

ENERGY EFFICIENCY – COMPONENT OF THE SUSTAINABLE DEVELOPMENT

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Rezumat. *Eficiența energetică a devenit o necesitate economică, exprimată concentrat prin condiția de reducere a ponderii cheltuielilor cu energia în cadrul costurilor totale de producție. Potențialul estimativ de economie de energie pentru diverse sectoare industriale variază în domeniul 10 - 50%. În cadrul lucrării s-a explicat semnificația și importanța eficienței energetice și s-a trecut în revistă potențialul de creștere a acesteia în diversele sectoare industriale, precum și direcțiile principale de creștere a eficienței energetice. Majoritatea pachetelor de măsuri de creștere a eficienței energetice au drept consecință imediată și reducerea impactului asupra mediului. Esența unei politici energetice corecte constă în realizarea unui echilibru între cererea și oferta de energie în condiții suportabile din punct de vedere economic, social și ecologic. De asemenea, s-a prezentat cadrul legislativ pentru susținerea acțiunilor de promovare a eficienței energetice.*

Abstract. *Energy efficiency has become an economic necessity, expressed by the condition of focused energy cost reduction in the share of total production costs. Estimated potential energy savings for various industrial sectors is in the range of 10-50%. In this paper has explained the meaning and importance of energy efficiency and has reviewed its growth potential in various industrial sectors and the main directions of increasing energy efficiency. Most packages of measures to increase energy efficiency have the immediate result and reduce environmental impact. The essence of the right energy policy is to achieve a balance between energy supply and demand conditions of the economically affordable, socially and environmentally. It was also presented the legal framework to support actions to promote energy efficiency.*

Keywords: Energy efficiency, energy saving, energy policies

1. Energy efficiency – semantic, importance

Development with the highest efficiency of all categories of resources (material, human, financial, etc.) is a current requirement for both production and unproductive activities. Among the categories of resources listed above, the material ones are not only expensive but also finite, which constitutes an additional argument in favor of their use with maximum efficiency. The energy resources are an important part of the material resources, which became notorious

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after the so-called oil crisis that hit the economies of the industrialized countries that imported primary energy carriers during the eighth decade of the last century. The reactions of the developed countries, initially unrelated, were materialized over the next decade and took the concepts of alternative energy development, renewable energy, energy management and energy efficiency.

The energy efficiency increase within a given outline, inside which a profitable activity takes place, is a requirement stemming from the more general need that the respective activity to bring a maximum benefit to those who have invested money in it. The energy costs, also known as the energy bill, are part of the total expenditure involved for the satisfactory accomplishment of the work performed within the analyzed boundaries. They represent all the effort for the acquisition and / or production within the perimeter of all the energy forms necessary for the end-use processes. If an unprofitable activity is conducted within the outline, this requirement is limited to minimizing the costs and possibly to their bordering in certain preset limits. It is generally considered that an activity is more energy-effective as the inventoried energy losses within the outline of the respective activity are lower. The concept of energy efficiency gains an actual character and content only if it is related to a well-defined outline and to an activity that takes place in an organized manner within this outline [1].

Historically, the syntagma energy efficiency appeared in the English vocabulary as a necessity imposed by the reality of the dramatic increase of the energy carriers' prices without being defined and theoretically substantiated by the specialists. Currently, the notion of energy efficiency has two meanings. Narrowly, the concept of energy efficiency has the meaning of energy performance. In this context, the increase of energy efficiency results in energy savings. More broadly, the concept has the same meaning as in English, being related to the requirement of reducing the energy bill amount or the energy specific expenditure [2].

Naturally, saving energy results in the energy bill reduction, but one may face situations in which the bill can be reduced while energy consumption within the analyzed outline remains unchanged, and vice versa. The two meanings are not so very different, the broader sense of the concept including or fundamentally involving its narrow meaning. The broad sense of the energy efficiency concept is perfectly compatible with the market economy. The analysis of energy efficiency in a given area begins by specifying the qualitative and quantitative aspects. Within the context of sustainable development, the energy efficiency is an issue of general concern for the efficient use of all resources, caused by their finite nature awareness. The practical effect generated by this situation was the response of the industrialized and developing countries to the prices increase of the non-renewable material resources. The concern related to the environmental pollution

mitigation had lately a similar effect. The need to reduce the pollutants discharged into the environment is a consequence of the legislation and regulations emerging in the developed countries, obliging those who still pollute the environment, to pay substantial damages. Taking into account that pollution is, in many cases, a consequence of natural or synthetic fuels, there is now a direct link between energy efficiency and environmental quality.

2. The potential for energy efficiency increase

Table 1 shows the estimated energy saving potential for some industrial sectors. There is a variation of the energy savings growth potential ranging between 10 and 50% [3].

Table 1. Estimated energy saving potential for some industrial sectors

<i>Industrial sector</i>	<i>Estimated energy saving potential</i>
Metallurgical industry	20 – 45 %
Chemical industry	25 – 40 %
Oil industry	30 – 45 %
Cement industry	10 – 50 %
Food industry	25 – 45 %
Glass manufacturing industry	30 – 40 %

The production costs for an industrial company include raw material costs, operating and maintenance costs and energy costs. The energy costs have a significant share, depending on the industrial sector specificity, and can reach up to 70% of the total costs. As the share of energy costs from the total costs is higher so the energy resource management becomes more important. Thus, Table 2 illustrates the variation of the energy cost share from the total costs for different industries [3].

Table 2. The energy costs share in the total costs for several industrial sectors

<i>Industrial sector</i>	<i>The energy costs share in total costs</i>
Cold production	70.0 %
Cement industry	55.0 %
Ammonia production industry	50.0 %
Aluminum production industry	30.0 %
Steel industry	30.0 %
Glass manufacturing industry	30.0 %
Chemical fertilizer industry	25.0 %
Paper industry	25.0 %
Ceramics industry	20.0 %
Metallurgical industry	15.0 %
Textile industry	12.5 %
Food industry	10.0 %
Oil industry	7.5 %

3. Main directions of energy efficiency increase

The technical solutions for the energy efficiency increase currently derive from the change in the overall perception of how the energy could be rendered profitable in a given outline (enterprise, production line, plant, equipment) [4].

The projects developed to increase the energy efficiency include rationalization, changes and even replacement of some parts of the energy consuming facilities.

Taking into account the above mentioned the following action directions summarized in “packages of measures” result:

- changes of the supply solution and / or of the concept of energy use within the enterprise;
- partial or total replacement with electricity of the fossil fuel or imported heat supply (from outside the company balance outline) for some heating processes, based on a certain saving of the energy expenditure per unit of product;
- energy losses reduction for the existing industrial outline;
- advanced recovery of the energy resulted from the technological process (especially of the heat), based on new types of heat exchangers;
- changes of the technological process within the considered industrial entity;
- changing of the energy flow nature taken from outside;
- changing of the energy conversion and/or distribution way;
- replacement or addition of some subsets from/in the existent industrial outline;
- implementation of new techniques and procedures;
- reduction of the environmental pollution, especially when it is related to the natural or synthetic fuels use;
- implementation of the computerized energy management system for a series of energy consuming installations, also known as Monitoring & Targeting (M&T) system. The energy efficiency continuous or periodic monitoring and evaluation system (M&T) is designed as to self-improve step by step, on the condition of the human factor sustained interest and commitment at all levels of government [5].

The energy management within an industrial outline requires deep knowledge of the activity performed inside these boundaries, the monitoring (supervision, registration, control) of each energy carrier consumption, the analysis of their

energy capitalization, and ultimately the improvement of the energy use efficiency within the respective outline. With an unquestionable multidisciplinary character, the method includes technical, organizational, economic, design, operational and information transmission and processing procedures.

The most packages of measures to increase energy efficiency have the immediate consequence of environmental impact reduction, but apart from these, there is a category of measures directly aimed at environmental protection, especially when pollution is due to energy consumption. The measures taken to reduce the pollutant emissions do not result in direct energy or costs savings; in many cases they could have an opposite effect. In these cases, indirect benefits may arise from the waiver for the purchase and installation of expensive gas, wastewater or other pollutants treatment plants, as required by in force regulations. The previously mentioned action directions are not totally independent of each other. They can combine and complement to obtain the aimed result [6].

4. Energy efficiency – a current priority of the society

In the recent years, both governments and people have understood and realized the need for energy conservation measures and for energy bill decrease. The experience gained so far has shown that in order to achieve a high level of energy efficiency, an organization must use the latest technologies and the available human potential.

The essence of the right energy policy is to achieve a balance between the energy supply and demand in economically, socially and environmentally affordable conditions.

The energy resources are an important part of the material resources, which became notorious after the so-called oil crisis that hit the economies of the industrialized countries that imported primary energy carriers during the eighth decade of the last century. The reactions of the developed countries, initially unrelated, were materialized over the next decade and took the concepts of alternative energy, renewable energy, energy management and energy efficiency. All these concepts have had an undeniable practical character and beneficial effects on all the economic activities of these countries [5].

The disconnection of the consumption from the economical growth is the energy policy common tendency, which seeks to reduce the energy sector negative influences on the environment and social life. Among the action directions recommended in the latest documents, energy conservation, energy management and promotion of new renewable energy sources are included.

The energy efficiency should be a constant concern and a priority for any organization (enterprise, company, society, etc.) management, in order to reach a high level.

The improvement of the energy efficiency requires:

- to identify the energy losses;
- to establish the most profitable measures to eliminate the losses;
- to preliminarily estimate the costs and profits of the chosen methods;
- to find the most convenient financing sources for the respective projects.

Until recently, the attention of all decision makers was concentrated on the supply, which favored the irrational consumption and triggered the energy crisis situations with global repercussions. In the past twenty-five years, the stakeholders have understood the need to change the approach on the energy problem. A new type of energy policy clearly appeared, having as priority action directions the energy conservation and the promotion of the renewable energy.

The regulations based on which the current promoted energy policies are developed stipulate:

- financial support for demonstration and pilot projects in this area;
- promotion of the research and technological development in this field;
- free technical assistance for new technologies implementation;
- rapid dissemination of the positive results;
- support for staff training;
- support for experience exchange, international relations and contacts.

It is recommended that the regulations for energy conservation to be individualized by areas and target groups. Thus, the regulations must be designed to distinctly report to different sectors: industrial, tertiary and residential.

Depending on the nature of the energy receivers, the energy efficiency regulations may relate to installations, equipment, appliances and buildings.

The purpose of the regulations aimed to increase the energy efficiency, is to promote and stimulate innovative approaches and mechanisms such as:

- consumer energy management;
 - development of the energy efficient technologies;
 - promotion of the new and renewable energy sources;
 - development and diversification of the energy efficiency services;
 - professional training and education for energy efficiency;
 - promotion of the energy efficiency international cooperation programs.
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The development of the specific regulations for energy savings encouraging and promotion in any area is a complex and time consuming task which requires the knowledge of both global developments and country specific conditions for which regulations are developed.

5. The legislative framework to promote energy efficiency and renewable energy resource

The legislative framework to support the actions to promote the energy efficiency includes [7]:

- Law no. 199/2000 on energy efficient use, amended by Law no. 56/2006;
- Law no. 3/2001 on Kyoto Protocol ratification;
- Governmental Emergency Ordinance no. 174/2002, on specific measures to rehabilitate the high-rise buildings, approved by Law no. 211/2003;
- Governmental Decision (GD) no. 1535/2003 on strategies for renewable energy sources use
- GD no. 443/10.04.2003 on promotion of the power production from renewable energy sources;
- GD no. 163/2004, „The national strategy for energy efficiency”;
- GD no. 219/2007 on cogeneration of high efficiency;
- Law no. 13/2007, Power Law;
- Governmental Ordinance no. 22/2008 on energy efficiency and promotion of the renewable resources use.

EU Policy on energy efficiency

Directive 2006/32/CE (ESD) [7]

According to this Directive, the energy end-use efficiency increase requires:

- the adoption of the indicative targets, mechanisms and promotion measures and the creation of the necessary institutional, financial and legal framework for energy efficient use;
- the creation of the favorable conditions to apply and promote the energy services market.

The target objective: for 2008 – 2016 an energy saving of 9% is aimed, respectively 1% per year confronted by the energy annual final average consumption realized in the last 5 years (2001 – 2005). The sectors of the emission market are excluded.

Based on this legal document, the National Action Plan for Energy Efficiency was prepared, having as deadlines: June 30th, 2007; June 30th, 2011; June 30th, 2014.

Directive 2001/77/EC on the promotion of electricity from renewable energy sources

The target objectives are:

- the target of 12% of gross inland energy consumption from renewable sources in 2010;
- the target of 21% of renewable sources in electricity consumption in 2010.

Directive 2003/30/EC on the promotion of biofuels or other renewable fuels for transport

Target: the minimum proportion of biofuels in the market existing fuels: 2% starting on December 31st, 2005 and 5.75% starting on December 31st, 2010.

The EU climate and energy package, published in the EU Official Journal from June 5th, 2009.

Proposed targets:

- the reduction in EU greenhouse gas emissions of at least 20% below 1990 levels up to 2020
- a 20% reduction in primary energy use compared with projected levels, to be achieved by improving energy efficiency, up to 2020;
- a 20% of EU energy consumption to come from renewable resources and a minimum target of 10% to come from biofuels, up to 2020.

The Romanian Policy on energy efficiency [7]

The National Strategy for Energy Efficiency (GD no. 163/2004)

Targets:

- a 40% reduction of the primary energy intensity below 2001 levels up to 2015;
- energy saving: 2,122 mil. toe/year.

The Strategy on renewable sources use (GD no. 1535/2003) and the promotion of the electricity based on renewable energy sources (GD no. 958/2005, as amended):

Targets:

- the proportion of RES in the energy gross domestic consumption: 11% in 2010
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- the proportion of RES in the electricity gross domestic consumption: 33% in 2010, 35% in 2015, 38% in 2020.

The promotion of biofuels and other renewable sources use in transport (GD no. 1844/2005, amended by GD no. 456/2007)

Targets:

- minimum portion: 2% in total in 2007;
- minimum portion: 5.75% in total in 2010.

The National Plan on Energy Efficiency

Target:

- a 20% saving energy from the EU primary energy consumption up to 2020, confronted by the reference scenario “business as usual”, considered for 2005 – 2020, 13.5% up to 2016, respectively 1.5% per year.

The main measures for the improvement of the projected energy efficiency in the industry sector are:

- signing of long term agreements;
- energy demand management and energy balance achieving;
- implementation of the GO no.22 on the energy efficient use, republished;
- promotion of a GD to approve the co-financing of 50% from the energy balance costs in industry, for SME with consumptions of 200 – 1,000 toe/year and for the public buildings with areas larger than 1000 m² ;
- promotion of a GD to approve the state aid scheme to finance the programs that aim to increase the energy efficiency in the industrial sector;
- financial support of the investments aiming to reduce the energy demand;
- financing of the energy efficiency projects by accessing FREE;
- providing state budget subsidies for co-financing of the projects aiming to increase energy efficiency;
- European projects on the development of the financial incentive mechanisms for energy efficiency;
- realization of some investment projects co-financed from FS and FC.

The measures to improve energy efficiency in the residential and tertiary sector are:

- thermal insulation and ventilation in high-rise buildings constructed during 1950 – 1990;
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- the implementation of the Government Emergency Ordinance (GEO) no.174/2002 approved by Law no.211/2003: the expenditures for thermal rehabilitation works are financed as follows: 34% from budget state allocations ; 33% from local authorities budgets; 33% from owners' association funds.
 - performance certificates for buildings: from 2007 for the new buildings and the existing ones from the tertiary sector; from 2010 for the existing residential buildings;
 - improvement of the energy efficiency of the heating/cooling systems in the individual dwellings;
 - control actions at the HVAC systems and boilers introduction on the market (ARCE and ISCIR);
 - determination of the consumption in the individual households (REMODECE project);
 - promotion campaigns for alternative energy sources use and energy efficient appliances and equipments for households;
 - promotion of high efficient cogeneration;
 - adoption of the corrected harmonized reference values applicable at national level;
 - realization and implementation of the bonus type scheme in order to promote the high efficiency cogeneration through governmental decision;
 - improvement of the public lighting system;
 - replacement of the lighting appliances, continuation of the inefficient equipment replacing program, introduction of the light reduction devices on main roads during periods of low traffic;
 - promotion of the energy efficient appliances and lamps;
 - promotion and supporting the replacement of incandescent lamps with energy efficient lamps and replacement of the appliances with energy efficient appliances;
 - promotion of a government decision to support the replacement of refrigerators, washing machines and air-conditioners, with funds from the state budget (bonus when buying a A/A+ class appliance);
 - promotion of the energy services companies ESCO development;
 - elaboration of the legal framework aiming to develop energy services companies ESCO;
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- analysis of the methods to support the energy efficiency increase programs (white certificates, ESCO, performance contracts);
- signing of performance contract as support mechanism for ESCOs;
- identification of the existing barriers for ESCOs functioning in Romania.

Conclusions

(1) The Romanian politicians and experts (in the sectors mentioned above) should develop and then implement a long-term energy policy in line with the strategic directions set by the European Commission. In these circumstances, reaching the current level of energy efficiency existing in EU member countries will require considerable experience from the entire Romanian society.

In this context, the higher education institutions have an important role and responsibility.

(2) The state develops a partnership with the energy end-users, taking the responsibility to finance the adaptation mechanisms. It is noticed by most countries, more or less developed, that both investment and a series of other measures are usually directed to increase energy production rather than to increase its efficiency. This finding has naturally resulted in the investigations of the barriers located in the path of the final consumption improvement process.

The performed studies and analyses revealed four types of barriers that hamper the implementation of energy policies.

Thus, the technical barriers consist of lack of competitive equipments, a group that includes measuring devices also, the lack of knowledge and experience in energy management and the lack of an adequate framework for scientific research and technology transfer.

(3) The economic barriers consist of prices of energy carriers that do not reflect the costs of their generation, transmission and distribution within the price control system and not including the marginal prices in the energy stake deformation and in the cost prices of products. The financial barriers are related to the limited funds available for energy saving measures and the lack of an adequate framework for the procurement of funds (financial and tax tendering, other additional priorities, etc.).

(4) The institutional and managerial barriers derive from the inadequate managerial decision-making structure at local and national level, the incomplete nature of the energy efficiency legislation and regulations, the ignorance of the energy conservation real potential, the lack of economic and banking advice in the field and the lack of modern energy management techniques in the companies.

Knowledge of these barriers is an essential element in establishing the energy efficiency strategies, because both the strategic objectives and the nature of methods and programs must be chosen so that they can overcome the barriers. It is also important the priority order in which these barriers are being tackled and the means used for this purpose.

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