The object of the study is financial and economic indicators of the integrated use of mineral raw materials at the enterprise. The problem of economic substantiation of the feasibility of integrated use of mineral raw materials at the microeconomic level, which is urgent for the creation of a green economy, has been solved.

The analysis demonstrates high financial and economic efficiency of the proposed solution. The average 10-year OIBDA to revenue ratio is 55.0 %, net profit to revenue ratio is 30 % and IRR is 23.79 %, which ensures high sustainability of the project in terms of operating activities and allows its financing at the expense of revenue. Although the project requires substantial investments, it is characterized by a relatively quick payback period: 5 years and 8 months at a WACC rate of 15 %. This indicates that the project is sufficiently attractive for investors. The implementation of the project reduces CO_2 emissions by 49,481 tons and waste by 15,834 tons in 10 years, and saves energy by 885,135 kWh, ensuring green economy priorities.

The method of discounted cash flows was used to analyze the economic efficiency of the project implementation.

The peculiarities of the obtained results are that a financial model was developed for the assessment, the advantage of which is the accounting of all major cash flows of the project, which ensures the interests of the enterprise.

The results of the study can be used in making managerial decisions to rationalize the use of raw materials at enterprises, as well as by government agencies for green economy programs

Keywords: financial and economic advantages, integrated use of mineral raw materials, resource conservation, diversification, mining industry

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IDENTIFYING THE FINANCIAL AND ECONOMIC ADVANTAGES OF INTEGRATED USE OF MINERAL RAW MATERIALS AT THE ENTERPRISE

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1. Introduction

The present stage of society development is characterized by a constant population growth, respectively, the volume of production increases with the simultaneous influence of factors of raw material scarcity and increase in its cost [1]. Almost all basic types of materials are characterized by a shortage of raw materials, which leads to the economy mode at many industrial enterprises [2]. This determines the relevance of the problem of resource saving in economic activity, the development of modern models of resource-saving strategy becomes important.

The condition for the rational use of mineral raw materials is the need to meet public needs in the production of industrial products, with such efficiency, which would be at the current level of socio-economic development and meet the requirements for nature conservation [3]. The realization of such a condition is facilitated by an innovative approach to the economy. The modern enterprise is characterized by a strategic focus on sustainable growth on the basis of gaining competitive advantages through the use of innovations [4].

The need for resource-efficient economic development arises due to the low level of mineral resources development. Mining industry uses only 3–4 % of the extracted raw materials, and 96–97 % are production wastes [5]. The reserves in rich deposits are sharply decreasing, production wastes are accumulating, technogenic emissions into the ecosystem are increasing, which occurs due to extensive use of natural, including mineral reserves [6]. In this regard, one of the leading vectors of economic development, which are designed to meet the increasing raw material needs of public production, is the use of secondary mineral raw materials.

According to the traditional approach to resource consumption, which is based on the use of only the most important components of mineral raw materials, only primary resources are favored, which not only negatively affects the environment, but also hinders sustainable economic growth [7].

On the other hand, it is necessary not to absolutize, but to optimize the use of ore, because when extracting some components that are in the raw material, there is a possibility of an unsolvable or multi-complicated technological difficulty [8] and, as a consequence, the lack of economic feasibility of such an action for the enterprise.

In general, there is some contradiction between the environmental requirements of the state and financial and economic interests of subsoil users, especially in a market economy. In this direction, the topic of financial and economic advantages of integrated use of mineral resources, which stipulate the expediency of applying this approach at enterprises, is relevant.

2. Literature review and problem statement

In the scientific literature, the definition of the term «integrated use of mineral raw materials» (hereinafter – IUMR) is considered from different points of view. For example, in the study [8] defines IUMR as simultaneous or sequential extraction of additional components from the obtained raw materials at different production stages. However, there are still unresolved issues of optimality of extraction volumes. The degree of complex utilization of raw materials increases with the expansion of consumed components, and the increase in the extraction rate affects the growth of completeness of IUMR. This problem can be solved by adding the attribute of financial and economic feasibility of realization and/or processing of additionally extracted raw materials.

This approach was used in [9], according to which IUMR is the extraction and recovery from the subsurface of the full range of useful components contained in spent reserves. The reasons for the complexity of understanding "utility" may be the uncertainties with the profile of this category (technical, technological, economic, etc.). This approach can be labeled as maximalist, but, in general, this should be the strategic vector of production in the IUMR application.

In [10] the concepts of integrated use of raw materials and technology are directly connected, which leads to the IUMR definition as a technology that provides cost-effective extraction of products that have quantitative and nomenclature correspondence to the maximum possible at this stage of the economy and technological development. It should be noted that the key feature here is profitability, which makes this definition more specific and directed towards resources. All this suggests that it is advisable to consider additional mineral raw materials as a resource.

The financial and economic advantages of IUMR implementation are provided through the use of resource saving and resource supply functions. The resource-saving function saves financial, material, labor and natural resources in the production of goods on the basis of secondary raw materials, reduces costs for the preservation and decontamination of waste, for the restoration of land affected by the development of deposits for the extraction of primary raw materials, reduces product losses, rationalizes the location of enterprises, reduces the stock intensity of the mining industry.

The function of resource supply is to expand the mineral resource base of industry. The advantages of including wastes in the production are the reduction of atmospheric and water pollution, including groundwater, which entails a reduction in environmental costs, the withdrawal of land in economic turnover is reduced [11]. However, it is possible to identify other results: the needs in goods created on the basis of wastes, which are sources of raw materials, are satisfied, the range of products is expanded and their quality is improved, the use of technological resources is rationalized, etc.

It should be noted that developed countries have relatively high prices for mineral products. As a result, users of mineral resources value each unit of raw materials extracted from the sources. The high level of prices of mineral raw material products is explained by insufficient level of provision of production with certain types of mineral raw materials, at the same time progressive technology is applied during extraction and, especially, during deep processing, and creation of end-use products on its basis. High prices of mineral raw materials in some countries (Germany, Canada, Great Britain, etc.) arise also due to the influence of the resource-saving policy implemented by the government [12]. All this suggests that due to relatively high market prices it becomes possible to stimulate IUMR, relying on a high level of development of productive forces.

The foundation of wasteful consumption is the contradiction of social and technological needs and unwillingness to abandon the exploitation of natural resources. In connection with the development of material production, there is a constant growth of public needs satisfied through exploitation and environmental degradation [13]. The reasons for this may be the following. For developing countries, firstly, the task of creating a system for environmental management does not correspond to the technological level of production. Most of the modern technologies are aimed at increasing the consumption of natural resources rather than using them rationally. This has led to the fact that the extraction of mineral raw materials is carried out in huge amounts and, if this level is maintained in the coming years, will have a disastrous effect on humanity [14]. Secondly, there is no formulation of the task of alternative variant of social development without the provision of resources from the natural base. The way to overcome these difficulties can be the justification of financial and economic advantages of the IUMR implementation at enterprises.

Summarizing the various approaches, it is possible to conclude that IUMR is a method of rational use of minerals, which achieves positive financial and economic benefits (positive effects) from all components of ores possible for processing and/or sale.

By introducing cardinal solutions to the problems of resource provision and nature conservation, it is expedient to create low-waste and zero-waste technological processes and production. At the same time, the success of the waste limitation strategy depends on whether the technical and technological problems that require significant expenditures on research and production modernization in various industries will be eliminated.

The concept of substitution contains strategic ways to rationalize the consumption of resources and represents the replacement of some processes, materials, technologies, devices – by others [15]. The reason is the evolutionary process, which is caused by the reduced cost and advantages in the functions of the introduced materials or processes in comparison with the original ones. In recent years, there has been an increase in the development of new materials. For example, the US spends up to 56 % of total R&D expenditures on new materials [16]. This suggests the advisability of combining the vectors of IUMR and innovative production.

Aluminum, steel, titanium are replaced by plastic, composite materials and ceramics in the manufacture of automobiles and airplanes. In addition to reducing the damage that is caused by environmental pollution, the replacement of materials is realized in order to reduce production costs and damage intensity [17]. To solve the problem of rationalization and integrated use of mineral raw materials, strategic directions of resource consumption, recycling of materials are important.

IUMR is one of the tools for the realization of sustainable development policy preventing threats to future generations. Compliance with the requirements of the system of handling mineral raw materials, which are written off as waste according to the accounting system, is a condition for sustainable social development [10]. One of the priority directions in this sphere can be the reuse of certain fractions of generated waste, as well as their transformation into an energy source.

The study [8] emphasizes that waste is unused and not having consumer properties residues of raw materials, semi-finished products, goods, which are formed during manufacturing or consumption. Indeed, waste is an unused part of natural resources that are involved in the production process, but it is necessary to recognize the presence of consumer properties of waste, even if they are not yet disclosed at this level of scientific and technological progress.

Most of the mineral resources classified as waste are applicable in the manufacture of various products (an example is the use of a significant part of overburden), as well as in the creation of materials for construction (from waste from iron ore beneficiation): crushed stone, lime, building sand, cement, silicate materials, etc. [18]. And recycled waste in the form of ash or ash and slag is used in the following areas [19]:

– production of construction materials (34 %);

– construction (43 %);

– agriculture (23 %).

Inefficient utilization of waste products results in large economic losses consisting of loss of valuable elements of waste products, expenses on tailings ponds and restoration of damaged lands.

One of the IUMR benefits is achieved through product range and product mix expansion. This is also reflected in the overall increase in the value of the product obtained during extraction and raw material processing. According to a study by [20], the capital that is invested in the manufacture of goods from waste materials most often has an effect much greater than when invested in increasing the level of extraction of the underlying minerals. However, the study used a long payback period of investments, which significantly reduces the investment attractiveness of the proposed solution.

Billions of tons of mining, overburden rocks are stored in dumps, with huge resources spent on prospecting, exploration, mining, transportation, storage and other works that have a value [21]. At the same time, their accounting, economic evaluation, including as part of the mineral and raw materials state balance sheet is not carried out due to the fact that the costs of prospecting and exploration are not included in the fixed assets of the industry for the extraction of minerals, as well as in their cost. All costs incurred in the extraction, transportation and storage of associated components are written off.

According to research, through the integrated use of mineral raw materials it is possible to stimulate:

– scientific and technical development and financing of innovative directions in the creation of the latest equipment and technologies for waste treatment [22];

– development and implementation of environmentally friendly production facilities with no or minimized waste [23];

– reducing the use of primary resources and increasing the use of secondary resources [9].

The latter is particularly important due to the limited reserves of mineral raw materials, the difficulties encountered during their extraction and the lack of reproducibility of a large number of resource types, and at the same time due to the high level of efficiency in the use of secondary resources. IUMR allows for the release of primary raw materials, materials and fuels, which leads to a change in the ratio of resource extraction and processing industries, as well as leads to the reallocation of financial investments in manufacturing industries.

The advantages of the integrated use of mineral raw materials consist in the possible effects of the sphere of material production, positively affecting the financial and economic performance of the company. This is beneficial to enterprises, as it allows to increase the profit of organizations, reduce environmental costs, implement economically beneficial innovative developments, and develop processing production. These advantages are provided by the functions of resource saving and resource supply inherent in the integrated use of mineral raw materials.

Thus, the financial and economic advantages of integrated use of mineral raw materials lie in the positive effects that are achieved as a result of a rational approach to the organization of production. This direction is beneficial not only to the state (society) as a whole, but also to enterprises, as it allows increasing the profit of organizations, reducing environmental costs, introducing economically beneficial innovative developments, and developing processing production. Nevertheless, at the present time practical research substantiating the financial and economic feasibility of integrated use of mineral raw materials for enterprises is insufficient.

3. The aim and objectives of the study

The aim of the study is: to substantiate the financial and economic advantages of the integrated use of mineral raw materials at the enterprise, which will make it possible to interest not only the state, but also private business in this direction.

To achieve this aim, the following objectives are accomplished:

– to give a general characterization of the proposed project on integrated use of mineral raw materials at a particular enterprise;

– to calculate the expected results of the project;

– to assess the financial and economic efficiency of the proposed project;

– to identify the environmental and social benefits of the proposed project.

4. Materials and methods of research

The object of the study is financial and economic indicators of the integrated use of mineral raw materials at the enterprise. The analysis was carried out on the example of oil and gas company «SOUTH-OIL», located in the Republic of Kazakhstan, which belongs to the developing countries. The assumption in the course of the research is that this company starts to realize the project of complex use of mineral raw materials already in the current period, while the market is a dynamic phenomenon.

Hypothesis of the study: the integrated use of mineral raw materials provides economic and financial advantages for the enterprise in the short term.

A financial model was developed for the appraisal, the calculations of which take into account all the main cash flows of the project, including operating expenses, capital investments, proceeds from the sale of products. Input data for the appraisal were obtained from project documentation, statistical reports and global experience data.

The discounted cash flow method was used to analyze the economic efficiency of the IUMR implementation project. This method allows estimating the actual value of future income, taking into account the time factor. Within the framework of the study the following indicators were calculated: internal rate of return, net present income, and investment payback period. The simplification adopted in the study is to keep the discount rate constant for the entire projection period.

Commercial viability indicators include the financial implications for the investor, assuming that they make all the necessary expenditures to implement the project and take advantage of all the results obtained.

Commercial effect from the project realization P^t_{com} is calculated according to (1):

$$P^t_{com} = \sum_{t=1}^{t} \left(P_{add,t} + P_{rep,t} + P_{eco,t} \right) \cdot k_r, \quad (1)$$

where:

– k_r – discount factor that provides comparison of unequal values and results obtained in different time intervals for time period t;

– t – ordinal number of the year, the costs and results of which are brought to the estimated year;

– $P_{add,t}$ – profit from the sale of by-products, production waste and additional products in t -period;

– $P_{rep,t}$ – the effect of replacing the initial raw materials with waste from own production or raw materials obtained in the process of production of the main product in t -period;

– $P_{eco,t}$ – effect from reduction of expenses for environmental use and compliance with environmental requirements in t -period.

In turn, the discount factor (k_r) for time period t is calculated by (2):

$$k_r = \left(1 + d_n\right)^{t_b - t}, \quad (2)$$

where:

– d_n – discount rate;

– t_b – the serial number of the billing year.

The project is characterized by indicators of commercial efficiency, taking into account the financial consequences for investors, and assumes the existence of necessary production costs from the implementation and use of all its results. The investment project is evaluated by calculating the efficiency through the comparison of indicators in different periods of time due to their reduction (discounting) to the value of the initial period. Different costs, results and effects are given with the discount rate E, which is assumed to be 25 % (according to the UNIDO method). The profitability index is calculated by the ratio of the sum of the present effects to the amount of capital invested.

The environmental effect is calculated by means of comparative analysis of CO_2 emissions, waste volume and energy costs associated with mining, calculated by (3):

$$Effect = (T - N) \cdot P, \quad (3)$$

where:

Effect – the amount of savings realized;

T – the costs of traditional mining methods;

N – the costs of a new mining method;

P – production volume.

Calculation of social effect is an assessment of indicators: the number of direct and indirect jobs created, the average salary per 1 job, the increase in deductions to the budget, the number of potential consumers of products, the number of people potential users of the infrastructure created for the implementation of the project.

The results were processed using Python Jupiter Book software (USA).

5. Results of assessment of financial and economic advantages of integrated use of mineral raw materials

5. 1. General characterization of the proposed project on integrated use of mineral raw materials at enterprise

The Kazakhstan company «SOUTH-OIL» carries out oil exploration and production in fields located in the Kyzylorda and Ulytau regions of the Republic of Kazakhstan. For the first time in the history of the country, the company's specialists discovered oil and gas bearing capacity in shale rocks of the Karagansai formation, including the Akshabulak field.

«SOUTH-OIL» first put shale oil reserves on the state's balance sheet in 2023. For the next 3 years a plan has been created to drill about 15 wells for shale oil production, and up to 150 wells are planned to be drilled for a period of up to 25 years.

As a global example of IUMR in the oil shale industry it is possible to highlight the power boilers, which work by the process of direct combustion of oil shale and the production of furnace oils and gas as a result of its processing. Oil shale industry enterprises are engaged in oil shale processing to obtain liquid and gaseous fuels, bitumen, road oil, adhesives, construction mastics, varnishes, tanning agents, etc. [24, 25].

At the present stage it is expedient to establish by «SOUTH-OIL» a profitable low-waste enterprise in the sphere of processing, energy or other profile, providing IUMR, which will use oil shale and reserves of natural resource potential.

Diversification of production and constant demand for energy carriers will ensure financial stability of «SOUTH-OIL». This requires an energy technological complex based on a solid heat carrier unit, which will make it possible to produce fuel oil, high-calorific gas and raw shale gasoline, which will make it possible to meet the growing demand for end products.

The investment costs of this project consist of two main parts: capital investments aimed at the construction of the complex and working capital required to ensure its operation. The working capital requirement of the project is formed on the basis of planned production and sales volumes. Part of the working capital can be financed at the expense of current balance sheet liabilities. Total investment in the project, including capital and working capital, will be as follows:

1) the first investment – 48 thousand US dollars (hereinafter – USD, $);

2) the second investment is 4,864.6 thousand USD;

3) the third investment – 100.8 thousand USD.

Total 5,013.4 thousand USD (including VAT).

The weighted average cost of capital (WACC) is 15.25 %.

IUMR, based on the use of oil shale processing waste, will optimize the financial and economic activities of SOUTH-OIL and, in general, will start the Kazakhstan oil shale industry in its intensive direction.

5. 2. Calculation of expected results of the project on integrated utilization of mineral raw materials at enterprise

Table 1 contains information on the planned production and sales volume of products, on the basis of which the working capital requirement is calculated.

Retained earnings and/or a short-term loan will be used to cover this need. The production revenue for the 10 years of the Integrated Mineral Utilization Project will be 28,634 thousand USD, while the net profit will be 8,589 thousand USD (Table 2).

The strategic model assumes OIBDA at 55 %, which indicates a high margin of the project. Amortization of investments at the enterprise is carried out in a linear manner and evenly distributed over 10 years, taking into account these costs, the average profitability of the project is 30 %. The break-even point is 45 %. This means that if this level is exceeded, each additional dollar of revenue will make the profit of the enterprise, which characterizes this production as reliable and stable to potential risks in the form of price or sales volume reduction.

Table 1

Results of sales and marketing activities

Indicator/project period	1	2	3	4	5	6	7	8	9	10
Revenue, thousand dollars	1,556	2,159	2,509	2,871	3,370	3,586	3,813	4,052	4,303	3,852
Fuel oil, thousand dollars	351	487	552	621	708	760	817	877	942	1,832
Output, tons	916	1,145	1,181	1,208	1,262	1,244	1,226	1,208	1,190	2,124
Price per ton, dollars	383	425	468	514	561	611	666	726	792	863
High-calorie gas, thousand dollars	1,042	1,445	1,690	1,941	2,296	2,437	2,585	2,740	2,902	1,536
Output, thousand cubic meters	13,882	17,352	18,443	19,262	20,899	20,353	19,807	19,262	18,716	9,085
Price per cubic meter, dollars	0.08	0.08	0.09	0.10	0.11	0.12	0.13	0.14	0.16	0.17
Crude shale gasoline, thousand dollars	163	227	267	308	367	389	411	435	459	484
Output, tons	659	824	881	924	1,011	982	953	924	896	867
Price per ton, dollars	248	275	303	333	363	396	431	470	512	559

Source: elaborated by authors according to the strategic development plan of «SOUTH-OIL» company.

Table 2

Financial performance – expected profit and loss statement of the project

Indicator/project period	1	2	3	4	5	6	7	8	9	10
Revenue (excluding VAT), thousand USD	1,389	1,927	2,240	2,563	3,009	3,202	3,405	3,618	3,842	3,439
LRF, thousand USD	–417	–578	–672	–769	–903	–961	–1,021	–1,085	–1,153	–1,032
Materials, thousand USD	–139	–193	–224	–256	–301	–320	–340	–362	–384	–344
Services of third-party organizations, thousand USD	–69	–96	–112	–128	–150	–160	–170	–181	–192	–172
OIBDA, thousand USD	764	1,060	1,232	1,410	1,655	1,761	1,873	1,990	2,113	1,892
OIBDA, %	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0	55.0
Amortization, thousand USD	–501	–501	–501	–501	–501	–501	–501	–501	–501	–501
Payments to the budget, thousand USD	–53	–112	–146	–182	–231	–252	–274	–298	–322	–278
Net income, thousand USD	210	447	585	727	923	1,008	1,097	1,191	1,289	1,112
Net income, %	15.1	23.2	26.1	28.4	30.7	31.5	32.2	32.9	33.6	32.3
Breakeven point, thousand USD	625	867	1,008	1,153	1,354	1,441	1,532	1,628	1,729	1,548
Breakeven point, %	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0

Source: elaborated by authors based on the data of «SOUTH-OIL» strategic development plan.

5. 3. Assessment of financial and economic efficiency of the project on complex utilization of mineral raw materials at enterprise

The assessment of the financial and economic efficiency of the project, based on cash flow analysis, is presented in Table 3.

It should be taken into account that investments in the zero period amount to 5013 thousand dollars. Free cash flow, has a positive value starting from 1 year after the main investment, which indicates the effectiveness of the project and the ability to finance operating activities at the expense of profit, without attracting additional funding. Key performance indicators of this project are shown in Table 4.

According to these calculations, it is possible to see that the NPV (Net Present Value) is 3,135 thousand dollars. The positive value of NPV indicates that the project is profitable.

IRR (Internal Rate of Return) is 23.79 %. This rate exceeds the required rate of return (WACC) included in the calculations, so the project is considered attractive for investment.

The payback period of the project is 5 years and 8 months (Fig. 1).

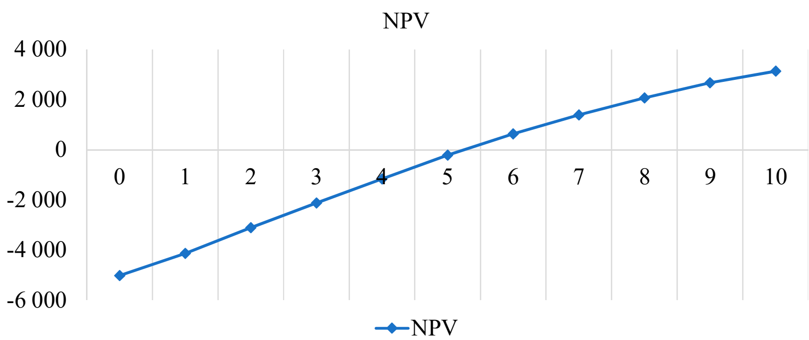

Fig. 1. NPV dynamics by years, thosand dollars
Source: elaborated by authors according to Table 4

Table 3

Statement of cash flows, thousand USD

Indicator/project period	1	2	3	4	5	6	7	8	9	10
Income from operating activities	1,556	2,159	2,509	2,871	3,370	3,586	3,813	4,052	4,303	3,852
Outflow from operating activities	–650	–902	–1,048	–1,199	–1,408	–1,498	–1,593	–1,693	–1,798	–1,610
Operating result	906	1,257	1,461	1,671	1,962	2,088	2,220	2,359	2,505	2,242
Free cash flow	906	1,257	1,461	1,671	1,962	2,088	2,220	2,359	2,505	2,242

Source: elaborated by authors based on the data of «SOUTH-OIL» strategic development plan.

Table 4

Calculation of NPV of the project, thousand USD

Indicator/project period	1	2	3	4	5	6	7	8	9	10
Free cash flow	906	1,257	1,461	1,671	1,962	2,088	2,220	2,359	2,505	2,242
Savings on payments to the budget	132	165	176	185	202	196	191	185	179	173
PV	879	1,021	996	957	946	846	757	677	605	462
NPV	–4,134	–3,113	–2,117	–1,159	–213	633	1,390	2,067	2,673	3,135

Source: elaborated by authors based on the data of «SOUTH-OIL» strategic development plan.

Thus, the conducted financial analysis of the project for construction of the energy technological complex indicates its high financial and economic efficiency. The application of the discounted cash flow method allowed to estimate future revenues and costs of the project, taking into account the time factor. The obtained results indicate a positive net present value, which indicates that the project will bring profits exceeding the initial investment. The average internal rate of return confirms the attractiveness of the project for investors.

5. 4. Environmental and social benefits from the implementation of the project on integrated use of mineral raw materials at enterprise

By processing pulverized oil shale, which is often considered a waste product, valuable products such as heating oils and gas can be obtained, which helps to save energy and reduce greenhouse gas emissions. Implementation of the project promotes efficient use of resources, which reduces the need to extract new hydrocarbons and minimizes the negative impact on the environment.

From an environmental perspective, the project contributes to the reduction of CO_2 emissions, waste and energy efficiency (Table 5).

For this project, the savings over 10 years would be:

– CO_2 emissions per ton of fuel oil: 2,540 (0.2*12,702 tons);

– CO_2 emissions per ton of high-calorie gas: 44,265 (0.25*17,7061 tons);

– CO_2 emissions per ton of raw shale gasoline: 2,676 (0.3*8,922 tons);

– waste per ton of extracted feedstock: 15,834 (8 %*198,685 tons);

– energy costs per ton of fuel oil: 78,752 kWh (5.2 kWh*12,702 tons);

– energy consumption per ton of high-calorie gas: 708,245 kWh (4 kWh* 177,061 tons);

– energy costs per ton of shale gasoline: 98,138 kWh (11.68 kWh*8,922 tons).

In addition, the project will create new jobs, which will contribute to the development of the local economy and improve the social well-being of the population. The project envisages training and professional development programs for employees, which will not only improve their professional skills, but also raise awareness of the importance of environmental responsibility and sustainable development.

From a social point of view, the project contributes to job creation, improving the quality of life of the population and increasing budget revenues (Table 6).

The amount of increase in tax revenues is calculated based on a tax base of \$589 thousand per year:

$$\begin{pmatrix}35\text{ people}*992\text{ USD per month}+\\+20\text{ people}*718\text{ USD per month}\end{pmatrix}\times$$
$$\times 12\text{ months}.$$

The social impact associated with the construction of the access road is based on the number of people living in the area of the road.

Thus, IUMR not only contributes to the economic growth of the enterprise through resource conservation and diversification of production, but also creates a more sustainable and environmentally friendly future for generations and provides additional social effects.

Table 5

Environmental benefits of the proposed project

Indicators/result	Traditional method	Project technology	Economy
Output of tons of CO_2 per ton of fuel oil	0.5	0.3	0.2
Yield of tons of CO_2 per ton of high-calorie gas	2.75	2.5	0.25
Yield of tons of CO_2 per ton of feedstock shale gasoline	2.3	2	0.3
Of waste per ton of extracted raw material, %	10	2	8
Energy consumption for production of a ton of fuel oil, kWh	16.7	10.5	5.2
Energy consumption per ton of high-calorie gas, kWh	37.5	33.5	4
Energy consumption for extraction of a ton of shale gasoline, kWh	106.68	95	11.68

Source: elaborated by authors based on the data of «SOUTH-OIL» strategic development plan.

Table 6

Social benefits of the proposed project

Social benefits	Affected person	Estimate at first year prices
Financial advantages of the project		
Creation of direct jobs	35 persons	Average salary of 992 USD per month (38 % higher than the average salary in the region)
Indirect job creation	20 persons	The average salary of 718 USD per month is in line with the regional average
Increase in tax revenues to the budget	55 persons	59 thousand USD a year
Non-financial benefits		
Improvement of infrastructure (roads, transportation)	10,000 persons	

Source: elaborated by authors based on the data of «SOUTH-OIL» strategic development plan.

6. Discussion of the results of the assessment of the integrated use of mineral raw materials at the enterprise

Oil shale is a type of solid hydrocarbon fuel used in the chemical and energy industries. 72 % of the extracted oil shale is used in the energy industry, up to 23 % in the technological industry, and the remaining part, which is about 5 %, is used by enterprises in the production of construction materials [26].

Due to the construction of its own oil shale processing production, it is possible for a mining company to transition to self-sufficiency through the production of goods with a high level of consumer properties and wide sales opportunities, transition to the use of modern technologies of oil shale processing, which will lead to a reduction in emissions of harmful substances and compliance with the level of maximum permissible concentration.

It is possible to increase the IUMR and efficiency of the oil shale mining enterprise through the implementation of technical and organizational processes, which include:

– thermal processing of oil shale used in combustion, resulting in ashless and low-sulfur products, including oil shale fuel oil, high-calorie gas and crude oil shale gasoline;

– conversion of boilers to maintain heat output when burning oil shale gas, providing for the use of oil shale as a reserve fuel;

– increasing the volume of used oil shale up to the level at which the required heat output of boilers at shale gas production is ensured;

– sale of oil shale fuel oil and oil shale gasoline as commodity products of the energy market.

The economic feasibility of measures for the integrated use of oil shale and wastes obtained during their extraction and processing is achieved in the project using oil shale ash from fluidized bed furnaces and from crushed stone screening as an ameliorant for liming of acid soils and production of coagulant, potassium fertilizers.

Oil shale ash can also be locally consumed by the nearest rural farms with minimum production and transportation costs. The study [27] revealed the absence of negative effects of ash on soil and plants and confirmed the stimulation of biological activity of soils.

In order to achieve the above mentioned it is necessary: to use the optimal technology of oil shale processing, which has been mastered in the industry; to create a project for the construction of the boiler house; to search for vacant areas on the industrial site near the boiler house in order to place additional equipment and communications; to find opportunities to manufacture or purchase equipment, to purchase pipes and rolled metal at minimal costs; to increase the oil shale supply to the boiler house; to purchase energy resources in the form of steam, water, electricity and compression.

Due to the construction of the energy technological complex, fuel oil, raw oil shale gasoline and high-calorie gas will be produced, which will make it possible to achieve optimal and priority prevention of oil shale industry problems, as well as ensure financial stability of the enterprise due to the diversification of production and due to the constant demand for energy carriers.

Calculation of the results of SOUTH-OIL's production and sales activities under the proposed project of integrated use of mineral raw materials in shale production showed (Table 1) that diversification of production results in 10 years in the form of revenues of 32,071 thousand USD. And this is provided that the volumes of production and distribution by product mix are formed according to a conservative scenario and do not take into account a possible increase in the number of wells.

The full cost of production includes all costs associated with production and sales, such as wages and salaries, cost of raw materials, energy resources, depreciation of fixed assets, taxes and other deductions. According to preliminary calculations, the share of OIBDA in the project revenue is 55 %, taking into account amortization and payments to the budget – the share of net profit in the project revenue averages 30 % over 10 years, which indicates a high margin of the project (Table 2).

The project for construction of the energy technology complex demonstrates high financial efficiency. OIBDA in the first year of production will amount to 764 thousand dollars and will steadily grow to 1,892 thousand dollars in subsequent years. Net profit in the first year of production will amount to 210 thousand USD, and by the tenth year of the project will increase to 1,112 thousand USD, cumulatively reaching 8,589 thousand USD. The share of OIBDA in the company's revenue will amount to 55.0 %, the share of net profit in revenue will be 30.0 %. Even if difficult market conditions persist, the project will provide investors with a high return on investment.

In terms of the financial performance of the energy technology complex project, it can be seen:

1. Already from the first year the enterprise will have a positive free cash flow, which indicates the high financial stability of the project and the absence of the need to attract borrowed funds for its financing (Table 3).

2. The NPV of the project is 3,125 thousand dollars for 10 years, which indicates the commercial attractiveness of the project at the current market rate of WACC 15.25 % (Table 4).

3. The project will remain sustainable even if the WACC increases to 23.79 % (Project IRR). Which also indicates a high degree of reliability of the project. This means that even with an increase in the cost of capital, the project will continue to generate positive cash flow and provide a return on investment.

4. The estimated payback period of the project is 5 years and 8 months, which indicates a fairly quick return on investment. The invested funds will return to investors within a short-term period, which reduces financial risks and increases the attractiveness of the project for potential investors.

Despite the significant initial investment, in contrast to [28], where the payback period of the IUMR project is 20 years, this result with a discounted period of 5 years and 8 months allows to justify the attractiveness of the solution for the oil shale industry even at its start. This is possible due to the offer of an extended nomenclature and methods of utilization of secondary raw materials.

In addition, the realization of this project has a number of environmental and social advantages that can be used both in the interests of the company and the region as a whole.

The environmental benefits are that the processing of oil shale yields valuable products such as heating oils and gas, which helps to save energy and reduce greenhouse gas emissions. The use of cleaner combustion and processing technologies reduces air pollution and improves the quality of life in the project regions. This, in turn, improves public health and contributes to environmental sustainability. Project implementation reduces CO_2 emissions by 4948.1 tons and waste by 1,583.4 tons each year, and saves energy by 88,513.5 kWh (Table 5).

Social benefits include the creation of new jobs, which contributes to the development of the local economy and improves the social well-being of the population. By creating jobs and increasing tax revenues to the regional budget, various social programs can be implemented. Creation of jobs for 55 people and improvement of the quality of life of 10,000 people, as well as tax revenues for 59,232 thousand dollars per year (in prices of the first year) provide social effect from the project implementation (Table 6).

Thus, the project implementation will allow not only to meet the growing demand for products, but also to provide a stable profit to investors, as well as to contribute to the solution of social and environmental problems of the territory.

The limitations of this study are that the project assessment is based on the assumption of full-scale launch of shale production by the enterprise. If it is decided to develop shale production in stages with gradual inclusion of wells, or if some of the wells turn out to be unsuitable, the financial and economic advantages of IUMR in the proposed project will have to be re-evaluated. Another limitation is the assumption of stability in market development. High market volatility could lead to significant changes in both the cost of attracting WACC investment and the cost of production, in which case the economics of the project could change significantly.

It should be noted the difficulties of combining IUMR and innovative technologies into a common strategy in a new industrial sphere for a developing country, which requires significant financial investments. Like any investment project, this initiative involves certain risks associated with fluctuations in the prices of raw materials and energy resources, changes in tax legislation and other external factors. These are the shortcomings of the study, the subject of which does not cover the consideration of external factors. To minimize these risks, it is necessary in the perspective of the study to develop and implement a set of measures aimed at increasing the flexibility of production and reducing dependence on external factors.

7. Conclusions

1. The design solution of the integrated use of mineral raw materials on the example of oil shale mining enterprise is proposed in the form of construction of an energy-technological complex, which will produce fuel oil, high-calorie gas and crude oil shale gasoline, which will ensure diversification of production. The total investment in the project amounts to 5,013 thousand dollars.

2. The analysis demonstrates high financial and economic efficiency of the proposed solution. OIBDA share in revenue is 55.0 %, net profit share in revenue on average for 10 years is 30 %, which ensures high sustainability of the project in terms of operating activities and allows to finance them at the expense of revenue. IRR (23.79 %) of the project significantly exceeds the average market values, which means that even in conditions of increase in the cost of capital the project will continue to generate positive cash flow and provide return on investment.

3. Although the project requires substantial investments, it is characterized by a relatively quick payback period: 5 years and 8 months at a WACC rate of 15 %. The project is sufficiently attractive for investors.

4. The use of cleaner production technologies improves the environmental situation in the region by reducing the level of pollutant emissions into the atmosphere and minimizing the negative impact on the environment. The project implementation allows reducing CO_2 emissions by 49,481 tons and waste by 15,834 tons, as well as saving energy by 885,135 kWh over 10 years. In addition, the implementation of the project creates new jobs and contributes to improving the living standards of local residents.

Conflict of interest

The authors declare that they have no conflict of interest in relation to this research, whether financial, personal, authorship or otherwise, that could affect the research and its results presented in this paper.

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The study was performed without financial support.

Data availability

Data will be made available on reasonable request.

Use of artificial intelligence

The authors have used artificial intelligence technologies within acceptable limits to provide their own verified data, which is described in the research methodology section.

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