Fifth International Conference on Construction in the 21st Century (CITC-V)
"Collaboration and Integration in Engineering, Management and Technology"
May 20-22, 2009, Istanbul, Turkey

Investment Appraisal of a Small Hydro Power Plant: A Case Study for a Small Hydro Power Plant in Bosnia and Herzegovina

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Abstract
Many developing countries today are facing a growing demand for energy to support the development taking place. With the prices of crude oil reaching record levels and with the introduction of stricter environment protection laws; many of the countries are looking towards alternative supplies of energy which are cheaper, renewable and eco-friendly to meet the growing demand. As a result there has been an increasing trend in exploitation of hydro-power resources in countries where it is possible to utilize the water resources in order to produce energy.

This study will analyze a proposed small hydro-power plant project in Bosnia and Herzegovina for which a detailed financial analysis was performed. Based on the Net Present Value (NPV) and Internal Rate of Return (IRR) obtained from the financial analysis a decision can be brought whether this project will be feasible or not. Factors which may affect the outcome of the project such as an increase inflation, increase in the real wage, movement in the price tariff of electricity, investment cost over-runs and others will be determined by carrying out a sensitivity analysis for the project. The financial analysis will also show how the financing of the project may be affected by an increase in inflation by looking at the Debt Service Capacity Ratio (DSCR) and the Annual Debt Service Coverage Ratio.

Keywords
Financial analysis, Sensitivity analysis, Net Present Value (NPV), Debt Service Capacity Ratios (DSCR)

1. Introduction

Many developing countries today are facing energy problems with crude oil prices reaching record levels during the past summer and limited reserves, as well introduction of stricter environmental laws. Many countries are turning towards more eco-friendly and renewable energy resources. A study carried out by Utility Data Institute, USA, predicts that almost 22 per cent of the new energy generated will come from hydro power (Hydropower and the world's Energy Future, 2000). One of the countries that is looking to utilize its hydro potential is Bosnia and Herzegovina.

During the past seventeen years Bosnia and Herzegovina has experienced immense suffering. The bloody war that took place from 1992 till the end of 1995 brought large destruction of the whole economy of the country. One of the hardest hit sectors as a result of the conflict was the electricity sector.

Prior to the break up of former Yugoslavia (SFRY), Bosnia and Herzegovina as one the republics that constituted SFRY was one of the main sources of energy supply for the whole country, as well as an important supplier of energy for the whole region.

With its large thermo and hydro potentials Bosnia and Herzegovina was able to supply almost 50% of SFRY electric power. In 1990 hydropower plants in Bosnia and Herzegovina produced 3040 GWh and thermal power plants produced almost 9252 GWh and the net production for the whole country was 12,613 GWh (Scholl, 2008).

Upon the signing of the Dayton Peace Agreement that ended the war, the country was divided into two parts, the Federation of Bosnia and Herzegovina and Republika Srpska. This division brought along a division in the national power company, Elektroprivreda Bosnia and Herzegovina (EPBiH) , was broken up into three separate companies; a new Elektroprivreda Bosnia and Herzegovina (EPBiH), Elektroprivreda Hrvatske Zajednice Herceg-Bosne (EPHZHB) and Elektroprivreda Republike Srpske (EPRS), with each one of these companies serving its ethnic community. According to the estimates of the World Bank in 1996 Bosnia and Herzegovina's electrical energy production was only 7340 GWh, even though the net production of electricity decreased drastically the hydro generation in 1996 exceeded 1990 levels due to favorable hydrological conditions.

In a study carried out by Dzafo and Campara (2002); they ranked Bosnia and Herzegovina as last among the European countries that utilizes its hydro potential.

The theoretical hydro potential of Bosnia and Herzegovina is measured as 99,256 GWh/yr which ranks it among the top eight in Europe. This theoretical hydro potential enables construction of three hundred and fifty six small and large hydropower plants rated at 6795 MW and with production of 23,935.5 GWh/yr (Dzafo and Campara, 2002).

As of the beginning of 2006 a total of 120 licenses for new small hydro power plants have been issued. One such hydro power plant is Small Hydro power Plant (SHPP) Botasnica.

The SHPP Botasnica is proposed to be located in the upper central region of Bosnia, on the river Luznica, which together with river Suha makes up the river Gostovic. The hydro power plant is designed to operate with two Francis turbines, installed capacity of 490 KW per turbine. The project is supposed to employ three people, a head engineer, and two technicians. The estimated gross annual energy provided will be 4.002 GWh. This project is proposed to be build on a Build Operate Transfer (BOT) contract in which the investor will be responsible for construction of the SHPP and operation and shall transfer to Elektroprivreda BiH after 30 years of the contract.

This study will detail out the necessary steps taken to perform a financial analysis and sensitivity analysis using Microsoft Excel for the above mentioned SHPP.

2. Financial Analysis

The financial analysis of a project is a key tool to determine the financial sustainability of projects and their overall success. A financial analysis of a project can also be described as a process that requires organization of specific data requirements in certain statements, followed by the application of certain investment criteria to these statements to determine the financial profitability or sustainability of a project (Jenkins, 2004).

Typically in developing a financial analysis three building blocks have to be considered. The building blocks for a financial analysis of any type of project are:

- Technical Block
- Market Analysis Block
- Project Financing Block

The data from all the above mentioned blocks are combined in a manner that will be described later on. Another key element in the financial analysis is the sensitivity analysis. The sensitivity analysis is performed once the investment criterion is obtained. The goal of the sensitivity analysis is to test how sensitive is the criterion to changes in certain parameters of the analysis.

3. Methodology and Development of the Financial Analysis

In developing the financial analysis and determining the status of the project a two phase methodology was used. Figure 1 shows the step by step The first phase consisted of investigating and acquiring data and arranging it into the technical block, market analysis block and project financing block for a financial analysis, much of the data collection was done through consultations and interviews with experts from different background.

Technical block consisted analyzing the location for the project and analyzing the different technical alternatives for the project. This analysis was performed by a hired consultant and the best possible alternative was chosen. Upon choosing the alternative the construction costs estimates were obtained as accurately as possible and the labor requirements for the operation of the project were identified. Since these small hydro power plants can be remotely operated a decision to employ one engineer and two technicians was brought. Wage rates for the labor were also decided by taking into consideration the average wages in the energy sector of Bosnia and Herzegovina.

The second part of the first phase was to establish the market analysis block. This block defines who the customers of the project's output will be, whether the output of the project will be sold on the domestic market or on the international market (Jenkins, 2004). Price of the output must also be established and an accurate estimation of the possible growth in the price of the output should be considered.

In the case of SHPP Botasnica the customer of the energy produced will be Elektroprivreda BiH, who will buy all the energy produced. Price of electricity purchased from SHPP in Bosnia and Herzegovina was established by the government of the Federation of Bosnia and Herzegovina in 2002. The price was established as 7.74 pf/kwh. At the time the study was performed the price was corrugated to 9.16 pf/kwh and the latter price was used as the electricity tariff.

Other data included in the market analysis is the current inflation rate and a projected inflation rate for the future as well as income tax and import tax.

In the final stage the project financing block the amount of contribution by equity holders and debt to the financing of the project was decided. 70% of the project's initial investment cost will be financed through a loan that would be taken from a bank and 30% will be financed by the equity holder.

Having established all the building blocks for the financial analysis, the financial model was developed in Microsoft Excel in sequential method. Data obtained in the above mentioned building blocks, was placed in the table of parameters. Upon the development of the table of parameters, each item was linked to the relevant tables of the financial model. By linking them to the table of parameter, analytical tools of Microsoft Excel such as the sensitivity analysis was used to carry further analysis. The financial model of this particular project consists of fourteen tables. The fourteen tables are shown in Table 1.

Table 1: Tables of Financial Analysis

Table Number	Description
Table 1	Inflation Rate Projections
Table 2	Electricity Tariffs
Table 3	Investment Schedule
Table 4	Energy Sales and Revenue
Table 5	Operating and Maintenance Costs
Table 6	Working Capital
Table 7	Loan Schedule
Table 8	Depreciation Schedule
Table 9	Income Statement
Table 10	Total Investment Cash Flow (Nominal)
Table 11	Total Investment Cash Flow (Real)
Table 12	Debt Service Capacity
Table 13	Equity Holder's Cash Flow (Nominal)
Table 14	Equity Holder's Cash Flow (Nominal)

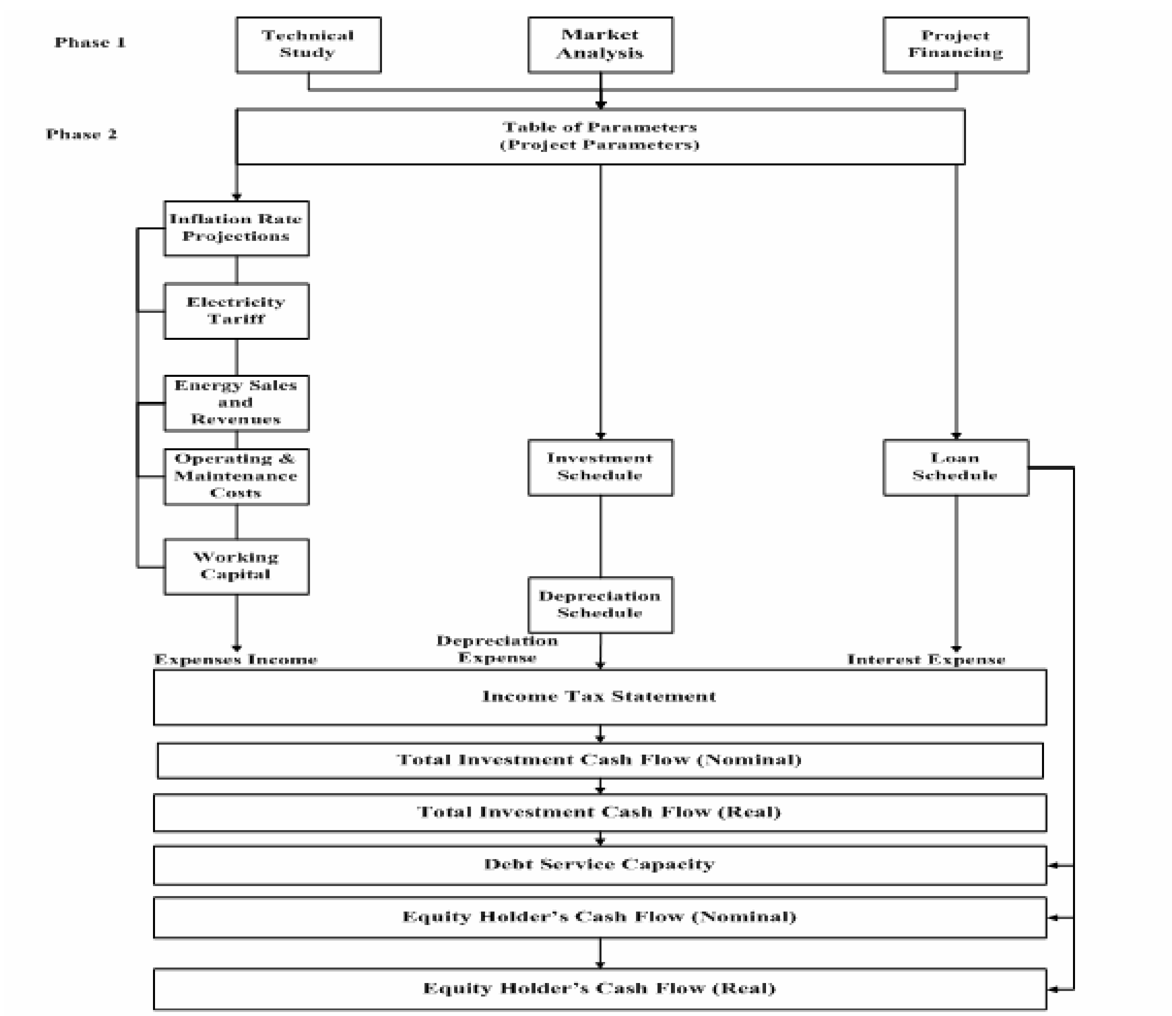

Figure 1: The Financial Model

Four cash flows were constructed during the analysis; two from the total investment point of view and two from the equity holder's point of view, a nominal cash flow for each point of view was constructed and a real cash flow for each point of view. A nominal cash flow includes inflation while a real cash flow rids the values of inflation.

A cash flow for the total investment point of view looks at the project from the banker's point of view and the loan schedule is not including, after constructing the total investment point of view cash flow two important parameters were calculated; Annual Debt Service Coverage Ratio and Annual Debt Service Capacity Ratio.

Equity holder's cash flow is almost the same as the total investment point of view cash flow except that it includes the loan schedule as well, since this cash flow represents the owner of the project. Using the real equity holder's cash flow the Net Present Value (NPV) was calculated by discounting all the cash flows to year 0 (start of the construction period), internal rate of return (IRR) was also calculated using the IRR formula available in Microsoft Excel.

The final step was to perform the sensitivity analysis in order to see how sensitive NPV and IRR are to a change in the inflation rate, increase or decrease in the electricity tariff, investment over runs, etc as shown in Figure 2. By utilizing the sensitivity analysis the risk parameters that may endanger the project profitability were identified. The Sensitivity analysis was performed using the analytical tools of Microsoft Excel.

A sensitivity of the debt service ratios was also performed in order to see their behavior when certain parameters change.

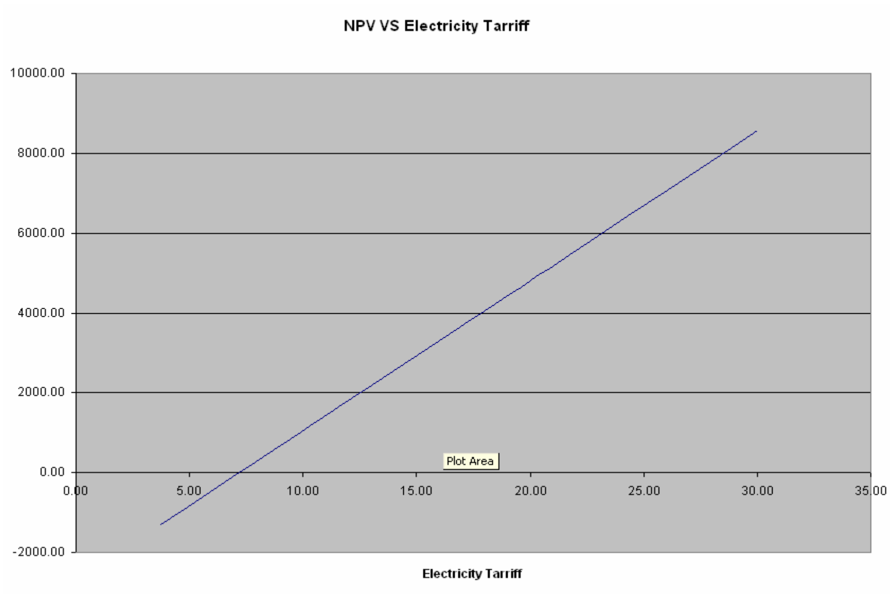

Figure 2: Change in NPV with Change in Tariff

4. Results of the Study

The financial attractiveness of a project is determined by the NPV of its net cash flows. This criterion is widely is accepted by financial analysts and economists as the only one that produces correct project choices in all circumstances. The NPV criterion can be expressed in the form of a set of decision rules:

Decision Rule 1: Do not accept any project unless it generates a positive NPV when discounted by a relevant discount rate.

Decision Rule 2: To maximize the net worth choose the project with the highest NPV. If the there is a budget constraint, then choose the project or package of projects that maximizes the NPV of the fixed budget.

Decision Rule 3: If there is no budget constraint and a decision should be made between two mutually exclusive projects, investors should choose the project with the highest NPV (Jenkins, 2004).

The NPV from the analysis was found to be equal to 732,390.00 KM (KM=Convertible Mark National Currency of Bosnia and Herzegovina). Therefore applying the above mentioned decision rules a decision was brought that the project was financially viable, had the result been a negative NPV the project would be rejected or corrective action would be taken in order to find the break even point. The above mentioned NPV was calculated on the basis of the data from the three building blocks.

A sensitivity analysis was performed to see how changes in different parameters would affect the NPV of the project. Parameters chosen to be tested were: 1) Changes in domestic Inflation, 2) Increases in the real wages of the labor, 3) Changes in the Electricity tariff, 4) Investment Cost over run. Each one of these parameters was tested against the NPV separately. The results revealed that the NPV was most sensitive to the change in the electricity tariff as it shown in Figure 2. It was observed that if the price of the electricity tariff was to drop from 9.16 pf/kWh to 6.74 pf/kWh, the NPV would change from 732,390.00 KM to -179,400.00 KM and the project would be in danger of failing, while at a price of 7.22 pf/kWh the NPV is zero. A corrective action that should be taken is to negotiate a fixed floor price with Elektroprivreda BiH, so to ensure that the project's NPV shall not fall into negative territory.

Debt service capacity ratios (DSCR) are crucial factors that, determine the project's ability to pay its operating expenses and meet its debt servicing obligations. As mentioned earlier the cash flow from total investment point of view was used to evaluate the debt service capacity ratios.

The first ratio that was calculated was the annual debt service coverage ratio (ADSCR); it was calculated using the following formula:

ADSCR = (Annual net cash flow in real terms/Annual debt repayment in real terms)

The purpose of calculating this ratio is to show whether the project will be able to cover its costs of operation and meet the operating expenses on yearly basis from the net cash flow. If the ratio for a particular year is less than one (ADSCR < 1), in that case the project might not meet its debt obligation for the year from the cash flow. On the contrary if ADSCR >1 the project will not have a problem of meeting its debt obligations.

In this particular project the calculated ratios show that the project could face cash shortages in the first two years of operation in order repay its debt as the ratios were 0.42 and 0.96 respectively, and for the later years of repayment there would be sufficient cash.

The overall project's debt service capacity ratio (DSCR) was the second ratio to be calculated. It was calculated using the following formula:

DSCR = PV (Annual net cash flow real terms)/PV (Annual debt repayment real terms)

DSCR determines whether there will be sufficient cash from the project to make bridge-financing in one or more specific periods when there is inadequate cash to service the debt. Same criteria as for ADSCR is used to asses the DSCR that is; if DSCR<1 there it will not be possible to have bridge financing and if it DSCR > 1 it will be possible. Calculations for the project indicate, that the project will have sufficient funds to be able to obtain bridge financing as all the ratios are above 1, even for the first two years where it may have trouble in repaying its debt obligations.

Furthermore a sensitivity analysis was carried out to see how changes in inflation and changes in the electricity tariffs would have an effect on the above mentioned ratios. The results obtained indicate that with an increase of inflation the ratios will fall, due to the fact that with an increase of inflation the real value of the cash flows falls as well. In other words cash obtained through operations would lose its value and inflation would bring about an increase in the operating expenses and less cash would be available for repayment of debt expenses. Since Bosnia and Herzegovina has through out all this time since its independence enjoyed rather low rates of inflation, inflation should not play such an important role compared to the electricity tariff. As it was shown for the NPV the change in the electricity tariff would play once again a key role even for the debt service capacity ratios.

It can be concluded from the sensitivity analysis that if the electricity tariff was to drop it could have adverse effects on the financing of the project. It is clear that there sufficient cash would not be generated to meet the debt obligations. Since if the electricity tariff drops from the current 9.16 pf/kWh to 7.74 pf/kwh the NPV of the project would still be positive, but the debt service capacity ratios would drop significantly. The ADSCR would be below 1 for three years and DSCR would drop to just above 1 for the respective years.

5. Conclusion

A financial model for SHPP Botasnica was developed using Microsoft Excel in order to assess whether the the project is financially viable or not. Using the Net Present Value (NPV) as an investment criterion and the rules governing the decision making, it can be concluded that SHPP Botasnica is a viable project.
A sensitivity analysis was carried out using the analytical tools in Microsoft Excel in order to test the sensitivity of the project's NPV and debt capacity ratios. The NPV was found out to be 732,390.00 KM.
The sensitivity analysis revealed that the electricity tarriff plays a key role in both the financial viability and project financing and as a result was singled out as a risk parameter for the whole project. When the price of the tariff dropped from 9.16 pf/kWh to 7.22 pf/kWh the NPV dropped from 732,390.00 KM to 0.00KM.

6. References

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