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RISK ANALYSIS OF RIVER-TYPE HYDRO-POWER PLANTS

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ABSTRACT:
Hydropower has been the major source of energy generation for Albania. Eleven classes of risk factors were determined based on the expert interviews, field studies and literature review as follows: sitegeology, landuse, environmental acceptance, financial issues, grid connection, social natural hazards, political/regulatory changes, terrorism, access to infrastructure and revenue. Financial analysis was conducted in eight hydropower plant scheme project in Albania to look at the financial sustainability of the project. The risk rose from the variability of the interest rate, electricity tariff and degree of utilization and pointed out some important issues and gave an enormous help in spotting the possible problems that the project may face which in turn, have an adverse impact on the financial feasibility. Various measures must be taken to reduce the exposure to these risks and to help future projects into a better and more improved project design.
Keywords: ***Hydropower Plant, Financial sustainability, Risk analysis***

INTRODUCTION

Albania is a small country in south Eastern Europe. Albanian economy is growing at approximately 6% per year and together with the growing economy even the demand of energy is increasing. Hydropower plants are becoming nowadays an attractive alternative for both government and investors. The government of Albania is currently encouraging private investors to invest in hydro electricity generation, though concession agreements and different type of contracts while guaranteeing the purchase of their output. Renewable energy projects life cycle is full of various risks which will cause cost and schedule overrun or project failure. Construction of river-type hydropower plants involves uncertainties because of various external factors such as site geology, grid connection and environmental issues. These factors increase the construction costs and duration. In the literature there are several studies considering the risk analysis in construction projects but risk analysis in renewable energy projects, especially for hydropower plants is very limited.

FINANCIAL ANALYSIS

The financial appraisal assists in determining the viability of the project. The financial assessment shows in other words the projects potential for success or for failure. It gives us all the necessary information needed in decision making process for investors, in deciding whether the project is worth to be undertaken according to the given conditions or not, and also what adjustment can be made accordingly so that the project can become financially sustainable.

PARAMETERS AND ASSUMPTIONS

Operational Life: The project is a 35 year concession. The project starts operating after the second year of the construction, since 3 of the hydropower plants will be finished until then. The operational life of power plant is 33 years.

Capacity and the degree of utilization: Capacity of the plant is 30650 KW and the degree of utilization is assumed to be 95%.

Electricity Production: The project is presumed to produce annually, during the first two years of operation 28.3GW/h energy, the third year a gross energy of 43GW/h annually, the fourth and fifth year of operation an annual electricity production of 97.1GW/h and starting from the sixth year of operation until the end of the operational life, an annual gross electricity production of 153.79GW/h.

Electricity Price: The price of electricity is €0.065/KWh in year zero prices (year 2009). This price is already adjusted for inflation the first 8 years and is expected to increase 3% annually. The price is set by the Power Sector Entity, ERE, according to the formula for the concession agreements.

HYDROPOWER PLANT	EQUITY (EUR)	LOAN (EUR)	TOTAL
HPP GJORICE	1,858,803	4,051,357	5,910,160
HPP BOROVA	580,436	1,082,210	1,662,646
HPP SEBISHT	1,121,066	2,744,953	3,866,020
HPP OKSHTUN	5,689,245	13,957,155	19,646,400
HPP PRODAN 4	176,288	539,908	716,196
HPP PRODAN 5	197,161	606,657	803,818
HPP LUBALESH	6,031,860	18,111,540	24,143,400
HPP TERNOVE 7	205,572	623,370	828,942
TOTAL	**15,860,430**	**41,717,151**	**57,577,582**

Investment Funding Sources by Hydropower Plant

Source: Attained from the pre-feasibility study done for the project

Depreciation: The straight line method depreciation is used.

Inflation Rate: The inflation rate used is the inflation of the Euro zone which is assigned to be 4.2% and is assumed to be constant though out the time of the project.

Taxation: The corporate income tax rate is 10% on the annual revenue. No taxes are paid unless the project generates profits (positive net cash flow) and no losses are incurred thought the years for the tax intention. The project is exempted from sales, V.A.T and Import taxes.

Financial Analysis Results

From the financial analysis we look at the project from two different points of views. The first one is the investment point of view or banker's point of view and the second one is the equity holder or owner's point of view.

TOTAL INVESTMENT POINT OF VIEW

The nominal cash flow statement from the investment point of view simply puts all the benefits that create inflows into a project and all the costs that create outflows.

Annual Debt Service Coverage Ratio (ADSCR)

$$ADSCR = \frac{\text{Annual Net Cash Flow (Real)}}{\text{Annual Debt Repayment (Real)}}$$

The ADSCR shows whether the project will be able to service its debt from its yearly cash flows. The calculation of ADSCR is on a year to year basis calculation and it starts from the beginning of the loan repayment until the last payment of the loan. The evaluation criteria for ADSCR is if ADSCR is greater than 1 then the project is able to service its debt, and if ADSCR ratio is smaller than 1 then the project will not be able to meet its debt obligations.

ADSCR Results from Financial Analysis

Year	Annual Net Cash Flow (REAL)	Annual Debt Repayment (REAL)	ADSCR
2	-6,082,603	1,335,032	-4.56
3	-5,118,556	1,884,690	-2.72
4	-7,559,946	2,344,436	-3.22
5	-6,533,033	3,217,775	-2.03
6	-1,354,655	4,342,327	-0.31
7	6,328,472	4,759,331	1.33
8	9,348,274	4,179,752	2.24
9	10,103,543	3,648,190	2.77
10	10,377,802	3,144,752	3.30
11	10,664,863	2,437,582	4.38

Debt Service Capacity Ratio

DSCR = PV (ANCF $_{\text{end year of debt}}$)/PV (Annual Debt Repayment $_{\text{end year of debt}}$)

The DSCR tells the banker if there is enough cash generated from the project so that bridge financing can be present and available for the project, in specific periods when there are inadequate cash flows to service the debt. It has to be noted that the present values are using the real interest rate being paid on the loan financing. From the financial analysis we obtained the results given in the table below.

DSCR Results from Financial Analysis

Year	PV of Annual Cash Flow (Real)	PV of Annual Debt Repayment (Real)	DSCR
2	2,578,223	27,481,476	**0.09**
3	13,184,736	26,852,398	**0.49**
4	19,787,558	25,641,836	**0.77**
5	25,578,579	23,926,431	**1.07**
6	34,033,265	21,267,789	**1.60**
7	41,661,588	17,382,450	**2.40**
8	44,177,682	12,963,943	**3.41**
9	38,871,139	9,021,364	**4.31**
10	30,319,983	5,518,249	**5.49**
11	20,762,284	4,811,080	**4.32**

As we can examine from the table 6 DSCR ratio seems to be quite low the first 5 years. This implies there is likely for the project not to have adequate cash flows to safety repay the bridge financing required to cover the possible shortfalls during these years. This will be a reason for the banks not to provide bridge financing for the project during these years.

OWNER'S POINT OF VIEW

The owners of the project are the sponsors of the project. The cash flow statement form the owner's point of view help the owners of the project in the decision making process, telling them if a project worth to be undertaken or not. The owners of the project receive the net cash flow after paying all the expenses. If the project receives any grants or subsidies, these should included as receipts in the cash flow statement; and if the project pays taxes these should be included as cash outflow. From the net cash flows obtained, the Net Present Value (NPV) is calculated. According to Jenkins et al. (2004) the NPV is an algebraic sum of the present values of the incremental expected positive and negative net cash flows over a project's anticipated lifetime.

$$NPV^{year\ 0} = \frac{(\sum of\ Cash\ flows\ in\ year\ t)}{(1+r)^t}$$

Where "R" is the discount rate representing the discount rate equal to the cost of capital, in other words the rate of return that owners of the project expect to receive for investing their funds in the given project which in our case is 7%.

If NPV>0, than the project if financially viable from the owner's point of view and the project should be accepted, If NPV<0, than the project is not financially viable for the equity holders of the project, and the project should be rejected.

Also in the cash flow statement from the owner point of view, Internal Rate of Return (IRR) is also taken in consideration. The IRR is the discount rate that sets the NPV = 0

$$\frac{\sum Cash\ flows\ in\ year\ i}{(1+\rho)^I} - I = 0$$

Where "I" is the Initial Investment and we have to solve for ρ which is IRR.

The project should be accepted if $\rho > r$, and rejected if $\rho < r$.

RISK ANALYSIS

Most of the key variables and their values used in the financial analysis unlikely can be projected with certainty throughout the entire life of the project. Therefore, as a consequence the outcome of the project and the ratios evaluating these outcomes will be as well uncertain.

<u>INFLATION</u>

Predicting the inflation is a complex and difficult task. It is almost impossible to forecast accurately the fluctuations of inflation. In our case a step custom (step) distribution was assigned to this parameter.

<u>Electricity Tariff</u>

Electricity tariff usually is under observation of the government and other responsible institutions and is managed to use to the purposes of different groups. This probability distribution assigned to this parameter is the normal distribution since the data about this variable generally clusters around an average price.

Mean and Standard Deviation		
Assumption: Electricity Tariff		
Normal distribution with parameters:		
	Mean	0.085
	Standard Deviation	0.01
Selected range is from-Infinity to +Infinity		

DEGREE OF UTILIZATION

This is the last risky variable chosen from the sensitivity analysis. The probability distribution assigned for this variable is the triangular distribution.

RESULTS OF RISK ANALYSIS

After we identified and assigned the probability distributions for each of uncertain variables (Define the Assumptions), the next thing to do is to define the forecast. Defining forecast means selecting a variable to be tested in order capture its output result while taking into consideration the assumptions made. In our analysis we defined these forecast:

Minimum, Likeliest and Maximum for Degree of Utilization

Assumption: Degree Of Utilization		
Triangular distribution with parameters:		
	Minimum	36%
	Likeliest	95%
	Maximum	100%
Selected range is from 36% to 100%		

Statistic for ADSCR Year 2	
Certainty Level is 99.69%	
Certainty Range is from -Infinity to -4.02	
Display Range is from -5.11 to -4.02	
Entire Range is from -5.13 to -3.87	
After 10,000 Trials, the Std. Error of the Mean is	0
Trials	10000
Mean	-4.54
Median	-4.53
Mode	---
Standard Deviation	0.22

NPV,IRR,ADSCR Year 2 (First year of repayment),ADSCR Year 3 (Second year of repayment),ADSCR Year 4 (Third year of repayment),ADSCR Year 5 (Forth year of repayment) ,ADSCR Year 6 (Fifth year of repayment),DSCR Year 2 (First year of repayment),DSCR Year 3 (Second year of repayment), DSCR Year 4 (Third year of repayment)

After defining the forecast we start to run the simulation and 10,000 trials of Monte-Carlo Simulation were performed using the Crystal Ball™ software and we obtained the output for each defined forecasts. The probability that the NPV will be between negative range and 0 is 1 %.

The results from the simulation give

as well optimistic outcome for IRR.

The mean of IRR is 11.57% and a standard deviation of 1.95%.The certainty level is 1.13% for IRR to go below 7%. Similarly we show that forecast of DSCR year 3 to year 4. As indicated from the graphs above even DSCR seems to have high probability of experiencing a Value less than 1.

Similarly the results we get form the simulation optimistic outcome for IRR from ADSCR year 3 to year 6.

CONCLUSIONS

In this research, the data was obtained from eight hydropower plant the competent institutions available and related to the country profile and its energy sector. The risky variables were inflation rate, electricity tariff and degree of utilization. Even if ADSCR and DSCR ratios improve it is important to emphasize that with such ratios on the first years of loan repayment, no financial institutions will be willing to lend to such a project. Different measures can be taken to improve this ratio and reduce the exposure to this risk.

The project owner's may renegotiate the terms of the loan repayment , so they can delay the first repayments of the loan at a later times, when the cash flows from the sales will be higher and sufficient to cover the debt.

Investors may also require a restructure term of a loan, toward lower interest rate on the loan so that the annual ratios look better and attractive to the banker provide financing.

Another option may be for the investors to decrease the amount of debt financing and to add up more equity, so that the annual repayment of that loan becomes smaller and the ability of the project to service the debt becomes much more certain.

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