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# **Solving the problems of optimizing the need of energy resources in oil and gas industries**

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**ABSTRACT:** The article makes a systematic analysis of existing methods for minimizing the consumption of energy resources, identified the main factors affecting the energy efficiency of production. The importance and necessity of optimization of consumption of energy resources at the oil and gas industry enterprises are grounded. The method, algorithm and block diagram of solving the problem of optimal calculation of energy resources needs are presented, and the main ways to reduce energy consumption are given.

**KEYWORDS:** Energy resources, energy intensity, energy efficiency, energy saving.

## **I. INTRODUCTION**

Problems of energy conservation and energy efficiency were addressed by scientists like Bushuyev VV, Bashmakov IA, Yarullina GR, Andrizhevsky AA, Golstrem VA, Gasho EG, Stepanova MV, Stafievskaya VV, Frolov VA, Frolov EV, Khakimyanov MI and other scientists who have made a significant contribution to the study of rational energy resources in various industries, including.

The importance of energy resources in industrial enterprises is determined by the fact that they are directly used in the technological process of production. In this regard, the amount of their expenditure has a direct impact on the formation of production costs and, accordingly, the prices of products, as well as its competitiveness.

## **II. STATEMENT OF A PROBLEM**

The results of the system analysis of energy efficiency conducted in the oil and gas industry have revealed the following problems in the sphere of energy saving production processes:

- large expenditure of energy resources;
- constant increase in tariffs for energy resources, difficulties with the connection of additional capacities;
- Increase in energy consumption restricting production growth;
- ensuring the uninterrupted supply of high-quality energy resources;
- high energy intensity of production processes of the enterprise;
- physical and moral wear of technical equipment;
- physical and moral wear of power equipment;
- imperfection of production and technical processes;
- a low level of culture of the use of energy resources [1].

In this regard, one of the priority activities of the oil and gas industry is to increase the efficiency of the use of energy resources. There are many ways to increase the efficiency of the use of energy resources, among which is the formation of a reliable and optimal regulatory framework for the consumption of energy resources, optimal consumption planning, and the operative management, recording and analysis of resource use [2].

## **III. THE CONCEPT OF THE PROBLEM DECISION**

The task of optimizing the consumption of energy resources in the oil and gas industry is a nonlinear problem of mathematical programming. The non-linearity of the problem of optimal production planning arises from the

complex dependencies of production parameters on the knowledge of variables, for example: the material balances of installations vary depending on the quantity and quality of incoming fuel and energy resources (FER); consumption of energy resources and auxiliary materials depends on the loading of facilities, equipment, etc. The mathematical formulation of the problem of optimal planning of the energy resources needs in general form can be written as follows:

$$F = \sum_{i=1}^m c_i x_i - \sum_{j=1}^n d_j r_j \rightarrow \max \quad (1)$$

Here  $c_j$  - the selling price of a unit of production  $x_j$ ,  $j = 1 \div n$  - types of products,  $d_i$  - the cost of purchasing (costs) a unit of energy resources,  $r_i$  -  $j = 1 \div n$  - types of energy resources.

To solve the problem (1), it is necessary to minimize the needs of energy resources, i.e. optimize energy consumption. The main goal of this work is to increase the efficiency of energy resources use, to reduce the unit consumption costs by identifying the main sources of losses, reducing overexpenditure, optimizing the distribution of purchased and own energy resources. To achieve the goal, it is necessary to solve the problems of optimal planning of the consumer of energy resources by production units on the basis of reliable norms and standards.

Planning of energy consumption  $X^p_j$  is defined as follows:

$$X^p_j = \sum_{i=1}^n Q_i * r_j,$$

where  $r_j$  - is the rate of FER consumption, per unit of  $i$ -output;

$Q$  - volume of  $i$ -products.

The actual energy consumption by  $j$ -subdivision  $X^f_j$  is calculated by summing up the difference between the energy consumption values at the end and the beginning of the period:

$$X^f_j = \sum_{j=1}^n (K_j - N_j),$$

where  $K_j$  - indication of the expense counter of the  $j$ -energy resource, at the end of the period;

$N_j$  - the meter reading of the  $j$ -energy resource, at the beginning of the period.

To achieve goal (1) it is necessary:

$$\Delta = X_j^p - X_j^f = 0$$

where  $\Delta$  - deviations between the planned and actual consumption of FER.

The enlarged block diagram of the algorithm for solving optimal FER scheduling is shown in Figure 1.

In the process of solving the problem, the differences between the actual and planned indicators for the analyzed period  $\Delta = X_j^p - X_j^f$ . With a ratio of  $\Delta < 0$ , it is assumed that the energy consumption of the  $j$ -unit exceeds the planned consumption of FER. In this case, a decision making subsystem is included to eliminate deviations from the planned consumption of FER. And at  $\Delta > 0$ , means the actual consumption is less than the planned one, therefore, the norms of FER are adjusted.

To achieve goal (1), the following organizational measures should also be used: - systematic replacement of old electrical equipment, power parts of equipment with modern and economical electrical equipment. One-time high acquisition costs will soon be compensated by a significant reduction in energy consumption and their increased efficiency compared to older models; - installation of electricity metering devices; - reduction of power consumption by optimizing the operation of production equipment by installing frequency-controlled drives for controlling electric motors; - Conducting automation of energy saving plants; - operative monitoring of changes in resource parameters for energy saving, taking into account the fact that any changes in pressure, humidity, temperature affect the quality of the product produced and can lead to increased electricity consumption.

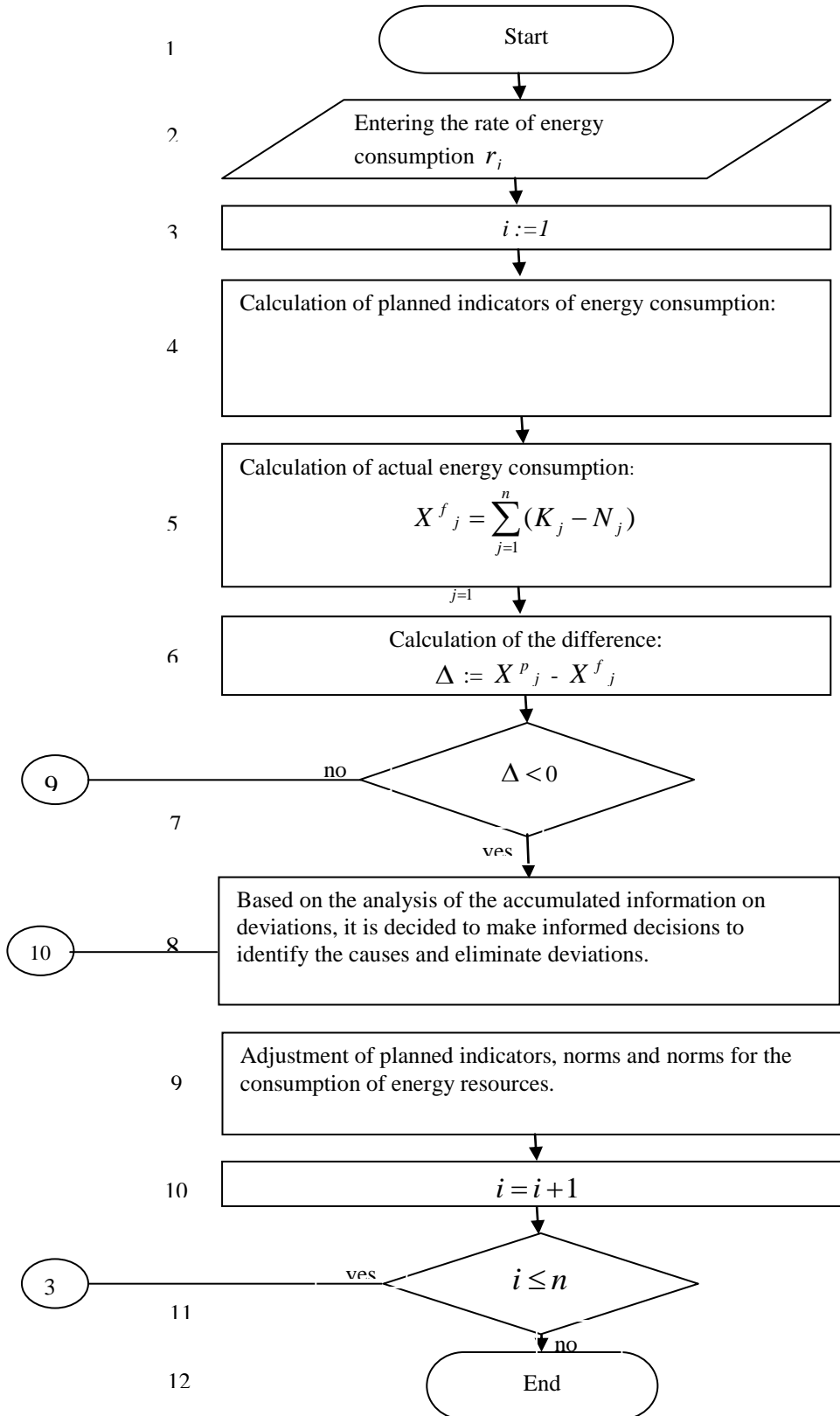


Figure 1



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