Solar energy workshops for technical students

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Abstract. *This article describes the activities of European Solar Days 2009 at IES Escolas Proval in Nigran (Spain). Several workshops related to solar energy and its applications were carried out during this celebration, including simple solar cookers construction and use, small solar-powered toys, solar electronic power supplies and applications, experimental parabolic cookers and exhibitions of electric vehicles.*

Keywords. Solar Energy, Workshop, Electronics.

1. Introduction

The first 'Tag der Sonne' or 'Solar Day' was celebrated in Austria in 2002. The idea was then taken up by Switzerland and Germany and spread to other countries leading to the celebration of the first European Solar Days in May 2008, with the participation of countries like Slovenia, Belgium, Italy, France, Norway, Portugal and Spain. More than 4000 different events were staged in these European countries. The second edition took place on 15-22 May 2009.

In Spain it is organized by ASIT (Asociación Solar de la Industria Térmica), and contact and inscription can be made by its web page: http://www.diasolar.es

Figure 1. Solar Days spanish brochure

This initiative tries to promote the use and knowledge of solar thermal, thermoelectric and photovoltaic energy throughout Europe. A wide variety of organizers are invited to join the initiative, like schools, research institutions, enterprises, cities and energy agencies.

Fig. 1 shows the spanish brochure of European Solar Days and one of the toys made in our workshops.

2. European Solar Days in Nigran

As part of European Solar Days 2009 activities in Spain, IES Escolas Proval of Nigran (Pontevedra) has programmed its First Solar Week from may 18 to 22. During this five days several activities and workshops have been carried out, like construction and use of solar cookers, design and construction of small toys powered by a small photovoltaic cell, solar home powering, electric vehicles and exhibitions of different solar devices and applications.

The detailed program of activities can be found at:

http://centros.edu.xunta.es/iesescolasproval/enerxias/diasolar.html

These activities have been organized by teachers from the Departments of Electronics, Technology and Design with the collaboration of the local company NORBIKE SL that furnished electric vehicles and its experience.

Fig. 2 shows some of the materials employed during the activities, like a parabolic cooker and photovoltaic electrification kits.

Figure 2. Some of the materials used during the Solar Week

3. First Day: Solar cookers workshop

The first day of activities was dedicated to solar cookers construction and testing. Among the wide variety of models existing we decided to make the Fun-Panel cooker. This cooker has a very simple design and construction and can be made with cheap and recycled materials. This model has been adapted by Dr. Celestino Ruivo (Univ. Algarve) to achieve a better performance in colder climates like portuguese and spanish.

The first part of the workshop was a theoretical presentation (Fig. 3) about solar cookers and how they can help stop climate change and prepare food in many situations, like refugee camps and natural disasters. It covered also a brief explanation about the technical properties of solar cookers like low temperature solar collectors, different types of solar cookers, design and construction, materials and how to use them in different countries and cultures.

Figure 3. Presentation about solar cookers

The second part of the workshop was the construction of fun-panel cookers by students.

The third part of the workshop was an exhibition and demonstration of use of the cookers in which it was planned to cook different meals. Unfortunately sunlight was not present at that time so this activity could not be made.

Fig. 4 to 8 show different stages of the construction proccess, like measuring and marking of polypropylene panels (Fig. 4), cutting and folding to get the proper shape (Fig. 5), application of glue and reflective sheet (Fig. 6) and final assembly of the whole cooker (Fig. 7).

Figure 4. Measuring and marking of panels

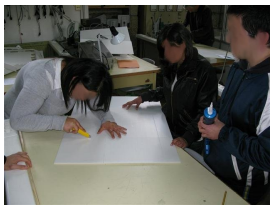

Figure 5. Folding and cutting of panels

Figure 6. Application of reflective sheet

Figure 7. Final assembly

Fig. 8 shows the exhibition of fun-panel cookers made in the workshop.

Figure 8. Solar cookers exhibition

4. Second Day: Solar toys workshop

The second day of activities was dedicated to design, construction and testing of small photovoltaic toys, which we called 'fotosaltóns'. Fig.9 shows some of the basic prototypes and a commercial type (on the right).

Each student received a small photovoltaic cell and a micromotor with eccentric, of the same type that are widely used in cellular phones. Both elements can be seen in figure 10.

Students received also an instructions manual

with a basic design to help them starting with their own creations. Older students with electronics knowledge served as monitors to younger children.

Students had to design and build the body of the toy with materials of their choice, like cork, wood, carton, plastic, etc. Cells and motors were then glued and soldered to the body. When exposed to sunlight the toy would move and jump if properly designed, if not it remained quiet.

Fig. 11 and 12 show materials employed in the workshop, students making their own toys and assembling and testing of toys.

Fig. 13 shows several examples of toys made by students jumping and crashing together.

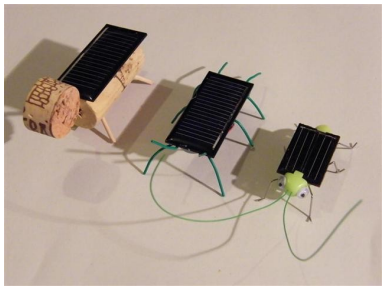

Figure 9. Some examples of solar toys

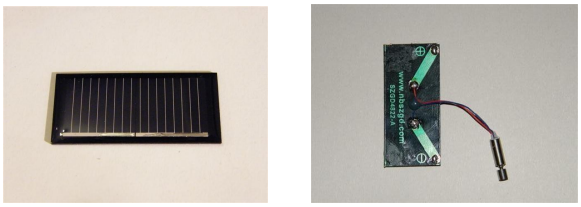

Figure 10. Miniature solar cell and vibrating micromotor

Figure 11. Materials and students at work

Figure 12. Assembling and testing

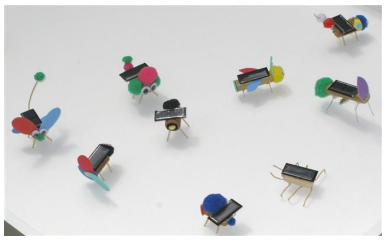

Figure 13. crash test

5. Third Day: Solar powering workshop

The third day there was a solar electronics workshop for technical students. The first part was a presentation about solar cells and panels, electronic devices for charging and regulation of batteries and applications.

The second part of the workshop was the assembling of different solar devices and kits, like:

- self made battery charger and regulators with switched regulator LT1074-LM2576.
- High power led devices (LUXEON) used for high efficiency lighting (Fig. 14).
- Solar lighting kit with 12V battery and 12V low consumption bulb.

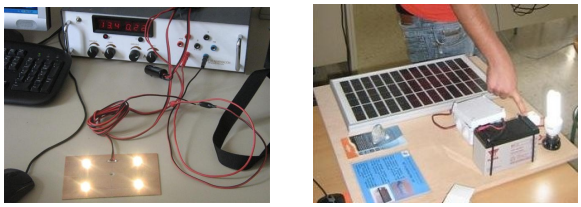

Figure 14. High power leds and solar powered low consumption bulb

- Solar lighting kit with 12V battery, electronic ballast and fluorescent lamp (Fig. 15).

Figure 15. Fluorescent lamp with 12V ballast and lead-acid battery

- Solar electrification kit for small houses,

made of a 10W solar panel, self-made charge regulator and modified UPS as charge storage and mains supply (Fig. 16).


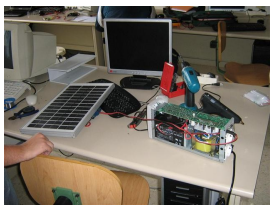

Figure 16. Electrification kit with solar recharged UPS

6. Fourth Day: Solar prototypes workshop

This day was dedicated to construction of different prototypes of thermal solar devices, like solar collectors, solar cookers and others. The first part of the activity was a brief explanation about different types of solar collectors: parabolic and fresnel concentrators, vacuum tubes and others.

The second part of the activity was the construction of a parabolic concentrator using a recycled dish from an old parabolic antenna, which was covered with sheets of metallized polypropylene. The sheets were previously cut into triangular pieces.

The resulting concentrator is cheap and materials can be easily obtained. It can be used as part of a thermal solar collector or a solar cooker.

Figs. 17 to 20 show different stages of construction and final test of the concentrator, that consisted in burning a piece of wood.


Figure 17. Cleaning and preparing materials


Figure 18. Cutting reflective sheet


Figure 19. Applying reflective sheet


Figure 20. Finishing and testing reflector

7. Fifth Day: Electric vehicles exhibition

The last day of the Solar week there was an exhibition of electric vehicles. They were furnished by NORBIKE, a local distributor of this type of vehicles. First there was a presentation about history of electric vehicles, its characteristics and future. Then there was an explanation of the parts of an electric bike like battery, brushless motor and control unit (Fig. 21). And the last part was a practical demonstration of electric bikes that were tested by students and teachers (Fig. 22 and 23).

Figure 21. Electric foldable bike from NORBIKE, SL


Figure 22. Electric vehicles and presentation


Figure 23. Students testing electric vehicles

8. Future activities

This Solar Week can be considered as an starting point for many activities related to solar and renewable energies and environmental education. We are planning to continue with solar cookers construction and design of new thermal and photovoltaic applications.

In the field of electric vehicles, we have established a long term cooperation with NORBIKE company and are planning to make the first recharging point for electric bicycles in our area.

9. Conclusions

- IES Escolas Proval has celebrated its First Solar Week from 18 to 22 of may, 2009 in coincidence with European Solar Days.
- Many activities have been carried out during these five days, like design and construction of solar cookers, solar lighting devices and small solar toys.
- Many students from all educational levels took part in these activities, contributing to knowledge of solar technologies and renewable energies.
- We consider that the Solar Week was a great success and are planning to continue with this kind of initiatives in following years.

10. Acknowledegements

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11. References

[1] Diz J, Obradoiro de cociñas solares. Parte I: Construcción dunha cociña Fun-Panel, 2009. http://solaina.es/drupal/files/obradoiro_cocina_solar_2009_0.pdf [09/20/2009]

[2] Diz J, Kit de electrificación solar de baixo custo, 2009. http://solaina.es/drupal/files/minikit_solar_artigo_gal.pdf [09/20/2009]

[3] Diz J, Manual: Construcción de fotosaltóns, 2009. http://solaina.es/drupal/files/obradoiro_fotosaltons.pdf [09/20/2009]

[4] Solar Cookers International, Solar Cookers: How to make, use and enjoy (10th edition), 2004. http://images3.wikia.nocookie.net/solarcooking/images/5/57/CooKit_plans_detailed.pdf [09/20/2009]

[5] Solar Cookers International, Cocinas Solares: Cómo construirlas y utilizarlas, 2009. http://solaina.es/drupal/files/cocinas_solares_como_construirlas_y_utilizarlas.pdf http://images3.wikia.nocookie.net/solarcooking/images/8/81/CooKit_Plans_detailed_Spanish.pdf [09/20/2009]

[6] Aula de Enerxías Renovables do IES Escolas Proval (Nigrán), 2009. http://centros.edu.xunta.es/iesescolasproval/enerxias [09/20/2009]

[7] Fundación Terra 2009. http://www.terra.org [09/20/2009]

[8] Intermón Oxfam, 2009. http://www.intermonoxfam.org [09/20/2009]

[9] Ingenieros Sin Fronterias (País Vasco), 2009. http://cocinasolar.isf.es/camp_paneles.php [09/20/2009]