ISSN 2336-3630

№ 3(5)
•
2014

Středoevropský VĚSTNÍK pro vědu a výzkum

Central European Journal for Science and Research

EKONOMICKÉ VĚDY

NR 3 (5) 2014

Středoevropský věstník pro vědu a výzkum

Praha
Publishing house Education and Science
2014

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PLACES OF FORMATION OF ECOLOGICAL AND ECONOMIC LOADS AT ALL STAGES OF ENERGY PRODUCT LIFE CYCLE

This article gives a definition of the term «energy product», as a final result of the electric power industry. The definition of the term «life cycle of the energy product» was suggested and its stages were determined. The place of formation of eco-economic pressures at each stage of life cycle was investigated, and the integral result calculating formula as an index of performance was suggested.

Key words: energy products, environmental and economic losses, environmental and economic costs, the integral result autolosses.

INTRODUCTION

Effectiveness of any industry is determined by various economic indicators. Previously it was investigated that the different stages of energy products life cycle have a significant environmental impact. As this is a human pressure in this area of economic activity, while efficiency is to be determined taking into account the environmental and economic indicators. After analyzing the scientific work of domestic and foreign scholars, it was determined that the model for calculating the economic result of activity of for the full energy product life cycle based environmental components were not previously considered.

The eco-economic losses were classified by the method of their infliction. The purpose of the article is to determine the index of the integral result of the electric power industry, taking into account all the loads that occur at the stage of the life cycle of the energy product.

BASIC RESEARCH

Energy products should be understood as the result of human industrial activity, in which the properties of primary or secondary used energy resources disappear, and the resulting product has an independent consumer value and fully meets the needs of a consumer [6,9].

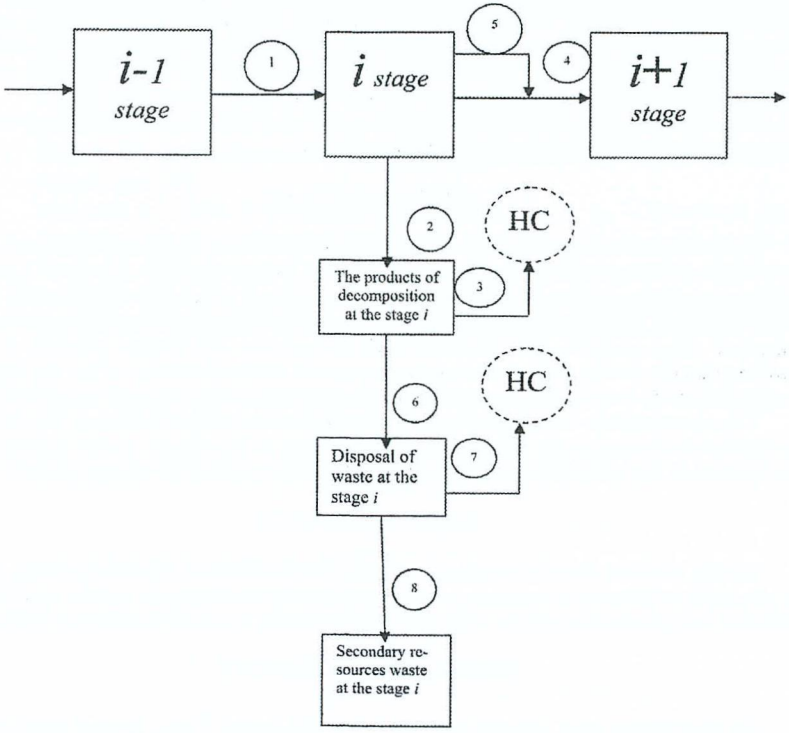
PROBLEM STATEMENT

As everything else, energy product has a life cycle. Then, energy product life is the time from the date of application of efforts in obtaining or receiving energy resources and their subsequent conversion into electrical energy until its consumption (use) and possible utilization.

Stages of energy product life cycle are as follows: 1) scientific and technological forecasting of energy equipment; 2) origin of ideas for finding and extracting energy resources and their implementation in scientific research; 3) extraction of energy resources (coal, gas, peat , uranium ...); 4) energy processing to condition suitable for the production of energy products; 5) production of electricity; 6) emergence of various waste products of economic activity; 7) waste disposal of the product at various stages of life cycle; 8) the distribution of electricity; 9) electricity consumption; 10) utilization of electrical energy.

In order to identify the specific locations of environmental stress on the individual stages of energy product life cycle (EPLC), let's consider a particular stage *i* of the whole EPLC and all possible processes, which take place there, Figure 1.

Figure 1



Source: developed by the author

Figure 1. Characterictics of EPLC at the stage *i*

Conventional processes taking place at the stage *i*:

1 – resource shift from stage (*i*-1) to the stage *i*;

2 – formation of degradation products at the operation stage *i* (formation of heat during combustion to the stage of electricity production);

3 – throwing out of decay products, which were formed on the stage *i*, in the environment – air, water and soil pollution;

4 – transition of energy product from stage *i* to the step (*i*+1);

5 – partial/full cost warning at the stage (*i*+1) due to greening at the stage *i*;

6 – emergence of waste at the stage *i* and their utilization;

7 – throwing out of wastes in the environment – air, water and soil pollution;

8 – reuse of the part of wastes from the stage *i*.

The stage (*i* -1) gives to the stage *i* energy resources (item 1). Then, there is processing of this resource as a result of which there is a product that goes into the next stage (*i* +1) that there acts as a resource (item 4). Power industry, like most industrial sectors, is not a waste free production. This means that at the stage *i* there are decay products, most of which can be trapped with special filters, and then disposed of (item 2), and yet most of the industrial waste pollute the environment (item 3), contaminating with all components of biosphere, atmosphere, hydrosphere, lithosphere. As a result of examining the stage *i* there are so-called «wastes of activities (WA)» (item 6). Some of these wastes can be put to reuse (item 8), resulting in emerging of new decay products from waste utilization, which, making pressure on the environment, contaminate it (item 7). During a shift of energy product from the stage *i* to the stage (*i* +1) , there is another component, which suggests complete or partial prevention of ecological and economic costs of stage (*i* +1) due to greening stage *i* (item 5). For example, if at the stage of processing of energy resources into the resource suitable for use in power plants we conduct environmental cleaning of the resource, then in the production of electricity at a power plant efficiency will be higher, CO_2 emissions to atmosphere will be less, which reduce ecological and economic damage and prevent environmental burden. If there is a greening process at the stage *i*, item 5 of EPLC at the stage (*i*+1) may be omitted.

The main task of stage separation of energy product life cycle is to maximize net profit (result of activities) throughout life cycle with reducing of environmental and economic costs. As the process at the stage *i* are identical to the processes at the stage (*i* ± 1), so in order to get the overall ecological and economic results of total life cycle, let`s determine the result of activity at the stage *i*. For this we consider all ecological and economic indicators that affect the final result of this stage.

1. Income. Activity of any enterprise, including enterprises of electricity sector aims to encourage its operation more income to sustain ecological and economic security. Ecological and economic security of business entities depends not only on the profit (income), but also on the strengthening of market benefits, holding market positions, ensuring sustainable development for the future. Income of any activity is determined by the number of products sold at a price fixed at the plant, that is:

$$Д_i = \sum_{j=1}^{l} Ц_{ji} \cdot Q_{ji} \quad (1)$$

$Ц_{ji}$ – price per unit of *j*-th sold product at the stage *i*, UAH/ton;
Q_{jN} – sales of mined/produced/sold product *j*, ton;

j – number of products at the stage *i*, from the sale of which the company generates income.

2. Economic costs. One of the main parameters characterizing the enterprise is the economic costs expressed in monetary terms the cost of production and marketing. This means that any economic activity has economic costs for all items of costing: raw materials, fuel and energy, wages and others. Through this grouping we may identify causal relationships and then, based on them, determine the level of costs arising from the production of a product, compare and monitor actual costs in relation to the expected ones, make informed management decisions [2]. Therefore, the economic costs of the stage *i* will consist of the sum of local economic costs :

$$В_i^e = \sum_{k=1}^{f} В_k^e \quad (2)$$

$В_i^e$ – economic costs at the stage *i*, UAH;
$В_k^e$ – economic costs by the number of costing items *f*, UAH

3. Economic profit. We know that income is a part of the proceeds remained after reimbursement of all costs of production and commercial activities of a company. Profit is a main financial source of enterprise development, scientific and technological improvement of its material base and production of all forms of investment. It serves as a source of tax income. Regarding on the value of all the profits, any enterprise activity is focused on its growth. Thus, profit as an economic category reflects the income that is created in the process of material production in the business sphere:

$$П_i^e = Д_i - В_i^e \quad (3)$$

Profit is a summary measure of the results of enterprise business, after taxes and other payments from profits to the budget a company has a net income. A part of it may be referred to social and industrial capital investments.

4. Ecological and economic costs. Regarding on the current state of the environment it can be said that the environmental load of different industries results in human suffering. Because our law lacks such amendments in the Law of Ukraine on the polluters pay for environmental damage inflicted, which were ecological and economic losses (costs) for it and had a significant contribution to reducing profit. In order

to prevent or reduce the losses incurred by the company it is required to give economic costs to environmental protection of the area, which should be such as to ensure sanitary standards for levels of pollutants in the environment. Such costs are called ecological and economic ones, that is expressed in financial losses in the form of the national economy (losses, additional expenses, lost profits) of ecologically destructive business entities.

$$B_i^{ee} = \sum_{n=1}^{m} B_n^{ee} \quad (4)$$

B_i^{ee} – total ecological and economic costs incurred at the stage *i*, UAH; B_n^{ee} – sustained ecological and economic cost of a recipient *n* at the stage *i*, UAH.

5. Ecological and economic losses. Ecological and economic losses in the period of time t can be classified with respect to the period (t-1) as follows:

5.1 residual ($У_{зал.}^{ee}$) – ecological and economic damage, the value of which in the time period t has not changed with respect to the period (t-1);

5.2 possible ($У_{можл.}^{ee}$) – ecological and economic damage that may be caused to the national economy as a result of emissions of pollutants into the environment in the period t;

5.3 eliminated ($У_{лікв.}^{ee}$) – ecological and economic damage, reduced during time period t relative to period (t-1);

5.4 prevented ($У_{відв.}^{ee}$) –difference between the possible and the actual losses:

$$У_{відв.}^{ee} = У_{можл.}^{ee} - У_{фякт.}^{ee} \quad (5).$$

6. Internalized ecological and economic losses at the stage *i* of EPLC. Today environmental management has a system of payments, but its calculation methods cannot be called perfect, because its calculations take into account only the direct impact of recipients, and recipients are not included. Water bodies used in industrial purposes lose their proper assignments properties. Thus, the payment for the use of water now does not compensate the public funds spent on community drinking water for their own needs.

Internalized ecological and economic losses, as well as ecological and economic ones are classified into liquidated ($У_{лікв.}^{ін}$), averted ($У_{відв.}^{ін}$), residual ($У_{зал.}^{ін}$).

7. Costs for averted transformed ecological and economic loss. While a detailed review of the final components of the resulting effective functioning at the stage *i* (Figure 1) index of full/partial prevention of ecological and economic costs of the stage *(i +1)* due to greening of the stage *i* was implemented. So this point is particularly important in the stage division of EPLC. Prevention of anthropogenic impact is more beneficial in terms of both economy and ecology than doing everything possible for liquidation and compensation of pollution. Therefore, the process of product greening at the stage *i* will reduce the burden on the environment in the next stages of the electricity energy product life cycle.

8. Ecological and economic losses, transformed from the stage *i* to the stage *(i+1).* This indicator should be understood as all possible calculated, eliminated and residual ecological and economic losses that may be or have been deposited to the environment during the transition of the resource from the stage *i* to the stage *(i +1)* under omission of the stage for elimination of losses in this area. They are expressed in kind and cash forms, deteriorating of environmental quality, affecting the health of the population and ultimately affect the economy (GDP) of the country.

This type of losses is also classified into liquidated ($У^{ін}_{лікв.}$), averted ($У^{ін}_{відв.}$), residual ($У^{ін}_{зал.}$).

9. Integrated ecological and economic results. Economic activity in any industry is characterized by separate economic and environmental indicators and by the system of ecological and economic ones. For a more accurate description of the enterprise system of ecological and economic indicators, integrated ecological and economic results must be calculated to the final integrated result with above given proposed ecological and economic indicators.

10. In order to determine the effectiveness of the functioning of a sector of the economy it is necessary to calculate efficiency indices. As such an index of efficiency for electricity energy product life cycle may be an indicator of the integral result calculated by the following formula 6:

$$Р_{інт_i} = Д_i + Д_{утил.відх._i} + Д_{тр.екол.посл.i} - (В^{е}_i + В^{ее}_i) - В_{утиліз._i} - (У^{ін}_{1i} + У^{ін}_{2i}) - В_{тр.екол.посл._i} \quad (6)$$

$Д_i$ – measure of profitability of a company at the stage *i* of the implementation process of production to the companies with the stage *(i+1),* thous. UAH;

$Д_{утил.відх._i}$ – measure of profitability of the stage *i* from the process of waste disposal at this stage for other companies, thous. UAH.

$Д_{тр.екол.посл.i}$ – measure of profitability of a company at the stage *i* from transformation of environmental services (services related to the prevention of environmental protection costs in subsequent stages of the cycle), thous. UAH.

The income of this component can be expressed by providing additional benefits for the protection of the environment;

$В^{е}_i$ – index of total economic costs incurred in the operation of the stage *i* according calculation items, thous. UAH.

$В^{ее}_i$ – set of ecological and economic costs incurred by the enterprise of the stage *i* and on the prevention or elimination of environmental pollution, thous. UAH.

$В_{утиліз._i}$ – total economic costs of the enterprise of the stage *i* incurred for accommodation and recycling of its operations, thous. UAH.

$У^{ін}_{1i}$ / $У^{ін}_{2i}$ – integrated ecological and economic losses (costs) incurred during activity at the stage *i* / waste disposal activities, thous. UAH.

$B_{тр.екол.посл_i}$– costs for transformed environmental services associated with the complete or partial prevention of environmental pollution in the next stages of energy product life cycle in power system (sulphur delivering, grinding rocks, etc.).

Closer look at each stage of energy product life cycle in power system enables to evaluate and create a mathematical model for calculating the integral result of the entire life cycle, that is, the sum of the activities at all stages *n*, thus

$$P = \sum_{i=1}^{n} P_{інт_i} \tag{7}$$

For achieving the main objective of economic activities of any company on accumulation of profit it is required to the proposed economic model of the integral result of the total energy product life-cycle in power system has become such a form:

$$P = \sum_{i=1}^{n} P_{інт_i} \rightarrow max \tag{8}$$

To achieve this condition in terms of this mathematical model, it needs to identify the most influential places with significant value for the final result. The challenge posed by the proposed model is to optimize business activities of the electricity industry in each of the stages of energy product life cycle in power system. It allows to compare numerically energy products life cycles derived from different energy right conclusions and to take a rational management decisions.

In order to fulfill conditions of equation 7 calculations must be conducted to identify the most influential components to obtain a positive result: to increase and to accumulate profits or reduce costs and losses.

CONCLUSIONS.

The article examined the eco-economic pressure at each stage of the energy product's life cycle with the purpose of derivation of a formula for the efficient function of the electric power industry. The concept of auto-loss was introduced and the energy losses of the territory were investigated.

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