

Trends and Issues in Renewable Energy Education

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Abstract: With worldwide demand for energy increasing every day, the development of new, clean, renewable energy sources is critical to Earth's environment. To use clean-energy technology to help developing countries improve their quality of life and economies. Turkey is an energy importing country. Turkey presently has considerable renewable energy sources. The most important renewable sources are hydropower, wind, solar, geothermal, and biomass. The use of renewable energy as a topic to study energy and its forms permits a novel way to motivate students, particularly those who energy topics taking conscience with the environment. We would like to achieve this by looking beyond the schools' curricula and by introducing modern environmental and energy management methods in Universities and Vocational High Schools. This increases the *methodological competencies of students* and facilitates their change from school to professional life. Students play an *active role in the systematic improvement processes* of the schools and are even eligible to be trained to become *environmental auditors*. The *modern internet-based learning methods and instruments* are highly attractive for the students and instructors.

Key words: Renewable Energy Education, Teaching Learning Material, Motivation

Introduction

Energy is essential to economic and social development and improved quality of life in all countries. Availability of cheap and abundant energy with minimum environmental and ecological hazards associated with its production and use is one of the most important factors for economic growth and also for the desired improvement in the quality of life of the people living in developing countries. Because environmental problems result from energy-related factors, energy and environment are closely related concepts. Studies in last 2 decades have predicted that energy education will be a new discipline in both developed and developing countries. It is therefore especially developing countries that should take into account those studies and make some decisions about their energy, environment, and educational policy. Two important strategies are being adopted by a number of countries around the globe. The first strategy calls for energy demand management, which effectively means promotion of various energy conservation and efficiency measures, and the second approach is the development and large-scale dissemination of renewable energy technologies. Many countries around the world took initiatives for the development and dissemination of renewable energy technologies immediately after the first oil crisis. However, in spite of ambitious programmes of many countries in this direction, the dissemination of these technologies has not met the expectations of the planners and implementing organizations. There have been only a few successful cases of the adoption of renewable energy technologies. The poor dissemination of renewable energy technologies may be attributed to several factors. One of the important inhibiting factors is the lack of a structured framework for providing energy education, in general, and renewable energy education, in particular. For example, in many countries, the lack of indigenous technology development capacity in the area of new and renewable sources of energy has often resulted in the promotion of very expensive and inappropriate designs. Similarly, in some other places, owing to the unavailability of local technical manpower of proper repair and maintenance of the initially installed systems, the users have decided to use some other energy resource – technology combinations. Some of the renewable energy technologies were not accepted by the end-users as they were unaware of their potential benefits and associated requirements. These and several other such problems are merely manifestations of the same root cause - lack of proper renewable energy education.

Many developed and developing countries have changed their energy policies to find and develop new, clean, and renewable energy sources. These countries have also been aware of the importance of formal and informal energy and environmental education to make their citizens aware of the problem. Therefore they have been planning to make required changes in their educational programs to integrate some energy and environment-related concepts, units, activities, etc. into their curricula at different levels.

As mentioned above, investments in the energy sector and development of this sector are vital for Turkey. For this purpose, several new policies have been continuously produced and changed according to new growing economic requirements in this sector. During this process, it is also important to take into consideration environmental and educational factors. It is obvious that one of these policies produced must be related to studies dealing with energy education to supply qualified employees to the sector, to increase energy efficiency, to prevent energy extravagancy, and to make citizens aware of the need to protect their environment. It should not be ignored that formal education institutions play the most important role in achieving all of these goals. Because energy is closely linked to concern for the environment, energy education should also include environmental issues (Garg 2006, Keser et al. 2003, Dinçer 1991).

Renewable Energy Education in the World

The need for energy education increases depending on war and economic turmoil day by day. What is important is to decide how teaching about energy education should be done and what should be taught without such crises. However, the problem is that sources and studies on energy education are limited. For instance, in the late 1970s and early 1980s, energy curriculum-development projects were underway in the US. A search of the ERIC database, using the key words “energy-education and local-studies,” reveals that in 1981 eleven documents or articles met that criteria and the next year the number jumped to 19. The same ERIC search that identified almost 2 dozen articles in 1982 located no articles on those topics in either 1989 or 1990 (Keser et al. 2003, Marker 1991). In the last decade, besides a few studies dealing with energy education, it can be seen that the number of web sites on this topic has been increasing due to developing technologies. Energy in itself has not been regarded as a separate discipline of education since the students in other disciplines (e.g., mechanical, chemical, electrical engineering, as well as physics) are just exposed to the relevant aspects (of energy extraction, conversion, transmission and distribution, utilization, etc.) as a part of their curricula. In these disciplines, the subject of energy is not pictured with all its own aspects. Thus independent courses dealing with energy-related issues are not offered to the students at any level of formal education. This has necessitated that energy be considered a very special topic and all its relevant dimensions be studied in considerable detail. Hence the need to establish a separate educational discipline for energy is urgent as well made some suggestions for this purpose (Garg 2006). In their study, they offered levels and desirable features of energy education programs. For creating awareness and interest among the public and also for providing first-hand exposure to the basic concepts and their applications, relevant inputs will have to be introduced at the school level. Short-term courses and the use of mass media techniques can also help in achieving the above objectives. Diploma level courses will have to be introduced for training of personnel in fabrication, installation, and maintenance of energy technologies and systems. Regular four-year bachelor degree courses in energy engineering with specialization in the area of renewable energy and energy conservation may be required for providing the required manpower for design development and evaluation of emerging technologies. Teaching and training programmes at the postgraduate level can be useful in imparting advanced level inputs to engineering graduates or science students preferably with certain specialization options. Finally, short-term mid-career training of scientists, engineers, policy-makers, and administrators in certain specific aspects may also be required. It must be emphasized that for effective and large-scale dissemination of Renewable Energy Technologies initiating and strengthening efforts at all the above levels is equally important. In some developing countries, especially in rural areas, a primary-school focus is particularly important, for this may be the only formal education children receive. The attitudes about energy inculcated at this time might have a profound effect, not only on the students, but also on their parents if they follow their children’s schoolwork. This can have a direct impact on the improvement of understanding among the general public, for example of the fuel wood problem and the need for innovation in stove design and solar crop-drying techniques, and such other renewable energy issues.

In many developing countries, secondary education is used to impart job-related trade skills, as well as to prepare for college. Programmes on the maintenance and repair of renewable-energy devices and the adaptation of non-local designs to local needs and materials should be introduced into high-schools and technical schools. This will not only provide societies with the skilled technical manpower needed to make introduction of renewable-energy

technology feasible, but it will also impart income-earning skills for a new era of energy use. Here again, training materials and equipment are needed and teachers must be trained in their use. It is probably desirable throughout the educative process, but particularly at the university level, that renewable-energy considerations be presented as part of the complete energy picture, and that energy considerations in general be placed in the development context, both rural and urban. There are several reasons for this. Renewable energies are more likely to receive their proper due if they are considered on a par with other supply options so as neither to exaggerate nor to underestimate their potential importance to any locals. Beyond this, the impact of energy issues on each economic sector and on intersectional coordination needs to be made clear and even emphasized.

Desirable features of an energy education program are as follows: It should include all energy resources (renewable and non-renewable) with particular emphasis on some specific ones depending upon the local needs and characteristics. It should cover all aspects of energy technologies such as resource assessment, technology, economics and energetic, socio cultural issues, and ecological and environmental impacts. Separate curricula should be developed for different levels (school, polytechnic, university) and for different audiences. Although to some extent the energy education programs may cater to the local, site-specific needs, they should at the same time be consistent with national, regional, and international priorities and requirements. It should be flexible and dynamic, thus allowing for improvement in the future, if desired. It should provide a balance between theory and practical aspects and should involve all aspects of teaching/training including lectures, laboratories, demonstrations, hands-on skills training, design, manufacture, trouble-shooting, etc. It should be capable of providing energy education to all in a minimum amount of time and should be economically viable so that the maximum number of people may be educated within the existing financial resources. Energy education should also ensure employment/self-employment for the students and should thus have a direct link with job requirements and responsibilities of the manpower required in the area of energy. It should be compatible with the global efforts in this direction and should allow effective and mutually beneficial experience sharing and interaction.

Renewable Energy Education in Turkey

The eighth Five-Year Development Plan of Turkey reports that the main objective in the energy sector is to meet the increasing demand for energy, in line with economic development targets, population growth rate, transition to industrialization, and taking into account the environment. The options related to some energy and environmental policies are the following General Policies:

- Measures to encourage wider use of natural gas
- Support the utilization of clean and renewable energy sources as well as passive solar energy applications
- Decentralization in energy generation
- Optimizing sustainability of energy supply and environmental costs
- Setting integrated energy consumption targets for organized industrial zones

Education and Training:

- Organization of energy conservation training at adult education centres
- Introducing energy conservation in formal education
- Organization of training for households in mass housing and rural areas (WECTNC 1999).

As mentioned above, investments in the energy sector and development of this sector are vital for Turkey. For this purpose, several new policies have been continuously produced and changed according to new growing economic requirements in this sector. During this process, it is also important to take into consideration environmental and educational factors. It is obvious that one of these policies produced must be related to studies dealing with energy education to supply qualified employees to the sector, to increase energy efficiency, to prevent energy extravagancy, and to make citizens aware of the need to protect their environment. It should not be ignored that formal education institutions play the most important role in achieving all of these goals. Because energy is closely linked to concern for the environment, energy education should also include environmental issues.

During the past decades or so, Renewable Energy Education efforts have primarily focused on postgraduate level teaching / training programmes. Several other undergraduate engineering degree programmes on Renewable Energy are offered. Short-term training and refresher courses are also being offered besides a large number of seminars, workshops, symposia and conference being organized on Renewable Energy and related topics every year. Some work has recently been initiated towards the development of vocational courses and courses for technicians and mechanics.

To Motivate Renewable Energy Education

We aim at improving the environmental and renewable energy awareness of young people for a sustainable development, and also, at the development of innovative approaches for the analyses and solution of problems.

We would like to achieve this by looking beyond the schools' curricula and by introducing modern environmental and energy management methods in Vocational High Schools. This increases the **methodological competencies of students** and facilitates their change from school to professional life. Students play an **active role in the systematic improvement processes** of the schools and are even eligible to be trained to become **environmental auditors**. The **modern internet-based learning methods and instruments** are highly attractive for the students and instructors. Teachers are profoundly consulted and accompanied in the field of **web-didactics**. An environmental and energy management system is a professional management instrument, which systematically directs the school organization as well as the processes and activities in the schools towards an environmentally friendly acting. All environmental media and material flows in the schools become transparent and the environmental awareness of those involved is improved. Previous experiences with Environmental and Energy Management System have shown that the consumption of resources and therefore costs can be reduced at the schools. In their every-day surroundings the young people learn about an environmentally friendly handling of resources and by means of out-of-school training forms they come to a positive attitude towards active citizenship engagement. All students have undertaken the steps for the introduction of an environmental and energy management system. Each step is described in detail and illustrated on the internal Learning Management System. The implementation has been realized by environmental teams consisting of both students and teachers. The necessary management skills have been transmitted in special compulsory optional environmental and energy classes or in optional environmental and energy trainings. Moreover, the schools have been realizing environmental projects involving different stakeholders such as students, teachers, parents and local organizations (environmental organizations and experts, energy suppliers etc.). Thus for example renewable energy resources were introduced to the students, whereby the environmental and energy groups provided necessary documentation and presented and explained the new concept in school meetings to all members of the school. In order to establish the comparability in the approaches, the teachers provided exemplary training units on the basis of a common pattern, which show how an environmental and energy management system can be introduced with students. The development of the blended learning approach (a mixture of face-to-face lessons and e-Learning) and the information-technological development is realised by the Training and Project Network. The Pedagogical Seminary of the University accompanies and evaluates the pedagogical development in the framework of the project on a European level. The environmental and energy contest will be developed by Environmental and Energy Management. These Joint Actions are about the possibility to do projects together in order to achieve synergy effects as it is intended in the resolutions of the programmes Socrates (general education), Leonardo da Vinci (vocational training) and Youth. In general these Joint Actions have to deal with subjects, which not exclusively are part of one of the areas general education, vocational training or youth. They favour an increasing cooperation between stakeholders of different sectors and fields of knowledge.

The learning material might be all kinds of office-files, like Word, Excel, PowerPoint, Pack and go-presentations, Access-data bases and other, but also small subprograms that do automatically start as web-based-training units on students computer, like flash-files. One further option to give illustrations is the provision of photo-files in all current formats, like jpg, gif-files. Further often used file-formats are PDF-files. Even small video sequences can be enclosed attached, like mpg-files. By clicking the particular file symbol you open the material online. In general it is advisable to save the learning material on PC, if necessary to print it as well.

Conclusion

It is essential to develop and implement a well-designed energy education program, including environmental issues oriented to formal and non-formal education in cooperation with all foundations dealing with energy before it is too late. A careful analysis of the course contents of many teaching / training programmes on new and renewable sources of energy reveals that more often than not the curriculums are strongly driven by the expertise

of available teachers rather than the inputs to be given to the students. A proper balance between theoretical and practical inputs is crucial for any renewable energy education programme. The laboratory component of renewable energy courses must ensure enough hands-on training of the students. There is an urgent need to develop suitable experiments which can be offered at different levels.

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