

TEACHING OF ALTERNATIVE ENERGY SOURCES IN ROMANIAN SCHOOL

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Abstract: Using alternative energy sources is already a reality in the current context of energy crisis and climate change due to the pollution created by burning fossil fuels. Parallel to the development and expansion of research on the use of renewable energy sources is important as the training of future specialists in this field. It is also important among the younger generation implementation of an education on environmental protection and reducing energy coming from traditional polluting sources. A key role in this respect is the school that is for any society the vector of sustainable development. This paper evaluates the need and the current approach to the study of alternative energies, especially solar energy, in the Romanian school. The conclusions of the paper were obtained from a study carried out between February and April 2011 on (a total of) 230 people from different backgrounds and different ages. We also discussed issues about the impact of teaching the unconventional energy sources on society evolution, the causes for which at this moment the subject is treated poorly in Romanian school and possible solutions to correct this situation.

Key words: curriculum, alternative energy sources, education system, learning, energy crisis.

1. INTRODUCTION

Witnessing a period of global energy crisis, the use of energy produced through solar photovoltaic effect has become in recent years, one of the priorities of global energy development. Thus, in 2009, the growth of annual rate in solar industry exceeded the value of 40%. This is fully justified if we think that within one hour, on the surface of the Earth there falls an amount of solar radiation which represents more energy (4.3×10^{20} J) than all the energy (4.1×10^{20} J) consumed by whole mankind in a single year [1].

In Romania, the potential of use of solar energy is relatively important. There are areas, such as the Black Sea shore, Dobrogea, or southern areas, where the flow of solar energy can reach up to 1600 kWh/m²/ every year. The monthly spread reaches impressive values: the maximum in June (1.49 kWh/m²/day) and the

minimum values in February (0.34 kWh/m²/day) [2]. At present, the applications which use solar energy in our country have not known a visible development while the market that uses such kind of energy is in continuous growing.

Although the solar power can be used in several ways (for lighting or solar water heating) the conversion of sunlight into electricity is the most desirable way to use it, because it can be easily transported over long distances and can satisfy almost any need for domestic energy industry. This transformation can be achieved in two ways. The first is to use concentrated sunlight for heating water or air in a turbine steam or motor, to generate electricity. Another way is to use the photovoltaic effect to develop solar cells which are both efficient and cheap. Today, the use of photovoltaic cells for conversion of solar energy is already a reality and their production on a larger scale is done concomitantly with finding solutions to increase their efficiency and to reduce the manufacturing costs. Therefore, the research is directed toward new materials that are possible replacements of the current silicon primarily used to build solar panels. The conversion efficiency of the solar cells depends on the electrical and optical properties of the semiconductor materials used in their production.

Together with the development and expansion of research on use of such alternative energy sources are important, of equal importance is the training of future specialists in this field. Getting the people aware of the importance of using alternative sources of energy is more than beneficial. The essential role in the formation of specialists with expertise in photovoltaic energy, responsible of implementation of education focused on environmental protection by using such alternative energy sources, is obvious the school, which represents in any society, the genuine vector of sustainable development.

The structural changes that have occurred in recent years highlight the need to rebuild our Romanian education on new bases, according to the social and economic needs [7]. These economic needs require the improvement of human resources, of qualification and labor flexibility. It is obvious that school ought to be a promoter of such an attitude, and this diversification needs to be done, so that each generation can be granted an individualized route. The individual-centered course will eventually lead to an education closer to the student's aspirations, a thing which will trigger both an increase in his school performance and the success of a training better fitting the social and economic needs of the current society [6].

The understanding of the photovoltaic effect integrates several disciplines such as physics, chemistry, material science, electrical engineering and electronics, but this phenomenon is not taught at school along with these traditional subjects. This omission is slightly corrected by introduction in the gymnasium and college curriculum of optional subjects, which among other things, studies the photovoltaic effect. However, the perception of young generation is that the subject is insufficiently tackled during classes. This conclusion was drawn while compiling data based on a survey done to a number of 230 persons from different social backgrounds and of different ages.

2. METHODS, TECHNIQUES AND TOOLS USED IN RESEARCH

The decision problem. An important aspect to be taken into account when designing the school curriculum is to answer the aspirations of society in education. The society is in constant dynamic, especially in the last decades when everything has changed rapidly and therefore its expectations about the educational system has continuously suffered transformations. As our Romanian school does not give sufficient importance to the study of alternative energy sources, we consider it useful to highlight the different aspects of the investigation.

The study aim. The research on study of alternative energy sources in the Romanian school and especially on the solar energy conversion took place in 2011 and aimed at the experimental validation of the following **assumptions**:

- I. The Romanian society is interested in alternative energy sources.
- II. In the Romanian schools, the subject of solar energy conversion into electricity is insufficiently studied.
- III. The high school graduates consider useful to study the solar energy conversion both in terms of change of mindset on the use of alternative energies in the detriment of classical ones and of preparation of future specialists.

Lot description. Research experimental group consisted of 230 high school graduates with different ages. Sampling type used is logical type. Selection of sample components was based on reasoning that the sample members must be persons aged over 18, high school graduates.

The research instrument used, the questionnaire, was completed by the subjects (self-managed).

It is noteworthy that most respondents attend theoretical-science and technical schools (Table 1).

Table 1

Distribution by type of graduate school

Type of graduate school	theoretical- science	theoretical - letters	technical
Number of respondents	152	34	44

The age distribution of the respondents is:

- 88 aged between 18 and 25
- 27 aged between 25 and 30 years
- 115 aged over 30 years.

The research was conducted by applying a questionnaire consisting of 12 items, of which 11 were closed and one open.

3. ANALYSIS OF DATA COLLECTED

The first question relates to the possible energy of the future (*Which types of energy do you think will be used in the future?*). As shown in Fig. 1, approximately 60% of those who answered the survey ranked the solar energy number one, choosing it over other possible: the hydro energy, wind and nuclear energy.

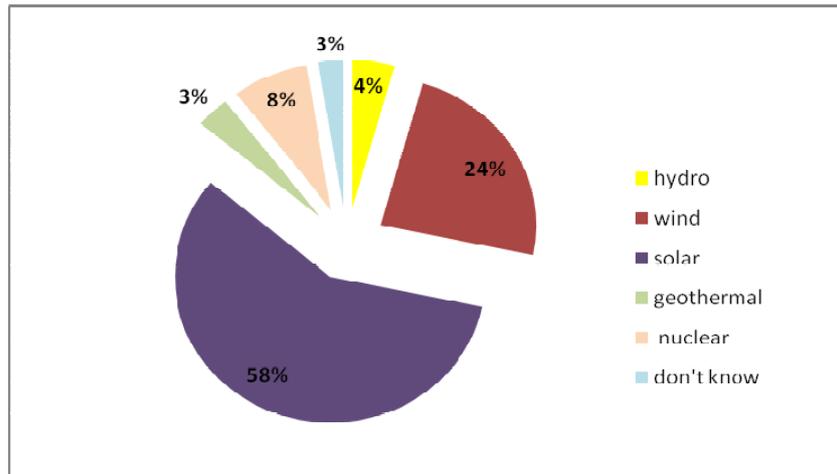


Fig. 1 – Future energy.

A large number of the respondents (191 of 230 see Fig. 2), consider that by achieving a certain level of knowledge about the production and use of alternative energies, the consumer's behavior will change, directing it from the classical energy consumption to the alternative energy one. This indirectly leads to the idea that an appropriate education will bear fruit in time. Therefore, if attitudes and habits of society must be changed, they cannot be changed overnight and the surest way to get good results is to start this process early in school. In addition, all well structured explanations of phenomena responsible of producing alternative energy, as well as presentation of its advantages and disadvantages, or of latest developments in this field, are more likely to convince the student to become a potential consumer of such future energy sources.

As shown in the data collected, approximately 75% of the persons asked know that the conversion of solar energy resides in the photovoltaic effect. While interpreting the answers to the following question (*How was acquired the information about the conversion of solar energy?*) we note that this information was acquired mainly from sources placed outside the school, such as radio, TV, newspapers, magazines, various publications, etc. According to the graph in Fig. 3, only 30% of the interviewed, have such information obtained in school, despite the fact that an overwhelming majority come from theoretical and vocational high schools.

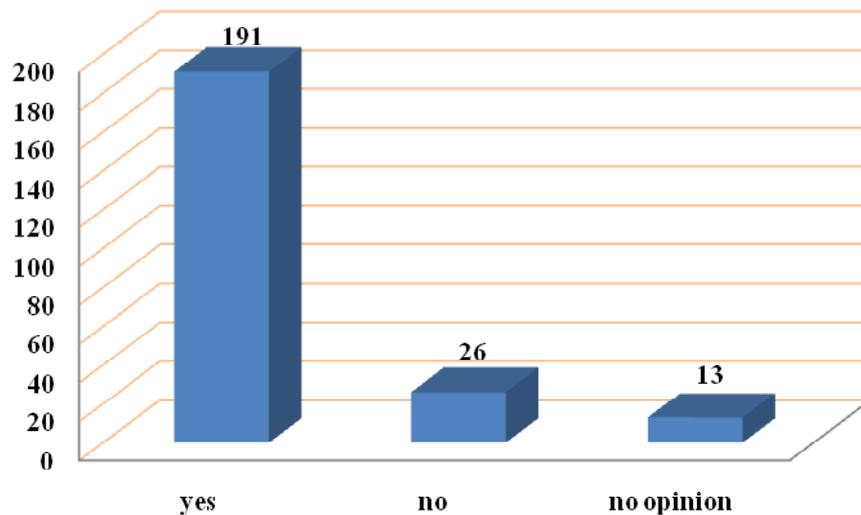


Fig. 2 – The perception of a link between knowledge concerning alternative energy production and consumer behavior.

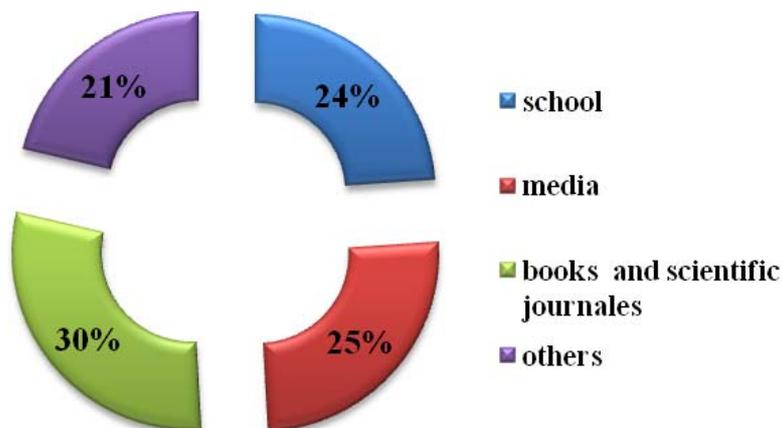


Fig. 3 – How was the information about solar energy conversion acquired?

When a subject is not given a comprehensive approach of all aspects, in an academically rigorous environment, with well structured data, but is treated in a way customary for a radio or TV broadcast, there are serious chances for the perception of the subject to be considered not rigorous in terms of science; some relevant information may fade over time easily. This explains why only 9% of respondents know that there is a difference between the operating principle of a thermal solar panel and a photovoltaic panel (Fig. 4), the remaining 91% mistaking the two notions.

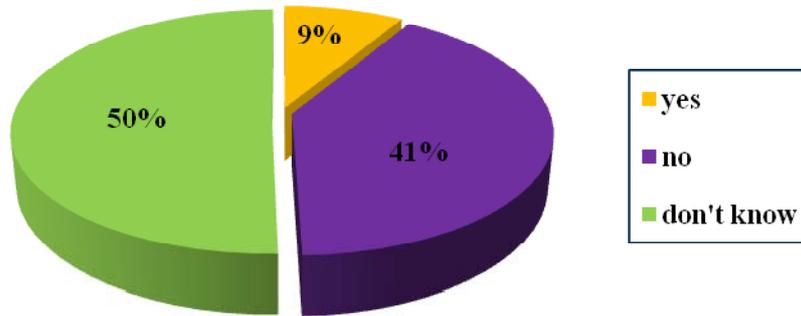


Fig. 4 – The differences in the operating principle of the thermal solar panel and the photovoltaic one.

The survey revealed that no form of alternative energy is studied in secondary schools or high schools. Therefore, over 80% of those asked did not attend a course in school about alternative energies (Fig. 5). This result proves that the Romanian curricula lack the educational chapters about the use of alternative sources of energy. All this while in other countries this issue is considered of major importance. This interest began with the onset of the oil crisis in the 70s and has grown steadily since then. From that very moment, the idea of using alternative sources or renewable energy began to gain ground and progressed to the point that the technical schools and the universities included departments specialized in creation, installation and maintenance of equipment needed to produce various forms of energy – solar, wind, geothermal, etc. [10]. In many countries, the curricula include themes aiming at education for sustainable development based on the use of alternatives energies; various programs offer students the opportunity to receive meaningful information appropriate for each school level, a complete education about energy [9]. Unfortunately, in our country there is not a unified vision and an overall education policy on this topic [5].

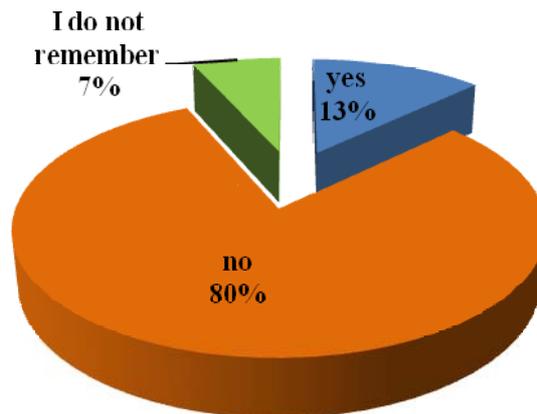


Fig. 5 – People who attended a school course on alternative energy.

According to the respondents, the possible causes of insufficient teaching of unconventional sources of energy in our school are primarily the lack of appropriate school programs (165 subjects responding with “absence of adequate curricula”), the shortage of laboratories with specific features (99 subjects responding with “absence of specific equipment for laboratories”) and lack of trained teachers (66 subjects responding with “absence of trained teachers”, Fig. 6). In this context it becomes imperiously necessary the need to prepare first of all the teachers with the specialized competencies in the field of renewable energy sources generally and, particularly in the field of solar cells [12, 13]. Teacher training in this area will provide opportunities for students to have schooling as their aspirations and needs individualized society [14].

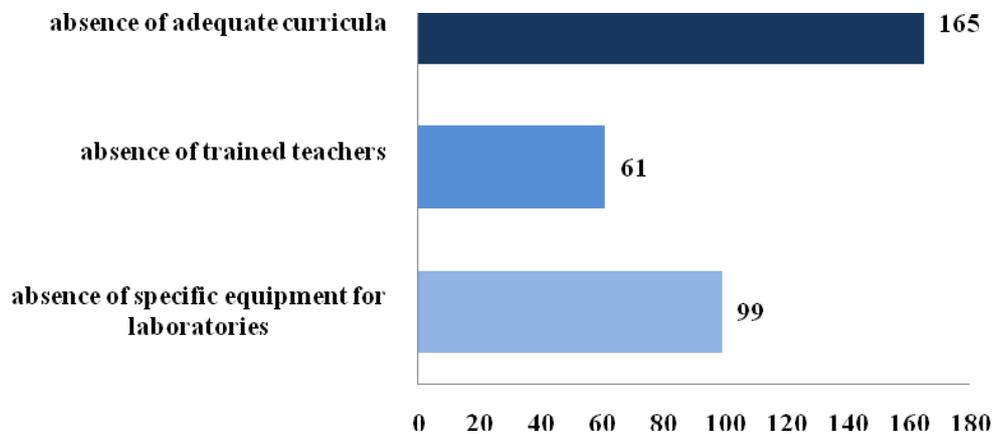


Fig. 6 – Possible causes of insufficient teaching of unconventional sources in school.

In the opinion of most, the studying of solar energy conversion into electricity in high school and middle school is insufficient. Consequently, if the solar energy conversion is not studied at these levels, then at college is even less probable. This explains why less than half of respondents (only 40%) think that there are no faculties where students study the solar energy. Surprisingly enough, a fairly large percentage of those who participated in the study, almost 60%, consider that Romania has research teams that study the solar cells.

The rapid expansion of renewable energy and the need to increase the energy efficiency in this area led to a global deficit, of staff trained for the needs of this sector and emergence of career opportunities in the field.

At the European level, according to a study by the European Photovoltaic Industry Association, the solar energy used may provide by 2020, 12% of electricity demand in Europe, which would help to create 2 million jobs in the field [3]. In this context, a large number of respondents (85%) believe that high school courses on solar energy conversion into electricity [11] can provide training for future specialists in the field (Fig. 7).

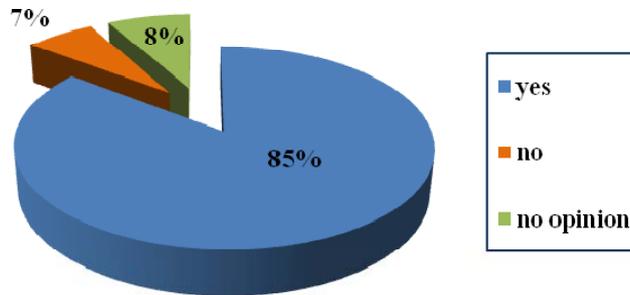


Fig. 7 – The necessity of studying solar energy conversion in high school – a premise for training future specialists.

Most of those who answered the questions (88%) believe that it is necessary to study solar energy conversion in school. Of these, 157 people consider high school as the school best suited for studying this subject (Fig 8). There are also views that advocate approaching the subject in secondary school (30 persons) or faculty (18 people – Fig. 9).

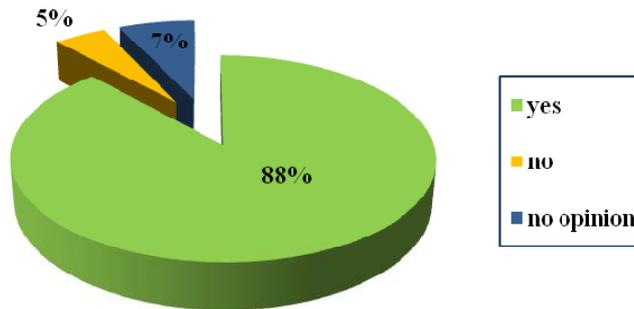


Fig. 8 – The need to study solar energy conversion in school.

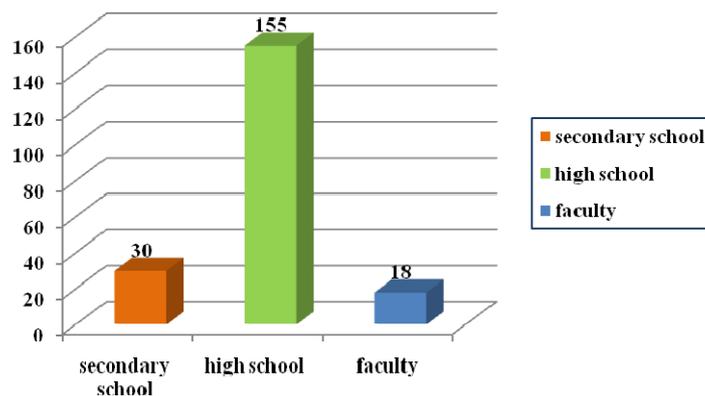


Fig. 9 – School level that is considered useful to study solar energy conversion.

4. CONCLUSION

Following the observations and analysis of the answers, we may conclude that the inclusion of study of alternative energy in the school curriculum is necessary because:

- It changes the mentality of people who use the traditional sources of energy widening their perception of the more current ecological trends;
- It leads to complete and accurate information about the non-polluting and renewable energy;
- It creates skills and forms specialists, offering the graduates job opportunities in an area in continuous expansion and development;
- Through a continuous route along the various stages of education (middle school, high school, faculty) a basis can be formed, a basis from which graduates may come off easily turning into research specialists who can innovate and develop this field;
- It creates the image of a modern and dynamic school, an institution capable of adapting to the continuously changing requirements and expectations of the current society;

This survey has also emphasized the idea that in the Romanian education, the solar energy conversion is an issue insufficiently approached although the society is interested in the topic and the evolution of the economic world is moving towards the use of alternative energies, where the solar energy comes in the first place.

Under these circumstances, we consider it necessary to intensify the efforts to transmit the knowledge about the solar energy conversion into electricity to the young generation. The leap that the society is about to make consists in developing the use of alternative energies and of solar energy in particular. This depends very much on the quality of training of future generations of specialists in this field, on the increase of their culture and awareness, on their will to change the attitudes and prejudices about the alternative energies; and this is to be done today, with our children, that are the main players in the world of tomorrow.

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