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## **ENTROPY ANALYSIS OF THE STATE OF THE INFORMATION-ENERGY SYSTEM**

**Introduction.** Diagnostics and management the economic systems in modern terms envisage a permanent supervision after the change of many performances of enterprise indicators: resources, clean money stream of enterprise, a structure of assets, capital etc. Such indicators do not reflect changes in the quality of life of the population in digital form as changes in the value of society. This makes the forecast of the development of the society and the decision on the development of the economic system in modern knowledge systems without prediction of the final indicators of development, which are submitted only verbally. Erroneous prognostication of development of the system can result in imbalance economic of all socio-economic system. Scientifically based definition of these objectives and aims of economic development of both the individual enterprise and society as a whole is extremely important.

The distribution of public resources to meet the public interest and welfare of the population has always been an important economic problem. Formulation and implementation tasks without considering community needs and without appropriate distribution of resources do not ensure its economic growth and can lead to insolvency of a population and even his of critic form – *socio-political explosion*.

**Values, Morals and Resources.** The need for a combination of commercial (economic) and social development needs of society has shown in the last century P. Drucker [1] as a method of program target budgeting and resource management. *The main problem of budgeting and management not only businesses, but the state there is no scientific definition of economically and socially meaningful goals and integrated indicators of the assessment of the planned economic development of the system.*

Values of society (or individual enterprise) – a determining factor in the development at all levels of management: operational, tactical and strategic. "The philosophy of values" the most consistently and systematically set out of Kant. The values can be *relative or absolute*. According to Kant the things that exist *independently of human will* and have no reason are *relative values* or *value for us*. "Man and generally every rational being exists as an objective in itself," and "this goal cannot be replaced by any other purpose" is "objective purpose" or "absolute value" [2], (p. 269). "Man, however, is not such a holiday, but humanity in her face should be her holy" [3], (p. 414). In keeping with the social values of economic development

must comply with the natural law of morality "*behave as if the maxim of your action using your liberty was to be a universal law of nature*" [2], (p. 261). According to Kant, the value of exists as an intelligent person and the human relationship to the world, as a measure of humanity and freedom. Therefore, we can talk about the existence of personal values, values important to the man, or *relative values (values-means)*.

Values determined by the type of society. The first Pan-European research values of different nations of Europe [4] showed that Soviet society has formed in Ukraine man fixated on material values, unable to enjoy life.

The sociological research based on international monitoring studies – World Values Survey (WVS) and the European Social Survey (ESS) [5] shows what the values are of Ukrainian society in 2015. The most important value to the Ukrainian and Europeans has public safety, a lesser health and the environment. In Ukraine in 2015 negatively evaluated conformity (intention to hurt others), achievement (the success of their abilities), power-wealth (own prestige, ability status), hedonism (own enjoyment of life), risk novelty (thrills of life), indicating that the Ukrainian passivity in life. Independence, hedonism and risk-novelty were ranked the lowest. Ukrainians have shown such negative qualities as a weakness, lack of willingness to make decisions, creative knowledge, indifference to their prestige and enjoyment of life. In recent years the importance of the values of independence until its rejection. With these qualities impossible Ukrainian economic growth and therefore economic development requires their modernization.

According to a public opinion poll on human rights in Ukraine, the Democratic Initiatives Foundation I. Kucheriv in December 2016 [6], the most valuable for Ukrainians are priorities in the direction of their reduction: security, information on social protection, freedom.

The difficult economic and political situation, the military conflict created an extremely complex symbiosis of outstanding value to a choice of priorities for economic development in Ukraine. The need for security relates to the priority needs of social communities. This security value is universal in the military conflict and is part of the value of "*man*".

Ukraine's experience has shown that in modern hybrid warfare, *information and science* take the next step in the hierarchy of values. The development of military-industrial complex, information, scientific and educational areas should be a priority Ukrainian society.

Poverty, which according to United Nations standards set at \$5 per day, is home to more than 80% of Ukraine. According to the calculations of Deputies, according to the laws established the living wage in Ukraine today is \$1.5 per day or \$50 per month. According to the law on the state budget for 2015, the subsistence minimum per person

per month from January 1, 2015, amounted to 1176 UAH. The minimum wage is 1218 UAH [7]. *Social Security* is an important value of modern Ukrainian society.

Priorities and a measure distribution of resources between a value determined on the basis of existing production resources what formed a business, there are mainly small and medium enterprises. Thus, *the business of SMEs* occupies an important place among the values modern society.

The earliest desire of the human race according to Hobbes, is "*eternal and relentless desire more and more power, a desire which ceases only with death*" [8], (p.156). A person has the right to protect its own existence, doing everything that it considers it good, but given the large number of people and means to achieve the goal of "*it will inevitably lead to the collapse of the state*" [8], (p. 547). According to other natural law "a man must accept if it agrees with on others, to the extent it deems necessary for the peace and protect themselves waive their right to all things and be satisfied with the extent of freedom in relation to others, which would it recognized by others in relation to ourselves". This is the law of the Gospel: "Everything you want others to do to you, that you do them" [8], (p. 156). Religious provision of social relations transformed through philosophic formalization of the emergence of the "golden rules of morality". It is this rule became known as one of the basic moral values of modern society – *morality*. Challenges of modern society complete a number of basic values such as *morality and ecology*.

Research conducted of the priorities of the basic values of the society of Ukraine for the accepted indicator – the ratio of the number of resources of the consolidated budget of the country for the formation of value to the annual budget otherwise *an index of value* (Table 1 and 2). Of course, can't be considered obvious, that the proposed index for value has the priority. All real management subsystem are open and interacting. For example, education – is not only a source of information and knowledge. In education generated moral principles, commitment to defending the homeland, the principles of scientific analysis etc. Obviously, the system of forming values of a society based on the principles of system analysis.

To simplify the analysis and detection of the main values and priorities in the management system in Ukraine are accepted such totalities of subsystems of organs forming of a budget, that is most influential for forming of values (Table 2).

Established the values of the highest priority to towards its reduction has been: *social security, safety, and information*. Rising costs in 2014-2017 for the formation of values social welfare, security, and information was directly proportional to the growth of the budget, approximately twice. At the same time provide *value security* (in the time of military conflict in relation to security of the state!) twice less. The value for *information* approximately is three times less compared to the value of a social security.

**Table 1. Values of Ukrainian society and the dynamics of their provision of resources\***

Priorities values of the human race proved philosophies	Priority values in 2017	Dynamics software resources formation of values in Ukraine, billion. UAH. in the costs of 2014			
		2014	2015	2016	2017
Security (security and stability societies relations)	<b>2</b>	50,01	83,25	100,66	126,44
Liberty - independence (independence of judgment and decision making, creativity, knowledge)	<b>4</b>	13,50	14,99	9,92	13,28
Information	<b>3</b>	30,10	30,30	73,49	79,06
Science - risk, novelty (enthusiasm, novelty, thrills, life with you-Fang and difficult tasks)	<b>5</b>	6,68	4,69	2,62	4,32
<b>Social welfare</b>	<b>1</b>	<b>102,99</b>	<b>127,85</b>	<b>226,45</b>	<b>222,55</b>
Business SME - achievement (personal success through their own abilities according to social standards)	<b>7</b>	0,05	1,56	0,11	3,08
Morality (conformism - containment actions and intentions that can cause harm or condemnation of others)	<b>8</b>	0,08	0,04	1,06	2,16
Ecology or universalism (tolerance, welfare protection, environment)	<b>6</b>	7,03	4,11	4,56	5,27
The cost of the budget provision of basic values		210,44	266,79	418,87	456,16
Consolidated budget		498,0	509,1	676,4	774,5

\* built according to the author [9, 10, 11, 12]

**Table 2 Resource providing basic values of Ukrainian society\***

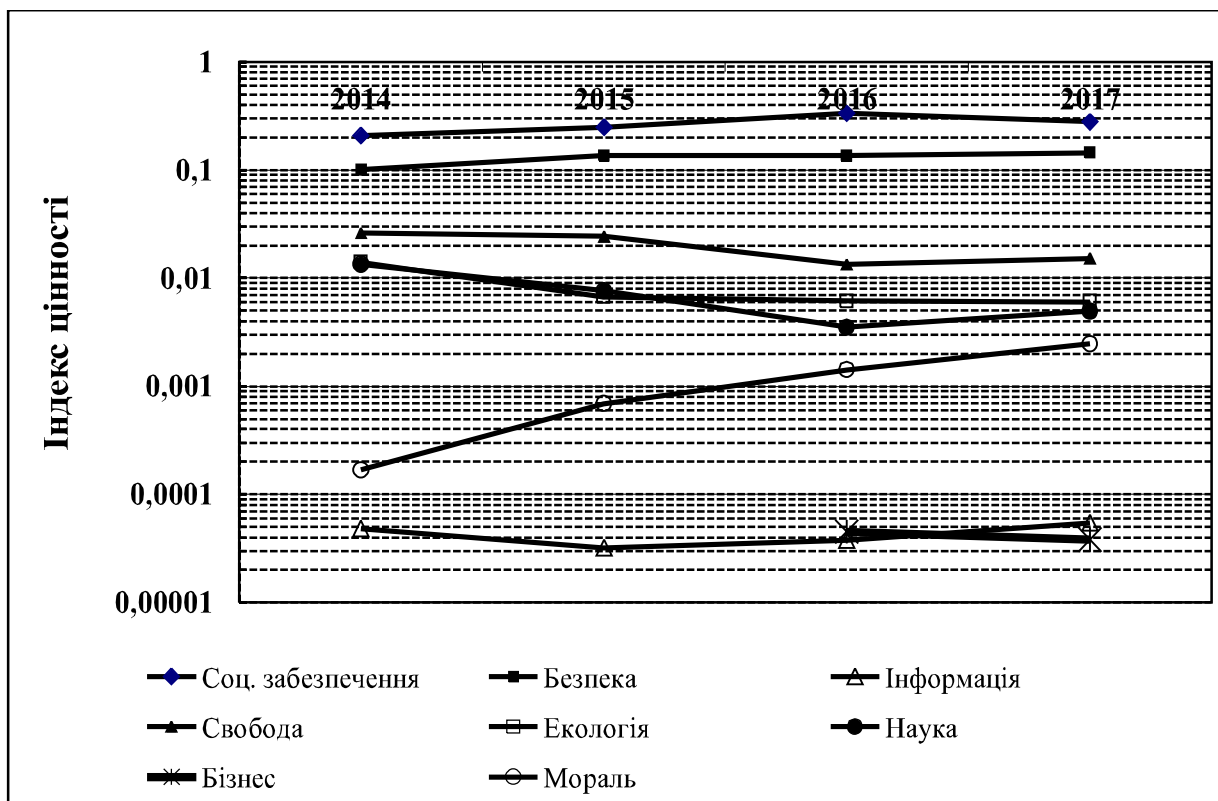
Values	Sources Resources (planned budget support)
Security	Ministry of Defense, Interior, Foreign Affairs, the Nuclear Regulatory Inspectorate, Intelligence ...
Freedom	Authorities Court of Justice and the prosecutor's office.
Information	Committee and Council for Radio and Television, Ministry of culture, Education, Youth and Sports, Information Policy, Service of Special Communication ...
Science	National Academy of Sciences
Social welfare	Ministry of Health of Ukraine, Ministry of social policy of Ukraine, Ministry of Regional Development, Construction and Housing and Communal Services of Ukraine
SME Business	Support for small and medium enterprises
Morality	Antitrust and anti-corruption bodies
Ecology	Ministry of Environment and Natural Resources

\* Grouping is done by the author [9, 10, 11, 12]

The value of information is almost three times less than the value of social security, the values for freedom on the order, and the environment, science, business,

and morals are two orders less. The dynamic for the index of basic values (social security, security, information, freedom, environment, science, business, and morality) presented in Fig. 1. The Indices values a social security, security, morals and private business in the 2014-2017 increases while increasing costs of their formation (Table 1). At the same time, in the European materially secured society [5], *material support is not even considered among the basic values*. Indices values of freedom, ecology, and science reduced while reducing the cost of resources for their formation.

The index value of the business grows, but budget expenditures on its development are minimal, approximately the three orders of magnitude smaller compared to the costs of maintaining the value of a social security. Overall, the ecology, science, morality, and information have very low resources offer for the formation of values. It shows the negative trends in their formation for the insufficient resources.



**Fig. 1. Dynamics of indices of core values Ukrainian society**

designed and built according to Table 1

The economic situation characterized by the fall of Ukraine's GDP, by the permanent increase of the level of unemployment, budget deficits, and rising inflation, low standard of living 80% population decline in foreign direct investment (Table 3).

As a method for adding to the budget, and for stabilizing of the economy growing can exemplify experience of economic strategy of post-war reconstruction of Japan after 1945 [14]. In 1945-1955 Japan's industrial enterprises were provide own capital

only by a third. In 1946-1948 Japan received from the US to \$980 million, or 4.2% of GDP. The obtained funds primarily spent on food imports from America to pay off public debt and build's investments.

**Table 3. Some indicators Ukraine's economy (growth rates, %) \* [13]**

Year	GDP dollars. US per capita		The budget deficit, million UAH		FDI, million USD	The inflation index	Unemployment rate, %
2013	4030,3	+4,5	-63590,3	-4,37	4498	100,5	7,7
2014	3014,6	-25,2	-72030,5	-4,60	410	124,9	9,7
2015	2115,4	-29,8	-30898,2	-1,56	2961	143,3	9,5
2016					2098	111,4	9,8
2017		+3,0	-77500,0	-3,0		108,1	8,6

\*Index values are given in % relative to the previous year

Since 1946, the national political forces exercise attempts to get out, from under the guardianship of the United States. The problem is solved by channeling resources of social savings in the investment process.

In Ukraine, the problem of resources can be solved by their removal from the shadow economy and voluntary contributions to the real economy. For example, these billionaires like Bill Gates give been benefit all people when engaged in humanitarian assistance and patronage [14]. Light industry in Japan as a stabilizing factor in the economy has been offset losses due to cheap labor and cheap goods receipt basic industries. In Ukraine, such a stabilizing factor is agriculture. Japan's tax system was based on principles of social justice, on the direct taxes and on progressive income tax. Mostly economic policy was focused on supporting small and medium enterprises. Germany's most important task was not to maximize public welfare but create conditions for the development of market economy and effective employment [15].

With the growth of attracted resources, while respecting the principle of social justice in Ukraine problem of restructuring the basic values of a society can be solved by spending mediated transformation of social security into the development of the real economy. So in the economy can be achieved the growth the number of jobs and wages, in general, the growth of social standards. A number of employees should be one of the most important factors in planning for economic development. Such comprehensive economic development of Ukrainian society on the basis of the implementation of established basic values is the implementation of *balanced (containment) or sustainable development*.

As the conclusion of the research is established:

- a planning for economic development in the current political and economic conditions should be based on the definition of basic social values and their priorities in order to identify priority areas of economic development,

- fundamental values of a society in an unstable economic transformation in the direction reducing their priorities are security, freedom, information, science, social welfare, business SMEs, morality, and ecology,
- a morality through revealing people's actions is an economic category,
- economic, social and environmental accents – the main priority of economic development,
- in generally that comprehensive economic development of society based on the realization set of core values is the epitome of a balanced (restraining) or sustainable development.

**Quality of life.** In modern conditions, the decisive value of society is the man himself and his development. Investment in human development is considered by business and the state as an important factor in economic growth, increasing the competitiveness of enterprises and, at the same time, as a means of humanizing the relations of labor and capital, which in turn will contribute to the stability of society.

The concept of human development was published by UNDP in 1990. As an indicator of human development, the Human Development Index (HDI) was adopted. This indicator reflects the level of achievements of the countries in the most important socio-economic spheres and expresses the level of satisfaction of the material and cultural needs of the individual in the provision of consumer goods. It characterized mainly by quantitative indicators: purchasing power, income, consumption of goods and services, level education, health, culture, etc.

**Table 4. Dynamics of indexes of human development ratings**

Country	Index of human development ratings			
	2005	2010	2011	2012
US	4	4	4	3
Japan	12	11	10	10
Poland	44	41	39	39
Belarus	62	61	51	50
Russian Federation	68	65	50	50
Ukraine	66	69	78	78

Source: constructed by the author using data [16, 17, 18].

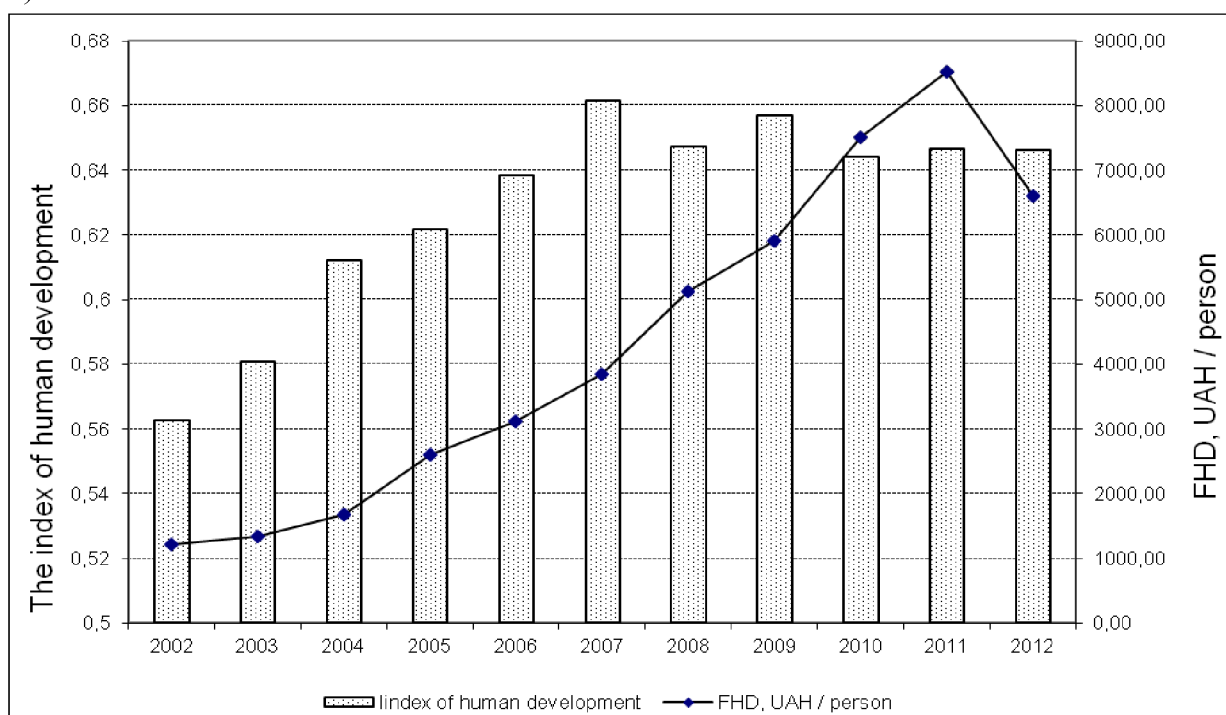
The dynamics of the ratings of the human development index of some countries is presented in Table 4. It is noteworthy that the US, EU, Belarus and Russian Federation ratings on the human development index have been steadily increasing over recent years, while Ukraine's rating has decreased by 12 points from 66 in 2005 to 78 in 2012.

The problem of raising the quality of life of a person is a key issue of the state policy of Ukraine. All models of social policy combine three important aspects of the economy – quality of life, an efficiency of management and justice, which does not



allow social tension. The methodology of Libanova E. (Institute of Demography and Social Studies named after MV Ptukha of the National Academy of Sciences of Ukraine) [19, 20], as well as the methodology of the United Nations Statistics Division [21], was used to calculate the human development index. In calculating the index of human development, the following factors were taken into account: expected life expectancy, purchasing power of the population, environmental factor, (as the consumption of water for domestic consumption needs), health of the population, creative intelligence of people (as financing of scientific works), education of population and the safety of life.

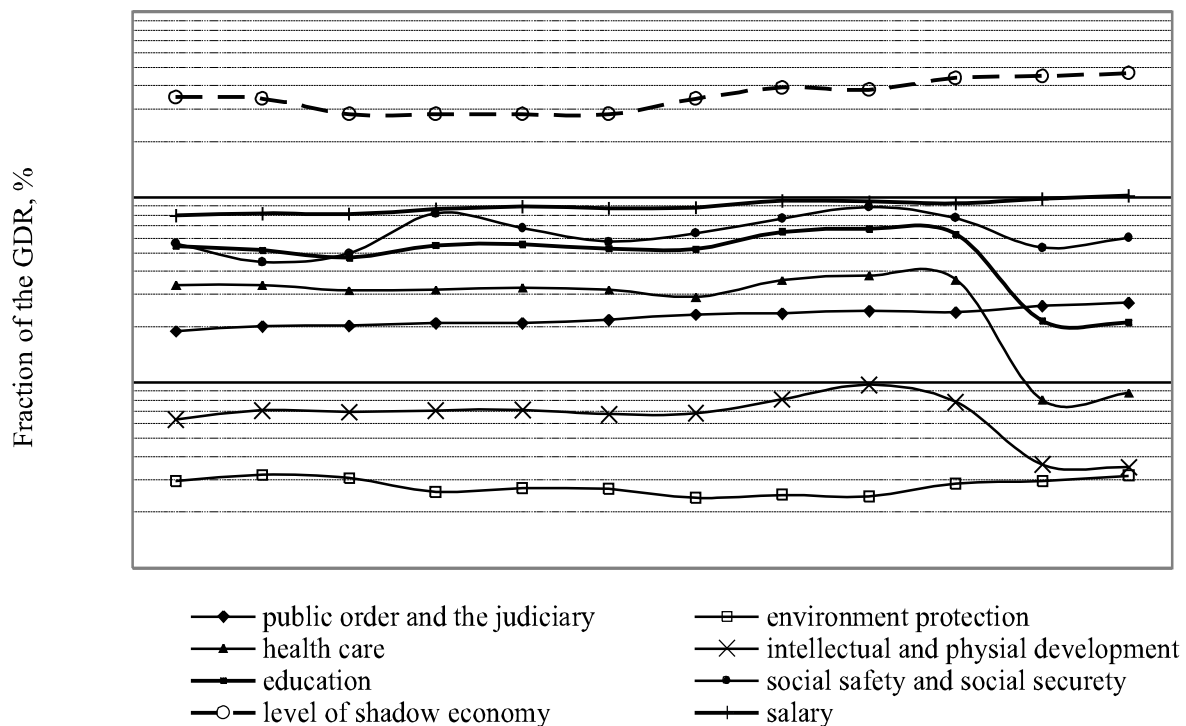
The main sources of human development are the components of public expenditures on social security, healthcare, education, spiritual and physical development, environmental protection, as well as wages, otherwise in generally - a human development factor (FHD). Logically – the growth factor of human development causes the growth of the index of human development. But the dynamics of the Ukrainian economy will not confirm such dependence. In 2007-2010, with the growth of FHD, the index of human development declined. From 2010 onwards, when reduced in the FHD, the index of human development was almost unchanged (Figure 2).



**Fig. 2. Dynamics of the index of human development and FHD**

Source: constructed by the author using data [20, 21, 22, 23, 24].

The growth of FLR in 2007-2010 is accompanied by an increase in the level of the shadow economy (Figure 3), and therefore the fall of the FHD is a consequence of the inappropriate use of public expenditures in the interests of people.



**Fig. 3. Dynamics of the structural elements of the FRL and the level of the shadow economy**

Source: Built by the author using data [22, 23, 24, 25].

The shadow economy has increased to the level of by an order of magnitude greater than the HDI changed off.

In this regard, even significant changes to the FHD after 2010 could not affect HDI. In the structure of state expenditures, the lowest level has the cost of environmental protection and spiritual and physical development, the provision of the public order, security and judicial power, the highest – social costs.

By eliminating such a contradiction, even without changing the total cost, it is possible indirectly to achieve an increase in HDI. The solution to this contradiction lies in the elimination of the shadow economy and in the effective management of economic activity.

**Energy concept of economic systems analysis.** It is generally recognized that the indicator of the economic state of the system is the gross national product as the aggregate of the market value of the total volume of final production of goods and services for one year in monetary terms. In order to analyze the dynamics in time, such a monetary indicator of the produced product and services needs to be adjusted to the magnitude of inflation. This means that the gross product produced in monetary terms is an inappropriate indicator for a comparative analysis of the economic state of the system. The problem of establishing absolute indicators of the state of the economic system for the purpose of correct analysis and management needs to be solved.

Money is the total equivalent (or unit of measurement), which expresses the value of the product or service. The basic property of money is the stability of value by which they fulfill the most important economic function of the means of payment and accumulation of value. Forecasting of the hryvnia exchange rate since 1996 is impossible. The stability of the monetary unit in modern conditions is determined by the world's national gold and currency reserves. Since 2008, after the global financial crisis, the dollar is considered the most stable currency [26]. International accumulation in foreign currency reserves of the dollar decreased from 71.01% in 1999 to 64.16% in 2015. [27]. One can even talk about inflation of the dollar, approximately, at 6.85% for fifteen years. Consequently, for the practice of assessing the economic status of the system, the monetary unit is unacceptable.

As a measure of interaction between system components in the economy, the concept of value is traditionally used, although the physical basis of such interaction is energy in general. The totality of material bodies that are in energy interaction is called the thermodynamic system. The energy affiliation and subordination of the physical, chemical, biological and social processes to the second law of thermodynamics have been recognized by many scholars (P. Chambadal [28], V. Weinick [29], G. Odum and E. Odum [30], Lyndon LaRouche [31, 32]).

Energy resources and costs used in the economic system, perform the same function - ensure its viability. "A priori" all value indicators are prone to inflation. The main external factor of inflation change in Ukraine is the change in the value of the imported fuel. In the fraction from the division of the indicator of the economic state of the system in monetary units by the weighted average price of energy resources used in the economic system from the outside, the external factor of inflation is excluded. Such a share from the division of the traditional indicator of the state of the system in monetary units by the weighted average price of energy resources used in the system is a parameter of the state of the economic system in energy units, which is *independent of external inflationary factors*. This indicator is called the energy index (for example,  $GDP_E = GDP/P$  – Energy Gross Domestic Product, J, where GDP – Gross Domestic Product in monetary terms, UAH; P – average weighted of external energy price used in the system, UAH/J). A system in which information about system state indicators is presented in power units is called *the information-energy system* (IES).

The main factors behind the effects of production processes in the economic system that reflect its state of affairs are the productive resource potential *PRP* and the production costs *PC*.

PRP features:

- the function is always positive;
- the value of a function does not depend on the way it is received, but only on the final states of the information and energy system.

If the production resource potential is always a positive function that is deducted from absolute zero and does not depend from the form of the thermodynamic process, then the value of *the productive resource potential* is the absolute value and the function itself is *the parameter of the state of the system*.

The development (change of state) of the information-energy system is always accompanied by the participation in the processes (or costs) of material, financial, labor and energy resources, which in total can be positive (production costs) or negative (in the generation of energy from the system) values similarly energy thermodynamic processes. Consequently, *thermodynamic and economic processes are similar*.

Absolute temperature of thermodynamic systems is a parameter of the thermodynamic system and has the same signs with the productive resource potential of the economic system. These functions are always positive and their value does not depend on the way of receiving. Consequently, the function of productive resource potential and absolute temperature - similar thermodynamic functions, which are parameters of the state of the systems.

Classical thermodynamic and economic processes have common features - these are thermodynamic processes. On this basis, we can conclude that the classical thermodynamic and economic processes are similar. The basis for conclusions about analogy is the similarity (analogy) of objects, properties, and relations [33].

The second law of thermodynamics is represented by the formula:

$$dS = dQ/T, \quad (1)$$

where  $dS$  – change of entropy, J/K,

$dQ$  – the energy involved in the process, J,

$T$  – absolute temperature, K.

According to the analogy of energy and economic processes, the second law of thermodynamics in the information-energy system is represented by the formula:

$$dE = dPC/PRP, \quad (2)$$

where  $dE$  – change of the entropy of the economic system,

$dPC$  – Production Costs, J,

$PRP$  – Production Resource Potential, J.

The value of entropy change characterizes the system's approach to decay. This means that the value reversed to the change in the entropy of the information-energy system characterizes its ability to withstand crisis processes, that is, characterizes the stability of the information and energy system. The value of the inverse for the change in the entropy of the information-energy system is called the *Stability Coefficient of the information-energy System*:

$$CSS = PRP/\Delta PC, \quad (3)$$

The analysis of the indicators of the state of the information-power system allowed obtaining the equation of the economic state of the informational and energy system in a generalized form:

$$F(\text{PRP}, E) = 0, \quad (4)$$

The production of material goods and the satisfaction of the material needs of man, his well-being is the main objective of the economy. This goal can only be achieved with the efficiency of economic processes. The production of material goods and the satisfaction of the material needs of man, his well-being is the main objective of the economy. This goal can only be achieved with the efficiency of economic processes. The degree of economic satisfaction of the welfare of people in the society in economic science is accepted to evaluate the *index of human development of HDI*. Consequently, the state of the information-energy system is evaluated by indicators – the productive resource potential and production costs (or entropy), human well-being - the index of human development. On the basis of the functional connection of the parameters of the productive resource potential, entropy, and index of human development, the equation of the state of the information-energy system in the generalized form:

$$F(\text{PRP}, E, \text{HDI}) = 0, \quad (5)$$

or

$$\text{HDI} = f(\text{PRP}, E), \quad (6)$$

According to the data processing results of the agricultural enterprise of the forest-steppe zone of Ukraine for the period of 2010-2015, the statistical method of linear regression obtained the equation of the state of the information-energy system of the investigated enterprise in an algebraic form:

$$\text{HDI} = 0.006456 - 0.00031 * 10^{-8.42786} * E - 15 * \text{PRP}, \quad (7)$$

where  $\text{HDI} = (I_{pp} * I_{sc})^{1/2}$  – index of human development of employees of the enterprise,

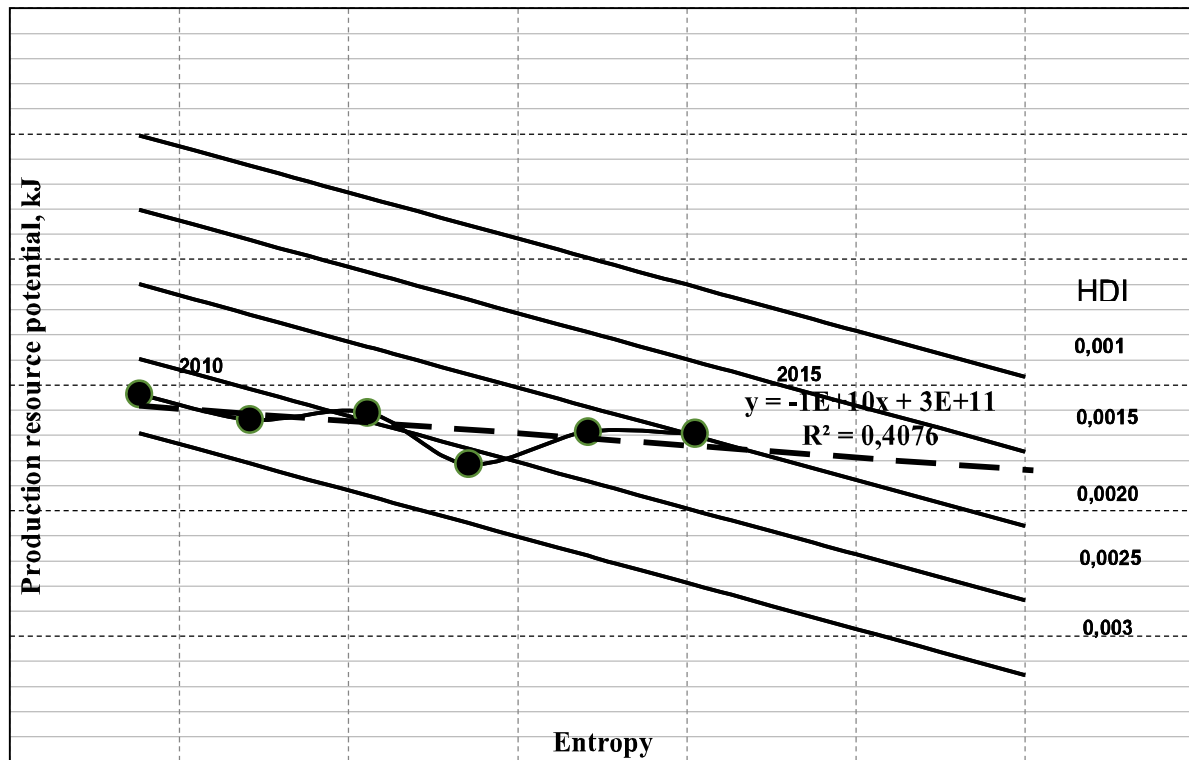
$I_{pp}$  – a subindex of the purchasing power of the employees of the enterprise,

$I_{sc}$  – a subindex of social costs for an employee of an enterprise.

The free term and coefficient in equation (6) depend on the functional links between the elements of the system, which are determined by the tasks set before it, which is oriented of a manager on the values of society and the social satisfaction of its needs.

On the basis of equation (6) is made of an entropy-resource diagram of the state of the enterprise, what is depicted in Fig. 4. The figure shows that the economic development of the investigated enterprise is carried out in the direction of degradation (growth of entropy) and reduction of productive resource potential, while trying to maintain standards of quality of life for workers as the highest value of a human society. This is a typical situation for most Ukrainian enterprises in modern conditions.

This confirms the relevance and reliability of the proposed energy concept of the study of economic systems.



**Fig. 4. An entropy-resource diagram of the state of the information-energy system**

### CONCLUSION

According to the results of the research, it was proposed:

- the energy concept for the study of the development of economic systems;
- absolute indicators of the state of the information-energy system – of entropy and production resource potential, which provided an opportunity for graphic (visual) representation of economic processes;
- system stability coefficient, how is the size the opposite to the change of entropy in the process;
- an entropy-resource diagram for the visual assessment of indicators of the forecast of the development of the information-energy system (entropy, production resource potential and the index of human development) with the indirect consideration of the values of society for the purpose of management;
- the prospect of research is seen in the disclosure of the concept of the impact of the values of society on the balanced development of the economic system.

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## **ECOLOGIZATION OF THE PRODUCTION AT AGRARIAN ENTERPRISES AS THE MAIN COMPONENT IN THE CONCEPT OF SUSTAINABLE DEVELOPMENT AND FOOD SECURITY OF THE COUNTRY**

**Introduction.** Over the past decades there has been a sharp increase in the negative influence of the economic activity of a society on environmental conditions. At that this issue is both local and international.

For today globalization of economy remains a multifaceted and complex process which is caused by the development of a human civilization and reveals additional possibilities and economic benefits for world countries. The processes of global integration into the world space were preceded by the information revolution and acceleration of paces of economic interaction and possibilities which it unveils. Conceptually it was manifested in the term “globalization”, which later became a synonym of the trend in world welfare and progress [1, p. 14]. At the same time this process possesses negative consequences, which are manifested at first in the anthropogenic influence on the environment. In particular it concerns the field of agrarian production which is most sensitive to any invasion in the development of the agricultural ecological system.

This fact caused the need for a principally new vision of features for providing ecological-economical balance – a concept of sustainable development.

**Research results.** Greening of the agrarian production is an integral part of implementing the concept of sustainable development. However, sustainable development of the agrarian production is possible with corresponding actions of agrarian enterprises towards greening and innovative approach to production with the purpose of their transition to a qualitatively new level of agricultural business activity, where the preference is provided for ecologically safe development of the agrarian production. Therefore the problem of the transition of agrarian enterprises to the ecological type of development is essential and provides the base for the concept of sustainable development [2, p. 278].

The concept of sustainable development is considered as a precondition for the long-term progress of humanity, which is accompanied by the increase in the capital and improvement of ecological conditions. Main principles of this concept were declared in Rio de Janeiro at the Conference of the UN on Environment and Development in 1992, with the participation of experts from 179 countries. The World