Available online www.jocpr.com

Journal of Chemical and Pharmaceutical Research, 2013, 5(9):263-267

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Small hydropower's construction and relative financial analysis

[1]Liu Yuanxin, [2]Zhuang Yan and [3]Zhao Xing

[1]School of Economics and Management, North China Electric Power University, Beijing, China
[2]Shenyang Institute of Aeronautical and Engineering, Shenyang, China
[3]College of Humanities and Development, China Agricultural University, Beijing, China

---

ABSTRACT

In recent years, as a way to address the severe electric power shortage, small hydropower (SHP) has been instrumental in rural electrification. Chinese investment in SHP has been booming consequently, the effectiveness analysis of investment on SHP project has become extremely crucial .This paper established a simplified model basing on NPV and FIRR to evaluate the investment both in financial and national economic perspective. This paper then extended the analysis on the uncertainty during investing SHP projects and presented a risk analysis model. Moreover, this paper not only evaluated effectiveness of SHP projects from the economic perspective, but also analyzed it from social and ecological perspective. In the end of the paper, an empirical analysis on a real project is presented to verify the framework. With the comprehensive analysis on financial, social ,national economical, and uncertainty, this paper are therefore able to build up a framework to evaluate the investment of SHP in China .

Key words: Small hydropower; Investment and Construction value; NPV

INTRODUCTION

China is becoming a heavy energy consumption country, the energy crisis has become a significant challenge to our country's development, under this condition, utilizing the clean energy effectively has become a trend in future. As a important part of the clean energy, small hydropower is abundant in amount and has good environment effectiveness in China, so more and more people are paying attentions to this energy [1].

This paper evaluated the economic effectiveness of small hydropower from the aspect of financial effectiveness and national economy effectiveness. It also discusses the investment risk which comes from the uncertainty of the above.

EVALUATION OF SMALL HYDROPOWER'S CONSTRUCTION VALUE

Small hydropower project is small project that the installed capacity is below 25000kw and relative new construction, reconstruction, renovation and extension, it also includes rural middle hydropower which capacity is below 50000kw [2]. For the rightness and profitability of hydropower investment, we must take a feasibility analysis, and the economic effectiveness evaluation is a important part of feasibility analysis, it includes financial effectiveness and national economy effectiveness, it also analysis the risk by uncertainty analysis. Social and ecological effectiveness's evaluation are indispensable, it can evaluate the effect that the project will bring to the society and environment.

INVESTMENT AND COST BUDGETARY ESTIMATE OF SMALL HYDROPOWER CONSTRUCTION.

The economic evaluation is based on the cash flow in life cycle, so how to compute the cash flow accurately of the construction is the essential condition, we can estimate it from such two aspects which are investment and cost.

Investment estimation

Fixed assets investment estimation. Fixed assets investment includes engineering cost, budgetary cost and others. Engineering refers to construction expenses and equipment's buying and installation; other cost refers to relative expenses which is none of the business of installation and buying, such as managing cost , land acquisition and compensation cost, designing expenses and project insurance; budgetary expenses includes basic budget allowance and project adjustment allowance.

Circulating capital investment estimation. This circulating capital refers to all fluid capital which is used to maintain the small hydropower station's operation, because the electrical generation is instantaneous balance and there is no stock, so it only includes monetary resources and accounts receivable.

The circulating capital of small hydropower can be estimated by fixed assets' capital rate, the formula is as below:

Circulating capital = fixes assets × capital rate of fixed assets Eq.(A.1)

Estimation of profit and cost. Cost estimation refers to all expenses in one year after the project is put into operation, the cost estimation can take the method of production factors estimation[3].

Operation profit per year

For small hydropower, its annual operation profit mainly comes from its electricity generation, main formula is :

Annual profit = annual net electricity capacity × average price Eq.(A.2)

Annual operation cost

Small hydropower's annual operation cost mainly includes salary, repairing expense, resource fee and others[4].

Economic effectiveness evaluation

Financial evaluation. Financial evaluation is a kind of method which is used to decide if the project is feasible in finance [5]. Its main job is to compute the direct financial fee and profit, prepare statement, inspect profitability, debt-paying ability and so on.

Basic index of financial evaluation

The main indexes in financial evaluation are FIRR and loan paying term, NPV, NPVR and rate of investment profit are auxiliary indexes [6]. For the features of small hydropower, we only analysis the NPV and FIRR.

a. FIRR refers to the payback rate of expectation, its formula is as below:

$$\sum_{t=1}^{n}(\mathrm{CI}-\mathrm{CO})_t(1+\mathrm{FIRR})^{-t}=0 \qquad \text{Eq.(A.3)}$$

When the FIRR is bigger than the standard, we can say that the profitability of this project is good and it is feasible in finance, otherwise we should refuse this project.

b. NPV is used to measure the profitability in computing term, its formula is :

$$\mathrm{NPV}=\sum_{t=1}^{n}\ \mathrm{CI}\ \mathrm{CO}_t 1+\mathrm{i}_c{}^{-t} \qquad \text{Eq.(A.4)}$$

If the NPV was bigger than zero, we can accept this item, otherwise we should refuse. If there were some items that we can choose, which NPV is the biggest which is the best.

Simplified financial evaluation method of small hydropower construction project. For small hydropower's installation capacity is small and plan term is short, so we can choose simplified method to evaluate rural project, there are some conditions to use thus method:

c. Gross installation capacity is lower than 6000kw
d. Construction term is no longer than 3 years
e. Term of putting into operation is shorter than 1 year.

The simplified formula of FIRR is as below:

$$\frac{[(1+FIRR)^m-1](1+FIRR)^{n-m}-\frac{m}{I}S_v(FIRR)}{(1+FIRR)^{n-m}-1}=\frac{m}{I}(B-C-T) \quad \text{Eq.(A.5)}$$

The simplified formula of ENPV is as below:

$$NPV=(B-C-T)\frac{(1+I_c)^{n-m}-1}{I_c(1+I_c)^n}-\frac{I}{m}\frac{(1+I_c)^m-1}{I_c(1+I_c)^m}+S_v\frac{1}{(1+I_C)^n} \quad \text{Eq.(A.6)}$$

Evaluation of national economy

National economy effectiveness evaluation is based on the rules of properly assigning resource, shadow price, shadow salary , shadow exchange rate are used to analysis and compute item's benefit to national economy, and provide decision base [8].

ENPV. ENPV is a absolute index which is used to reflect the benefit to national economy, its formula is :

$$ENPV=\sum_{t=1}^{n}(B-C)_t(1+I_s)^{-t} \quad \text{Eq.(A.7)}$$

If it is bigger than 0, we can accept , otherwise we should refuse.

The simplified method. The simplified method of EIRR's formula is as below:

$$\frac{[(1+EIRR)^m-1](1+EIRR)^{n-m}-\frac{m}{I}S_v(EIRR)}{(1+EIRR)^{n-m}-1}=\frac{m}{I}(B-C) \quad \text{Eq.(A.8)}$$

The simplified method of ENPV's formula is as below:

$$ENPV=(B-C)\frac{(1+I_s)^{n-m}-1}{I_s(1+I_s)^n}-\frac{I}{m}\frac{(1+I_s)^m-1}{I_s(1+I_s)^m}+S_v\frac{1}{(1+I_s)^n} \quad \text{Eq.(A.9)}$$

For the inspect scope is different, so this two results are not always same, the result of national economy evaluation is the first choice. When the financial evaluation is not feasible but the national economy evaluation is feasible, we can inspect this investment item again and improve finance or take into account of national subsidy.

CONCLUSION

During the construction of our country's electricity engineering, hydropower is a very significant one. We have abundant water resource, and it provide a good foundation for hydropower. For historical reasons , the small hydropower is still operated in a low level, but the challenge from energy crisis claim that it is a in the near. For the rural area, the small hydropower is also the best choice.

For the backward of small hydropower, some small hydropower's rate of return on investment is low, so the feasible evaluation is a indispensable step.

ANALYSIS OF GAOHEKOU SMALL HYDROPOWR'S CONSTRUCTION

Gaohekou station has been constructed in October,2001, it was put into operation in November, 2002, the gross investment is 6130000, the installation capacity is 1500kw.

Analysis of investment

According to the methods that have been mentioned, we will analyze the investment values from such aspects as investment and cost, economic effectiveness and uncertainty analysis.

Investment and cost estimation

The gross investment. The gross investment in 6130000, and the construction term m=la, computation term n=21a, for the ratio of immaterial assets and circular assets are small, so we set the fixes assets I=6130000

Annual operation profit. For the capacity is 1500kw, the annual electricity amount is 4200000kwh, we set the index of valid electricity as 0.96, the inside loss ration as 0.1 and the net price as 0.35, according to the formula above, annual valid electricity will be4032000 and annual net electricity will be 3628800kwh.,the annual profit is 1270100.

Economic effectiveness evaluation

For the construction term is no longer than 3 years, so we can choose the simplified method to analyze:

Financial effectiveness evaluation. According the formula, we can get the FIRR=7.85%, and it is smaller than 10%; when the basic standard is 10%, the NPV is －883400, and it is smaller than 0. For such reasons, we can conclude that this station is not feasible in finance.

National economy evaluation. According the formula above ,we can get the result that EIRR=13.10%＞12%, when the standard ratio is 12%, NPV=466200 and it is bigger than 0.

Uncertainty analysis

Financial sensitivity analysis. We set investment and effectiveness as uncertainty factors and analyze the effect to net profit, the fluctuation is ±10%~±20%，and the chart is as below:

From the analysis above, we know that when the investment or profit has a small change, the FIRR will change a lot, so the hydropower station's anti-risk ability is poor.

National economic sensitivity analysis. We set investment and effectiveness as uncertainty factors and analyze the effect to net profit, the fluctuation is ±10%~±20%，and the chart is as below:

Table A.1

	-20%	-15%	-10%	-5%	0%	5%	10%	15%
invest	10.67%	9.87%	9.14%	8.47%	7.85%	7.28%	6.76%	6.26%
profit	3.08%	4.32%	5.52%	6.70%	7.85%	8.98%	10.09%	11.19%

Table A.2

	-20%	-15%	-10%	-5%	0%	5%	10%	15%
invest	16.93%	15.83%	14.83%	13.93%	13.10%	12.34%	11.64%	11.00%
profit	7.57%	9.00%	10.39%	11.76%	13.10%	14.42%	15.73%	17.02%

Acknowledgements

Supported by "the Fundamental Research Funds for the Central Universities". During the wiring of the paper, Mrs. Zhao who is my colleague has given me so much suggestion and Mr. Zhuang has supplied so much first hand materials and Mr. An has seriously checked the paper's spelling and grammar, thank you very much!

REFERENCES

[1] Baki, R., **2004**, *Energy Sources*, Vol. 26, Issue 14: 1105-1118,
[2] Bing, Y., Xu, L.Y., **2012**. *Procedia Environmental Sciences*, 13: 891 – 898. DOI: 10.1016/j.proenv.2012.01.083.
[3] Dai, S. F., Wu, Y. S., **2011**. The Comparative Analysis and Revelation of Economic Benefit of Small Hydropower Plants. 2011 IEEE, pp: 5859-5862. DOI: 10.1109/AIMSEC.2011.6009731.
[4] Ding, Y. F., Tang, D. S., Wang, T., **2011**. Benefit Evaluation on Energy Saving and Emission Reduction of National Small Hydropower Ecological Protection Project. Energy Procedia, 5: 540–544. DOI:10.1016/j.egypro.**2011**.03.094.
[5] Li, J. P., Yue, C.Y., 2011. Comprehensive Benefits based Multi-objective Evaluation with incomplete information for Hydropower Plant Construction. **2011** IEEE, Power Engineering and Automation Conference (PEAM), pp:60-64. DOI: 10.1109/PEAM.**2011**.6135015.
[6] Li, T.H., 2010. Study on Ecological Compensation System of Hydropower Development. **2010** IEEE, E-Product E-Service and E-Entertainment (ICEEE), **2010** International Conference on,
[7] DOI: 10.1109/ICEEE.**2010**.5660259.

[8] Shao, Q. C., Brian, D. F., Chen B., **2010**. *Procedia Environmental Sciences*. 2: 725–728. DOI:10.1016/j.proenv.**2010**.10.083.