

# Bringing green energy to Arab schools in the Negev, south of Israel: Solar ovens

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**Abstract** — In this paper, we describe a solar oven (solar cooker) project that we introduced to the Arab school, ALhuzayyell, located in the city of Rahat in the Negev. Although the use of solar energy for cooking is well established, it is not generally popular—a situation supported by the results of a questionnaire that we distributed to the students at Beit Berl College. With this project, we demonstrate that it is possible to bring complex ideas—albeit very important ones to humanity—to school-age children, starting from kindergarten.

**Keywords** — Kindergarten, green energy, solar oven, Arab schools

## 1 INTRODUCTION

Are our children really aware of their ability to make a difference to the environment? Do they know how to move from awareness to action so that they can contribute to the future of our planet? Renewable energy education in the classroom attempts to bridge this gap.

Our limited natural resources are under increasing pressure. Water shortages, soil exhaustion, loss of forests, air and water pollution, and degradation of coastlines afflict many areas. As the world's population grows, improving living standards without threatening public health and development or destroying the environment is becoming a real global challenge.[1]

The choice to preserve or abuse the environment can have a large impact on determining whether living standards improve or deteriorate. Increasing populations and urban expansion result in increasing use of resources; resource exploitation further diminishes their limited supply. Without practicing sustainable development, humanity faces a deteriorating environment—and may potentially invite ecological disaster.

Many steps toward sustainability can be taken today: for example, using energy more efficiently; managing cities more productively; phasing out subsidies that encourage waste; managing water resources and protecting freshwater sources; harvesting forest products rather than destroying forests; preserving arable land and increasing food production through a second Green Revolution; managing coastal zones and ocean fisheries; protecting biodiversity hotspots; and adopting an international convention on climate change.[1]

Although population growth is slowing, the absolute number of people continues to increase—by about one billion every 13 years. Slowing

population growth would help improve living standards and would buy time to protect natural resources. In the long run, however, sustaining higher living standards will require the world's population to stabilize.[1]

Renewable energy is energy derived from such natural sources as sunlight, wind, rain, tides, and geothermal heat. In 2006, approximately 18% of global final energy consumption came from renewables, with 13% coming from traditional biomass, which is mainly used for heating, and 3% from hydroelectricity. New renewables (small hydroelectric, modern biomass, wind, solar, geothermal, bio-fuels) accounted for another 2.4%; this sector is growing very rapidly.[2] The share of renewables in electricity generation is around 18%, with 15% of global electricity coming from hydroelectricity and 3.4% from new renewables.[2]

Friedman's book, "Hot, Flat, and Crowded" is about creating a sustainable world through innovation. By hot, he means global warming[3]. By flat, he means a globalization that has brought sameness to societies. And by crowded, he means a growing population and its impact on biodiversity. He wakes us up to the dangers of an environmental crisis in his own unique way: "The world is warming up by 2 degrees, which doesn't seem much to most. After all the number looks and feels 'small.' But if your body temperature goes up by 2 degrees, you have a fever. And if it goes up by another 2 degrees, you end up in the hospital."

Friedman is convinced that the next era of innovation will be in "Energy Technology," which he calls ET. He says, "I don't know who will lead it, but I know that the next generation will be about ET." He calls on entrepreneurs and researchers to take action so that new, clean, inexpensive alternative energy resources are made available sooner rather than later. The world can't wait. He

tells us, "We are the first generation to strategically do something for our survival." [3]

A green world requires green actions. We must all take part in saving the planet. Because awareness leads to responsibility, one major challenge is educating people about the importance of environmental protection. Notably, the World Wide Web provides much information related to green education (partial list only) [4–8].

In an effort to increase environmental awareness in the region, we have sought to impart some of this knowledge to Arab schools in the Negev. For example, we have introduced science projects relating to solar energy to the middle school at Lakiyya [9] and we have developed and applied activities relating to global warming in Alzarafa kindergarten [10].

Solar energy, radiant light and heat from the sun, has been harnessed by humans since ancient times using a range of ever-evolving technologies. Solar radiation, along with secondary solar-powered resources such as wind and wave power, hydroelectricity and biomass, account for most of the available renewable energy on earth. Only a minuscule fraction of the available solar energy is used [11].

The sun is a major green energy source and solar energy has many applications worldwide. [11] Solar cooking is one such application that could easily be imported to schools, starting from kindergartens. For people who are fortunate enough to have gas or electric stoves in their homes, the choice to cook with solar energy is just that: a choice; for them, the convenience and environmental benefits of solar cooking might be reason enough to try solar cooking. For the billions of people around the world who cook over fires fueled by wood or dung, who walk miles to collect this fuel, or spend much of their meager incomes on it, solar cooking is less of a choice and more of a blessing. This situation is especially true for the millions of people who lack access to safe drinking water and may become sick or die from preventable waterborne illnesses. For them, pasteurization is a life-saving technology. The World Health Organization reports that in 23 countries 10% of deaths are due to just two environmental risk factors: unsafe water, including poor sanitation and hygiene; and indoor air pollution due to solid fuel use for cooking [15].

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## 2 MODEL OF ACTION

We have used a solar cooker kit [13, 14] to demonstrate the experience of cooking with energy from the sun to the children of the Alzarafa ("The Giraffe") kindergarten in the city of Rahat in the south of Israel.

Here, we describe our model of action for importing a solar cooker project into Arab schools in the Negev, south Israel. Among the several methods available for teaching and training, we adopted a constructivist approach. The model comprised three basic steps, which could be repeated several times to reach a satisfactory conclusion:

- Determining the learners' prior knowledge of the concepts and basic principles of solar energy and solar cooking;
- Discussing and experimenting to improve this knowledge and to correct misconceptions if or when they arise;
- Evaluating the improvement in knowledge.

We prepared the following set of questions to determine the level of basic knowledge regarding renewable energy, solar energy, and solar cookers:

1. What is renewable energy (green energy)?
2. What is the importance of renewable energy?
3. What are some applications of green energy?
4. What is solar energy?
5. What are some applications of solar energy?
6. What is a solar cooker?
7. What is the importance of the solar cooker?
8. What are the parts of the solar cooker?
9. How does the solar cooker work?

This activity could be prepared for different levels of learning, starting from kindergarteners up to university students.

## 3 DATA COLLECTION

We collected data from college students who were preparing to become teachers in various disciplines. Notably, none of the students were taking solar energy classes. The following Tables summarize the answers provided by the students to the previous questions.

Table 1. Responses of the students to Question 1: "What is renewable energy?"

Entry	Response	Number of responses
1	It is a type of energy produced in a manner different from the	28

	burning oil (from natural resources or from the sun)	
2	It is energy that substitutes for electricity like water and air	4
3	It is energy that does not harm the environment	4
4	It is the energy of water	6
5	It is energy that we use when the energy resources are exploited	6
6	I don't know	46

Table 2. Responses of the students to Question 2: "What is the importance of renewable energy?"

Entry	Response	Number of responses
1	It is a new natural resource	3
2	It reduces pollution	18
3	It saves money	6
4	We use it when classical sources are exploited	6
5	It is a renewable energy source	9
6	It saves the environment	15
7	I don't know	43

Table 3. Responses of the students to Question 3: "What are some applications of green energy?"

Entry	Response	Number of responses
1	Water heating, electricity generating	12
2	Solar car	6
3	Wind, water, sun	6
4	Running simple machines	3
5	Used in factories	3
6	Wind turbines	3
7	I don't know	67

Table 4. Responses of the students to Question 4: "What is solar energy?"

Entry	Response	Number of responses
1	It is energy that comes from the Sun	30
2	It is energy that results from the heat of the Sun	6

3	It is energy that results from the strong Sun rays	12
4	The energy that produces electricity comes from the Sun	12
5	It is energy that absorbs a body from the Sun	3
6	It is the heat of the Sun	6
7	It is heat energy that comes from the Sun	12
8	I don't know	19

Table 5. Responses of the students to Question 5: "What are some applications of solar energy?"

Entry	Response	Number of responses
1	Water heating	42
2	Solar cars	6
3	Calculators	3
4	Producing electricity	12
5	Solar cooker	3
6	Activating solar cells to produce electricity	3
7	Producing heat	6
8	I don't know	25

Table 6. Responses of the students to Question 6: "What is a solar cooker?"

Entry	Response	Number of responses
1	Water heater	18
2	Device that absorbs solar energy	12
3	I don't know	70

Table 7. Responses of the students to Question 7: "What is the importance of the solar cooker?"

Entry	Response	Number of responses
1	Water heating	15
2	Produces electricity	3
3	Absorbs solar energy	3
4	Used for cooking	3
5	I don't know	76

Table 8. Responses of the students to Question 8: "What are the parts of the solar cooker?"

Entry	Response	Number of responses
1	Glass, heat conducting material	3
2	Iron housing, glass, black coating	15
3	Electrical wires	3

#### 4 SOLAR COOKING IN THE KINDERGARTEN

Following the same guidelines described in Section II, we introduced the solar cooker to the kindergarteners.

Initially, the children brainstormed concepts and ideas related to solar cooking. Here, we summarize the activity and the points that were discussed.

Teacher: "We plan to cook using the energy from the sun!"

Students: "How will we do that? Won't the food be spoiled? Will the food be ready? Where will the heat come from?"

Teacher: "What is solar energy?"

Students: "It heats the house and the ground, evaporates water, gives the green color to the trees, gives the moon light, heats the water in the pipes."

Teacher: "What is the sun?"

Students: "It is a star, an energy source"

Teacher: "What does the sun do for us?"

Students: "It gives us heat, dries food, dries the skins of animals"

Teacher: "Is it possible to cook with the sun?"

Students: "We don't know!"

Teacher: "OK, let us experiment with a solar cooker."

After this brainstorming session, we moved on to experimenting with the solar cooker. We used a "CooKit" solar cooker obtained from Solar Cooker International,[15] whose website provides technical information regarding the concept of a solar cooker, how to build one, and several recipes. The experiment lasted for two weeks. In the first week, we discussed the terms and the concepts and prepared for the experiment. During the second week, we used the solar cooker to boil eggs and

potatoes. The children followed the experiment starting from morning time until 1 pm (the cooking process lasted ca. 5 h). Throughout the experiment, the students experienced several of the processes that are important when conducting research. For example, they observed, raised questions, and experimented with the orientation of the solar cooker. They became very excited and active during the experiments, and they were exposed to several points related to safety: they touched the hot surface and felt the heat and they had to deal with the reflected sun rays while being careful not to become dazzled by them.

The photographs below (see figures 1-4) display the activity of the children during their experimenting with the solar cooker.



Figure 1. The children observing the boiling of eggs in the solar cooker.



Figure 2. The children placing eggs in the designated spot for food.





Figure 3. The children aligning the solar cooker while being careful of the heat and the reflected sunlight.



Figure 4. Boiled eggs at the end of the solar cooking process.

## 5 SUMMARY AND CONCLUSIONS

In this study, we developed a solar cooker project in the Arab schools in Alzarafa kindergarten in Rahat, a city in the south of Israel. Our motivation behind this project was twofold: (i) overcoming the lack of knowledge among teachers regarding solar cooking and (ii) demonstrating the importance of the solar cooker as a cheap device that could be used in the desert, especially by poor families living far from civilization.

The project was realized as a result of the combined efforts of the college and the kindergarten. Know-how was transferred from the college to the kindergarten. Together we set the goals and drew the activity plan.

To test for knowledge about renewable energy and solar cooking, we distributed a questionnaire to 100 people in two different groups: 50 students at the college, training to become

teachers, and 50 teachers in the field. The findings were interesting: although a few teachers knew something about renewable energy, almost all of them claimed to have no knowledge of solar cooking. At that stage, we provided the teachers with some basic facts about the solar cooker. We suggested proceeding with a study attempting to improve such understanding by developing activities for preschool children at the Alzarafa kindergarten. The students were very excited while experimenting with the solar cooker, which they used to observe the process of cooking potatoes and boiling eggs. They displayed interesting basic knowledge that they had gained from their regular life in the desert.

In this green energy project, college students from Beit Berl, teachers from Kindergarten Alhuzayyel A, and children from Alzarafa Kindergarten in Rahat all participated in learning how to use the sun—with the aid of the solar Cookit—to cook their lunch.

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