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ENERGY EFFICIENCY OF THE INDUSTRIAL DEVELOPMENT: THE CURRENT STATE AND PERSPECTIVES

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Анотація. Метою написання статі є узагальнення передумов підвищення енергоефективності на вітчизняних промислових підприємствах. Звернено увагу на перешкоди і бар'єри на даному шляху. Виділено практичні кроки підвищення енергоефективності на вітчизняних промислових підприємствах. Зокрема, розглянуто засади впровадження енергетичного менеджменту на підприємствах у системи міжнародних стандартів якості. Виділено макроекономічні важелі, спрямовані на підвищення енергоефективності у промисловості.

Ключові слова: промисловість, підприємства, енергоефективність, енергоємність, нетрадиційні джерела енергії, державне регулювання, системи якості, енергоменеджмент

Аннотация. Целью написания статьи является обобщение предпосылок повышения энергоэффективности на отечественных промышленных предприятиях. Обращено внимание на препятствия и барьеры на данном пути. Выделены практические шаги повышения энергоэффективности на отечественных промышленных предприятиях. В частности рассмотрены принципы внедрения энергетического менеджмента на предприятиях в системы международных стандартов качества. Выделены макроэкономические рычаги, направленные на повышение энергоэффективности в промышленности.

Ключевые слова: промышленность, предприятия, энергоэффективность, энергоёмкость, нетрадиционные источники энергии, государственное регулирование, система качества, энергоменеджмент.

Abstract. The purpose of this manuscript is the generalization of pre-conditions of energy efficiency enhancement of domestic industrial enterprises. The attention is paid to the barriers on this way. The practical steps of energy efficiency enhancement on domestic industrial enterprises are pointed out. In particular, the principles of power management introduction are considered on enterprises in the system

of international quality standards. Macro- and microeconomic measures, directed at the enhancement of energy efficiency in industry, are pointed out.

Key of words: industry, enterprises, energy efficiency, power-hungriness, renewable resources, non-traditional energy sources, government control, systems of quality, energy management.

Introduction. The problem of natural resources exhaustion and limited access to energy recourses touches all countries, what determines it as a global problem. On the other side, the high power-hungriness of products caused such consequences as inefficiency of economy, not competitiveness of products, small realization on world and internal markets, expenses on an export, putting up the ineffective enterprises. That is why, the question of introduction of energy efficiency policy, which is based on the tasks of the saving and rational using of energy resources, became more urgent today. This requires clear vision of reasons of unsatisfactory situation in the field of energy efficiency, understanding of barriers on a way to positive changes in this direction and connection of ways of activation of processes of energy efficiency increasing. The special attention is paid to the problem of energy efficiency in the industrial sector of domestic economy. In fact, in modern conditions energy efficiency is one of indicators of industrial products competitiveness, the criterion of industry innovative development, and economies of Ukraine as a whole.

The analysis of recent researches and publications. The question of the saving and the rational using of the energy resources always stood next to the measures of intensification of economic development. Today problem of energy using optimization is connected with energy efficiency (table. 1). Ukraine was engaged in the energy efficiency in 1994 years, and the detailed report about the situation in Ukraine in this sphere was published yet in 2006 year [1].

Key tasks of energy efficiency achievement in national economy are determined in the legislation that is called to regulate the question of energy efficiency in the domestic economy in accordance with the European and world standards of energy efficiency [2-8].

Table 1 -The determination of energy efficiency

Determination	Interpretation	Source
Energy efficiency	- the effective using of fuel and energy resources is on such stages of life cycle of products: planning and development of technical requirements, development of products, production, control, testing and inspections, exploitation, utilization	[2]
Energy efficiency	- state of the system, at what achievement of aims and implementation of its functions carried out at the minimum charges of energy	[10]
Energy efficiency project	- project which directed on reduction of energy consumption, namely: reconstruction of networks and systems of supply, adjusting, and account of consumption of water, gas, thermal and electric energy, modernization of non-load-bearing constructions and technologies of production processes.	[3]
Energy efficiency of production, technology, equipment	- products or method, mean its productions which provide the rational use of fuel and energy resources by comparison to other variants of the use or production of goods of identical consumer level or with analogical technical and economic indexes	
Energy efficiency	- decline of consumption of energy without the decline of the use of energy by a production and equipment, that the rational use of energy resources and alternative energy sources is diminishing of general requirement in energy resources after separate directions.	[6]
Energy efficiency	- description, which represents the relation of useful effect from the use of power resources to the charges of power resources, mine-out with the purpose of receipt of such effect, in relation to products, technological process, legal entity, individual businessman	[5]
Energy efficiency	- the absolute or specific value of consumption of PER (taking into account their normative losses) is scientifically grounded on the production of unit of products (works, services) of any setting, which is set normative documents	[4]
Energy efficiency	- "fifth type of fuel". It. above all things, careful attitude toward energy in any sphere and it harmless production.	[8]

Considerable attention to energy efficiency as important factor of dependence diminishing from the external suppliers of energy resources and increasing of competitiveness of domestic producers is given in manuscripts of such scientists as S. F. Ermilov, Yu. P. of Yaschenko, In. In. Grigorovskiy, V. M. Geyec' [9]. The researches of Ukrainian energy efficiency potential in industry and ground of measures which will allow to overcome an unsatisfactory situation in this sector of economy are made in works [10, 11, 12].

In spite of increasing of energy efficiency in an industrial sector, the economy of Ukraine remains one of the most power-hungry in the world. The Power-hungriness of Ukraine exceeds the middle analogical index of countries members of organization of economic collaboration and development

(OECD), and in enumeration on the parity of purchasing power – in 3,2 times exceeds a middle index for OECD [13, p. 17].

Researches of the Ukrainian experts [14] demonstrate that in the case of energy efficiency increasing in every sector of the Ukrainian economy to the level of European Union, the energy consumption of Ukraine would reduced twice for the maintenance of existent structure of economy. Potential of annual energy-savings in agriculture, industry, building, in the sector of services and housing sector makes 31.9 million t oil equivalent, that approximately 39 milliards of m³ of natural gas correspondingly – more than all import from Russia

The components of the general problem which were not solved before. It's worth mentioning that deciding of problem of energy efficiency isn't only the measures of the macroeconomic regulation (establishment of costs of power recourses consumption, diversification of sources of supply, state financing of the programs of capacity). Despite the separate enterprises can not control a price on energy resources, to influence on the policy of government in the field of energy capacity or global economy, its can choose ways of energy effectiveness management.

Perfection of power resources management can provide profitability an enterprise by the maximal using of traditional energy and assets of renewable energy sources. This action can shorten both the value of energy and volumes of its consumption. At the same time, the question of domestic industrial enterprises capacities increasing requires more detailed consideration. It's mean that the decision has to make not only due to external possibilities but also to account of mobilization of internal barriers. Consequently, the question of generalization of strong and weak sides of energy recourses management on the domestic industrial enterprises needs in additional research.

The purpose of the article. The purpose of the manuscript is a determination of reasons, which caused low energy efficiency at industry, generalization of barriers that hinder the decision of problem of energy efficiency in the industrial sector of domestic economy and ground of measures of energy efficiency increasing in the conditions of domestic industrial production.

The results and discussions. A situation in relation to energy efficiency in industry remains unsatisfactory. One of reasons of such state is the ineffective structure of industrial production with predominance in it of branches of the primary processing of raw material. These industries are most energy-, fuel- and material capacious (table. 2).

Table 2 - The structure of electric energy consumption in within basic branches of industry and groups of users in 2011-2012 yrs. [16]

Basic branches of industry and group of users	Consumption of electric power (mln. кВт per-hour)		+,- % 2012/ 2011	Specific gravity, %	
	2011	2012		2011	2012
Consumption electric power total (netto):	150768,3	150721,0	0,0	100,0	100,0
1 Industry	73001,3	70761,4	-3,1	48,4	46,9
1.1 fuel	9519,8	8935,5	-6,1	6,3	5,9
1.2 metallurgical	37733,7	36936,0	-2,1	25,0	24,5
1.3 chemical and petrochemical	6248,5	5993,0	-4,1	4,1	4,0
1.4 machine-building	6399,7	5833,6	-8,8	4,3	3,9
1.5 build materials	2705,5	2530,4	-6,5	1,8	1,7
1.6 food and processing	4648,6	4713,8	1,4	3,1	3,1
1.7 other	5745,5	5819,1	1,3	3,8	3,8
2 agriculture consumers	3547,8	3830,9	8,0	2,3	2,5
3 Transports	9887,1	9279,1	-6,1	6,6	6,2
4 Buildings	954,7	1013,4	6,1	0,6	0,7
5 Communal domestic users	18334,9	18508,1	0,9	12,2	12,3
6 Other non-commercial users	6583,0	7061,4	7,3	4,4	4,7
7 Population	38459,5	40266,7	4,7	25,5	26,7

Especially considerable energy expenses are in metallurgical, chemical, machine-building industry, and also communal sphere. Power-hungry commodities of domestic production are uncompetitive at the internal and external markets. The result of its disparity with existent demand is the low middle level of profits and considerable stratification of population after profits.

One of the reasons of inefficiency in the industrial sector, the part of which has 45% from the general consumption of primary energy, are the extraordinarily large wear of production funds (on separate enterprises arrives at to 80 %) and combination with insufficient introduction of modern technologies, and also absence of registration devices and proper CASS in an industrial sector.

In such situation strategy energy resources maintenance in industry is focused on such directions of activity: diminishing of consumption of energies and power resources on unit of made products; prognostication of development of sectors of economy; introduction of the government programs in the most perspective sectors of economy; introduction of new energy keepings technologies of issue of products and services; organizational measures, directed on the maintenance of power resources and types of energies; total account of the energy resources using.

The special attention has to be paid to the perspective of non-traditional and renewal energy sources introduction. Today in a structure of fuel and energy resources consumption dominant role belongs to natural gas, specific gravity of which is 36,4 %, coal – 13,1 %, electric power – 16,2 %, crude oil and oil products – 16,7 %, bio energy – only 1,4 % [16].

For today part of non-traditional and renewable energy sources (URES) in the production of energy in the world yet is not considerable (about 14%). But its potential on a few orders exceeds the level of world consumption of fuel and energy resources. The rates of volumes growth of URES production also considerably exceed analogical for traditional kinds energies. In the nearest 10 years, year-on-year growth of world production of electric power as traditional sources is forecast 2,8 %, and electric power of URES – 9,2% [18].

Non-traditional and renewable energy sources became one of important criteria of suitable development in the world. The searching of new and perfection of existent technologies of the energy production on the way of energy keeping, is one of main task of modern development. In accordance with the Power strategy of Ukraine on a period to 2030 year the basic advantage of using of non-traditional and renewable energy sources is their inexhaustibility and ecological cleanness which is instrument of the improvement of the ecological state and supporting of power balance on a planet.

General annual technical power potential of URES of Ukraine in a count on a conditional fuel makes about 79 millions, t c. f., including 63 million t c. f. – due to mastering of alternative energy sources, 16 million t in. p. – due to the using of off-balance sheet (second) energy sources [19]. Perspective directions of development of URES using in Ukraine is: bioenergetics, booty and utilization of mine methane, use of thermal energy of environment, mastering of economic expedient water potential of the small rivers of Ukraine. The indexes of development of the URES using after basic directions of mastering (base scenario) are erected in a tab. 3.

Table 3 - Indexes of development of the URES usage according to the main directions [19]

Directions of mastering of NVDE	Level of development URES, mln. t c.f./year			
	2005	2010	2020	2030
Bioenergetics	1,3	2,7	5,3	8,2
Off balance sources of energy	13,8	15,0	15,7	15,4
Sun energy	0,003	0,032	0,254	1,1
Small water energy	0,12	0,52	0,85	1,13
Thermal energy	0,02	0,08	0,19	0,7
Mine methane	0,05	0,96	2,8	5,5
Wind energy	0,018	0,21	0,53	0,7
Energy of environment	0,2	0,3	3,9	22,7
Total	15,51	19,83	30,55	57,73

Despite the declaration of the necessity of URES using by sides of different branches of power and legislative acts which touch development of URES, – the real steps in relation to introduction of URES is done enough. Part of URES in power balance of country makes only 7,2 % (6,4 % are off-balance sheet energy sources; 0,8 % are renewal sources) [19].

Thus, Ukraine has urgent need in measures of energy efficiency and using of ecologically clean technologies, which is in characteristic of URES. To change the situation is possible by the lead through of the proper energy policy, perfection of legislation and bringing in of investments in development of URES. Certainly, this process is not fasts, but providing of future economic growth in Ukraine and taking deserve place in European community require activity decision of this actual problem.

For example, Energy strategy of European Union is characterized with the concentration on 20 percent declining of primary energy consumption to 2020. The offered measures orient on the increase of energy efficiency at all stages of "power chain": production, transformation, distributing and eventual consumption [5].

The change of situation in this direction depends not only on measures which are accepted on a macro level but also at the level of separate enterprises. Energy strategy of Ukraine on a period to 2030 year determines priority directions and volumes of energy-savings in Ukraine, potential of development of renewable and non-traditional energy sources due to such components of structure of energy-savings potential of enterprises:

- technical (technological) component of energy-savings potential, which provides the increasing of efficiency in production, transformation, transporting and consumption of energy resources and accordingly declines the power-hungriness of products and services, due to introduction of the newest energy effective technologies and energy keepings measures;

- branch energy-savings component of energy-savings potential, which provides the introduction of new energy keeping technologies and equipment; improvement of existent technologies and equipment; reduction of energy resources losses; perfection and reduction of losses of raw material and materials; substitution and choice of the most effective power mediums;

- intersectoral energy-savings components of energy-savings potential, which provides the modern effective systems of account and control after the charges of energy resources; using of the second power resources; introduction of CASS in energy consumption management; using of the economic systems and devices of electric lighting; introduction of the modern systems and facilities of power electronics; perfection of the systems of warm supply; using of modern technologies of incineration of bad quality hard fuel;

The important role in providing energy efficiency is in the introduction of energy management system on enterprises in accordance with the International standards of ISO 50001. Realization of energy management measures on an industrial enterprise has system and complex character and is directed at [20]:

- the increase of integration on enterprises due to achievement of organizational effect, which is directed on the improvement of production cycle, optimization of business processes and effective management of energy consumption;
- the optimization of charges, which will allow to get a financial effect due to the improvement of financial indexes of company by the direct economy of all types of energy resources, cutback of spending, exposure and removal of unproductive charges, increase of financial transparency of enterprise, guarantee of investing in energy keepings projects;
- the support of image and reputation due to achievement of social responsibility for the using of natural resources and contamination of environment and forming thus of attractiveness of enterprise before consumers, partners, investors.

Integration of the system of energy management in the corporate culture of industrial enterprise provides a daily management of energy efficiency for an account:

- the awareness of essence of the energy using;
- the formation of plans of permanent growth of energy efficiency;
- the organizational basis for permanent work of improvement of energy efficiency indexes.

The characteristic of domestic industrial enterprises in the field of energy efficiency means the efficiency of the power resources using. It is arrived more due to changes in the methods of management in its and less due to introduction of new technologies.

As experience of foreign producers which successfully work at the domestic market, front-rank technologies are pre-condition of energy efficiency, and also source of the potential economy growing. More effective using of energy is possible in the case of application of the best accessible technologies and equipment. Due to the economy of electric power some energy effective decisions can be covered a cost during a few first months of work. In a long-term perspective its also will provide the operating cost and expenses cutting on technical service. By technology of effective production of the industrial systems can be optimized due to planning of integrated system, using of more energy effective components, application of more perfect approaches to the energy-savings and "push" technologies of the energy using. It follows to apply such approach in relation to all chain of creation value added of products [21].

It follows to pay the special attention on that Ukraine owns considerable energy-savings potential, – 47,6 % from a current energy consumption. Introduction of modern technologies will allow to decrease energy consumption almost twice [1, p. 3]. However for maximal realization of the noted potential there are necessary investments.

Unlike the domestic mechanism of providing energy efficiency, which is more oriented at the legislation and institution instruments, in world practice the most attention is paid to financial mechanism of efficiency of the energy resources using, namely to such it's instruments:

- the development of strategies and a special purpose programs which determine methods and terms of achievement of certain indexes of efficiency of the fuel-energy resources using;
- tax regulation of supply and consumption of the fuel-energy resources using;
- budget support and regulation of process of efficiency increasing in the economy;
- the investment support of projects, directed at the efficiency enhancement of the usage of power resources in the economy.

Experts mark that the volume of investments for the increase of energy efficiency of industry of Ukraine to the middling European level makes from 25 to 100 milliards dollars [22]. They mark that today on 1000 dollars of Ukrainian production used 0,55 tons of conditional fuel, while at Czech – 0,22 tons, at Romania – 0,19 tons, in Germany – 0,15 tons.

It's necessary to underline, that for the cutback of spending on power resources almost in two times, Ukraine needs about 25 milliards dollars USA of investments in energy efficiency and energy-savings projects. Some experts estimation arrive at greater numbers, in particular in 100 milliards dollars of the USA.

It follows notices, that by the Government special purpose economic program of energy efficiency and development of spheres of power mediums production from renewable energy sources and alternative types of energy sources on 2010-2015, foreseen the financing of projects from energy efficiency more than on 200 milliards dollars of USA, including – from the state budget about 10 milliards UAN [23, p. 17]. In the conditions of budget deficit a main sources of financing of projects from energy efficiency are an own money of enterprises and favorable having a special purpose credits of international financial organizations (EBRD, World bank and others like that).

The conclusion and directions of further researches. Thus, energy efficiency factor is one of determinative ones for development of domestic industrial enterprises. This question is not concentrated only on problems of efficiency of FEK (fuel and energy complex in Ukraine) and its resource ability to provide the effective functioning of economy on the whole but also on potential of energy efficiency of industrial enterprises.

Researches of approaches and interpretations of energy efficiency concept allowed us to generalize that energy efficiency is the activity of industrial enterprises which follows to examine the process of providing by energy resources in the conditions of the rational using of traditional power resources and minimization of their losses, creation and exploitation of assets of URES. As result, energy efficiency must provide an economic effect which exceeds expenses for its achievement. Thus, next to quantitative criteria, energy efficiency must create pre-conditions for high-quality changes in industry, in particular, instrumental in the increasing of competitiveness of products, diminishing of negative influences, on an environment.

The enhancement of energy efficiency requires not gradual transformations, but cardinal changes in relation to a production, distributing and consumption of power-energy resources. For the positive decision of this task it's necessary to connect the near-term macroeconomic decisions with overcoming the barriers, which consist in absence of stimulant measures for effective use of energy, overcoming of the so-called "market failures", incomplete information, influence of negative external factors, high transaction charges and absence of financing [11].

These decisions have to be made by enterprises in the context of the introduction of the energy management system, the newest technologies, and activation of work in the relation to bringing the investors into the sphere of energy efficiency.

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