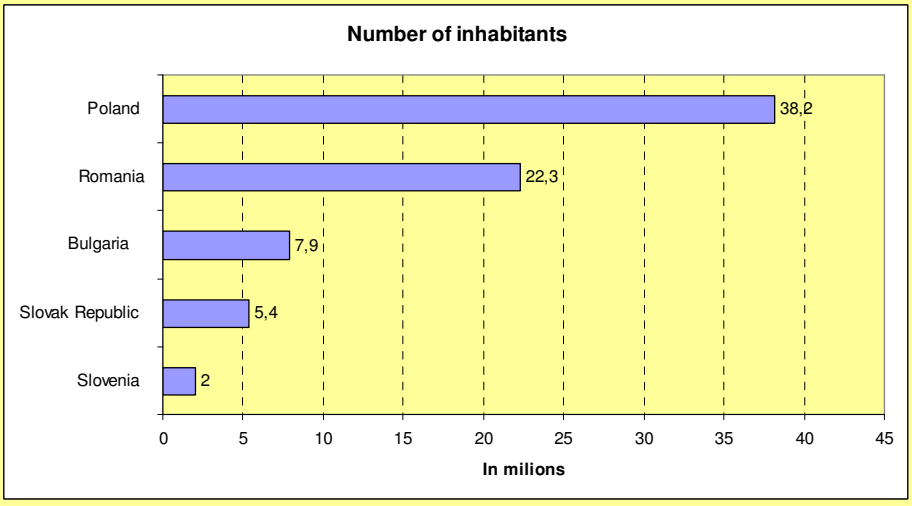


Slovenia is a coastal Alpine country of 20.274 km^2 located in southern Central Europe with 2 million inhabitants. From 2007 national currency is Euro. In 2005 the GDP was 14.116 € per capita.

More that half of the territory is covered by forests. Degree days on Slovenian territory vary between 2400 Kday and 4000 Kday with yearly solar radiation on horizontal plane between 1000 and 1400 kWh/m^2.

The five countries presented in this summary gather 75.800.000 inhabitants which represents almost 20% of the total EU population. A characteristic of those countries is that they lag behind old EU-15 countries according to their GDP per capita (see figure below). However, they have generally doubled their GDP in the last decade and they reduce the difference with EU-15 countries. Population is stable despite noticeable migration trends on account of low birth rate. In all countries population is getting older and lowering of living expenses will be important in the future. This indicates that expenses for the energy will be relatively even more important than today.





2. Energy demand and RES national polities

Primary energy (PE) demand increased by 9,5% in the period 2000 to 2005 and reached 880 PJ in the year 2005 or 114 GJ per capita. The most important energy source in PE supply is coal with a 39% share, followed by liquid fossil fuels (24.5%), nuclear power (20%) and natural gas (6.6%). Share of RES in PE is 4.9% (biomass 35.2 PJ/a and hydro energy 7.9 PJ/a). Final energy (FE) consumption increased by almost 20% in the last five years and was 423 PJ in 2005. Liquid fossil fuels have a 38% share in FE supply, following by electricity (22%) and coal (12%). The energy consumption in households was in last decade almost constant at 96 PJ per year. Electricity has highest share with almost 36%, followed by district heat (20.5%) and biomass (26.5%). Meanwhile in period between 1997 and 2003 electricity consumption decreased by 3% and the use of biomass increased significantly (+14.2%). Ratio of FE to PE was in the year 2005 only 48.2%. Energy dependency reached 70% in year 2005.

The national objectives regarding RES are stated in the Energy Law, Chapter Eleven "Promotion of power generation from RES and combined generation". At the end of the period of 2005 – 2015 it is expected that the heat generated from biomass will cover 36% of total demand.

Primary energy demand increased from 3357 PJ in 2001 to 3982 PJ in 2005. In the same year the PE demand per capita was 104 GJ. Share of hard and brown coal decreases strongly, but it still represents 57% of PE supply, followed by oil 21% and gas 13%. Share of RES in PE consumption was in the same year 4,4% (178 PJ). The biomass is currently the most important RES, followed by hydro energy. Since 2002 final energy consumption increased by 2.75% per year and reached 2070 PJ in 2005. The share of coal FE supply decreased systematically from 36% in 1995 to 20% in 2004. Lately oil fuels became dominant with the share of 31%. Electricity and natural gas consumption has slightly risen and reached 15% and 13% in 2004. Most FE was in 2004 supplied to the households (644 PJ/a) and to the industry sector (610 PJ/a). Electricity production is first based on hard and brown coal (94.5%) with very small contribution of hydropower plants. Other renewable energy sources like wind and biogas are insignificant.

The Renewable Energy Sector Development Strategy was adopted by the Parliament on August 23rd 2001. The document formulates a strategic objective, which is the increase of share of energy from renewable sources in the Polish primary energy balance to 7.5% in 2010 and to 14% in 2020. Guidelines for Energy Policy of Poland until 2020 foresee following targets for RES until 2010:

- Increase the share of RES in the primary energy supply to 7.5%.
- 7.5% Renewable Electricity production of the national electricity gross consumption as the indicative target in the Directive 2001/77/EC.
- 10.4% Renewable Electricity sold to final consumers as an obligation to the power utilities (suppliers) in the Decree of the Minister of Economy.

Primary energy consumption per capita is about 67 GJ. Final energy consumption decreased sharply in the early 1990s, due to an economic crisis and changes in energy accounting methods. Since 1999, consumption has stabilized at 1.026 PJ. Mainly, the evolution of energy consumption has followed the national economy and industrial activity trend, with significant decreases in 1990 and 1991, and slow increases in 1992-1996. In 1997-1999, the need for energetic resources, electric and thermal energy decreased again, following the national economy. In 2000, the consumption

increased with 2,2% in comparison with 1999, and in 2002 increased with another 6,8%. Natural gas has the share of 37%, followed by oil (25.2%), coal (23,9%), biomass (6.8%), nuclear energy (4,0%) and hydropower (3,2%). FE consumption has stabilized in last year at 440 PJ per year. The present efficiency of production means and networks is very poor, mainly due to a lack of investment.

The National Strategy for Energy Development (2006 – 2009) aims at creating efficient energy markets. The Romanian government is planning to implement a new program for increasing the use of renewable energy that includes photovoltaic, wind energy, biomass, and geothermal energy. Target for heat production from RES up to 2010 are 0,31 PJ per year from solar energy (0,5% of potential), 136 PJ from biomass (43% of national potential) and 0,72 PJ per year from geothermal energy (10,5% of potential). There are some doubts about achieving these goals especially in the field of biomass exploitation. The electricity production from RES should rise from 0,7% in the year 2005 to 4,3% in the year 2010.

Primary energy demand in Slovak Republic increased by 1,4 % from 791 PJ in 2001 to 802 PJ in 2005 or to 148,5 GJ per capita. The natural gas is by far most important energy source. 76% of municipalities in the country with 94% of the total inhabitants use the natural gas for heat production. Natural gas has 83,7% share and is followed by coal (13%) and biomass (1,4%). FE consumption has stabilized in last year at 440 PJ per year. Currently most important RES is hydro energy (18,3 PJ/a), following by biomass (11,5 PJ/a), waste (4,5 PJ/a), geothermal energy (1,2 PJ/a) and bio-fuels (1,2 PJ/a). 57% of electricity is produced by nuclear power plants, the share of thermal and hydropower plants is 19% and 15%. Ratio of FE to PE was 55% in 2004.

The medium-term objective defined in Energy policy document from the year 2000 was to reach 4% share of RES in primary energy supply by the year 2005. National target for electricity production from RES is defined as 5,85 TWh per year, which corresponds to 19% share of electricity produced from RES in 2010. This value is much lower than that one defined by European Committee (31% or 9,23 TWh from RES) but from the economic point of view it is realistically reachable.

Continuing growth of PE was characteristic for Slovenia in the period 2000 – 2005 (+2,9% per year). In 2005 primary energy demand reached 307 PJ or 152,3 GJ per capita. The liquid fossil fuels have biggest share (34%) in PE supply, followed by coal (21%), nuclear energy (21%) and natural gas (14%). Share of RES in PE supply was approximately 11% (33 PJ/a – 12.5 PJ/a hydro energy and 20.5 PJ/a other RES). FE consumption has grown for 2.2% per year in last five years and reached 207 PJ in year 2005. To this the electricity consumption growth has contributed mostly with +3.8% annual rate, followed by natural gas (+2,8%) and liquid fossil fuels (+1,7%). FE consumption increased in manufacturing, construction and transport sector, decreased in households and other sectors (in households from 28.7% in 2000 to 23.7 % in 2005). Ratio of FE to PE was 73% in year 2005. Energy dependency reached 52.3% in 2005.

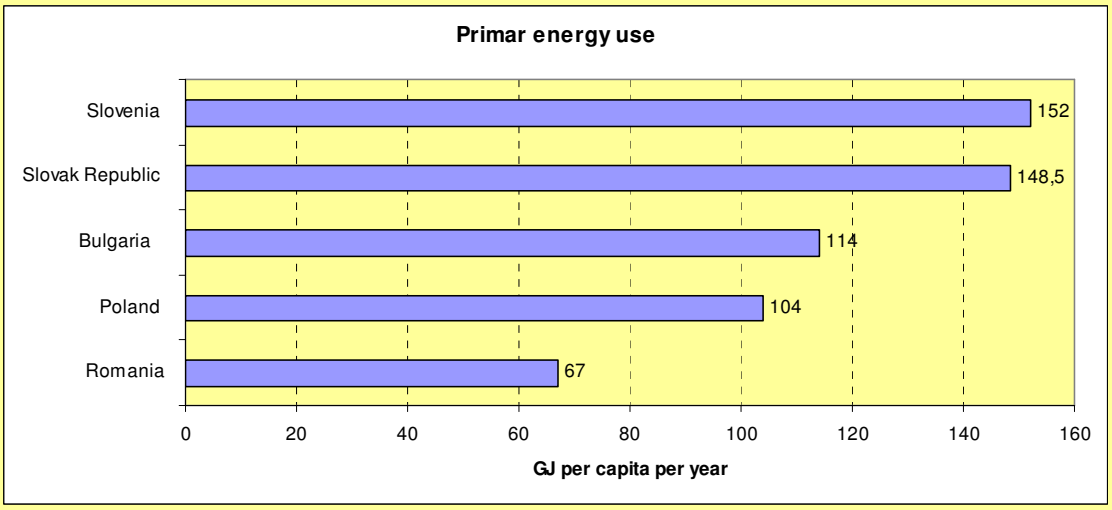
The national target regarding RES can be found in two national strategic documents: Resolution about National Environment Protection Program 2005-2012 from 2005 and National Energy Program from 2003. Share of RES in primary energy should increase up to 12% until year 2010. According to the plan additional 4 PJ per year must be provided up to 2010 by additional use of biomass (3,1 PJ per year), biogas (0,4 PJ per year), geothermal energy (0,4 PJ per year) and 0,1 PJ per year from other RES. This should be fulfilled by:

- enlarging RES thermal from 22% in 2002 to 25% until 2010,
- by enlarging the RES electricity from 32% in 2002 to 33,6 % until 2010,

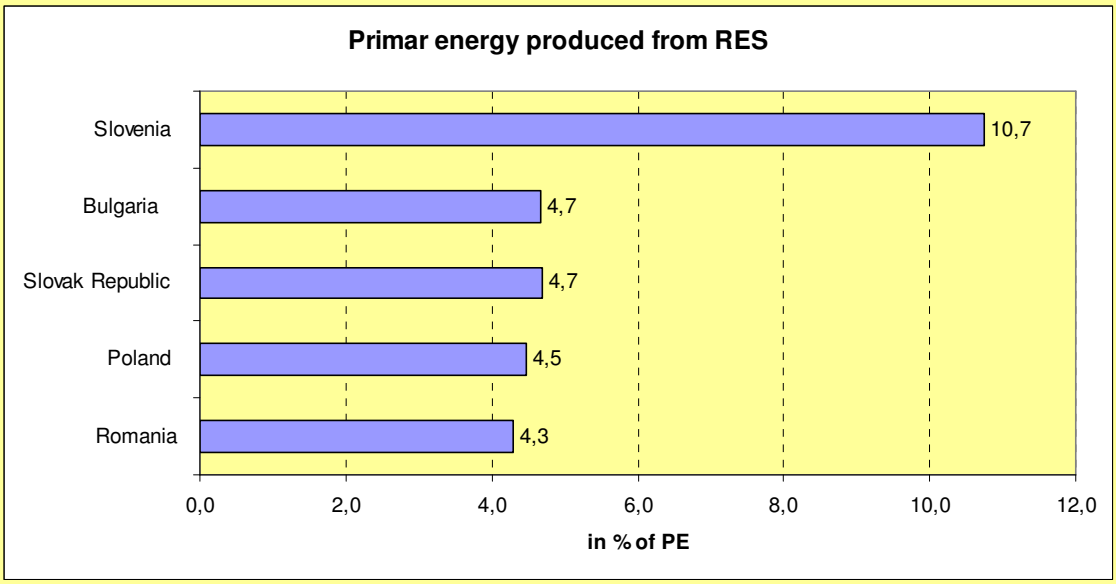
- by implementing Directive on biofuels - 5,75% by volume until 2010.

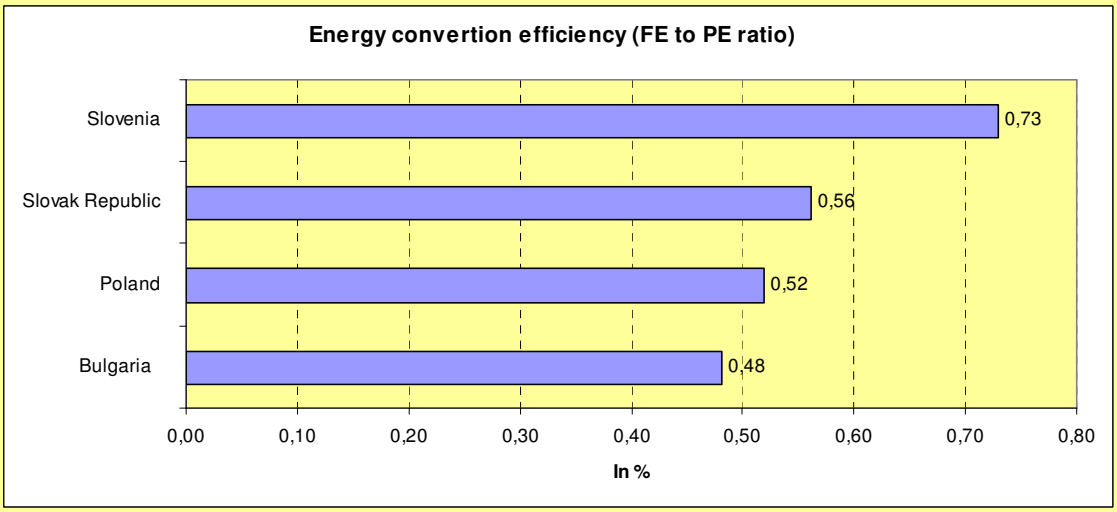
At present biomass is emphasized in frame of national energy policy compared to other RES and especially compared to solar energy.

Primary energy (PE) consumption per capita in analysed countries is in the range between 68 GJ and 152 GJ. PE consumption, on the 2000-2005 period, is rising in Slovenia (+2,9 % per year) and Bulgaria (+2 %). Consumption in Romania and Slovakia is stable during last 5 years and PE consumption per capita decreased in Poland (-2 %). Coal is still the most important energy source in Poland (57 % of PE) and Bulgaria (39 %). In Slovenia the largest share is accounted to liquid fossil fuels (34 %), in Slovakia and Romania most important source is natural gas. Energy intensity, which is the ratio between final energy (FE) and primary energy (PE), is between 73 % (Slovenia) and 43 % (Romania). A characteristic of all analysed countries is that energy intensity is increasing, which means that efficiency of energy transformation is improving.



The increased FE consumption and the dominant role of fossil fuels cause great impacts on environment and on energy dependency. An increased use of renewable energy sources coupled with energy efficiency and demand management policies are necessary to tackle those issues. Solar energy can have an important role as all of the countries have big potential of solar energy. As we have seen, the yearly solar radiation is between 1000 and 1100 kWh/m^{2}a in Poland, 1200 to 1500 kWh/m^{2}a in Slovakia, 1400 to 1600 kWh/m^{2}a in Bulgaria, 1000 to 1300 in Romania and 1050 to 1400 kWh/m^{2}a in Slovenia. This is comparable to other developed European solar thermal market such as Germany.





Energy strategies ,in all of analysed countries, include commitments about enlarging role of RES. Targets for electricity production from RES are defined for all countries regarding to the RESe directive. In some cases, targets seam to be to optimistic especially because electricity consumption grows more that other energy sources. Targets for heat production from RES are not defined in details but this should change with the adoption of the European Directive on RES for heating and cooling. Biomass and geothermal energy are the most used RES for heat production while solar energy for heat production has still a relatively minor role in energy strategy documents in all of the analyzed countries – the range of predicted heat production from solar energy until the year 2010 is 2,3 PJ in Poland, 0,3 PJ in Slovak Republic and Romania and 0,1 PJ per year in Slovenia. For Bulgaria it is 5,6 PJ/a until 2015. Solar thermal is a largely non exploited potential that could contribute greatly to national objectives in terms of RES and should be integrated in the future national plans for RES.

3. Solar hot water market

3.1. Current status, market targets and supporting actions

Large scale governmental programmes in the 80s have lead to the installation of 50.000 m^2 of solar collectors, mainly in the tourist facilities for hot water supply on the Black sea coast. Since 1990 Bulgaria is in transition and major part of the tourism facilities and industrial enterprises have been privatised or are undergoing this procedure. This is one of the reasons for poor maintenance, which lead to the present bad status of the installations. Solar thermal market just starts to develop once again. National target is that at least 5% of total heat demand (currently 112 PJ per year) should be provided by solar thermal systems (5.6 PJ/a) until 2015. Expert estimations show that in 2005 in Bulgaria there were 56.000 m² of solar collectors (SC). The actual expected installation of SC is 5000 m^2/year by 2010 and 8000 m^2/year by 2015. So in reality it is expected in 2010 Bulgaria to have 80.000 m^2 SC and in 2015 to have 120.000 m^2 SC installed. Statistical data for the market of solar thermal systems is not available. Estimation of the market development of SC is done by reviewing respective sectors.

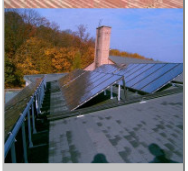
There are no state funds in Bulgaria for RES utilisation including solar thermal systems, but some other financial schemes are established. Among them, the Kozloduy International Decommissioning Support Fund. The financial support for utilisation of RES could be in form of grant or partial financing in various co-financing structures with other loan applications. A programme between USAID and some national banks was established. Under this programme USAID guarantee that up to 50% of the investment, credits are available.

Solar active systems are nowadays used mostly for domestic hot water heating in single family houses. There are several large solar thermal systems installed in schools, public buildings and multifamily apartment buildings, hospitals, sanatoriums but total area of solar collectors installed in those systems are. The solar thermal market is growing and total area of installed solar collectors is estimated at 167.500 m^2 (year 2004) which produce 0,24 PJ of heat per year. This is a significant enlargement compared to the 3.000 m^2 installed before 1999. The Renewable Energy Sector Development Strategy was adopted by the Parliament. The document formulates a strategic objective, which is the increase of share of energy from renewable sources in the Polish primary energy balance to 7,5% in 2010 and to 14% in 2020. According to this document additional 800 MWt (100 MWt of air SC and 700 MWt of water SC) will be installed till 2010, and the forecast for 2030 is that solar thermal systems could provide 60 PJ in agriculture sector only.

The National Fund for Environmental Protection and Water Management is the largest institution financing environmental protection projects in Poland. The loans from the National Fund are soft loans from 0,2 to 1,0 times the Polish base rate, for up to 50% of total project costs. Every year around 800 projects receive support from the National Fund. EcoFund is a foundation established by the Ministry of Finance. The EcoFund's task is to subsidize environmental protection projects. One of the priorities are solar thermal systems. The grants are between 30 to 60% of the project costs. EcoFund has also launched a so-called "fast path" of the awarding grants for development and production of solar collectors. The amount of the grand is 261 € per m^2 of produced solar collector, but not more then 2.610.000 € per year or not more then 40% of the project costs.

Starting in the beginning of the 80s, a large scale program for various solar applications has been launched for solar domestic hot water systems for hotels on the Black Sea coast, for apartment blocks and solar drying for agricultural products. Until 1989, 1.000.000 m^2 of solar collectors, mainly flat plate, were manufactured and installed in Romania, among which large systems up to 9.000 m^2. After 1989, the solar thermal applications were abandoned. A very small part of the former installed collectors is still in operation. Altogether approximately 0,09 PJ of solar heat is produced today. However, due to poor quality and lack of maintenance, the majority of solar thermal systems are not in operation today. Regarding to the Strategy provisions, 0,307 PJ of solar heat should be produced in 2010. 215.000 m² of solar collectors will be necessary to fulfill this target.

In the late 80`s up to 3.000 $m^2$ of solar collectors were installed each year, followed by decrease of solar thermal market in 90`s during which approximately 600 m^2 of SC were installed per year. After the year 2000, the number of installed collectors increased quickly but decreased again after 2003, due to higher VAT. Present utilisation of solar energy for heat production is approximately 0,1 TJ per year. More than 50.000 m^2 of solar collectors are in operation. About 5.000 m^2 of solar collectors are installed yearly. Slovak target is to achieve 0,3 PJ of heat supply with solar thermal systems per year. It will be necessary to install additional 25.000 m^2 of solar collectors yearly between 2007 and 2010.



Financial support for RES exists since 1991. Two support schemes exist – "de minimis" supporting scheme for smaller projects (available support between 2.600 € and 100.000 €) and "State Aid Scheme" for bigger projects (available support between 50.000 € and 5.000.000 €). Beneficiaries are SMEs (support up to 65%) and large enterprises (Support up to 50%), associations of private and legal persons under 1.000 employees and organizations of state or public administration with business activities where private legal persons' share is at least 51%. Another support programs are Structural funds and Environmental Fund grants. There are also some other programs, but solar thermal systems hardly compete with other RES technologies because it is expected that applications assure very high decrease of pollutant emissions.

During the 80s the Slovenian producers of solar systems were leading in the market of formal Yugoslavia. A lot of systems were installed and some of them are still working well. After the independence, the Yugoslavian market was closed for Slovenian companies and production of solar systems decreased significantly. In last years the interest for solar heating systems is increasing again due to higher prices of fuel and more reliable solar systems. Share of RES in heat supply should increase from 22% in 2002 to 25% until 2010 and the target of 10.000 m² of yearly installed collector area until 2010 was already reached in 2007. It is presumed that solar systems with a total area of solar collector of 110.000 m^2 are currently in operation with nominal power of 77 MW_t which collect yearly 0,13 PJ of heat. According to this figure we can presume that 9650 tons of CO_2 emissions are avoided per year.

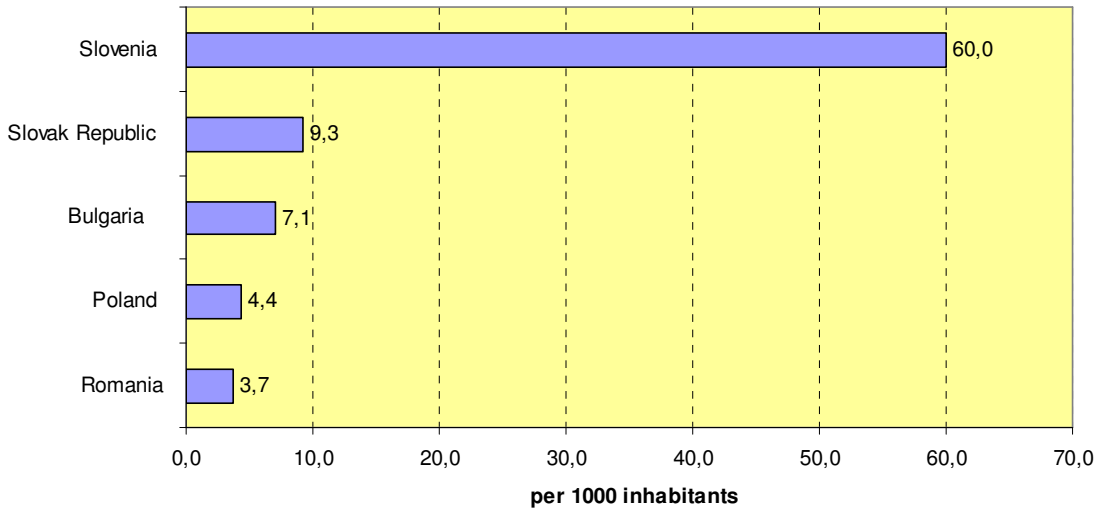
The national strategy for promoting solar thermal application is orientated mainly on promoting solar heating systems for tap water heating in single family buildings. In the last year the subsidy for private investors was of 125 € per m^2 of SC, but not more that 2.085 € for the solar system (in 2006, 788 applications with total solar collector area of 5.100 m^2 were subsidised). For the larger solar thermal systems, subsidies for the legal investors and enterprises were available only between 2002 and 2004. It represented 30% of eligible cost. If the investor was a SME, the subsidy was enlarged by 10%. There is no taxes reduction for solar system equipments at the moment. Soft

loan credits are available through state owned Eco-sklad.

Solar thermal markets were well developed during the 1980s especially in Romania and Slovenia as well as in Bulgaria. Low quality and poor maintenance caused afterwards a lost of confidence in solar thermal systems. All analysed partner countries went through a transition from socialism to capitalism in the 1990s, which resulted in additional decrease of investments in solar energy uses. Economic growth and economy strengthening in past few years influenced positively the solar market, which is slowly reviving. Results are new installations: around 5.000 m² per year in Slovakia, 10.000 m² in Slovenia and 35.000 m^2 in Poland. The market is still small in Romania and it is unknown in Bulgaria.

Small applications for domestic tap water heating prevail in all countries. Not more than 1 % of total installed solar collectors are installed in large solar heating systems. Hotels and elderly homes in Slovenia, Black sea resorts in Bulgaria, hospitals and sanatoriums in Poland (where 100 large solar thermal systems are in operation) and solar drying systems in Romania are most common applications for large solar thermal systems. All countries have underlined a lack of data about the sizes and operating efficiency, especially about large solar thermal systems. Monitoring of solar thermal systems performance is not established. GSR approach has thus a potential to overcome these barriers.

State support in the form of subsidies for the investments in small and large solar thermal systems is available only in Slovakia. In Slovenia subsidies are available for private investors only for solar systems for tap water heating in single family houses. They are determined as fixed values per square meter of installed solar collector and maximum SC area per house is limited. Poland, Slovenia and Slovakia have also state funds (soft loans with favorable interest rates) for financing the investments in systems for RES utilisation. In Bulgaria no state financial supports are available, same goes for Romania but significant financial support for RES and RUE in this country is being prepared. Only in Poland the producers of solar thermal system equipment can receive state support. Supporting methods varies a lot between countries, however, none of the support measures have been related to the quality and reliability of the solar systems up to now.



3.2. Specificities of national solar thermal markets

Nowadays there are several producers of flat plate solar collectors but none of them produce vacuum-tube collectors or selective absorbers. The heat storages are produced by a number of companies. Most of the collectors installed are composed of steel absorbers, black coating, single glass cover and galvanized steel collector surrounding. The quality of available products on the Bulgarian market can be estimated as good.

There is only one experimental laboratory in Bulgaria equipped for testing of solar collectors. The laboratory is not recognized as certification body. It is established at the Central Laboratory of Solar Energy and New Energy Sources (CLSENES) on Bulgarian Academy of Science (BAS).

In Poland there are 9 manufacturers of flat plate solar collectors and 4 manufacturers of vacuum-tube collectors. The two biggest producers have 74% of market share. During the last few years the number of installed solar collectors has been increasing significantly and reached 28.400 m^2 in 2006. In last 5 years, more than 30 large solar heating systems were installed, mainly in public buildings and health care centers. There are still some difficulties concerning quality and specially the maintenance of solar systems.

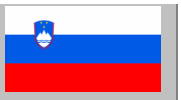
Poland has two testing laboratories. Outdoor tests, according to EN standards, are being performed by Institute for Fuels and Renewable Energy. Indoor tests, according to ASHRAE 93-77 standards, are being performed by Institute of Fundamental Technological Research.

Although there is no large request for solar-thermal systems in Romania, the number of producers and distributors on the market has increased in recent years. Local producers are offering low-tech and quite cost effective solar thermal systems. More efficient West European equipment is commercialized by many companies. There are 7 major players involved in promotion of solar thermal systems nation wide.

The current capacity of production is around 100.000 m^2 of collector area per year in Slovakia. Only about 10% of these are sold on domestic market, the rest are exported. In fact there is only one big producer of solar collectors and its share is about 90 % of Slovak market. All major European producers of solar collectors are presented on the market.

There are only two Solar Energy Laboratories at Technical universities in Slovakia. They are mostly intended for research and they have no right to issue official certificates. Another testing laboratory is under construction by the biggest domestic producer of solar collectors. All installed solar collectors are tested by well recognized foreign certification laboratories.

There is a wide range of product available on the Slovenian market. Unglazed, black paint, selective, vacuum, semi-selective and colored solar collectors are available. The quality of contemporary solar thermal equipment can be estimate as good. There is only one firm with own R&D and production of solar thermal systems. Together with another domestic producer they have a 70% market share. All important EU suppliers are acting on the Slovenian market.



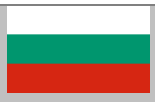
There is only one laboratory in Slovenia equipped for testing solar collectors, solar heat storage as well as for testing solar systems in-situ. It was established in 1984 on the Faculty of Mechanical Engineering, University of Ljubljana. Despite the long tradition, they are not recognized as certification body, but their report is recognized as national authority.

Solar thermal markets in the five EAST-GSR partner countries are quite different. There are small number of domestic producers of components of solar thermal systems in Bulgaria, Romania and Slovenia. As by the rule they produce low-tech products (solar collectors). High-tech products are imported, since all major solar thermal EU producers are presented on national markets. On the other hand there is only one large producer in Slovakia, which exports almost 90 % of its production. Only in Poland there is a large number of producers with modern production technologies (high tech vacuum collectors for instance) and they export approximately 10 % of their production.

There are some institutions with test facilities in these five countries, most of them belonging to research institutes at Universities. However, they are not recognised as certification bodies and therefore they are not included in EU wide certification schemes (like SolarKeyMark). This is due to a low domestic industry interest and lack of state support in research infrastructures. Establishing certification bodies should be a priority in all of the analysed countries.

The lack of experiences for solar thermal system design and installation is common and quality insurance methods have not been implemented until now.

3.3. General recommendations for enlarging the solar thermal market – barriers to overcome



Regarding the Bulgarian national overview, the following barriers must be overcome for potential enlargement of solar thermal systems:

- The Energy Law (adopted in 2003) treats only the promotion of electric energy generation from RES and cogeneration of heat and electricity.
- The various state institutions, although having a positive attitude towards RES, still don't pay the necessary attention to solar thermal energy.
- There are no state funds in Bulgaria for RES utilisation including solar thermal systems, even if some other financial schemes are established, such as the Kozloduy International Decommissioning Support Fund.
- Commercial network are insufficiently developed.
- There is a lack of highly qualified technical service.
- Insufficient information and experiences are noted.
- SC produced in Bulgaria can not be certified, as there is only one experimental laboratory in Bulgaria equipped for testing the characteristics of SC but it is not recognized as a certification body. In Bulgaria there is no production of selective absorbers nor of vacuum tube SC. They are all imported.
- There is no practice of concluding agreements for Guaranteed Solar Results.

There are a number of barriers hindering the development of solar technology in Poland. The barriers are a set of psychological, social, institutional, legal and economic factors. The main barriers include:

- The lack of regulations clearly defining a programme and policy concerning the utilisation of renewable energy sources.
- Insufficient economic mechanisms in the state budget, including particularly tax mechanisms permitting adequate benefits from relatively high capital-intensive investments in facilities, installations and plants for the generation of energy from solar thermal systems.
- The subsidies are mostly available for large solar systems, but small investors don't have possibilities to receive financial support.
- The renewable energy installation is still very expensive with long playback period.
- There is a lack of legal and regulatory frameworks, limited institutional capacity and excessive bureaucratic procedures.
- The lack of easy access to information on the distribution of the usable energy potential of individual solar thermal systems.
- There is no sufficient information on consulting, design and manufacturing companies involved in issues relating to solar collectors systems.
- The lack of easy access to information on procedures concerning the preparation and execution of investments in solar thermal systems and standard costs of an investment cycle on the one hand, the lack of information on economic, social and environmental benefits related to the utilisation of renewable energy sources on the other hand have been noted.
- Difficult access to new equipment and technologies.
- Insufficient number of domestic economic entities involved in the manufacturing of solar systems equipment on a larger scale.

- The lack of tax preferences for import/export of equipment and components for the systems utilising solar energy.
- Knowledge about planning, installing and maintaining large solar thermal systems is poor.
- Quality problems on national or imported collectors or relevant equipment offer.
- An inadequate primary and post-primary school syllabus which does not recognise renewable energy sources.
- The lack of education and training programmes concerning solar thermal systems targeted at engineers, design engineers, architects, representatives of the energy sector, banks and decision makers.

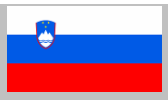
The barriers for the development of RES and especially for solar thermal systems market are as follows in Romania:

- Lack of a national programme for the development of renewable energy sources and related technologies.
- The various state institutions, although having a positive attitude towards renewable sources of energy, still do not pay the necessary attention to these energy sources.
- Lack of regional and municipal structures, dealing with energy planning and utilization of RES.
- There are no authorized laboratories for quality control of the produced equipment.
- Lack of related codes and standards covering the technical requirements of the equipments and installations.
- Although prices of conventional energy increased, the energy market is still not liberalized.

In Slovakia, as a result of different barriers, the expected development in RES exploitation and therefore use of solar energy was not achieved in recent years. Those barriers could be divided among:

- Market barriers discourage potential investors because of the lack of long-term stable incentive measures. As an example, an income tax exemption for the first five years of RES utilization was available before 2004 but has been abolished by the new flat tax since the year 2006.
- Lack of information and promotion activities, financial incentives and soft loans schemes for general population; weak interconnection of the practical experience and the theoretical instruction in schools and insufficient information on the environmental impact of fossil fuel combustion are important barriers. Those barriers are reinforced by the massive expansion of the natural gas grid all over the Slovak Republic (over 90 % of the population can be supplied by gas).
- Technological barriers still exist due to the fact that most of the modern technologies appear to be not enough developed; in addition there are insufficient structures of distribution nets and low preparedness of distribution companies for the integration of RES.
- Legislation barriers are among the most important ones- currently Slovakia has no specific Act dealing with RES and therefore with solar energy utilization. RES promotion articles are thus distributed among several energy Acts and relevant Regulations and Decrees

For increasing solar thermal market in Slovenia, following barriers should be overcome:



- Revising national energy policy document in the way, that target for solar thermal systems will be more ambitious, especially for large solar thermal systems.
- With the development of subsidy schemes the pay back time should be reduced, stop and go subsides must be avoided due to bad past experiences especially in the field of large solar thermal systems.
- Establishing national networks for quality control insurance to encourage demand side.
- Increasing the knowledge about planning installing and maintaining large solar thermal systems with train the trainer activities and supply side workshops.
- Close collaboration between research institutes and industry must be supported true R&D programs.
- Best case examples with performance monitoring are needed to present these technologies to all target groups.

In all presented countries similar barriers for a wider implementation of solar thermal systems can be exposed:

- Targets for solar thermal market development in strategic national documents are not ambition enough, when existing.
- Production of heat from RES is not treated equaly as production of electricity; therefore new Directive of RESh can help to promote this technology.
- Althrough price of fossile fuels are rising, this alone will not be sufficient to ensure the economy of solar thermal systems, subsidies schemes are crucial.
- There are different subsidy schemes: in Poland for example, they target large systems and legal investors; in Slovenia, small systems and private investors; no subsidies are available in Bulgaria, Romaniy and Slovakia at the moment. Subsidies are not ensured for long period.
- Often observed stop and go subsises must be avoided.
- A complete lack of regulative framework can be noticed in all of the participating countries.
- Insuficient awarness campains, training programs and experts knowledge are emphasized as barriers in all of the national reviews.
- Lack of experiances and monitoring of solar thermal systems efficiency is common for all countries.
- Domestic industry could play an important role in promoting solar thermal but unfortunatly all national solar thermal industries are poorly developed at the moment.

It is obvious that common barriers for all analized countries are well known from past experiences of countries which have nowadays a well developed solar thermal market. As the EAST-GSR project addresses political desision makers as well as supply and demand side actors, it can contribute to future development of the national solar thermal markets.

3.4. Market potential for large solar thermal systems

The following sectors are distinguished as most suitable for an application of large-scale solar thermal systems:

- hotels, holiday houses, campaigns, swimming pools, etc.,
- state and municipal buildings (hospitals, kindergartens, social houses, etc.)
- multi-story buildings (new and old ones).

Hotel sector

In the hotel sector, during a three-year period (2002-2005), the number of accommodation facilities has increased by 70 % (from 914 to 1555), the number of beds by 54 % (from 143.707 to 221.144) and the number of night lodgings by 56 % (from 10.285.668 to 16.071.313). The average electricity consumption is of 3,3 kWh/overnight. DHW, when it is obtained from electricity, accounts for 45-55 % of the electricity consumption. The calculations made show that in order to satisfy 60% of the needs for DHW for all new accommodations for the period May-September, it is necessary to construct annually 13.000 m^2 of SC.

State and municipal buildings

The number of state and municipal buildings is substantial. Among the building that can potentially apply for big solar systems, the following can be mentionned: in 2004 there was 3.301 kinder-gardens, 303 hospital establishments with 47.709 beds and 241 social establishments with 55.192 beds. Assuming that 1/3 of the state and municipal buildings (without kindergartens) are suitable for SC and that a ten-year program for their construction is followed, it means that annually 1.700 m^2 of SC have to be constructed.

Multi-storied residential buildings

The number of new dwellings built in the period 2001 – 2004 (number of dwellings increase from 5.937 in 2001 to 8.267 in 2004) indicates that even if large solar thermal systems are installed in a small percent of the buildings, it will have considerable impact on the final consumption of heat energy. From the above presented it can be concluded that it is advisable to promote the building of large-scale solar thermal systems simultaneously with construction of new residential buildings. Taking into account that 8.000 new dwellings are constructed each year with an average of 2,7 persons/dwelling, it will be necessary to build up between 20.000 to 30.000 m^2 SC annually.

Hospitals, Health care centers

It is estimated that 861 hospitals exist in Poland with total number of 222.735 beds and in addition there are more than 4.000 Health care centers. Most of them require thermo modernization, so it is good opportunity to install flat plate solar collectors. Assuming that every 4^{th} hospital in Poland will make thermo modernization, including installation of large scale solar thermal systems (more than 50 m^2), this will give the result of more than 10.000 m^2 collector area.

Schools

There are more than 39.000 schools. Most of school buildings have been constructed in the 70s. The energy is delivered from district heating systems, individual boilers and coal fired stoves. Assuming that every 10^{th} school building, which are occupied during the summer period, will make thermo modernization, including installation of large scale solar thermal systems (more than 50 m^2), it would results in more than 200.000 m^2 of collectors areas.

Social Welfare Facilities

The number of Social Welfare Facilities is 1.154. Assuming that every 10th Social Welfare Facilities in Poland will install large scale solar, this will result in more than 5.500 m^2 of SC.

Fire Stations

There are more than 17.268 Fire Stations. If every 10th Fire Stations in Poland will make thermo modernization with large solar collectors systems installation, this will give the result of more than 86.000 m^2.

Hotels, hostels and holiday houses

Generally, hotels sector in Poland includes many types of facilities, from five stars hotels to camping sites. The total number of hotel facilities is equal to 7.000. In 2004 the number of hotel facilities declined nearly by 613 compared with 1995 but the number of hostels and motels increased. I1.202 hotels exist in Poland with different standards, 116 motels and 241 holiday houses. The biggest hotels facilities have nearly 71.000 rooms, and can accommodate nearly 140.000 people. Assuming that every third hotel, motel or holiday house in Poland will make installation of large scale solar heating systems this will bring more than 26.000 m^2 of new SC area.

Multy family buildings

Poland has approximately 12.8 million dwellings with a total usable area around 885 million m^2. Almost 59% of the housing units are privately owned, 27% are owned by housing co-operatives and 10% by municipalities. Total number of dwellings owned by the housing co-operatives in 2005 is equal to 3.429.000. 23.1% of buildings have been constructed before 1945, 26.9% between 1945 and 1970 and 50% between 1971 and 2002. Most of these buildings require thermo modernization, so it is good opportunity to install flat plate solar collectors. Extends of refurbishment depend on many factors such as political stimulation programs, so no forecast of solar systems installation is provided.

Churches

The Central Statistic Office estimated that there are 10.066 Church Units in Poland. Assuming that every 10th Church Units in Poland will make thermo modernization, including installation of large scale solar thermal systems this will give the result of more than 50.000 m^2 collector area.

Hotel sector

The annual number of tourists visiting the Romanian littoral has an ascendant trend. The most suitable area of Romania to install solar systems is the Black Sea Coast, where the biggest numbers of tourists are registered per year. Recently, a natural gas network for heating purposes was introduced in Constanta, the capital of the Dobrogea county, the third largest city in Romania. Starting from Constanta, some adjacent resorts will enjoy the natural gas distribution. Already part of Ogfthe Mamaia hotels is supplied with natural gas.

The natural gas is today still a cheap resource for heating needs on the Romanian market, with a fuel price of some 310 Euro/1000 m^3. The solar thermal technology can hardly compete here.

So the potential study will address only the tourist resorts where the natural gas supply will not be available in short term. This means the zone South of Eforie resort, to the Mangalia city.

Here the existing heating systems are cost-expensive and excessively polluting (oil). Solar-thermal systems are a real alternative for these hotels, located on the South of

the littoral. Currently, one can not estimate market potential in this part, due to lack of available statistical data.

Housing sector

The Romanian housing stock consists of 4.846.572 buildings (8.110.407 dwellings), from which 23.5% are located in urban area. An average (fictive) dwelling has habitable surface of about 37.5 m^2 and can accommodate 2.6 persons. As of property form, 97% of the total number of buildings is privately owned, as the consequence of retrocessions, selling of all state owned buildings and the appearance of new buildings.

The great majority of these dwellings are in old buildings, between 15 and 55 years of age, with poor insulation and great wear.

The share of buildings with one dwelling (single family house), is well above 95% of the total number of the housing stock. Block of flats represents only 1,8% from the total number of buildings but shelter 39% (2.984.577 apartments) from the total number of dwellings in Romania (1992 census).

It is estimated that until the year 2010, a potential of energy savings in buildings for heating, hot water, air-conditioned and lightning is about 22% of the present consumption. Energy efficient measures realization depends on legislative framework, which is currently in the phase of preparation.

Other sectors to be considered

Sectors with potential for solar heating systems are also health sector, sport establishments, education sector, industry, and other public buildings in Romania.

For domestic systems, 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 a temperature of 45°C. According to the type of used collectors this is achieved with a 1 to 2 m^2 of solar collector surface. When it concerns big systems like hotels, restaurants 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 taken into account; whether the system will be used all the year around (the utilization of vacuum tube collectors is recommended). The monthly savings depend on the quantity of hot water that 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 a solar contribution between 50% to 85%, a percentage that represents savings from the traditional bill. An exact market potential estimate in this sector is also impossible, due to lack of needed data.

Hotel sector

Slovakia is currently in an underdeveloped position within European tourism, but the situation is changing and there are better predictions for the future. The number of accommodation facilities is rising; therefore this is a field for RES utilization in connection with energy savings. In 2005 the number of overnight stays of foreign visitors was 4,8 millions and it is still growing. The capacity is approx. 122.000 beds. Combined heat and power generation (CHP) is, in most of the cases, designed to cover space heating and hot water consumption needs. It is also possible to use the produced heat for air-conditioning.

Hotel sector has the highest potential for installing solar collectors due to the high utilization of hot water yearly. We can estimate the reasonable annual potential to 7.000 m^2 of installed capacity.

Housing sector

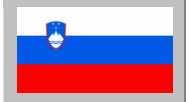
In the year 2005 one started construction of 19.796 flats, 14.863 flats were finished and 48 874 were in the process of construction. Of the whole number of the finished flats 58,6% were in one-family houses. For space heating, annual need of 100 000 TJ

is assumed. In 2005 the heat produced from solar energy was 50 TJ (increase from 37 in 2002). According to the strategy of higher utilization of RES, the goal is to produce 300 TJ of heat from solar energy in 2010.

Construction "boom" creates a potential for utilizing small and large solar systems. According to our predictions for housing sector, the reasonable target of installed solar surface is between 1200 and 1600 m^2 annually. The amount depends on whether the subsidy for collectors will be adopted or not as it is a stimulating factor.
Space heating represents the biggest share of energy consumption in households, both in flats (64% of the energy consumption) and in one-family houses (83%).
Hot water preparation is the second largest energy consumer in the household; in flats it counts for 18% of the energy consumption and in one-family houses for 8%. The hot water consumption in the housing sector is16,6 m^3 per inhabitant, which counts for 4,95 GJ. One GJ of heat costs in Slovakia between 17,6 and 20,5 €.
The data above suggests considerable possibilities for hot water preparation with solar systems.

Other sectors to be considered

Sport centers are other facilities with large solar potential due to the high water consumption for tap and pool water. The hot water consumption in sporting establishments varies between 30 and 60 l/shower/day. There are different kinds of these establishments and the potential is estimated to 4.000 m^2 of installed solar surface yearly.
Hospitals and schools are owned by state, regions or municipalities. Current economic situation of these establishments is not favorable and allows only a very limited investment with short payback periods.
In schools the potential is estimated to 3.000 m^2 of new solar surfaces annually. Because the schools enjoy holiday during the summer months, the potential can be lower if they don't rent the gym halls for public.
In Slovak Republic, the health-care service is offered in 84 hospitals and health centers, most of them are in public ownership. Additionally, there are 27 special medical institutions and highly specialized centers and 11 institutions for long-term unhealthy patients. In 2005 the number of bets in health-care area in Slovak Republic was 50.058. These numbers show potential of approx 3.000 m^2 according to our predictions.
Last to consider are public buildings and industrial objects. We don't have specific statistical data about the consumption; therefore we can only predict a potential of 7.000 m^2.



Multy–family buildings

One family houses prevail in the existing dwelling stock. Approximately 68 % (531.456 units) of dwellings are one family or one family row house and only 31 % (242.011 units) are multi-family houses. Today approximately 160 new multi-family housed are built yearly (with 3 to 50 flats). Space heating prevails in multi-family buildings energy consumption (8,5 PJ per year) meanwhile, the energy consumption for water heating is 2,1 PJ/year. The spread ownership, requirements for individual energy metering in each flat (this will cause solar thermal systems more expensive) and low cost of gas boilers with integrated tap water heater are reasons why multi-family buildings have significant barriers for solar thermal systems. Anyway approximately 1.000 m^2 of solar collectors installed per year (until 2012) in multi-family buildings seams to be a reasonable target, if subsidy schemes will be implemented for large solar thermal systems as well.

Tourism and sport facilities

Tourism is in Slovenia an important industrial branch. It contributes for 9,1 % to the

GDP and employs 52.000 people. In 2001, 4.300.000 overnight stays in hotels and 57.000 in motels were recorded. There are more than 170 hotels and motels, more than 90 mountains huts, 100 inns. Several (10 to 15, < 1000 m^2) large solar systems are already installed in hotels. Regarding to the number of overnight stays, heat consumption for tap water heating was only 1-1,2 PJ per year. If target for heat production from RES is to be fulfilled (25 %, up to 2010), 110.000 square meters of solar collector should be installed only in hotel sector (even if the period should be prolonged at least to the end of 2012). Concerning other tourism facilities, there are 40 campsites and only few of them already use solar systems for tap water heating, but recently almost half of them expressed interest for solar thermal systems. According to typical opening season in Slovenian campsites (May to end of September) and yearly profile of guests number, the solar system in camps could be efficient and economical. According to recorded overnights stays (680.000, in 2001), it can be estimated that up to 10.000 m^2 of solar collectors could be installed in total. There are 18 sport centers with indoor pool area around 12.000 m^2. If half of the pool water and tap water in these facilities will be heated with solar thermal systems, 6.000 to 10.000 m^2 will be required. 0,02 PJ of solar heat will be produced in these case. Important for the future development is that more than 80 % of the hotel sector is owned by private companies.

Hospitals, health care centers, elderly homes

Until 2005 the number of hospitals increasesd to 29. In the same year 2.545.000 hospitalization days were offered. Causing tap water heat demand of 2,5 PJ per year. If 10 to 15 % of tap hot water will be heated with solar thermal systems, one would need up to 10.000 m^2 of solar collectors. The Health care centers offer even better opportunities for solar system utilization, because they are smaller and reconstruction of building services installation will be easier. Around 100 health care centers operate in Slovenia with almost 10.000.000 visits of patients per year which result in tap water heat demand of 2,3 PJ yearly. At the moment only one large solar thermal system operates in this sector. The Slovenian population is getting older and it can be conclude that current number of 70 elderly homes will be increased in the future. Given that solar thermal systems are compatible with biomass heating, the elderly homes managers could be an important target group. Several applications already exist (Preddvor, Tezno, Šmartno pri Litiji). All together, using optimistic approach potential of the solar thermal systems is limited to less than 20.000 m^2 of solar collectors.

Biomass district heating systems

13 district heating systems using biomass operate in Slovenia, providing yearly 31 GWh of heat. More than 30 feasibility studies of such systems have been carried out with potential yearly heat production of 240 GWh. In most cases, according to the contract, they must provide heat also during the summer as well. In that time heat consumption is quite low and combining biomass district heating systems with large solar systems is perspective, but every system must be analyzed separately. If solar heating systems are supposed to provide 5 % of yearly produced heat in half of the systems, around 30.000 m^2 of solar collectors will be needed.

Public buildings

There are 197 municipalities in Slovenia. According to regional policy regulations every municipality must have primary school with gym, health care centre, post, library and administration building. A central register of public buildings in Slovenia does not exist. Some data about the number of these buildings is available: for example, there are 480 public primary schools with limited data concerning energy consumption. Nevertheless public buildings have significant potential for solar thermal systems. The GSR contract should be required in the frame of a public

tender.

Industry

There is no data about energy demand for heating of industry buildings, neither about the energy demand for process heat. Therefore we are not able to predict potential of industry solar thermal systems applications.

The authors of the national studies faced several barriers which have made prediction of large solar thermal system difficult. Among those barriers were: incomplete statistics about public and commercial buildings, no data about exact heat demand in almost all of the "target groups" for large solar thermal systems and so on.

According to the best knowledge of the authors and consultations of the national field stakeholders, the following potentials were predicted for large solar thermal systems (currently available data for Romania is not sufficient for an evaluation of large solar thermal systems market):

Potential in m^2

	BULGARIA	POLAND	ROMUNIA	SLOVAKIA	SLOVENIA
Hotel sector	13.000/a	26.000		7 000/a	110.000
State and municipal buildings	1700/a	200.000 Schools 91.500 Fire stations 50.000 Churches		3000 Schools	no data
Multi family buildings	20 000 to 30 000/a			1200 -1600/a	1.000
Camps					10.000
Sport centers				4000/a	6.000 to 10.000
Hospitals		10.000		3000/a	10.000
Health care centers					no data
Biomass district heating					30.000 – 50.000
Industry				7000 (public + industry)	
Total potential in m^2		**~380 000**			**~180.000**
Predicted potential in m^2 per year	**34 000 to 44 000**			**~25.000**	

3.5. Possible scenarios of large solar thermal systems market development

Pessimistic scenario

Pessimistic scenario is developed according to the high investments for the equipments needed for solar thermal installations. This determines the demand of non-selective type collectors, much cheaper but more imperfect. The fact that Bulgaria still lacks from sufficient technical information to lead the consumer toward the particular technologies and solutions has to be taken into account. The market is still in its youth and the competition between solar companies is not significant. There is no interest from the state for mass implementation of solar thermal collectors in state owned buildings or municipal buildings.

Optimistic scenario

Following the scenario for Europe, but with lower rate of increase. It is assumed a future development of the technology market, which will reflect on the price of investments and shorten their pay – back periods. To this might be added an eventual interest from the government concurring with the Energy strategy of Bulgaria, and programs for mass implementation of solar thermal systems for DHW in state and municipal owned buildings as well as measures for their refurbishments to be adopted. On average evaluation the quantity of solar energy from solar collectors in 2010 is to be 137 GWh (11.8 ktoe) and for 2015 – 239 GWh (20.6 ktoe).

Market growth in Poland is very optimistic, because it foresees that approximately every 10th building in each treated sector the will install large solar heating system. The highest potential is in the public sector, but this potential will be realized only if appropriate political measures will take place to support firstly renewal of large share of these buildings, and secondly exploitation of solar energy.

Pessimistic scenario

Without subsidies and incentives, the implementation of solar thermal systems will depend only on energy prices and economic growth. The vast majority of the solar collectors will remain small scale systems for the future to come, thus the payback period will go beyond 12-15 years.

Optimistic scenario

The optimistic scenario will follow the trend imposed by the European Union, but with lower rate of increase. It is predicted that if the price of natural gas and other classical sources of energy will increase drastically, then the solar power will face a bright future.

Slovakia has a relatively modest market development scenario. As in Poland, the biggest share of future systems will be on public buildings. In public sector, 7.000 square meters of solar collectors installed per year are foreseen in hotels. Large shares, together 7.000 m^2 a year are predicted together in sport centers and medical facilities.

Pessimistic scenario

Lack of money for National Program for Higher Utilization of Solar Energy and Biomass in Households (for period 2007 – 2015 with total budged approx. 23,5 mil. € i. e. average 2,2 mil.€/year) focused on individual dwellings and housing sector which is to be approved by the end of this year.

Low interest for proper using of Structural Funds (programming period 2007-2013) from programs which contains measures concerning utilization of RES because of huge bureaucracy. Without subsidies and incentives, the implementation of solar thermal systems will depend only on energy prices and economic growth.

Realistic scenario

National Program for Higher Utilization of Solar Energy and Biomass in Households will dispose of financial resources but only at limited amount.
There will be sufficient interest in energy projects submitted under Structural Funds Programs but most of them will not be accepted because of low quality of projects or violation of Structural Funds rules.

Optimistic scenario

National Program for Higher Utilization of Solar Energy and Biomass in Households will dispose of financial resources at full amount during the whole period.
Most of Energy projects focused on utilization of solar energy submitted under Structural Funds Programs will be successful.
According National Strategy for higher RES utilization there is the goal for heat production from solar energy 300 TJ in the year 2010 and – 1000 TJ in the year 2015 To achieve the goal 300 TJ in 2010, 25 000 m^2 must be installed during years 2007 -2010. i. e. in 4 years 100 000 m^2 will be installed which corresponds to 200 TJ.

Pessimistic scenario

Without subsidies and incentives, the implementation of solar thermal systems will depend only on energy prices and economic growth. Most certainly market will remain at the level of 10.000 m^2 of solar collectors installed per year. From which only minority will be installed in large solar thermal systems. The pay back period in this case will be more than 15 years.

Realistic scenario

Subsidies will be applied for small and large solar thermal systems as well as for solar cooling systems. Subsidey scheme are established for five years in advance and available for private enterprises, public institutions and individuals. It is expected, that these incentives result in installations of 50.000 m^2 at the end of a first 3 year period, from which 10 to 15 % in large solar thermal systems. At the end of the first period the scheme of subsides should be analyzed and revised. The amount of subsidies should insure pay-back period less then 10 years. Beside subsidies, limited number of pilot projects should be supported.

Optimistic scenario

In the case of very successful awareness raising campaigns, quick development of national solar industry, moderate increasing of energy price, high economic growth, well developed research community and extend long term subsidy schemes, the half of estimated potential of large solar thermal systems will be realized - 100.000 m^2 of solar collectors will be installed until 2012.

4. GSR

4.1. Background for GSR

The GSR contract has not been applied in Bulgaria until now. The GSR is a quality approach and is a complementary and powerful tool for disseminating and promoting high quality solar thermal systems. The application of GSR contracts in practice, however, will be a difficult and long process. The consumer, i.e. the end-user, should ask for GSR. In order to define GSR, it is necessary that the end-user defines the quantities of DHW, which will be needed and the respective temperature. Also it should be defined what percentage of DHW will be heated by the solar collectors, in order for the solar thermal system to have highest efficiency and to be economically most profitable. At present in Bulgaria there is no monitoring of the quantities of DHW and defining them precisely is a precondition for defining GSR. Regular information to the stakeholders and the end-users will be very important for a large implementation of the GSR method.

The GSR approach is an indispensable tool for enlarging the solar thermal market in Poland. The benefit of GSR will be, above all, the increased quality of the installed medium and large solar thermal systems. GSR contract will lead to mandatory CO_2 reduction, the quality on installed devices and material will improve as consequence of the contract obligations. It is known that GSR contract requires good engineering services and good maintenance and that GSR approach can ensure that pilot project will really be the best case practice which impress decision makers and investors. When having in mind the constant increase in the costs for heat energy and electricity, as well as the forecast for decrease in the cost of solar collectors, it is expected that the payback period of a medium and large solar thermal installation will decrease. The longer payback period (at the moment it is at least 10 years in case of no subsidy) will be accepted by investors, because they have guaranty for good and on time maintenance of thermal solar systems

The GSR concept has not been present in the Romanian market. The GSR is a complementary and powerful tool for disseminating and promoting high quality solar thermal systems. The GSR method looks in principle simple to implement and easy to understand but in common practice can arise several problems. It is up to both contractual parties to sign GSR contact, which must follow national law. The main issue will be extra costs for monitoring system and supplier's willingness to maintain the collective solar system for at least three years. It is assumed that reliable suppliers would welcome GSR concept with the expectation that solar systems of low quality will have to leave the market. The application of GSR contracts in the practice will be a difficult and long process. Regular promotion and good practices dissemination targeted to all stakeholders especially decision-makers will be very important.

The GSR method looks in principle simple to implement and easy to understand but in common practice can arise several problems. It is up to both contractual parties to sign GSR contact, which must follow national law. The main issue will be extra cost for monitoring system and supplier's willingness to maintain the collective solar system for more than three years. First testing of such contract will contribute to indicate the future potential of such concept. It is assumed that reliable suppliers would welcome GSR concept with expectation that solar systems of low quality will have to leave the market. I any case, implementation

of GSR will be a slow process. Regular promotion and good practices dissemination targeted to all stakeholders especially decision-makers will be very important. Good results of GSR concept could persuade both reliable suppliers and decision-makers to support incentives to solar thermal projects with GSR approach. Generally speaking, the GSR concept is in accordance with all strategic documents and helps to solve some of the problems the solar energy is facing in Slovakia. Among the most visible are the low awareness of population and the fear of low solar collector operational level. Beside the financial incentives these are known handicaps. Together with the subsidies starting in the year 2008 the GSR concept will help to raise the construction of collectors using solar energy for hot water needs.

Considering the previous recommendations, the EAST-GSR quality approach is a complementary and powerful tool for disseminating and promoting best practice know-how in an emergent solar thermal market. As a mater of fact, guaranteeing production of DHW to the end-user implies that the system is correctly sized and designed. Besides that, monitoring of the systems performance enable installer or supplier to deal with concrete data which demonstrates the reliability of the technology and the reality of the announced payback time. Nowadays, all relevant meteorological data is available for Slovenia. Major problem for the contractors will be determining heat demand as there are no monitored values about hot tap water demand, and that only data stating international standards are used in phase of planning. The planning process should be improved in such way, that "standardized" hydraulics schemes should be prepared. Most of all, simple hydraulics schemes are to be preferred. Solar market at this moment depends only on three domestic suppliers (56 % market share), a well organized "do-it.yourself" group (24 % market share) and several importers. In last years the share of do-it-yourself group has decreased, and one could expect, that it shall become even lower with the expansion of the solar market. In this case, national solar industry must prepare itself on this growth development of high technology (like selective SC) and durable products. The almost complete lack of operating experience of large solar heating systems needs to be improved and EAST-GSR project, as well as the GSR method itself, is a great opportunity.

4.2. Institutional, technical and financial requirements for a wide dissemination of the GSR concept

Regarding institutional requirements, the most important for further development of solar thermal market and GSR concept will be financial support and regulation framework. This should include creation of local and regional authorities to be responsible for RES development, including solar thermal systems, establishment of an association for solar thermal systems; creation of conditions for increasing and guarantee of quality both of solar thermal systems and of respective technical services (design, construction and maintenance) including creation of a laboratory for testing and certification of solar collectors and information campaigns.

To achieve success in the field of solar thermal it is necessary for the government institutions to treat thermal energy as substitute for electricity or the energy from natural gas or liquid fuels. This means that the preferential treatment and financial incentives of the different types of energy should be on equal level. At present in Bulgaria there is an "Energy Efficiency Fund" but there is no financial support for renewable energy resources. It is recommended that such a fund is established. In its new application it can be based on the GSR concept for large solar thermal systems.

When applying the Energy Efficiency Law for refurbishment and increasing the energy efficiency of state and municipal buildings with constructed area of more than 1000 m^2 it is recommended to consider the construction of solar thermal systems for DHW. The GSR will be part of the overall increase of energy efficiency of public buildings.

Currently, systems utilizing renewable energy sources are often not economically viable in Poland. Financial mechanisms addressed directly to the independent producers of energy from renewable sources are insufficient.

The RES development was not initially defined as a separate task of the system. The awareness of the RES role in the realization of the sustainable energy policy has been systematically increased in Poland during the last decade. The strategic objective is the increase of the share of energy from renewable sources in Poland's primary energy balance to 7,5% in 2010 and to 14% in 2020.

For many years utilization of solar energy in active systems was rather unknown. Solar active systems are used mostly for Domestic Hot Water systems in single family houses. There are now also many examples of bigger systems (with area of solar collectors above 50 m^2), that are installed in schools, public buildings and multifamily apartment buildings, hospitals, sanatoriums. In Poland there are 9 manufacturers of flat plate solar collectors and 4 manufacturers of vacuum-tube collectors. The GSR concept and activities in the frame of EAST-GSR project can help in overcoming barriers for a wider solar energy use in Poland.

Regarding institutional requirements, the most important for further development of solar thermal market and GSR concept will be financial support and regulation framework. The regulation framework should include creation of local and regional authorities to be responsible for RES development, including solar thermal systems, establishment of an association for solar thermal systems; creation of conditions for increasing and guarantee of quality both of solar thermal systems and of respective technical services (design, construction and maintenance) including creation of a laboratory for testing and certification of solar collectors and information campaigns.

There is no special Ministry of Energy in Slovakia, the energy sector is covered by the Ministry of Economy of the Slovak Republic namely by its Production & Network Industries Section. Ministry of Environment of the Slovak Republic covers environmental aspects of the energy sources in its several sections. Regulatory Office for Network Industries is the regulatory and control body for electricity, gas, heat delivery and water delivery, including the hot water delivery if it is the object of trading. It approves the prices for heat individually for each heat supplier; therefore there is no unified price in Slovakia.

For the future development of solar thermal market and GSR approach Sectoral Operational Programme Industry and Services (SOP IS) Measure 1.4 – "The Support of Energy Efficiency and the Utilization of Renewable Energy Resources" will be important. This program was prepared under Structural funds. Beneficiaries are SMEs, associations of natural and legal persons under 1.000 employees and organizations of state or public administration with business activities where legal persons' share is at least 51 %. The program is aimed at energy savings, modernization of heat and power plants, use of RES etc. There are many opportunities for the improvement of the solar thermal systems utilization in Slovakia - stricter implementation of the directive on the energy performance of buildings; energy audits of the public buildings; to raise the awareness of top and intermediate managements exploiting the relevant buildings, so as to consider solar installations or their improvement.
Another program supporting RES operated under Structural funds is Basic Infrastructure, particularly measure 2.2 Air protection e. g. by using RES. Beneficiaries are public and state-owned organizations where private legal persons share is not higher than 49 %.

At the moment energy issues are divided among several ministries - Ministry of environment and spatial planning, Ministry of the economy and Ministry of finance. To achieve successful solar thermal energy policy, an institution which would coordinate energy related activities should be established. This will also reduce the time necessary for procedures such as subsidies granting etc. If scenarios that predict enlargement of large solar thermal system wish to be realized, then some obligations about feasibility studies and implementation of these systems should be introduced. New national regulations in harmony with EPBD and especially long time expected RES-Heat directive are two of the possibilities. Equally important could be local community's initiatives that currently don't have any requirements. Such energy regulation framework should include and promote the GSR concept.
Successful implementation of GSR concept will rely, among others, on high quality solar systems components, planning procedures and regular solar systems maintenance. According to the findings about knowledge transfer workshops organized in the frame of this project, the technical barriers will be much easier to remove than the lack of awareness about environmental issues.

Large investors expect pay back time as low as 7 to 10 years. Despite the fact that energy price is lower (15-20 %) comparing to more economically developed EU countries, and that it could be expected that this difference will disappear, this will not be enough to persuade investors. Same goes for soft loans, which are currently the only available support for investors in large solar thermal systems. According to the experience soft loans are not very attractive for investors as subsidies. Tax relief introduction should be considered as well, but this is a less realistic measure. If optimistic scenario is realized and proposed subsidy schemes will be realized, 10 to 15 million € will be needed for subsidies. If 15 years of operation of solar thermal

systems is taken in to account, price of CO_2 emissions reduction financed from national budget will be 25 € per ton. GSR concept will support solar thermal market development, but without active energy policy, itself will not be sufficient despite its large awareness potential.

4.3. The benefits of the GSR approach

The benefit of GSR will be above all the increased quality of the installed big solar thermal systems and the increased confidence of the client in the payback period of the investments made.

- The guaranteed system operation and quality leads to acceptance of a longer payback period. The acceptable payback period for this type of investments (energy efficiency, RES) is about 5 years.
- Having in mind the constant increase in the costs for heat energy and electricity, as well as the forecast for decrease in the cost of solar collectors (due to the increase in industrial manufacturing) it is expected that the payback period of a big solar thermal installation will decrease to 3-4 years.
- GSR contract can lead to mandatory CO_2 reduction. The summarized estimates show that 100m^2 solar collectors save 10 tones of fuel and around 20 tones of CO_2 emissions each year.
- GSR contract requires good engineering services and good maintenance.
- GSR application will inevitably lead to wide acceptance of quality large solar collector systems.
- GSR contract is a prerequisite for obtaining a favorable bank loan.
- GSR contract is a basis for ESCO implementation.

The GSR approach is an indispensable tool for enlarging the solar thermal market. This hypothesis is based on the following statements:

- The heat delivered by solar systems, in most cases in Poland, is not being monitored or calculated; the GSR can contribute to the knowledge about real efficiency of the large solar thermal systems.
- The public tenders must include some quality guaranty and GSR approach offers such measures.
- The longer payback period (in case of no subsidy, because EcoFund will exist to the end of 2010) will be accepted by investors, because they have guaranty for good and on time maintenance of the solar thermal systems.
- The planning and installing procedures will improve as consequence of contract obligations.
- The quality on installed devices and materials will improve as consequence of the contract obligations.
- GSR approach can ensure that pilot project will really be the best-case practices which encourage decision makers and investors.

The benefit of GSR will be above all the increased quality of the installed big solar thermal systems and the increased confidence of the client in the payback period of the investments made.

- Having in mind the constant increase in the costs for heat energy and electricity, as well as the forecast for decrease in the cost of solar collectors (due to the increase in industrial manufacturing) it is expected that the payback period of a big solar thermal installation will decrease;
- GSR contract requires good engineering services and good maintenance;
- GSR contract must be obligatory for large solar thermal applications to ensure that solar thermal system will operate efficiently for long time and contributes to the significant reduction of CO2 emissions;
- Under the GSR contract the longer pay-back period of the solar system installation will be more easily accepted by the investors;

- It will be easier for the end-user to access bank loans, having in mind that the GSR is a guarantee approach.
- GSR contract is a basis for ESCO implementation which are at their beginnings in Romania.

The GSR approach could have a positive impact on the solar thermal market in the Slovak Republic if the following steps are assured in parallel to the introduction of a GSR approach:

- GSR contract must be obligatory for large solar thermal applications to ensure a solar thermal system will operate efficiently for long time and contributes to the significant reduction of CO_2 emissions.
- More strict measures concerning the solar systems quality and approval procedure of both domestic and imported solar systems must be assured.
- Producers and installers have to understand that GSR concept will bring higher trust in solar thermal systems which can result in the activation of the solar thermal systems market and that the additional costs for monitoring system will not be so significant.
- The designers of solar thermal systems should abandon easy approaches, based only on client requirements or suppliers´ suggestion and start using validated dimensioning and calculation methods.
- Under the GSR contract the longer pay-back period of the solar system installation will be more easily accepted by investors.
- Another major factor for the successful implementation of the GSR contract is the existence of certified measurement instruments for solar radiation, weather conditions (temperature, etc) and flow rate.

The GSR approach is an indispensable tool (in the long-term) for enlarging the solar thermal market and especially implement large solar thermal systems. Most important reasons are:

- The heat delivered by solar systems is in most cases in Slovenia calculated without scientific methods using very simple approach,. The GSR concept, which offers the tools and methods for large solar systems planning, will improve knowledge about true efficiency of the large solar thermal systems.
- The public tenders must include some type of quality guaranty and GSR approach offers these measures in simple and understandable way.
- The longer payback period will be easily accepted by investors, because they have guaranty for good and on time maintenance of the solar thermal heating systems possessing GSR contract.
- The planning and installing procedures will improve as consequence of scientific methods included in EAST-GSR deliverables and due to the GSR contract obligations.
- The quality on installed devices and materials will improve as consequence of the GSR contract obligations and possible penalty.
- GSR approach can ensure that pilot projects, which are very important for Slovenia according to current experiences with large solar thermal systems operation, will really be the best-case practice which will impress decision makers and investors.

Five national market studies show several advantages of GSR approach implementation in partner countries. On the other hand it was found out that several barriers should be eliminated before the GSR approach can play important role in solar thermal market . its role has to be appreciated on the long-term. Despite this and despite differences in national RES policy as well as national solar

thermal markets, common conclusions can be drawn for all countries:

- The GSR approach can contribute to public awareness about RES in general and their positive impact on environment protection.
- EAST-GSR project results can be used for developing new or redefined national implementations strategies for large solar thermal systems.
- The GSR approach could help to convince decision makers on national level to realize that subsides for (large) solar thermal systems can be justified.
- Certification bodies for solar thermal system components and systems quality insurance should be established.
- Nowadays, the heat delivered by solar thermal systems is, in most cases, calculated without scientific methods. The GSR approach will contribute to the quality of planning process and offer to the investors more precise data about solar thermal systems performance.
- GSR approach can ensure that pilot projects will really be the best-case practices which will impress decision makers and investors.
- Using the GSR approach the investors have a tool to commit suppliers and installers to build high quality systems by including GSR contract in to the public tenders.
- More efficient and reliable solar thermal systems with GSR contract will have shorter pay back period and will therefore be more attractive for investors.
- The GSR approach will force suppliers to offer only high quality certificated products and installers to educate themselves in the field of solar thermal systems installation and maintenance.
- The GSR approach will significantly contribute to the elimination of the large solar systems durability problems, which are typical for all of analyzed countries.
- Research community and national industry will benefit of the market requirements for quality solar thermal systems.

Regarding to this, short and precise conclusion can be drawn: at current market status of large solar thermal systems in all of partner countries, expectance and recognition of the GSR approach will be crucial and indispensable for future development of large solar thermal systems and their penetration on the markets. On the other hand common conclusion is that GSR approach can't replace state subsidies and will act mainly as promotion tool in the first phase of solar thermal market development.