Second International Postgraduate Student Workshop
Analytica, Think-Tank and Faculty of Electrical Engineering and Information Technologies
Skopje, Republic of Macedonia

Implementing Energy Efficiency through Renewable Energy Solutions - are Southeast European Countries on track?

- Positive examples, barriers to overcome, proposed measures and policies -

11th and 12th of June 2010
Organized by: Analytica, the Center for Low-Cost Solar Cell Technologies, Faculty of Electrical Engineering and Information Technologies

Possibilities for Exploiting Solar Energy in Macedonia

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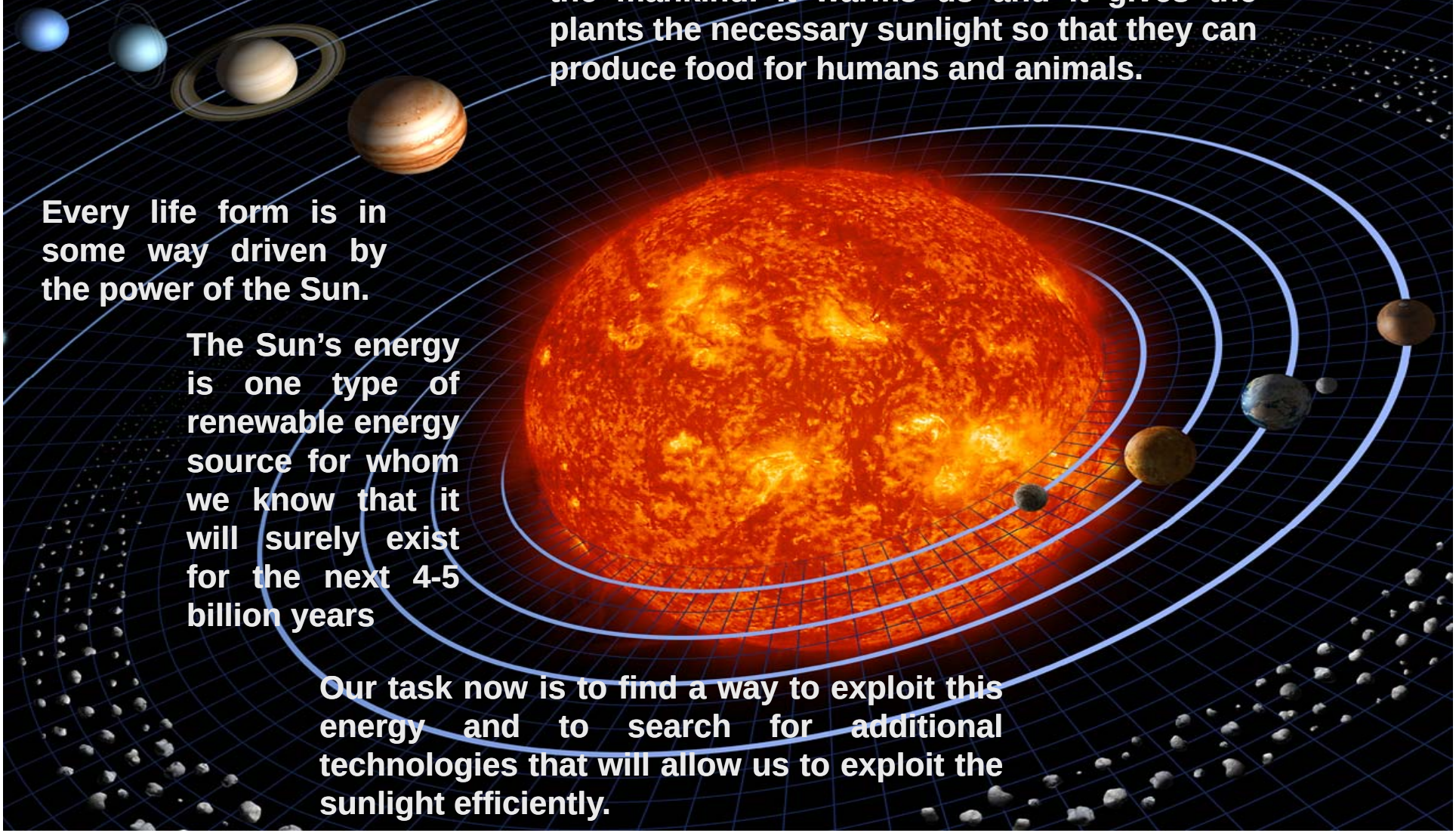
1.Introduction

The Sun is a real blessing for the Earth and the mankind. It warms us and it gives the plants the necessary sunlight so that they can produce food for humans and animals.

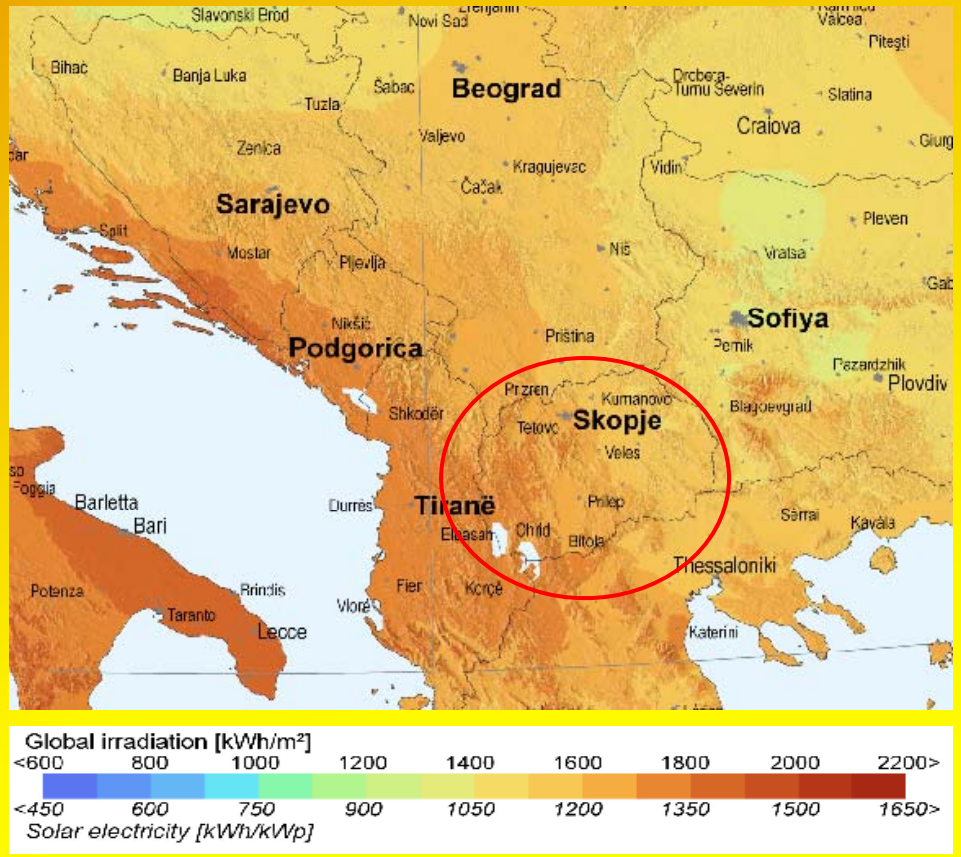


Every life form is in some way driven by the power of the Sun.

The Sun's energy is one type of renewable energy source for whom we know that it will surely exist for the next 4-5 billion years

Our task now is to find a way to exploit this energy and to search for additional technologies that will allow us to exploit the sunlight efficiently.

Where is Macedonia on the solar map?



Macedonia is located on the Balkan Peninsula, in southeast Europe, northern hemisphere. As it is shown on the map here, Macedonia has a very good incident solar radiation (insulation) between 1600 and 1800 kWh/m^2 and excellent geoposition for exploiting solar energy for both photovoltaic and solar thermal systems. As one of the sunniest countries in the region Macedonia has annual solar energy value of 10 GWh.

It is estimated that Macedonia has 2000-2400 sunny hours during the year and this generation potential can satisfy at least 75-80 percent of the annual needs for heating and for hot water. But for now numbers are disappointing:

- In Macedonia there are only 7.5 m^2 solar panels on every 1000 people, or 15000 m^2 installed solar panels.
- At the end of 2006 the total collector area in operation in Macedonia was 17,118m^2.
- From 500 000 households only 2500 – 3000 are using solar systems for water heating. This represents only 0.5 % of the total market for solar panels .

By 2010 this numbers are slightly increased.

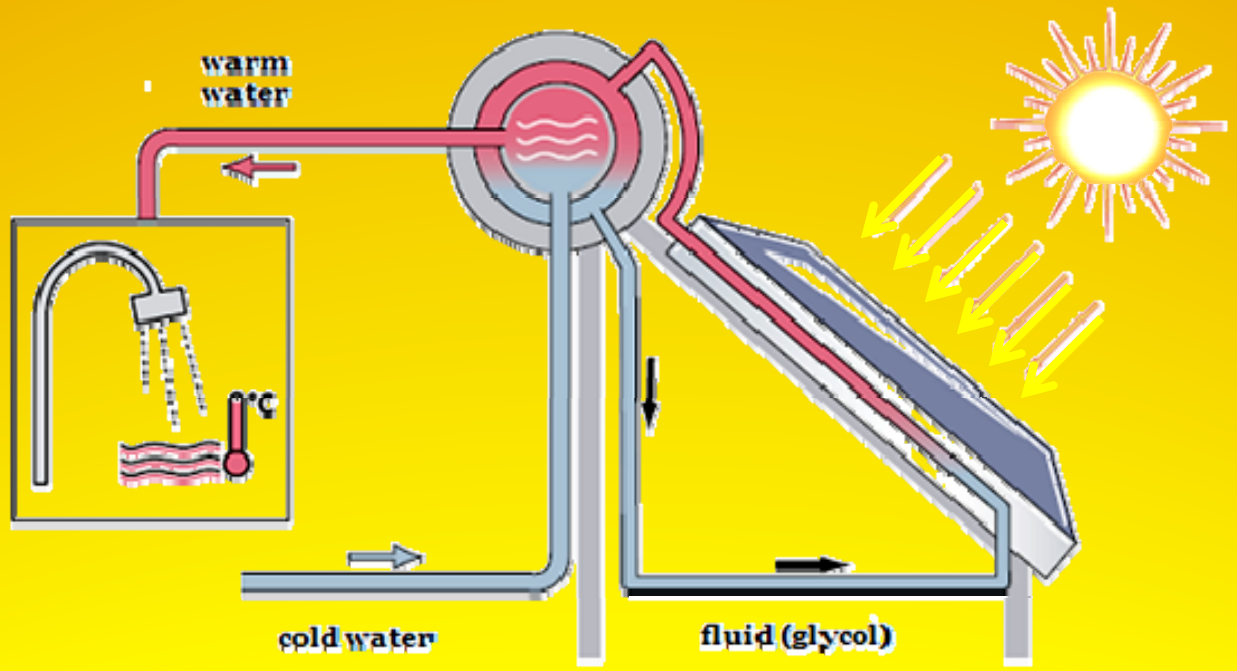
2. Solar water heating systems

- The most economic way for exploiting solar energy.
- Easy to install and use.
- Investment is returned for couple of years.

The idea of SWHS is to use some heat-conducting material with flat surface that can extract the heat of sunlight and efficiently transfer it to the system of pipes with some heat-transferring fluid.

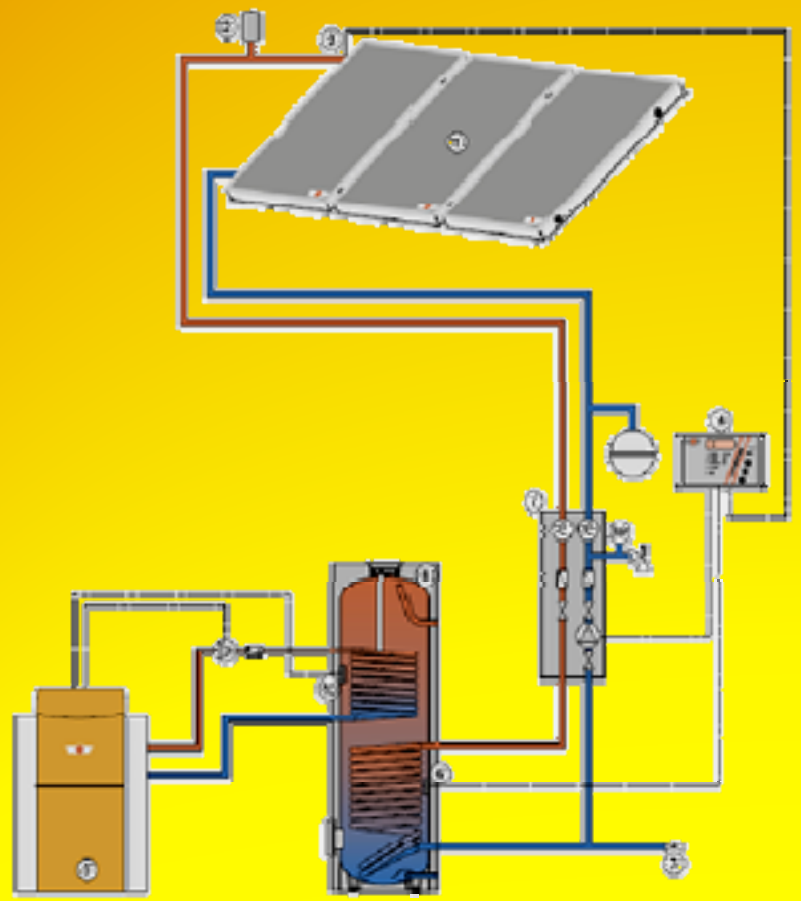
Passive and **active** systems.

2.1 Passive systems



Passive systems are cheaper and with less constructive issues. They use earth gravity in so called **siphon effect** when cold and warm fluid has different density (relative mass) and then the warm fluid with less density is rising up and the cold fluid with more density is falling down because of the gravity forces.

2.1 Active systems



Active systems are more expensive because, unlike the passive systems, they include additional control elements like pump, electronic control unit, sensors etc., but these systems are often used in areas where in winter air temperature drops below 0^0C, like Macedonia.

2.2 Practical example

city	Kochani		Skopje		Bitola	
	KWh/m2	KWh/m2	KWh/m2	KWh/m2	KWh/m2	KWh/m2
month	per day	per month	per day	per month	per day	per month
January	0.64	19.9	0.57	17.67	0.66	20.46
February	1.52	42.5	1.2	33.6	1.3	36.4
March	2.26	70.2	2.03	62.93	2.2	68.2
April	2.96	88.75	2.56	78.8	2.83	84.9
May	3.23	100.2	3.24	100.44	3.01	93.31
June	3.55	106.5	3.08	92.4	3.58	107.4
July	3.8	117.7	4.03	124.82	3.92	121.52
August	4.55	141	4.87	150.97	4.62	143.22
September	3.12	93.75	3.57	107.1	3.6	108
October	2.4	72.45	2.18	66.96	2.45	75.95
November	1.28	39.7	1.08	32.4	1.5	45
December	0.67	20.7	0.61	18.91	0.71	22
annualy		912.2		885		926.36

For objective and accurate presentation here is shown table with average daily and monthly amount of solar energy for 12 months in the year for three cities- Kochani, Skopje and Bitola. Analysis is performed with flat panel thermal collectors with one pyral and 1,5 l of fluid. It is important to remark that today's last generation collectors has 12 pipes with 4,5 l of fluid. With this upgrades today's solar collectors are more efficient by 20 %.

Every m^2 of solar collectors we can expect 1000 to 1100 KWh energy saving annually. One average solar collector with dimensions 195x95x10 cm can save up to 2000 KWh energy. If you have 3 collectors on your roof the math is simple:

• 3 collectors with dimensions 195x95x10 cm with 2000 KWh annually savings each equal to 6000 KWh.

• Momentary commercial price of energy for households in Macedonia is around 2, 45 denars. That means annual saving of energy costs of around 14 700 denars or 240 €.

• One complete solar water heating system with 5-6 m^2 heating surface is cost 1000-1300 €. This means that your investment will surely be returned in about 5-6 years. After that you have pure profit because an average lifetime of quality solar water heating systems is about 25-30 years.

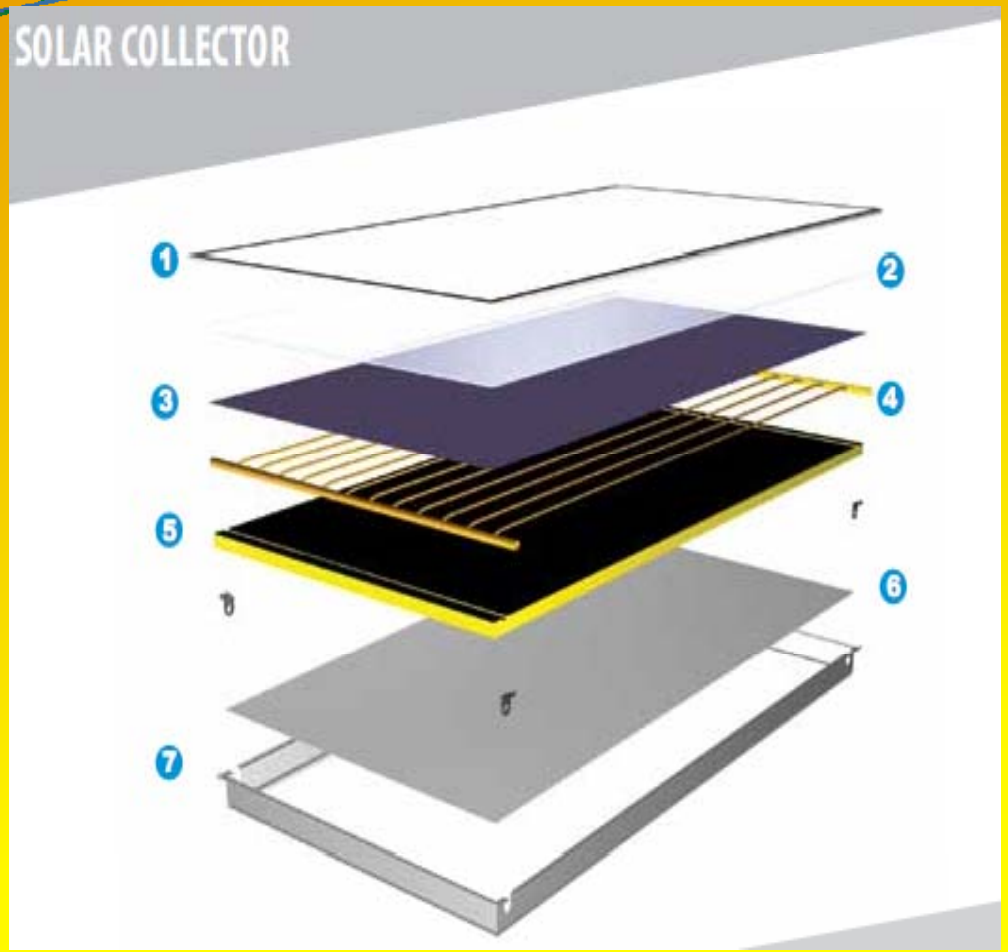
2.3 Solar collector’s production in Macedonia

There are dozens of companies in the solar energy business in Macedonia that offer complete solutions for solar water heating systems such as:

- Ekosolar doo
- Ekokonsalting dooel
- Sofkin ltd
- Eterna Solar
- Fonko
- Euroterm etc.

One of the leading factors in solar energy businesses in Macedonia and in the region is the “Euroterm” company located in the “Biljana” industrial zone in Prilep. Euroterm has its own production line of solar collectors for SWHS. The production is fully automated with machines-product from another Macedonian company- “Mikrosam” also located in Prilep. Euroterm is producing selective collectors with highest commercially accessible efficiency for residential types of applications. These types of collectors release up to 50 % more power by m^2 than conventional collectors. The materials that are used are reliable and tested:

- Tempered glass.
- Selective foil.
- Embossed back side metal sheet.
- Strong aluminum profile, enabling reliable functioning.
- The company has implemented quality standards such as ISO 9001 and SOLAR KEYMARK E DIN.



1. Aluminum batten
2. Solar glass
3. Flat absorber
4. Copper pipes frame
5. Insulation
6. Rear side
7. Collector body

PRODUCTION

2.4 Current situation

Although Macedonia has a great potential for exploiting solar energy the fact is that it‘s not completely used:

- 2 years of Government subsidies of 30% of investment for SWHS for households, but not more than 300 €. This action was stopped for this year. ☹
- There are still difficulties in the field of law like various licenses and permits.
- Landowner issues.
- Feed-in tariffs have decreasing tendency.

However, Macedonia is a developing country and EU-candidate and its abundance of sun is a real magnet for solar energy investors, domestic and foreign. The solar energy technology in Macedonia is yet to come. ☺

3. Photovoltaic systems

In this part of solar energy technology Macedonia, unfortunately, is far beyond developed countries like Germany, USA, Japan, etc. Technology for research and producing of solar cells is very expensive and still is a privilege of the wealthy countries. Macedonia as a developing country with great solar energy potential in near future has a task to attract some of the countries mentioned above to come here and invest in some research or producing facility.

For now the use of photovoltaic panels for producing electricity directly from sunlight is limited only for small stand-alone applications like park chandeliers, traffic lights etc. The great example for this is a small stand-alone photovoltaic system with 18 panels located near the faculty of Technology and Metallurgy in Karpos municipality in Skopje. It is used to power the near crossroads traffic lights:

For now the one and only grid-connected photovoltaic system in the country is a small plant with 10 KW installed power located in village of Kadino, municipality Ilinden near Skopje. This plant is a private investment by the company Sieto from Skopje. The photovoltaic plant is on a parcel that contains additionally one wind turbine and a so-called “eco house”. It is built with latest construction technologies and materials as well as with a solar water heating system on the roof. This project was realized with no help from relevant institutions in the country and it is a full private project. The aim of the Sieto chairman was to show to the public in the country and in the region that Macedonia has a great renewable energy potential and it must be used for the benefit of all.

Here are some photos of the site that I had opportunity to visit myself:

4. Conclusion

- Macedonia has full potential for exploiting solar energy.

- Macedonian companies have a great expertise, human and technology resources for enhance better energy efficiency and large use of free solar energy either for hot water for households, industrial heating or auxiliary water heating for central heating systems.

- Extra help is needed also from the Government, commercial banks with favourable credits and of course, foreign investors.

Thank you for your attention