

## INTELLIGENT USE OF ENERGY IN ENGINEERING EDUCATION

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**Abstract.** The concept „sustainable development” has become important in connection with alternative energy resources, current problems of environmental protection and the security of resources. People who are not directly involved believe that these issues do not concern them. With the purpose of raising awareness of the problem, it is important to integrate it in the education, particularly engineering education. The process of “saving the world” should be started with looking at ourselves. People’s behavior and habits have caused extensive energy consumption. The main reasons are, firstly, the lack of the knowledge of effective energy saving measures, and, secondly, people are not willing to change their habits. The authors of the paper carried out the research regarding the Latvia University of Agriculture engineering students’ basic knowledge of the renewable and non-renewable energy resources, effective energy use in the transport, industry and building, and energy saving measures. In order to encourage youngsters to change their habits regarding saving energy, it is advisable to involve students in various research projects on energy use at the university and at home, reflecting the findings in the term papers, research projects as well as in the presentations of “C” part study courses.

**Keywords:** engineering education, intelligent use of energy.

### Introduction

One of the features of the competitiveness of the country regards the development of the knowledge-based society, the main component of which is an educated and competent individual. The labour market demands qualified engineering staff with the sense of orientation in the cutting edge research, modern technologies and materials. This is a new challenge for engineering education. However, engineering education could not be separated from social life and problems. One of the most essential current problems is global warming and effective energy use. They concern everybody on the Earth, but engineers and future engineers need competence in understanding, know-how and problem-solving.

The authors of the paper have been involved in the international project “IUSES - Intelligent use of energy at school” that includes 14 countries. The project aims at promoting a more efficient way of using energy in everyday life among secondary schools students and teachers. From the digital alarm clock in the morning to the light one switches off before sleeping, the daily life is marked by constant use of energy. All of these cause CO<sub>2</sub> and other pollutant emissions as well as money expenditures. People usually do not reflect on their everyday actions very much: turning on the light, driving, taking a drink from a fridge. However, small changes in people’s behavior can lead to significant energy savings and a major reduction in emissions. IUSES is a team-work for developing a behavior-oriented educational package including: handbooks, multimedia animations and experiment tool-kit. The educational package is freely available for downloading from the project’s web site.

Such projects are implemented in various European secondary schools, therefore the situation at the tertiary level especially in engineering programmes is of interest. Are engineering students aware of the basics of renewable and non-renewable energy resources, alternative fuels, energy saving measures in buildings, the application of renewable energy resources in heating systems etc.? The study programmes contain study courses that touch upon the above mentioned themes, however, do students have sufficient knowledge? Has this knowledge changed their habits? What themes should be included in the programme, what aspects should be focused on during the studies at the university?

### Theoretical discussion

**Sustainability.** In connection with the discussion about alternative energy sources, environmental protection and security of supply especially one term became popular, sustainability. Sustainability nowadays is often used for different aspects of human life. The Brundtland Report [1] defined sustainable development as “...meeting the needs of the present without compromising the ability of future generations to meet their own needs”. Throughout the goals of the Agenda 21 [2] it can be understood that the sustainable development has to be a general approach, but is often falsely only linked to environmental issues. The sustainable development has to follow social, economic and

environmental principles. Concentrating only on one or two aspects does not lead to sustainability in general.

**Global warming.** Global warming maybe is one of the best known global problems with economic, social and environmental consequences that are discussed on an international basis. The main reason of global warming is the increasing of greenhouse gas concentrations (carbon dioxide, methane and nitrous oxide). Increasing of greenhouse gas emissions depends on human activities: burning of fossil fuels for electricity generation, transport, industry and households, agriculture and land use changes like deforestation, land filling of waste, use of industrial fluorinated gases. Global average temperature has increased by almost 0.8 °C and by about 1 °C in Europe. From 1995-2006 the warmest temperatures since 1850, when instrumental record of global surface temperature started, are observed. Global temperatures may increase further by 1.8 to 4 °C by 2100 [3].

Students should be aware of the main energy concepts, units of energy, and such energy types as Thermal Energy, Magnetic Energy, Chemical Energy, Nuclear Energy and Electric Energy. Energy resources can be divided into two main categories: renewable and non-renewable energy resources. Currently, the main energy sources used by humans are non-renewable. However, young people should turn their attention to other options, namely, renewable energy sources which include bio fuel, hydropower, wind power, geothermal power.

**Transport.** In everyday life people depend on transport. As shown in Figure 1, not only air pollution and noise are significant influences based on transport, traffic contributes also a big part to climate change, for example, through CO<sub>2</sub> emissions. Looking at the transport sector, one should also think about hazards connected with traffic. Thus students should be aware of traditional and alternative fuels. Since 2000, the European Union has started addressing the issue of replacing conventional transport fuels (gasoline and diesel) with alternative fuels, in order to meet its commitments related to climate change (reduction of greenhouse gas emissions), to environment-friendly security of power supply and to promoting renewable energy sources.

Hence, the EU have decided to replace more than 20 % of the conventional automotive fuels by alternative fuels until the year 2020, through its green paper “Towards a European Strategy for the Security of Energy Supply”, issued in 2000 [5]. The alternatives seen as most promising by the Commission are: bio fuels (8 %), natural gas (10 %) and hydrogen (5 %).

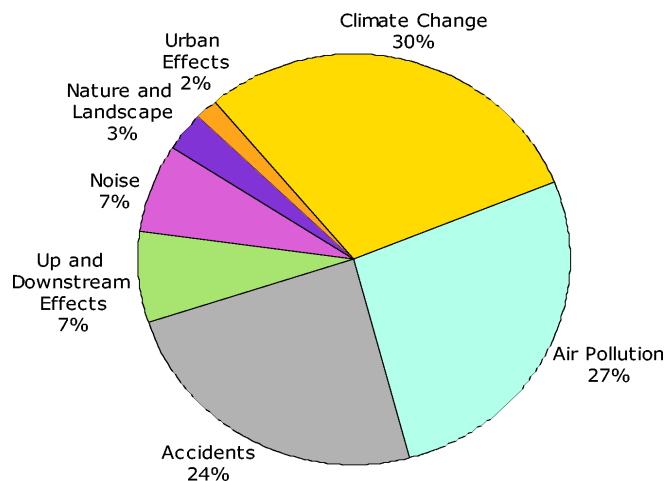


Fig. 1. Consequences of using transport (in terms of costs) in Europe, 2004 [4]

Recently such means of transport as bicycles, skateboards, roller-skates and “walking” have been considered as alternative vehicles promoting not only environment-friendly means of transport but also a healthy way of life that could be of interest for young people who prefer an active way of life. One of the alternative sources of energy for vehicles is electricity, the main elements of which are batteries. Electric vehicle batteries are rechargeable batteries used in whole electric vehicles or in plug-in Hybrid-Electric Vehicles.

**Buildings.** Recent answers to the challenge of sustainable development call for an integrated, synergistic approach that considers all phases of buildings’ life cycle. This “sustainable” approach

supports environmental concerns and results in an optimal balance of cost, environmental, societal, and human benefits while meeting the mission and function of the infrastructure. The main objectives of sustainable design are to avoid depletion of energy, water, and raw materials; prevent environmental degradation throughout their life cycle; and create built environments that are comfortable, safe, and productive. Building structures, e.g., an envelope and insulation and building materials influence energy efficiency.

One of the biggest energy consumers is climatization (heating and air conditioning), the main task of which is to maintain the thermal comfort in the internal space of the building. Heating systems have a great influence on energy consumption and they could be classified according to the source, type of heat carrier, temperature of the heat carrier, type heating element etc. The energy sources could be divided into fossil fuels, electric energy and renewable sources that include, for example, biomass, heat pumps, solar energy.

**Lighting.** Day lighting (through windows, skylights, etc.) has to be used as the main source of light during daytime in buildings where people live or work. Intensity of the light (illuminance) should react to the visual activity. This is closely connected with electric input and consumption of artificial sources of light; higher intensity – higher input and higher consumption [6]. It is possible to save 60-80 % of energy with replacing bulbs by fluorescent lamps. The simplest and most obvious way to eliminate useless energy consumption is to switch off lights when not necessary [7].

In Europe, consumption by all electrical appliances and lighting represents about 55 % of the electricity used by households. The appliances include the six large consumers of electricity (refrigerators, freezers, washing machines, dishwashers, TV and dryers), and many small appliances (see Figure 2). The choice of electric appliances and lightning depends on people.

The energy used by the electronics at people's homes should be minimized. It should be taken into account that home electronic equipment and entertainment and home office devices are increasingly being employed more and more hours a day. Their energy use often goes unnoticed; instead, an estimated 10 % to 15 % of all electricity used in European homes can be attributed to them [9]. The simplest and most obvious way to eliminate power losses is to unplug products when not in use [10].

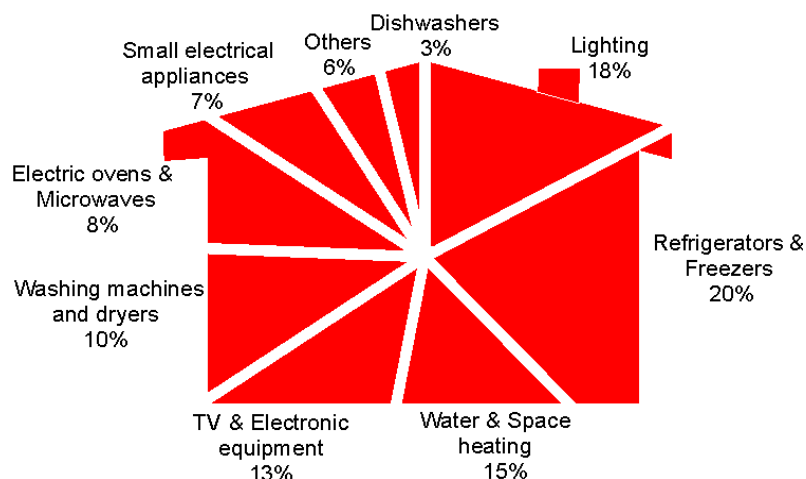


Fig. 2. Home electricity consumption [8]

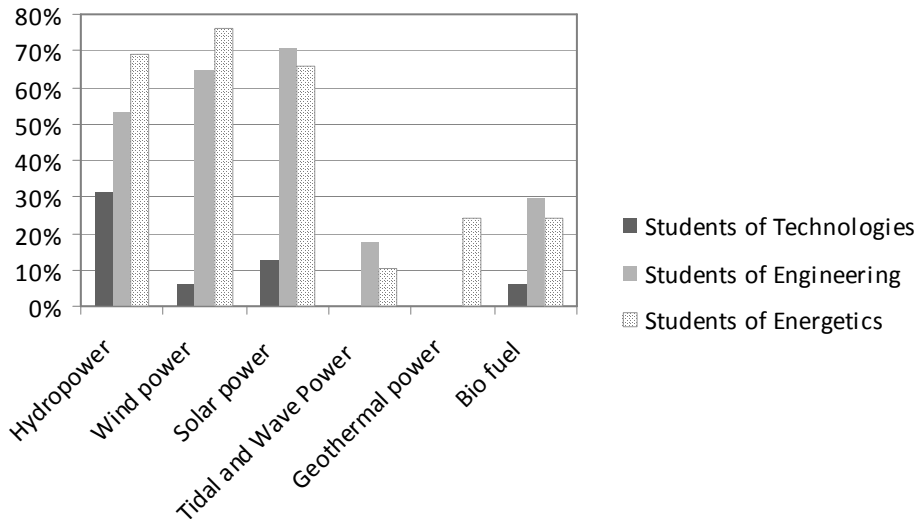
### Materials and methods

As the method of research the small scale survey of the 1<sup>st</sup> and the 2<sup>nd</sup> year students, the Latvia University of Agriculture, was used. The total number of participants was 152, the Faculties of Engineering (specialties of engineering and energetics) and Information Technologies were involved. The questionnaire contained 10 open-ended questions in which students had to show their knowledge regarding the intelligent energy use at home and in educational institutions as well as renewable energy resources. The purpose of the survey was to identify the students' knowledge, interest and attitude towards effective energy use. The questions touched upon saving energy in peoples' every day

life, the use of renewable energy sources for heating, transport and operating of various kinds of equipment.

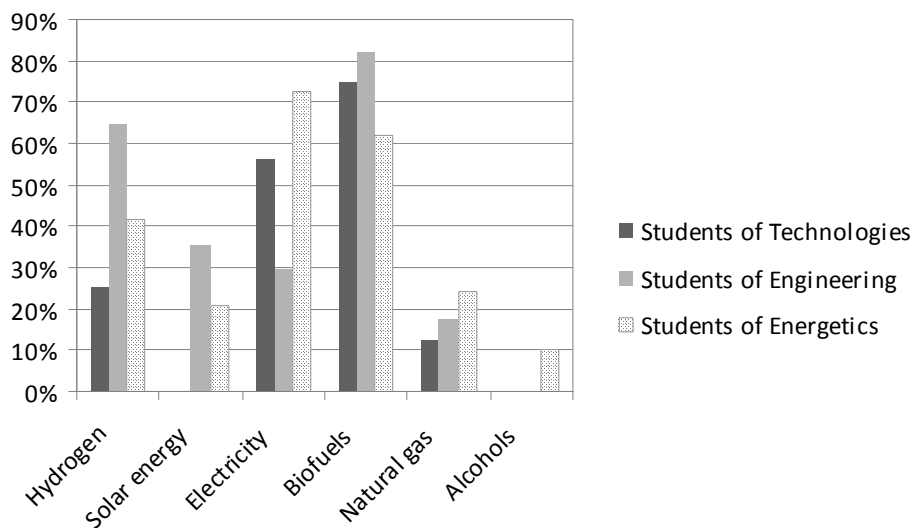
**Results and discussion**

Regarding the question about the renewable energy (see Figure 3), approximately 70 % of the students can name the sources of hydropower, wind power and solar power, but much less number of students are aware of such energy sources as tidal and wave power, geothermal power.



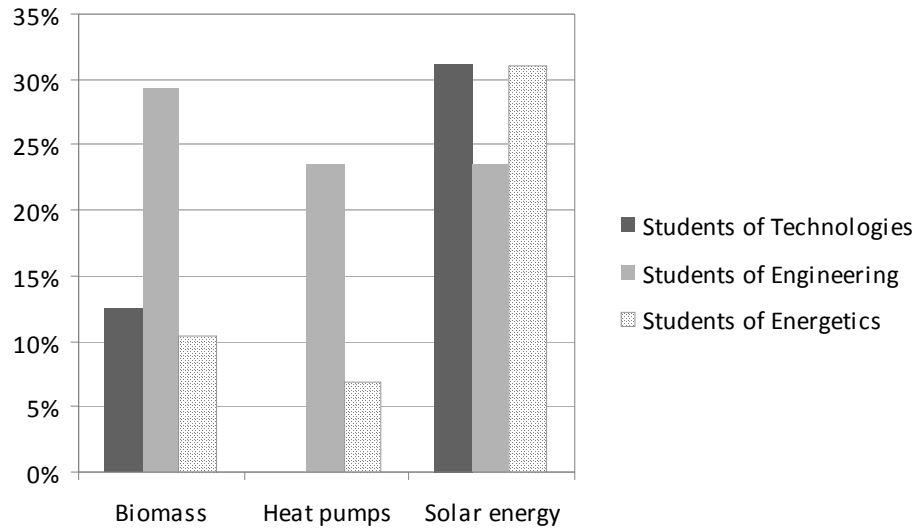
**Fig. 3. Students' knowledge regarding the renewable energy sources**

As regards the negative consequences of transport and their prevention with the help of alternative fuels, the best known alternative fuels by students are biofuels and electricity (approximately 70 % of the students), the least known are alcohols, natural gas and solar energy (see Figure 4).



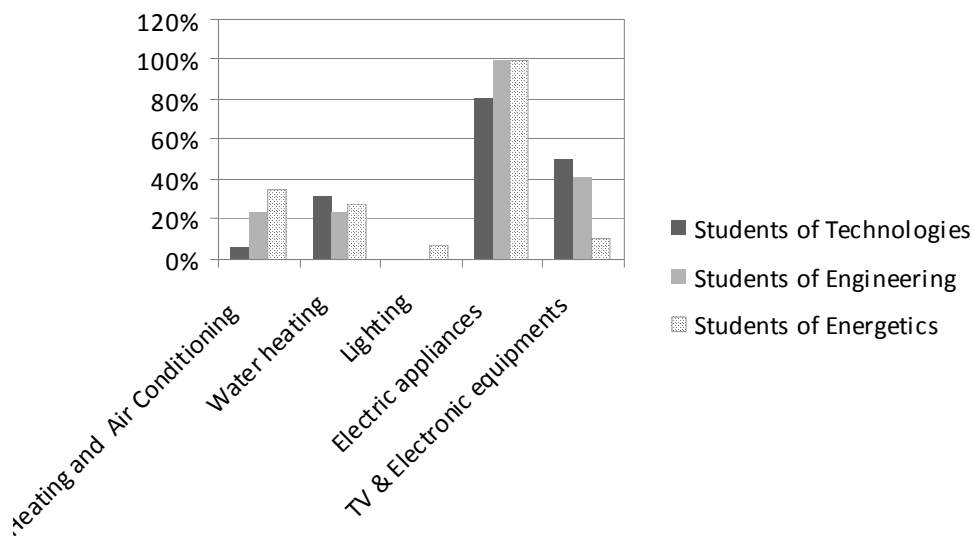
**Fig. 4. Students' knowledge regarding alternative transport fuels**

One of the key energy saving measures refers to energy saving in buildings. The results show that students are not interested in the use of renewable energy sources in heating systems since only about 30 % of students know about the use of solar energy in heating systems, but even less students are aware of the use of biomass and heat pumps (see Figure 5).



**Fig. 5. Students' knowledge regarding the use of renewable energy resources in heating systems**

As concerns students' knowledge of energy consumption by electric and electronic devices, almost 100 % of students have named electric home appliances, but it has occurred to very few students that lightning consumes electricity as well (see Figure 6).



**Fig. 6. The results of the survey regarding electric devices and electronic equipment that consumes energy at home**

Students' knowledge regarding the ways of minimizing the energy consumption by devices is insufficient (see Figure 7), it could be explained by the fact that the electricity bills are paid by parents since less than 40 % of students of engineering have heard of energy efficient devices, but none of students of Information Technologies mention them. Only about 50 % of students and less consider that devices should be used with purpose or should be disconnected when not used. Only few students mention motion sensors for switching on and off lightning.

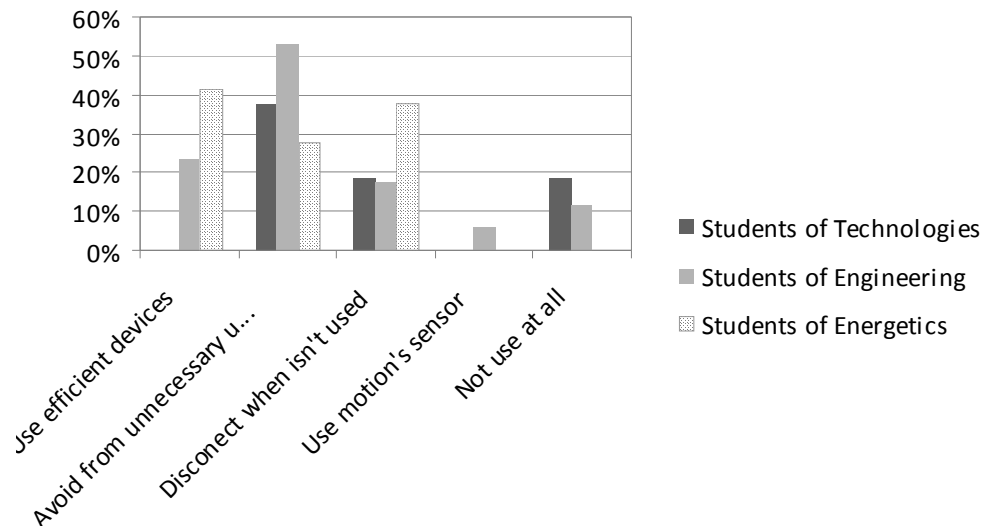


Fig. 7. The results of students' survey regarding minimizing the energy consumption at home

## Conclusions

The results of the survey show that the Latvia University of Agriculture students' knowledge regarding effective energy use is insufficient. Partly it could be explained by the low students' interest in these problems because paying bills does not concern them. The students' answers highlight young people's attitude towards global problems, which do not directly concern them. Certainly engineering students will touch upon the issues of intelligent energy use in certain study courses, however, it is not clear if habits of saving energy will become their conviction. Therefore, the issues of intelligent energy use require additional attention, either developing a new study course or integrating this theme into other subjects, including foreign languages.

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