

Education for Energy Saving in the House

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Abstract: Most of the energy comes from fossil fuels, causing the emission of a huge amount of carbon dioxide and, thus, damaging the environment. Energy resources will have to be used in a more sustainable way to reduce resource depletion and environmental pollution, which can lead to global warming and climate change. Most of the energy is consumed in the home. Both in the European Union countries and in Romania, the residential sector represents a very important potential for reducing the energy consumption by introducing some efficient non-pollutant technologies and an advanced energy management. The electricity consumption in residential sector is mainly focused on the lighting and domestic appliances. The first step in realizing the energy saving potential is to inform and educate students and their families how using energy more efficiently or using renewable energy sources (RES) in the home can help to reduce greenhouse gas emissions and prevent climate change. Suitable resources have therefore developed in TREAM, (4.1031/Z/02-055/2002), KITH (EIE/05/183/512.421632) European projects and CREFEN Romanian research project to be used in educating both students and their families. The emphasis has been on saving energy by the more efficient use of existing household appliances, the purchase of more energy efficient models when these appliances have to be replaced and the use of RES in the home whenever possible. Here have been developed multi-lingual resources in 9 languages (www.eais.info and www.kyotoinhome.info) with an enlarged European appliance database accessible via Internet, with new product groups that have been energy labeled recently, modules which explain the origins and impacts of global warming, product labeling and energy saving in the home through using appliances more efficiently and a set of activities together with resource material suitable for use in primary and secondary schools throughout the EU.

Keywords: Energy efficiency, Renewable energy, Energy label, Database, Internet, Education

1 Introduction

Most of the energy comes from fossil fuels, which are diminishing resources and for this reason alone we must use energy more efficiently and minimize waste. In addition the combustion of fossil fuels releases vast quantities of carbon dioxide (CO₂) threatening the future of the global environment, because CO₂ will act as a potent greenhouse gas causing global warming.

Therefore we must adapt our lifestyle to one that is more sustainable with the ecological balance of our planet. Energy consumed in homes account four greatest use of energy. Consciously changing our daily routines could produce large energy savings. By choosing energy efficient appliances, appliances with an A++, A+, A or B

energy rating we will contribute to a reduction in the worlds energy usage.

In December 1997, in Kyoto in Japan, the historic "Kyoto Protocol" was approved. It specified quantitative targets of limitation and reduction of anthropogenic Green House Gases (GHG) emissions for developed countries and economies in transition.

According to Kyoto Protocol, developed countries and economies in transition - Parties of the Protocol - are obliged to reduce their emissions of greenhouse gases not less than by 5% in average (comparatively to levels of 1990) by 2008-2012.

The European Commission has also adopted two important documents: "Green Paper on Energy Efficiency or doing more with less" and "Green Paper on European Strategy for Sustainable, Competitive and Secure Energy". These documents consider that the lack of information is the main bottleneck for the energy efficiency.

Through the Law no 3/2001, Romania ratified the Kyoto Protocol and then the implementation of the measures established by the Kyoto Protocol continued, aiming at 2 essential objectives: reduction of the emissions with 8% in comparison with 1989, for the period 2008-2012, and adopting a set of market mechanisms in cooperation with other countries.

The electricity consumption in domestic sector has a continual tendency of increasing at the international level. In Romania, this consumption reaches 8,2 TWh in 2003, that represents 22% of the final energy consumption. The consumption per habitant has reduced values (356 kWh/habitant comparatively with 1600 kWh/habitant - the medium consumption for the EU member states), so that the tendency of growing will continue and increase. It is essential that this increasing to be achieved in terms of efficiency [1].

The National Strategy in the energy efficiency field adopted by the HG 163/2004 underlines that the residential sector has a primary energy saving potential at 3.6 millions tones equivalent petrol through 6.8 millions tones of the total final consumers; it means more than 50%. This potential can be capitalize by the buildings heating rehabilitation, the improvement of the heating and lighting systems and of the electric domestic appliances.

The Government Program on the following years 2005-2008 states the necessity to accomplish the legislative and institutional frame in order to apply the flexible mechanisms adopted by the Kyoto Protocol, to pursue the implementation of the technical and economical measures for the reduction of the greenhouse gases (GHG) emission, in accordance with the features of the National Plan for the Allocation of the Emission Quotas, the development of the National Plan for

the Climatic Changes Action, the improvement of the energy efficiency and the promotion of the renewable energy sources.

In this frame and in accordance with the EU policies, there is a priority for Romania "To remove the non technological barriers by the market formation and education", by developing:

- Campaigns at the national levels for the people education and information concerning the energy efficiency concept, the significance of the energy efficient electric appliance choose (related with the appliance energy label), the opportunities to obtain important reductions of the energy consumption in residential sector with low levels of their costs;
- Education and information campaigns in general and high schools, universities and even children gardens concerning the energy savings.

According to the Green Paper on Energy Efficiency [2] major appliances, all together, have the greatest potential of energy savings, between 10 and 35 TWh/yr less energy used in 2010 in EU due to the new efficient technologies already on the market and mainly by replacing the outdated appliances from households.

2 Problem Formulation

2.1 Web-based applications to improve energy efficiency in the home. State of the art

Appliance usage is increasing within the EU Member States as living standards rise and manufacturers produce more household appliances. EU citizens now spend some 15 billion euros per year on buying appliances and 8 billion euros on operating them. The electricity consumed by appliances amounts to more than 100 TWh per year which results in more than 50 million tones of carbon dioxide emissions to the atmosphere. The only way that this increased energy consumption can be contained is if the energy consumption per appliance can be decreased and appliances used more efficiently.

The EU has introduced two labels that can be used for appliances – the energy label and the

ecolabel. The energy label is mandatory and displays information that can be used to compare the performance and efficiency of various models: it also enables the annual average operating cost to be calculated for each model. Choosing an energy efficient appliance is one way to do this while saving money [3].

The Environmental Protection Agency (EPA) and the DOE maintain a joint *Energy Star Web* site at www.energystar.gov. The Web site gives consumers an interactive search capability for energy saving appliances. The on-line "Calculator" feature allows consumers to customize their calculations for an estimate of savings from Energy Star products compared to typical appliances.

The Energy Labeling - *Energy Rating site* from Australia (<http://energyrating.gov.au/>) contains various details including energy efficiency and star ratings for a range of electrical appliances that carry an energy label. The consumer can use this website to select an energy efficient electrical appliance.

HomeSpeed (<http://www.homespeed.org/>) is a pan European database for energy efficient appliances for household equipment (white goods), consumer electronics and office equipment. The database provides information about the brand name (manufacturer, model name), availability in several European countries and the latest energy related information.

Topten (www.topten.ch) is a consumer-oriented online search tool which presents the most efficient appliances in various categories of products (household appliances, office equipment, consumer electronics, lighting and cars...).

2.2 Potential for appliance energy savings

Households in the EU consume more than 100 TWh per year. If one assumes a similar savings potential for the Member States, then the potential appliance savings for the EU could be as high as 34 TWh per year resulting in a reduction of 17 million tonnes of CO₂ per year. These savings are achievable using products that already exist and

do not require any further improvements in technology.

The potential energy savings is 33% for Romania, where average electricity usage/year is 2,400 kWh and average potential energy savings are 800 kWh.

Information and education are key to realizing this potential:

- resources can help with identifying not only where energy is used in the home but also the potential savings of various appliances;
- manufacturers and retailers can ensure that consumers consider energy efficient appliances when replacing their existing appliances which requires an understanding of the importance of lifetime cost and emissions;
- utilities and energy advisers/agencies can help by providing information and organizing education campaigns. Utilities could provide financial incentives where appropriate to investing in energy efficient appliances as part of managing their demand.

The school is the most important source of information and therefore crucial in raising awareness in families. The introduction of product labeling like the EU energy label has allowed products to be identified which are more energy efficient and perform better. Consequently resources for teachers and students have been developed which discuss the reasons for saving energy and also how energy can be saved through a series of practical activities.

It is important to raise awareness of the potential for saving energy in the home among parents as well as students. Whilst some of the resources developed for schools are also suitable for parents, additional information is required and in a different format.

3 Problem Solution

An *web-based application* has been implemented with the goal of enabling European citizens to access, via the Internet, energy and performance information for 12 household appliances sold several EU countries. The system is based on

information contained within the Energy Label and its associated Fiche.

The application is designed to perform the data supply and application layer onto the server side in the backend. Only the presentation is left over to the client computer. The clients will use a traditional web browser requesting the dynamic ASP pages over the server.

The server is a standard PC. The software used is Windows 2000 Server as operating system and MS-SQL Server 2000 as DBMS to develop the database. The interface was developed in Macromedia Dreamweaver, Java script and ASP (Active Server Pages). The architecture contains a firewall (who processes every network request for server, ensuring the system with a higher security level and also protecting the database).

The database includes white goods appliances currently stocked by the manufacturers or by the retailers, energy efficient models (A-C) manufactured by the suppliers of Romania, consumer electronics and office equipment and appliance groups which have recently been labelled such as ovens, lamps and room air conditioners.

The main functions of the web-based application are:

1. The Web-Interface for Data Acquisition: can be accessed for the users on the base of an ID and a password. After the authentication, the authorized user can choose here one of the web forms designed for data acquisition, specifically for each electrical appliance: fridge/two doors deep freezer, fridge/one door deep freezer, fridges, chest freezer, upright freezer, washing machine, washer drier, tumble drier, dishwasher, air conditioner, oven, luminaire (lamp). After the addition of equipment characteristics, the user can introduce data in the same form or go back to the web-page for choosing of another form. The validation of the data included in the web form is made function of the type of the fields.

2. Selecting energy efficient appliances: The EU label and fiche allows one to select a model in terms of its characteristics such as size or volume, performance, energy and water usage. This

information is stored in a database which can be consulted once you have defined your specific needs. The search mechanism in the database is perhaps the most useful service. Searching can use one or more criteria:

- Appliance selection criteria in terms of: Type, Size, Performance and Price Range. These parameters narrow the resulting set of appliances. Some useful hints help the user and assist selection.
- Manufacturer: useful when searching for the whole group of an appliance of one manufacturer.
- Product name: used when searching for a specific appliance.

3. Database outputs: Based on the searching parameters, the search mechanism generates a list of matching appliances along with all the data set that is stored in the database. The search output is listed in tabular form containing groups of 5 products plus the typical 10 years old model. For each appliance the following general information is provided: manufacturer/model, size, energy efficiency class, energy consumption and some specific information characterizing a group of appliances. The models are listed in order of lowest to highest energy consumption. The user has to select at least one product to see Lifetime Costs and Savings.

4. Lifetime cost: The lifetime cost is calculated based on usage of electricity, water and detergent (where applicable) and compared with the operating cost of a typical 10 year old appliance. This indicates how much energy and money you can save with a new appliance and what contribution this will reduce greenhouse gas emissions. This module is perhaps the most important of the system because it offers information about the energy efficiency of the appliance based on a 15 years lifetime.

The user can see both lifetime savings financial and lifetime savings CO₂ (Fig. 1). Energy efficient appliances have a lower running cost because they have been designed to use electricity, water and detergent more effectively [4], [5]. This lower running cost can offset part or all of the higher

initial cost. The comparison is made not only between the 5 products presented on the screen, but also with an typical 10 years old model. The user can then obtain detailed information about a specific model.

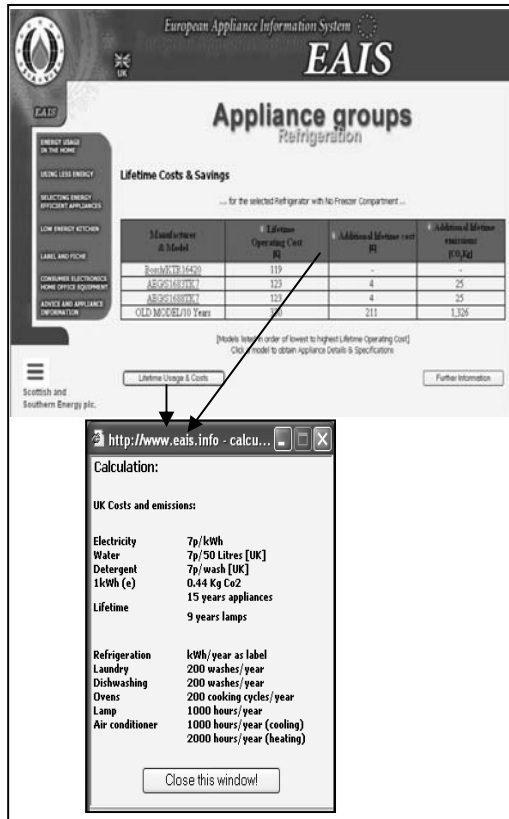


Fig.1 Lifetime cost calculation

Practical activities for schools have been developed to explain and illustrate one or more of the key themes of energy usage and savings in the home. The activity themes are: What is energy, Electrical energy sources, Greenhouse effect, Kyoto protocol, Energy savings in the home, Energy usage in the home, Using efficient energy appliances and Renewable energy.

These activities were then trialled in various types of schools with students of a range of ages and abilities, using the eBook available on Internet. Activities are suitable for both primary and secondary schools and can be given in any appropriate class, and in any type or size of school.

Activities are planned to be the core elements of the lessons. Every lesson should include one or

more activities. Activities are planned to be the core elements of the lessons. Every lesson should include one or more activities. For each activity there is resource material providing background information for introducing the subject, worksheets for students (downloadable from Internet) and notes for teachers. The work is done in small groups, discussing and helping one another, and exchanging information. The Role of the teacher consists in introducing the topics, helping the groups, discussing the outputs with the pupils, and summarizing and evaluating the results.

The topics are relevant, timely and of interest to both students and teachers. The resources proved to be suitable for dissemination. A number of barriers have been identified which will need to be addressed:

- the rearrangement of schedules to find the time to teach the lessons (optimal – 5 one hour lessons);
- the lack of teacher confidence to introduce such broad topics, especially using Internet;
- the agreement and encouragement of head teachers and local education authorities for teachers wishing to teach these topics;
- the integration of the topics and activities into existing lesson plans.

Ideally, every student should be introduced to these topics at least once in primary school and again in secondary school. Not only would their understanding be enhanced, but also the concept of individual behaviour having global implications would be reinforced.

The following resources have been developed for families:

- an appliance energy survey in the form of a spreadsheet downloadable from the EAIS website which can be used to quantify the potential savings due to appliance use;
- information on how to reduce domestic electricity bills;
- an updated appliance database with a suitable set of search criteria for each EU labeled product group.

The starting point of any survey is to examine the electricity bill and how energy consumption and tariffs are interrelated. Due to the high level of electricity price, there is a better incentive to encourage energy savings. Electricity bills including room and water heating are more difficult to interpret as these appliances have not yet been energy labeled. In addition, the heat loss of the dwelling is not considered within these resources. Thus the survey has concentrated on those appliances which are energy labeled as the potential savings can be quantified.

The energy survey calculates the energy consumption based on information entered by the family and can be completed on or off-line. The program then calculates the potential savings for each appliance group for a typical month. By this means it is possible not only to identify the appliances using the most energy, but also which group has the highest savings potential.

Analysis of the completed surveys allows the following conclusions to be made:

- the survey can estimate the consumption quite accurately if time is taken to fill in the form correctly;
- wide variation in usage reflecting family size, occupancy, age and appliance use;
- potential energy savings is not directly related to energy consumption;
- the nature of the possible savings varies in each household;
- statistical data on appliance use and age and on the use of low energy light bulbs.

4 Conclusions

Information and education are key to realizing this potential for appliance energy savings:

- resources can help with identifying not only where energy is used in the home but also the potential savings of various appliances;
- manufacturers and retailers can ensure that consumers consider energy efficient appliances when replacing their existing appliances which requires an understanding of

the importance of lifetime cost and emissions which are available via the EAIS database;

- utilities and energy advisers/agencies can help by providing information and organizing education campaigns. Utilities could provide financial incentives where appropriate to investing in energy efficient appliances as part of managing their demand.

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