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Dejan Bugarin[*], Ivan Jelić[*], Miljan Gomilanović[*], Aleksandar Doderović[*]

APPLICATION OF THE COMFAR III SOFTWARE PACKAGE IN DEVELOPMENT A FEASIBILITY STUDY OF INVESTMENT ON AN EXAMPLE OF TECHNICAL-CONSTRUCTION STONE OF THE OPEN PIT GELJA LJUT[**]

Abstract

This work presents the application of the COMFAR III software package in development a feasibility study of investment. The application of this program enables an efficient analysis of investment justification and numerous variations of both input and graphic and alphanumeric output data. The methodological basis of economic analysis, used in this software package, is based on decades of experience of economists, engineers, managers, ecologists and experts from the other fields, as well as on the experience of numerous investment projects within the United Nations Industrial Development Organization. The applied methodology is the current standard in the field of economic evaluation and analysis of the industrial development projects. The software package was used on a specific example of the open pit of technical stone Gelja Ljut-Gacko, in a function of providing the concession right of this deposit for the needs of the Gacko Mine and Thermal Power Plant.

Keywords: *Investment Feasibility Study, COMFAR III, investments, costs, techno-economic assessment*

1 INTRODUCTION

The Mine and Thermal Power Plant Gacko a.d. Gacko is a subsidiary that operates within the Mixed Holding "Elektroprivreda Republike Srpske", Trebinje. The main activity is the production of thermoelectric energy, and the other special activities are lignite mining at the open pit, quality improvement, transport and storage, quarrying, crushing and breaking of construction stone, chalk and limestone, machine repair, electrical equipment repair and sale of electricity to the customers.

In order to realize its basic goal, to ensure the production of planned amount of electricity, the Mine and Thermal Power Plant Gacko performs a number of activities in the function of stable, reliable and economically efficient production. The complexity of production process, the number and variety of activities and influential factors that are one of the basic characteristics of production within the Mine and Thermal Power Plant Gacko [1]. In the set of activities related to the surface exploitation of lignite and technological processes of excavation and exploitation of coal, there are significant needs for the technical-construction stone of appropriate quality within the preparatory and auxiliary works.

[*] *Mining and Metallurgy Institute Bor*

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In the process of exploitation, technical stone is regularly used for the needs of maintenance the transport and access roads [2], various embankments, construction of plateaus, drainage filling, construction of protective barriers and embankments for the purpose of improving the bearing capacity and stabilization of soil and slopes as well as the other purposes. In addition to this, in the coming period, there is a significant additional need for technical stone in order to regulate the flow of the river Musnica (Phase II) and construction the infrastructure facilities that accompany mining at the open pit.

The need for this type of material is variable and is mainly in the function of dynamics the development of coal mining works. Based on previous experiences, the annual need for limestone as a technical-construction stone of about 30,000 čm^3 has been estimated. For the construction of infrastructure facilities in 2020 and 2021, it is necessary to provide significantly larger quantities of limestone and they are estimated at an additional about 70,000 čm^3. In the previous period, the needs for technical stone the Mine were mainly provided from the open pit Ponikve, which also belongs to the Mine and TPP Gacko.

Considering the dislocation of the surface mine Ponikve in relation to the open pit of lignite, there was a need for analysis the provision of technical stone from the other sources as well. The Gelja Ljut limestone deposit has been identified as one of the possible sources of supply with technical-construction stone.

The area of concession right for exploitation the technical construction stone - limestone at the location of Gelja Ljut borders the concession area of the open pit Gacko - Centralno polje in its southwestern part. The subject concession area is in the immediate vicinity of the regulated course of the river Mušnica and the zone of influence the designed works on the external disposal of overburden and waste from the open pit Gacko - Centralno polje. In addition to this, a road and pipeline are located in the immediate vicinity, the infrastructure facilities that are maintained and exploited by the Mine and Thermal Power Plant Gacko.

As a basis for the future business decision, the management of the Mine and Thermal Power Plant Gacko required a development of a Feasibility Study for investment in providing the concession right at the Gelja Ljut deposit with a comparative economic analysis of providing the technical stone from the Ponikve location. The main goal of this study was to determine the economic parameters of investment in providing, purchase, a concession right for exploitation of limestone for the needs of the Mine and Thermal Power Plant Gacko at the Gelja Ljut deposit in order to make an investment decision.

In order to make this assessment of the Project success as objective as possible, in addition to the economic assessment of providing the concession in question, the other important factors were also considered, such as the possibility of using this space to form an external landfill of the Gacko - Centralno open pit and other forms of this area usage, and also an assessment was given for possible legal, technical and environmental risks both in the case of providing a concession and in the case of maintaining the existing situation [3]. The techno-economic assessment also includes the results of a comparative analysis of limestone providing from the existing open pit Ponikve and the open pit Gelja Ljut.

When providing the technical stone, it was necessary to keep in mind some special requirements, which differ from the usual system of providing technical stone for the market. In the first place, there is a high variability in the need for technical stone at the open pit. Requirements can often be urgent and high capacities are needed only for a limited time. In the periods of construction the important infrastructure facilities, it is

necessary to provide the quantities that exceed the capacity of the open pit many times, and these requirements are expressed in the periods related to the construction of the facilities themselves, i.e. they do not have a permanent character.

Also, the special purpose of purchasing a concession at the Gelja Ljut site is to prevent the occurrence of conflicts of interest in two neighboring concession areas. As both spaces are in the zone of influence of the other, it is possible for them to appear, and in the recent past there have been such cases when the interests of the owners of both exploitation fields are inconsistent. So far, this has not affected the works on coal exploitation at the open pit Gacko - Centralno polje in a way that would prevent the realization of planned works, but such a scenario is known in the future considering the formation of an external landfill next to the concession area of Gelja Ljut.

Based on the above given, three main purposes of financing have been identified as follows:

- providing a raw material base for the production of technical stone,
- providing adequate quantities of technical stone dynamically, capacitively and qualitatively in accordance with the needs of the Mine and the Thermal Power Plant,
- unification of concession areas in order to prevent conflicts of interest and use of the concession area of the Gelja Ljut deposit for formation an external landfill of the Gacko - Centralno polje open pit.

2 THE OPEN PIT GELJA LJUT

On the territory of the municipality of Gacko, as a distinctly limestone area, two concessions are currently issued for the exploitation of technical-construction stone - limestone. There are two limestone quarries - Ponikve and Gelja Ljut. The position of the concession boundaries is shown in Figure 1.

Figure 1 *Position of the concession area of the limestone deposit as a construction-technical stone Ponikve (1) and Gelja Ljut (2)*

The Gelja Ljut deposit is located on the southern edge of the Gatačko field. Since the development of the open pit Gacko - Centralno polje is planned along the entire Gatacko field, the deposit is located on the south side of the future con

tour [4]. The altitude of the deposit area generally ranges between 930 and 970 m above sea level. The deposit is defined within the exploitation field bounded by the coordinates of the breakpoints shown in Table 1 and Figure 2.

Table 1 *Coordinates of the breaking points of the boundaries of exploitation field of the deposit of construction stone - limestone "Gelja Ljut" near Gacko*

Point	Coordinates of points	
	X	Y
A	4,777,264	6,541,716
B	4,777,415	6,541,716
C	4,777,520	6,541,815
D	4,777,510	6,542,245
E	4,777,105	6,542,245
F	4,777,105	6,542,143
G	4,777,190	6,542,850
A	4,777,264	6,541,716

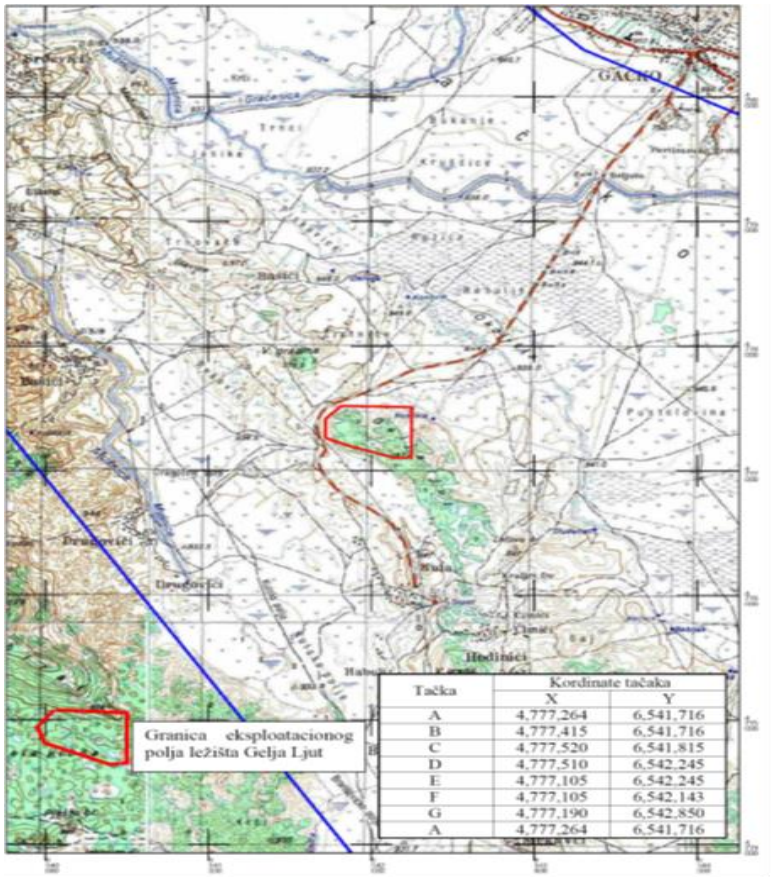


Figure 2 *Position of the exploitation field Gelja Ljut*

The open pit Gelja Ljut was opened in the 80s of the 20th century. During its existence, the open pit changed several owners, while the production was carried out on a larger or smaller scale, with longer or shorter interruptions. The mine is about 15 km away from the settlement of Gacko, while it is 3.6 km away from the open pit Gacko-Centralno polje. Until the moment when the works on coal exploitation in the roof coal series cut the road to the village of Kula, the distance from Gacko was 4 km.

3 COMFAR III

For the calculation of economic parameters, the COMFAR software package, formed by the United Nations Industrial Development Organization (UNDO), and in cooperation with the governments, business associations and individual companies engaged in solving the industrial problems, was used. COMFAR, in essence, is a tool for forming a computer model for feasibility analysis and reporting. The main module of program accepts the financial and economic data, prepares the financial and economic reports and graphical representations and calculates the performance measures. The additional modules help in the analytical process.

The methods of economic analysis developed by the UNIDO and costs and benefits of added value are included in the program, taking into account the methods used by the major international development institutions. The program is applicable for an analysis of investments into the new projects and expansion or rehabilitation of the existing companies, e.g. in the case of privatization projects. For joint ventures, the financial perspective of each partner or class of shareholders can be developed. The analysis can be performed using various assumptions regarding the inflation, currency revaluation and price escalation.

COMFAR III Expert is available for MS Windows 98 / ME and MS Windows 2000 / KSP / 2003 / Vista.

After determining the type of project in the program (industrial, agro-industrial, infrastructural, tourism, mining or environmental) and the level of analysis (feasibility or feasibility study), the user is guided through the data entry, data structuring, calculations, display and printing of results and charts.

COMFAR III Expert allows users a flexibility in determining the detailed analysis. The main features are: [5]

- new option or expansion / rehabilitation project
- joint venture option
- CDM / JI project option (Kyoto Protocol)
- variable planning horizon - up to 60 years
- variable time structure: construction and start-up
- up to 20 products can be listed
- data can be entered in up to 20 currencies
- direct cost option
- escalation / inflation option
- economic analysis option

The standard structure of investment costs, operating and marketing costs is extended to the entry of subchapters. Sources of financing include the capital, long-term loans, short-term finance and defining the terms of profit distribution (Figure 3).

With these facilities, the COMFAR III Expert can be applied to all types of investment projects, investments with the medium-sized companies, to the analysis of large projects or complex production units.

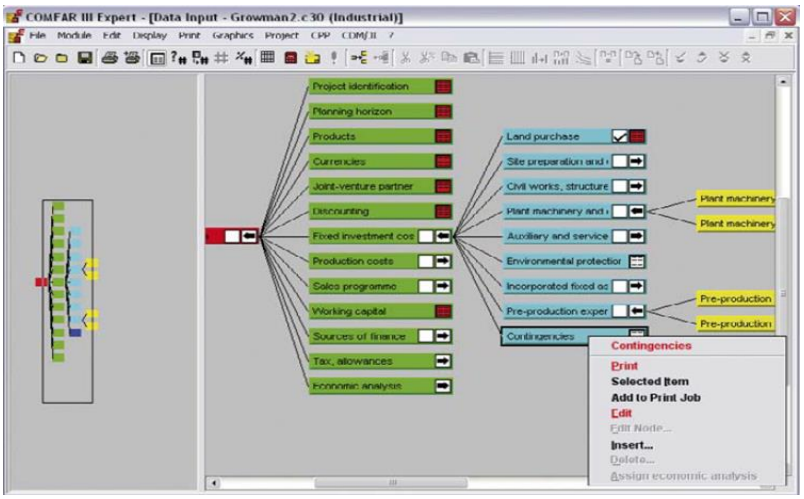


Figure 3 *Data structure within the software*

COMFAR III Expert - Cash flow model:

The COMFAR system distinguishes the cash flows in domestic and foreign currency, and at the same time requires changes in the exchange rates. A number of standard functions are available for calculating the net working capital, debt, annual depreciation of fixed assets and income tax. From different areas of finance and efficiency, the beneficiary can select those data needed to evaluate the project. Direct prices, allocation of indirect costs to profit centers and analysis in constant or current prices are also available.

Financial analysis:

The COMFAR III Expert, based on the entered data, provides the following information in Table with data, investment costs. production costs, production and sales program. Sources of financing and repayment, business results (financial cash flow, discounted cash flow, income statement, balance sheet, data on direct costs and product profitability - Figure 4).

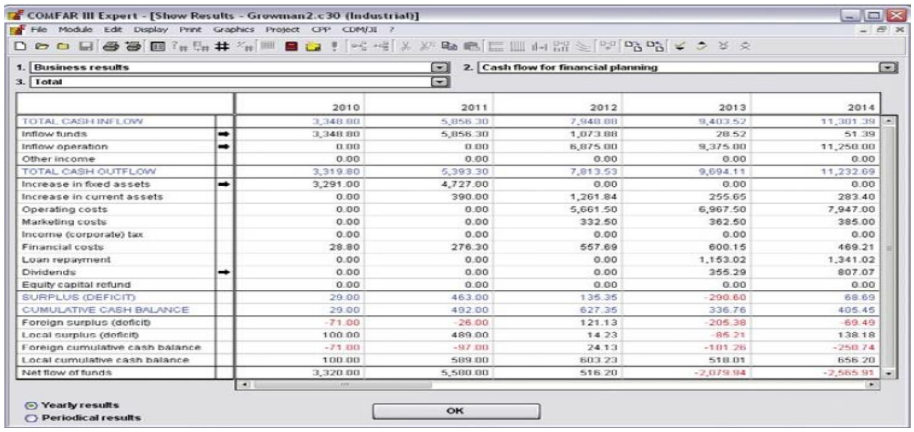


Figure 4 *Example of cash flow*

Economic analysis (macro level):

The economic analysis option allows the user to enter the approximate (expected, assumed) prices (to express inputs and project results in terms of economic prices) and to calculate the economic rates of return (Figure 5), value added, foreign exchange effects and effects on employment. All results can be calculated, including and excluding the external economic effects.

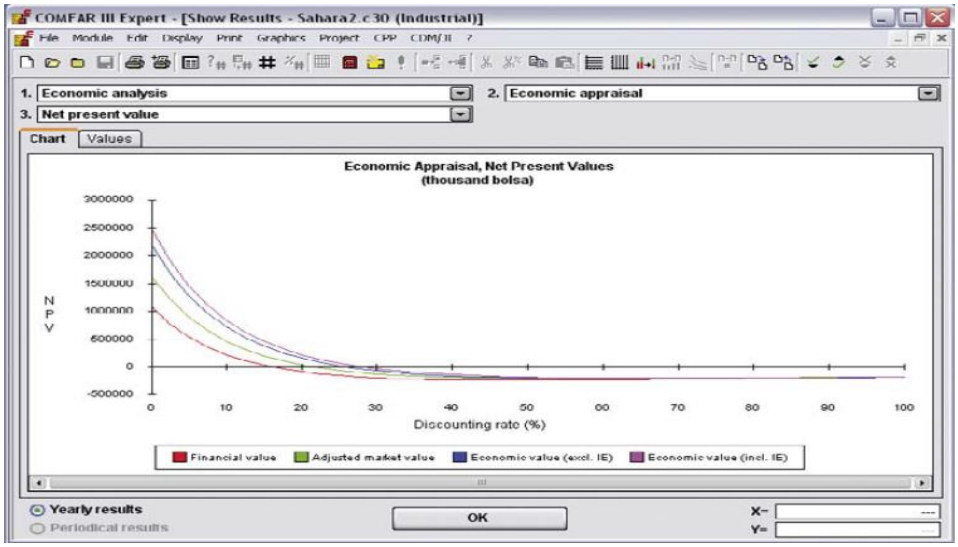


Figure 5 *Form of the program with presentation the results of economic analysis*

The COMFAR III Expert provides the user with an overview of possibilities of the average graphic presentation, as well as the structure of cash flows, costs and revenues (Figure 6).

Figure 6 *An example of output graph*

Sensitivity analysis:

Using the sensitivity analysis, it is possible to show how net cash returns or investment profitability change with different values assigned to the variables needed for calculation (sales prices, unit costs, sales volume, etc.). The COMFAR III expert facilitates the assessment of alternative project scenarios and identification of critical variables. Different graphs are available to analyze the structure of input and output projects, e.g. the structure of annual production and sales program, or variable and operating margins as well as the unequal sales volumes. The COMFAR III offers an additional analysis to facilitate the calculation of impact the project extensions or remediation.

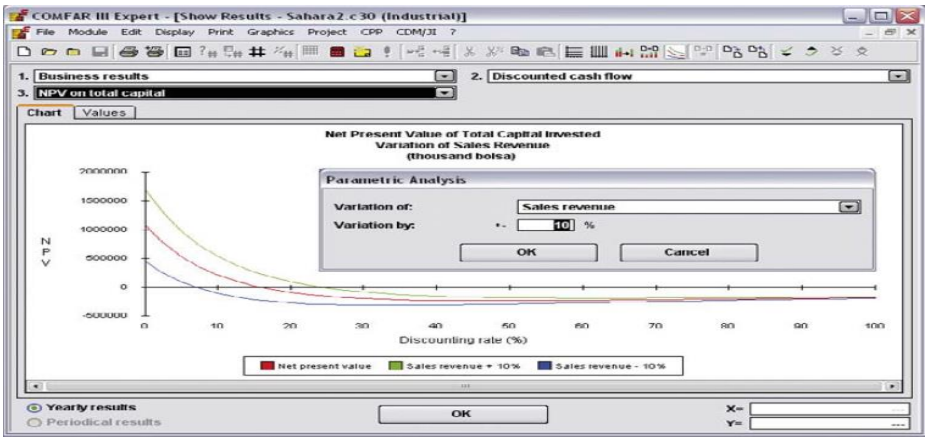


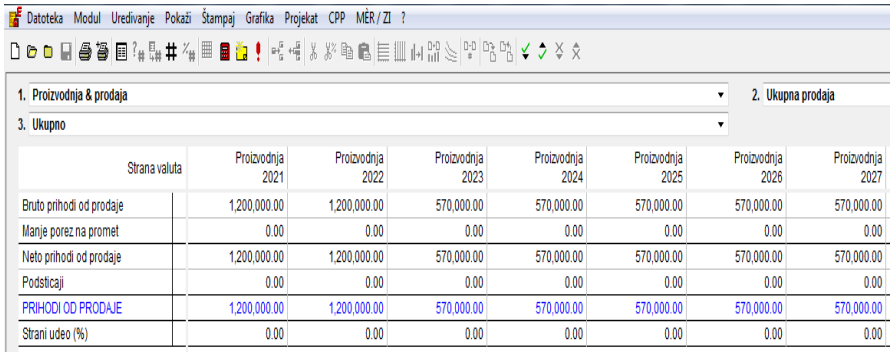
Figure 7 *An example of sensitivity analysis*

4 CALCULATION RESULTS USING THE COMFAR III SOFTWARE PACKAGE

4.1. Calculation and dynamics of income and expenses

Input data for the needs of economic analysis were obtained within the technical part of consideration the exploitation of technical stone from this deposit. They included both capital and operating costs of exploitation. In this part of the activity, the participation of experts from the field of mining is necessary in order to define the appropriate technical solutions, but the experts from other fields such as mechanical engineering, electrical engineering and construction, in order to give a realistic assessment of the value of existing facilities and equipment.

The total revenues from the open pit Gelja Ljut refer to the sale, i.e. placement of technical stone aggregates for the needs of the Gacko Mine and Thermal Power Plant, and infrastructure facilities that are being constructed for the needs of the mine. The annual product placement as well as its dynamics, revenue dynamics and calculation are presented in the form of an output form of the COMFAR III software package (Figure 8).



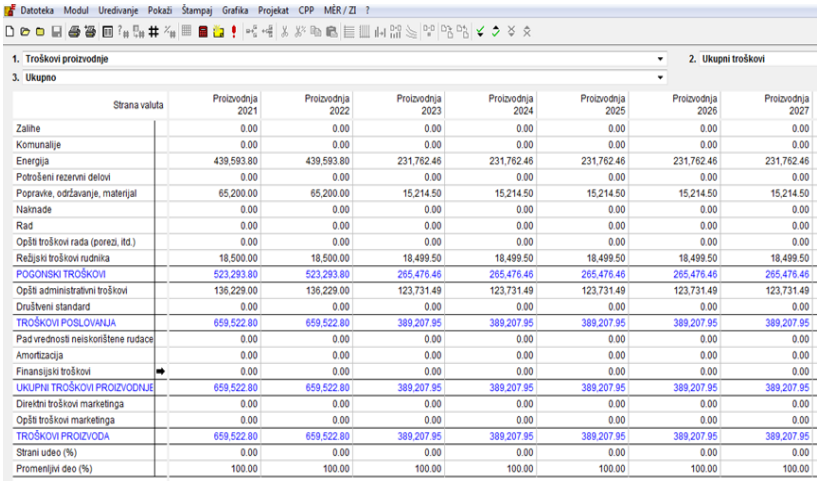
Strana valuta	Proizvodnja 2021	Proizvodnja 2022	Proizvodnja 2023	Proizvodnja 2024	Proizvodnja 2025	Proizvodnja 2026	Proizvodnja 2027
Bruto prihodi od prodaje	1,200,000.00	1,200,000.00	570,000.00	570,000.00	570,000.00	570,000.00	570,000.00
Manje porez na promet	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Neto prihodi od prodaje	1,200,000.00	1,200,000.00	570,000.00	570,000.00	570,000.00	570,000.00	570,000.00
Podsticaji	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRIHODI OD PRODAJE	1,200,000.00	1,200,000.00	570,000.00	570,000.00	570,000.00	570,000.00	570,000.00
Strani udeo (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 8 *Detail of an output form of the COMFAR 3 software package with dynamics and revenue calculation*

The total costs of production of limestone and aggregates at the open pit Gelja Ljut included:

- costs of standardized material,
- processing costs,
- labor costs,
- maintenance costs,
- investment costs, and
- other expenses.

The annual cost amounts as well as its dynamics are presented in the form of an output form of the COMFAR III software package (Figure 9).



Strana valuta	Proizvodnja 2021	Proizvodnja 2022	Proizvodnja 2023	Proizvodnja 2024	Proizvodnja 2025	Proizvodnja 2026	Proizvodnja 2027
Zalihe	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Komunalije	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Energija	439,593.80	439,593.80	231,762.46	231,762.46	231,762.46	231,762.46	231,762.46
Potrošeni rezervni delovi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Popravke, održavanje, materijal	65,200.00	65,200.00	15,214.50	15,214.50	15,214.50	15,214.50	15,214.50
Naknade	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Rad	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Opšti troškovi rada (porezi, itd.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Režijski troškovi rudnika	18,500.00	18,500.00	18,499.50	18,499.50	18,499.50	18,499.50	18,499.50
POGONSKI TROŠKOVI	523,293.80	523,293.80	265,476.46	265,476.46	265,476.46	265,476.46	265,476.46
Opšti administrativni troškovi	136,229.00	136,229.00	123,731.49	123,731.49	123,731.49	123,731.49	123,731.49
Društveni standard	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TROŠKOVI POSLOVANJA	659,522.80	659,522.80	389,207.95	389,207.95	389,207.95	389,207.95	389,207.95
Pad vrednosti neiskorištene rudace	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Amortizacija	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Finansijski troškovi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UKUPNI TROŠKOVI PROIZVODNJE	659,522.80	659,522.80	389,207.95	389,207.95	389,207.95	389,207.95	389,207.95
Direktni troškovi marketinga	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Opšti troškovi marketinga	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TROŠKOVI PROIZVODA	659,522.80	659,522.80	389,207.95	389,207.95	389,207.95	389,207.95	389,207.95
Strani udeo (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Promenljivi deo (%)	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Figure 9 *Detail of an output form of the COMFAR III software package with operating and investment costs*

4.2 Financial flow

In order to analyze in more detail the possibilities of evaluating the efficiency, i.e. the justification of realization of investments, it is necessary to enter into the analysis and measurement of the effects obtained from one investment project. [6] The measurement of effects brought by an investment project is done by calculating the cer-

tain indicators or criteria that express the effects of respective investment project. The financial evaluation includes consideration the effects of the investment project that the Investor has. The financial evaluation includes an assessment the profitability and liquidity of the project. The financial flow of the project is given in the form of an output form of the program package (Figure 10). All values are given in euros.

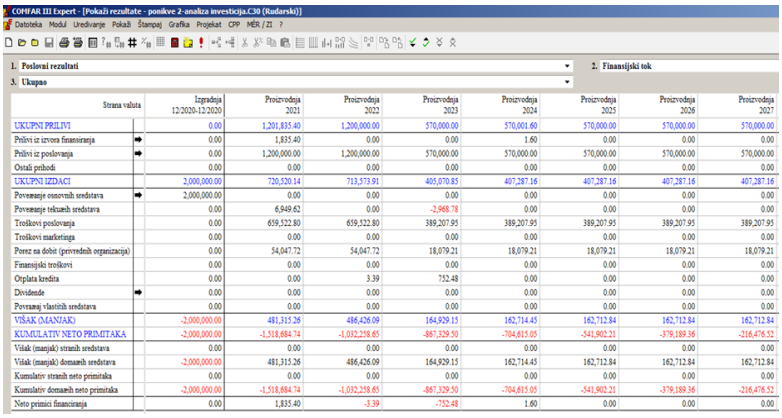


Figure 10 *Detail of an output form of the COMFAR III software package with financial flow*

4.3 Economic flow

For a successful evaluation of investment projects, it is necessary to take into account the preferences of time, i.e. to apply a discount account that reduces the series of future amounts to the present value. The basis of a discount account is a discount rate. In general, the discount rate is the interest rate at which the central bank gives liquidity loans to the commercial banks, but it is more often linked to the process of discounting and measuring the time value of money. In this particular case, the adopted discount rate represents the return expected from investment in the project. In this Study, a discount rate of 12% was adopted and it is significantly higher than the currently valid interest rate on loans with a currency clause of the Central Bank of Bosnia and Herzegovina, which amount to 3.139% for 2020.

A significantly higher discount rate is a measure of expectations of the Project success from community. The economic flow of the project was calculated for a discount rate of 12% and is presented in the form of an output form of the COMFAR III software package (Figure 11).

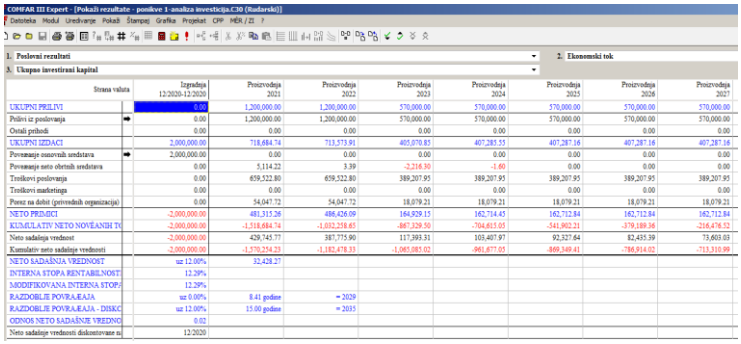
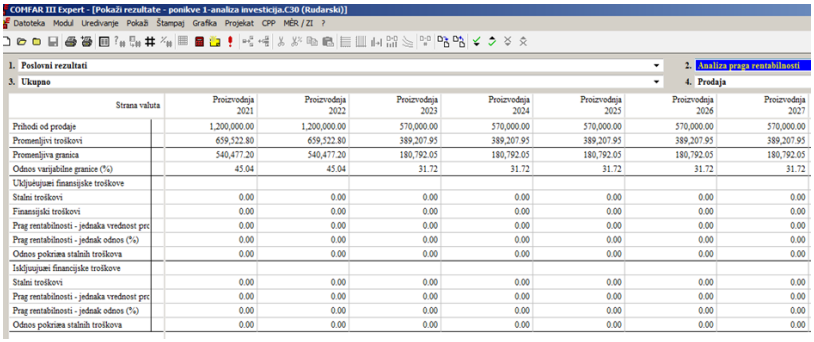


Figure 11 *Detail of an output form of the software package - Economic flow*

4.4 Profitability

Profitability is the ratio of difference between the total profit and total costs to the total profit. The amount of Profitability is given in the form of an output form of the software package (Figure 12).


COMFAR III Expert - [Pokaži rezultate - ponikve 1-analiza investicija.C30 (Rudarski)]

Datoteka Modul Uredivanje Pokaži Štampaj Grafika Projekat CPP MĚR / ZI ?

1. Poslovni rezultati — 2. Analiza praga rentabilnosti

3. Ukupno — 4. Prodaja

Strana valuta	Proizvodnja 2021	Proizvodnja 2022	Proizvodnja 2023	Proizvodnja 2024	Proizvodnja 2025	Proizvodnja 2026	Proizvodnja 2027
Prihodi od prodaje	1,200,000.00	1,200,000.00	570,000.00	570,000.00	570,000.00	570,000.00	570,000.00
Promenljivi troškovi	659,522.80	659,522.80	389,207.95	389,207.95	389,207.95	389,207.95	389,207.95
Promenljiva granica	540,477.20	540,477.20	180,792.05	180,792.05	180,792.05	180,792.05	180,792.05
Odnos varijabilne granice (%)	45.04	45.04	31.72	31.72	31.72	31.72	31.72
Uključujući finansijske troškove							
Stalni troškovi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Finansijski troškovi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prag rentabilnosti - jednaka vrednost pro	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prag rentabilnosti - jednak odnos (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Odnos pokrića stalnih troškova	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isključujući finansijske troškove							
Stalni troškovi	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prag rentabilnosti - jednaka vrednost pro	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Prag rentabilnosti - jednak odnos (%)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Odnos pokrića stalnih troškova	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 12 *Detail of an output form of the COMFAR software package with profitability expressed in %*

4.5 Evaluation of financial efficiency

The results presented in the illustrated financial flow, shown in the previous tables, clearly show the structural share of globally individual components of income, expenditure and periodic results. The dominant structural share of exploitation costs is 26% and earnings of 23% (Figure 13).

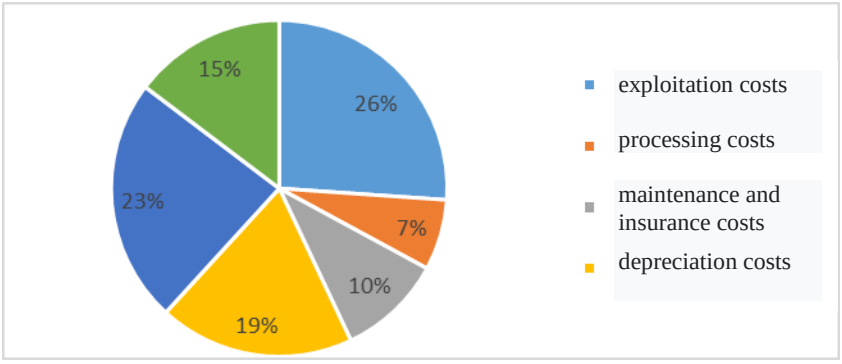


Figure 13 *Cost structure*

4.6 Variation of investments by the sensitivity analysis and investment risk

Sensitivity analysis was performed by changing the following parameters

1. Sales prices (Revenues from sales)
2. Investments - costs of providing the concession right (increase of fixed assets), and

3. Costs of production and processing of limestone (Operating costs)

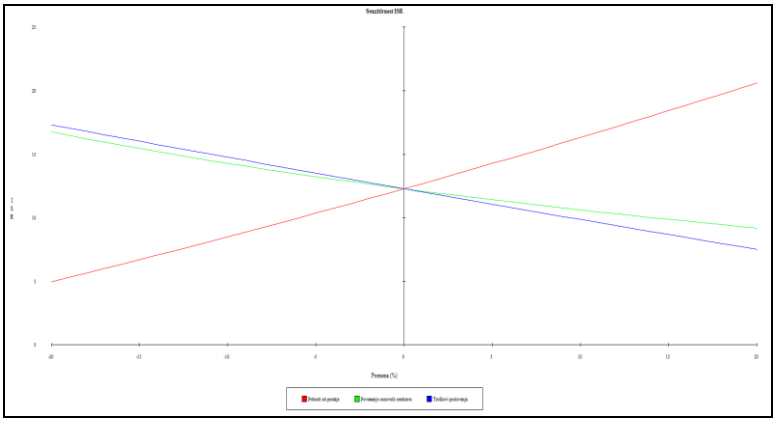


Figure 14 *Output form of the COMFAR 3 software package with sensitivity diagram*

Table 2 *Project sensitivity (%)*

Change (%)	Sales revenues	Increase in fixed assets	Operating expenses
-20.00 %	4.97%	16.77%	17.31%
-16.00 %	6.36%	15.71%	16.29%
-12.00 %	7.78%	14.74%	15.27%
-8.00 %	9.25%	13.86%	14.27%
-4.00 %	10.75%	13.04%	13.27%
0.00 %	12.29%	12.29%	12.29%
4.00 %	13.87%	11.59%	11.32%
8.00 %	15.49%	10.94%	10.36%
12.00 %	17.15%	10.33%	9.40%
16.00 %	18.86%	9.75%	8.46%
20.00 %	20.60%	9.21%	7.54%

Based on the presented values, it can be concluded that the Project is the least sensitive to the changes in investments, and the most sensitive to the changes in selling price of products.

In addition to the sensitivity of the project to the value of input values, the indicators of project economy for different values of investments in providing the concession right were especially considered. The results of the analysis are shown in Table 3 and Figure 15.

Table 3 *Cost-effectiveness indicators for a variable amount of investment*

Investments (€)	Internal rate of return (%)	Time of return (years)	Net present value of the Project (€)
1,250,000	22.03	3.8	628,963
1,500,000	17.45	5.34	430,118
1,750,000	14.42	6.88	231,273
2,000,000	12.29	8.41	22,428
2,040,000	12	8.66	0

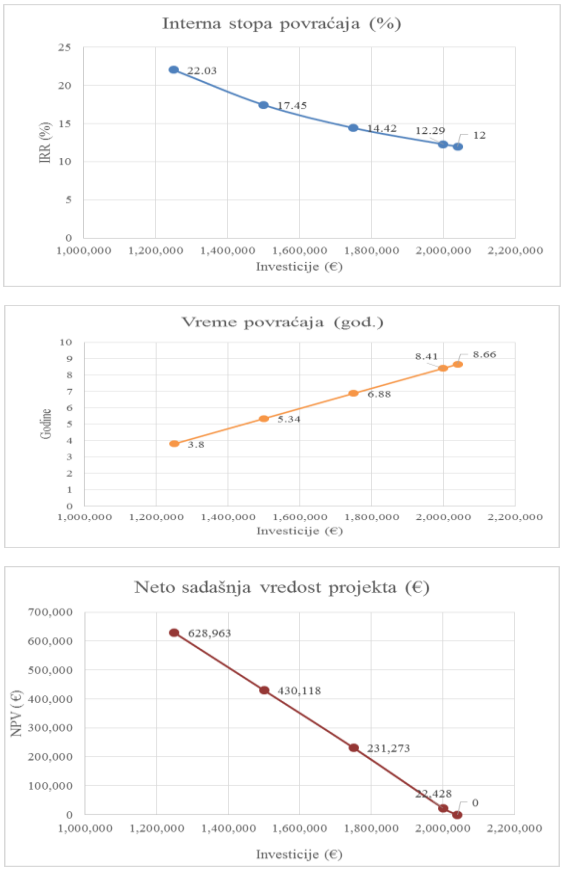


Figure 15 *Diagrams of IRR (%), time of investment return (%) and NPV of the project (€) as a function of investment amount*

5 CONCLUSION

Based on the calculated economic parameters, the provision of the concession right for exploitation of limestone as a construction-technical stone on the Gelja Ljut deposit, under the conditions presented in this Study, can be assessed as economically viable and socially favorable.

The applied methodology of economic evaluation implied an economic analysis taking into account the time factor and is fully in accordance with the methodology recommended by the United Nations Industrial Development Organization (UNDO).

All financial and economic parameters are positive.

The static value of the project is € 401,320, while the net present value of the project is for a period of about 14 years. This net present value of the project is a consequence of strict conditions under which the budget of economic indicators is calculated, a discount rate of 12% and maximized operating costs with limited capacity to the part that represents the direct needs of the Mine and Thermal Power Plant for this mineral resource and its products.

The social effects of the Project expressed through the ecological and general conditions of closure in the conditions of taking over the concession right on the Gelja Ljut deposit are positive.

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