eSAREP-Cuba ***NEWS LETTER*** ***(December 2002)***

SAREP is a renewable energy promotional programme jointly initiated by the Commonwealth Science Council, UK, the School of Science & Mathematics, Sheffield Hallam University, UK, the British Council and in-country counterparts to increase the public awareness and accelerate the use of renewable energy technologies.

SAREP Aims & Objectives are:

- To train young scientists in renewable technology areas through postgraduate programmes.
- To enhance the awareness of renewable energy applications among entrepreneurs, policy makers, politicians and the general public.
- To facilitate entrepreneurs in Asia to develop trade & investment relations with partners in other parts of the world including Africa, Australia, Canada, Europe, Japan and the United States.
- To start CARES (**C**entres for **A**pplications of **R**enewable **E**nergy **S**ources) as large demonstration projects in rural areas needing development, contributing to reduction of poverty.

RENEWABLE ENERGY TAKES OFF IN CUBA

The Isle of Cuba, with a surface area of 104,945 km^2, is located in the Caribbean Sea. It is a narrow and long island which represents 98% of the Republic of Cuba territory and where 99% of its 11.2 million population lives.

Fossil fuel consumption was around 9 million tons in 2001. Of these, 3.6 million tons of oil and gas were extracted from Cuban oil fields. Energy from renewable sources has been increasing and it represents about 25% of all the energy used. The largest share belongs to biomass, particularly cogeneration from the sugar industry. Energy obtained from sugar cane wastes adds-up to 3 million tons of oil equivalent, i.e, about 22% of total energy consumption. This energy is used to run the sugar industry and part of it is transformed into electricity. Last year this was the source of energy for 6% of generated electricity.

Cuba has no rivers of great volume. This limits the use of hydro-electricity, nonetheless, its use has been expanding. Facilities have been developed in the Cuban mechanical industry for the series production of turbines for mini and micro-plants. Hydro-electricity generation increased from 7.4 GWh in 1959 to a maximum of 162.5 GWh in 1997, with recent decreases due to extreme drought in some places. Last year, 161 mini and micro-hydro electric plants produced about 0.5% of generated electricity.

Wind pattern studies have been underway to find regions with adequate wind velocity. A few wind generators have been installed, though, their contribution to total electric power generation is not significant. The power of the largest two is 225 kW each. Use of wind powered water pumps has been increasing in the last decade. There are over 6,500 systems in use and national production of wind powered water pumps exist.

Biogas, wood dust, rice crust, coffee and forests wastes are also used as sources of energy. The hard economic situation originated by the disappearance of the Eastern European socialist countries and the U.S. economic blockade, forced Cubans to use all available means to reduce fossil fuel imports. Luckily, this has a positive contribution to the environment.

Use of solar thermal energy and photovoltaic (PV) is rapidly increasing. Water heating devices increased from 389 installed in 1999 to 1280 in 2001. The energy obtained from them last year was equivalent to 2,162 tons of oil. The photovoltaic has a tremendous impact due to various public awareness and social programmes. Even though the electric grid covers 95% of homes, health and education has to be guaranteed to the non-electrified 5%. Every Cuban is followed and assisted by a "family doctor" even in very remote places with hardly any population. The first photovoltaic system to guarantee electricity to a "family-doctor house" was installed in 1988. Today, over 300 "family-doctor houses" in very distant places, far away from the electric grid, are electrified with photovoltaic systems. The 400 Wp PV module is used for a small refrigerator for vaccines, a radio transmitter, three medical electrical equipments, a television set and lamps. At night, the "family-doctor house" becomes a meeting place where people become connected to the rest of the world through television.

Typical hospital powered by solar panels to serve mountain communities in Cuba.

These PV systems have had a great social significance and electricity has even saved lives in some cases. Another social programme has accelerated the use of PV during the last two years. An education channel was created through which actual classes are transmitted in order to give all children the opportunity to receive the best education from the best teachers, together with greater integral culture. Non-electrified regions, though few in number, could not be an exception. More than 2,000 schools have PV systems now, 975 of them have less than 10 students, 378 less than 5 and 21 only 1 student. A 165 Wp PV system guarantees 5 hours of television, 5 hours video and 2 hours lighting, with three-day autonomy in case of rainy days. In 2001, a new

decision was taken to give all children in schools access to computers. Therefore, an extra PV system has been installed to give electricity for personal computers. In this way, through television, video and computers, students in very distant and isolated places are in direct contact with up-to-date knowledge and culture. The social and cultural impact of PV systems can be tremendous, so additionally 1200 television rooms powered with PV have been created in small non-electrified communities to enhance people's culture. The fast increase in the number of PV systems (642 in 1999 and 3,216 in 2001) has promoted Cuban production of PV panels, as well as training of personnel for production, installation and maintenance of PV systems. Given the economic situation in Cuba, foreign investment is sought in order to even produce solar cells in the future. A new programme is on its way to provide electricity to all non-electrified homes. This will certainly be a significant contribution of PV to total energy used.

Finally, it should be mentioned that small children are introduced in schools to renewable energies and the respect for the environment is introduced at very early stages. A colourful book has been published for children and another book will follow for youngsters in secondary school. At University level, renewable energy related courses are delivered as part of masters, diplomas and specialized programmes. Different research activities in the field of renewable energy technologies take place at universities and research centres.

These activities in Cuba demonstrate the use of new technologies for social development especially in rural communities. This is an excellent example to follow for energy starving developing countries and also for developed countries who care about the environment and the future of our planet.

For more information regarding renewable energies and environmental aspects in Cuba, you may visit www.cubasolar.cu

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For more details on PV research & e-SAREP, click on:

Http://www.shu.ac.uk/schools/sci/teaching/as1/SCResearch.html

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NEW WAYS OF DEVELOPING Glass/Conducting Glass/CdS/CdTe/Metal THIN FILM SOLAR CELLS BASED ON A NEW MODEL. By IM Dharmadasa, AP Samantilleke, NB Chaure and J Young.

Abstract

Making use of the authors' experimental results and the evidence available in the literature, an alternative model for glass/conducting glass/CdS/CdTe/metal solar cells has been formulated. This model explains the device behaviour in terms of a combination of a hetero-junction and a large Schottky barrier at the CdTe/metal interface. The main experimental observations available to date are described and compared with the currently assumed p-n junction model and this proposed new model. It is shown that the proposed model explains almost all the experimental results more satisfactorily. The paper describes the guidelines to further increase the performance efficiencies based on the new model. Following these new guidelines, the authors have fabricated improved devices producing open circuit voltage (V_{oc}) values over 600 mV, fill factor (FF) values over 0.60 and the short circuit current density (J_{sc}) values over 60 mAcm^{-2} for best devices. Although the V_{oc} and FF could be further improved, the remarkable improvement of J_{sc} indicates the possibility of further development of multilayer graded band gap tandem solar cells based on CdS/CdTe system.

Current SAREP Participants:

Sri Lanka (Seven Universities, Solar Energy Society, Energy Forum & Solar Industries Association), Maldive Islands, India (Tata Energy Research Institute and Bhopal University), Nepal, Bangladesh (Bangladesh Centre for Advanced Studies), Pakistan (Pakistan Centre for Alternative Technologies, and Univ. of Punjab), Morocco (Five Universities, Afrisol and Ministry of Environment), Nigeria (Framac Ltd), East African Countries, China (XinJiang New Energy Research Institute), Mexico (Solar–Hydrogen–Fuel Cell Program, Energy Research Center–UNAM, Temixco) and Cuba (Cuba Solar).

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