

Sharat K Chand

Muni Seva Ashram, Goraj, Vadodara 391760, Gujarat, INDIA

www.greenashram.org

sharat.chand@greenashram.org

Solar Energy Related Curriculum for Schools in India

SCI (Solar Cooker International) has been making pioneering effort to involve school students for making and using solar cookers, in almost all developing countries and some developed country with an aim to inculcate concern about environment in the young minds. In the opinion of the author, school students should also get the appropriate inputs to relate the scientific learnings from the books and laboratories to that of solar energy available free and in abundance.

In Indian context, a thorough scanning of school books of CBSE¹ shows that the inputs regarding solar energy in general and solar cooking in particular hardly find any mention. Visualizing solar energy as “all pervasive free energy source which can be easily harnessed”, is difficult by the children unless they are able to relate it to all that they learn in the classrooms and laboratories. In view of India’s huge commitment to harness solar energy, it becomes essential to prepare next generation of young men and women as informed citizen who will take the mission forward.

In order to fill this gap, a tool-kit for students of 6-12 standard has been designed which offers an opportunity for students to experiment with variety of solar gadgets, supplied in the kit. With this toolkit, students will get a chance to explore and manipulate various solar gadgets to strengthen the concepts learnt in class room about light, heat, temperature, radiation and much more. The clear understanding of scientific principles generally fires young minds that leads to innovations and discoveries.

In addition, this kit will enable students to become ‘solar chefs’ as they will be able to cook and bake nutritious and delicious Indian dishes for themselves and for their parents and teachers and their class eventually fulfilling the mission of SCI.

It is hoped that this effort will result in “catching them young” at the junior and senior school levels who will be able to relate classroom learning to real life use of solar energy and thus, become flag bearers of solar brigade.

Solar Energy, Solar Cooking, School Curriculum, Education Policy, Work Education

¹ Central Board of Secondary Education is the main Education Board for schools in India

Preamble

Since its formation in 1987, SCI (Solar Cooker International) has been making pioneering effort to involve the communities in the developing world to learn solar cooking including making of solar cookers using locally available cheap materials. This initiative was basically aimed at reducing/ eliminating daily drudgery of collecting fuel wood by women folk which took away almost half a day of productive time every alternate day. As a bonus, this effort also reduced generation of harmful greenhouse gasses and saved the womenfolk from inhaling smoke from the firewood and dying early. This effort easily found many takers in African countries because of the way they cooked their meals which was eminently suited to slow solar cooking. SCI also pioneered the effort to teach school students for making and using solar cookers, in almost all developing countries and some developed country with an aim to inculcate concern about environment in the young minds. Many NGOs, universities, independent researchers and enthusiasts pitched in and came out with variety of cooker designs and teaching materials, available on internet mostly as open source material. Most of the teaching materials pertain to making of solar cookers and learning how to cook food, thus strengthening the objective and mission of SCI.

Status in India

Similar efforts to popularize solar cooking were made in India too and such efforts are still on but were mostly successful on institutional level where large installations are still functional after decades of useⁱ. Currently, more are being built with larger dishes and better tracking devicesⁱⁱ. Promotion of solar cooking at individual level or in village communities met with minimum successⁱⁱⁱ. Pushing solar cooking as a means of income generation in villages met with some success but could not be sustained. At school/ collage level, it was mostly restricted to establishing records for largest number of students participating to make/ cook on solar panel cookers^{iv}.

Objective

In the opinion of the author, in addition to learning solar cooking, school students should also get appropriate inputs to relate the scientific learnings from the books and laboratories to that of clean solar energy available free and in abundance. Going through the prescribed books of class 6-12 by CBSE, the largest examining board of India^v, it was found that solar energy and solar cooking hardly got mentioned in the six years of school curriculum.

Thus, the author formed the hypothesis that necessary inputs can be easily provided in the form of additional lessons which will surely be welcomed by teachers and students alike. This was essentially a bottoms-up approach.

This paper is author's effort in finding ways and means towards introducing lessons in solar energy in Indian schools for meeting this goal; an exercise to test his hypothesis.

India's Solar Mission^{vi} and need for solar warriors

India in general and western India in particular gets full solar radiation almost 300 days in a year. This is the reason why India embarked upon a very ambitious program of harnessing solar energy through its National Solar Mission, announced on 11th January, 2010 wherein 20 GW of utility and grid power including rooftop, 2 GW off-grid solar applications and 20

million square meters of solar thermal collectors were to be installed by the year 2022. The solar electricity numbers have now been revised upwards to 100 GW by 2022 out of which 40 GW is to come from rooftop solar installations. Solar thermal numbers remain same at 20 million m².

Application segment	Target Phase I (2010- 13)	Target Phase 2 (2013-17)	Target for Phase 3 (2017-22)
Solar collectors	7 million sq. meters	15 million sq. meters	20 million sq. meters
Off grid solar applications	200 MW	1000 MW	2000 MW
Grid power incl. roof top	1,000-2,000 MW	4,000-10,000 MW	20,000 MW

Against the above target, solar power installation till 30.9.2016 was 8513 MW. The installation of total solar collector till 31 December 2015, which included solar water heaters, solar cooking, solar cooling, industrial process heat applications, etc. is reported to be 12 million m². The gross potential is estimated 140 million m². Ministry has stopped reporting data thermal installations after capital subsidy was discontinued in Oct, 2014^{vii}.

The above capacity could be achieved in spite of severe shortage of technicians and working hand trained in solar thermal installations. Skill development centers (Vocational Training Centers and Industrial Training Institutes) have started proliferating which is a good sign but a much larger challenge lies ahead in meeting the goals set by the National Solar Mission. **To meet the targets set by Solar Mission, India will not only need solar trained manpower but will also need the support of aware mass of responsible citizen at various levels to appreciate and contribute to the common good and not be a doubting Thomas.**

National Education Policy and Education Boards

To achieve the objective of reaching out to students, the author made an effort to understand the current National Education Policy for schools in India. It must be noted here that the education system in Indian schools is quite different from that of the western world. Even after seven decades of independence, India is still struggling to settle for a comprehensive and robust education policy for its junior and senior schools and the experimentation is continuing. Even today there is a talk of doing away with CCE (Continuous & Comprehensive Evaluation) and reintroduce Board examination for class X. “No detention” policy may also be revised for class V onwards^{viii}.

Also, schools in India can be categorized in to three distinct types based on their location and patronage. At the top of the table are very expensive elite schools attended by the children of super rich and powerful and are found in metro cities or at exotic locations around the country or even abroad. Next are schools where sons and daughters of middle class and upper middle class of India go to seek education and training. These schools are generally in metros or tier 1 & 2 cities. In the third category are all schools in smaller cities, peri-urban areas and villages. Last two categories of schools can be either private or run by central/ local governments and comprise the largest segment. Though the aspirations of students may be similar in all categories, the final outcome is quite varied due to vast difference in the availability or otherwise of resources both in terms of finances and quality of teaching. While

large number of students from first two categories can be found manning the top jobs in the country or abroad, very few reach that level from the third category. In such a setting, author found it a daunting task to think of successfully introducing the subject of solar energy to schools of ALL hues and decided to restrict his quest to schools affiliated to CBSE (Central Board of Secondary Education), the largest school examining body in India where 2.5 million students appeared in final examination of class 10 (1.5 million) and class 12 (1million) in 2016 and this number is increasing every year^{ix}.

To explore the possibility further, author contacted principals and science teachers of some reputed schools in large/ small cities and some villages including that run by Muni Seva Ashram, Goraj^x. It transpired that the questions asked in the final examination are based on the prescribed books by NCERT^{xi} (National Council of Education Research and Training) and hence there is a great pressure on the teachers to finish the lessons well within the time; do at least one revision and take remedial classes for the weaker students. All teachers emphatically told the author that anything outside the prescribed syllabus will not be acceptable to the them or the students. In such a situation, it became a great challenge to lure the students and teachers to take up extra classes leading to learning and appreciating solar energy concepts.

Further research revealed that ALL schools in India had compulsory 6 hours per week of SUPW (Socially Useful Productive Work). This was introduced in 1978 by the Ministry of Education to promote values and educational ideas of Mahatma Gandhi^{xii}. In this program students learned number of vocational education activities like knitting, cooking (without gas, like sandwich making, cake decoration etc.), gardening, carpentry, painting and other crafts and hobbies. Senior students were also allowed to take up community work, based on the values and educational ideas of Mahatma Gandhi. The aim of SUPW was “.....to help develop among the students the habit to work as a community, encourage community thinking, increase awareness of scientific advancements and develop a scientific outlook. The training acquired in the classroom was expected to help students to solve day-to-day problems of the community.”^{xiii}

Thus, SUPW was the next best slot for pushing the present agenda of introducing solar energy lessons in schools. However, it was discovered that this activity oriented program was discontinued about five years back and has been replaced with WEd (Work Education)^{xiv} program, which has similar objective, in all schools covered under the approved boards.

This forced the author to scrap all earlier work of designing lesson plans related to solar energy and give up his hypothesis, implementation of which proved to be impractical. The only alternative left was to somehow include the “learning” in to the WEd program of ALL CBSE schools.

The Solar Thermal Toolkit

In such a situation, it was decided that a toolkit will be offered to schools for use during WEd (Work Education) which has been so designed that it makes learning about solar energy more fun than a burden. The redesigned toolkit will continue to have several solar cookers (box,

panel, parabolic dish), a solar dryer, ETC based hot water system and a solar still. It will also have a hay- basket, several types of thermometers, Fresnel lens and pots and pans suitable for solar cooking and other accessories. Lots of spare sheets, tapes and reflective material will also be provided for students to build their own solar items. In addition, the design, construction and working principle of all items in the kit in simple layman's language will be compiled and included. The documentation attached to each item in the kit will be modified to include extra learning in the form of questions and suggestions. A recipe book for all types of cooking/baking and frying possible in different types of cooker will be compiled from various sources including own experience, will be included in the toolkit.

Author is confident that the toolkit will be well received by the target schools. The regular use will result into better understanding of the concepts and also the students will learn to cook and share the delicious solar food with their friends, teachers and parents.

PS: The genesis of this effort of the author to introduce solar thermal energy concepts to junior and senior school students in India lies in the unrealized dream of late Dr Sirin Gadhia. Subsequent discussions with Deepak Gadhia, an avid solar thermal entrepreneur and promoter of inventions and innovations in the related field, and rummaging through extensive notes of late Dr Sirin Gadhia, author came to realize that there still existed an opportunity to help students of schools to learn and understand about the enormous amount of free and clean energy that was available to India, thanks to the Sun God. This effort is a small tribute to the departed soul.

References

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- iv <https://vimeo.com/154565423>, <http://www.thebetterindia.com/22268/suryakumbh-cooking-using-solar-power-maharashtra/>
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