Evaluation of Hydropower Projects Based on Pay Back Period-A Financial Feasibility Parameter

Pooja Mathur

University of Rajasthan
E-mail: poojamathur6111986@gmail.com

Abstract—*This article highlights a systematic approach in the subject matter by taking into consideration mega hydroelectric projects of NHPC Limited (A Govt. of India Enterprise) and aiming to evaluate financial feasibility of the selected projects based on the payback period, a financial feasibility parameter. In addition to the data assessment, a sincere effort has been made to undertake a comparative analysis among the projects, selected from different geographical domain of Himalayan.*

1. INTRODUCTION

1.1 Payback Methods

The payback method is a method of evaluating a project by measuring the time it will take to recover the initial investment.

1.2 Payback Period

Payback period is the length of time required to recover the cost of an investment. The payback period of a given venture or task is an essential determinant of whether to undertake the project, as extended payback periods are typically not desirable for investment positions.

2. ABOUT NHPC LIMITED

NHPC Limited (formerly known as National Hydroelectric Power Corporation Limited) is a Public Sector Enterprises under the administrative control of the Ministry of Power. The company was incorporated in 1975 as a Public Sector Enterprise of the Government of India with its registered head office at Faridabad. As on date NHPC Limited is the largest organisation for hydropower development in

India, with capabilities to undertake all the activities from conceptualisation to commissioning in relation to setting up of hydro projects.

NHPC Limited presently has an installed capacity of 6507 MW from 21 hydropower Stations on ownership basis including projects taken up in Joint Venture.

3. FORMULA

$$Payback\ Period\ = \frac{Cost\ of\ Project}{Annual\ Cash\ Inflows}$$

The above formula is applicable for the projects that generate equal amount of cash inflows every year. Where the annual cash inflows are unequal, the pay-back period can be found by adding up the cash inflows until the total is equal to the initial cash outlay of the project.

4. SELECTION CRITERIA FOR PAYBACK PERIOD ANALYSIS

Projects have been selected for financial feasibility analysis on the basis of geographical location. These projects are falling in the domain of Indian Himalayan region. List of projects selected for the financial feasibility analysis:

- **Kiru HE Project (660 MW), J&K:** Located in Doda District on Chenab River.

- **Kawar H.E. Project (560 MW), J&K:**

- Located in Doda District on Chenab River.

- **Tawang H. E. Project Stage-I (600 MW), Arunachal Pradesh**: Located in Tawang District on Tawangchu River.

- **Tawang H. E. Project Stage-II (800 MW), Arunachal Pradesh:** Located in Tawang District on Tawangchu River.

- **Teesta H. E. Project, Stage-IV, (520 MW), Sikkim:** Located inMangan on Teesta River

- **KotliBhel HE Project, Stage-1A, (195 MW), Uttarakhand:**Located in Muneth on Bhagirathi river.

5. DATA SHEET FOR PAY-BACK PERIOD CALCULATION

5.1 Kiru HE Project

Table 1: Pay-Back Period Calculation for Kiru HE Project.

YEAR	CASH INFLOWS	CUMULATIVE CASH IN FLOWS
1	970.32	970.32
2	946.86	1917.18
3	923.69	2840.87
4	900.85	3741.73
5	878.35	4620.08
6	856.22	5476.30

Cost of project: Rs 4426.33 Crores

Up to the fourth year the total cost has not recovered but the total cash inflows for the fifth year are Rs. 4620.08 crores i.eRs 193.75 crores more than the cost of the project. So the payback period is somewhere between 4 and 5 years. Assuming the cash inflows occur evenly throughout the year. The time required to recover Rs 684.60 Crores (4426.33 Crores – 3741.73) will be

$$= \frac{684.60}{878.35} \times 12$$

= 9.4 months

Hence the payback period is 4 years 9 months.

5.2 Kwar HE Project

Table 2: Pay-Back PeriodCalculation for Kawar HE Project.

YEAR	CASH INFLOWS	CUMULATIVE CASH IN FLOWS
1	1064.54	1064.54
2	1038.83	2103.37
3	1013.44	3116.82
4	988.42	4105.23
5	963.76	5069.00
6	939.51	6008.50

Cost of project:Rs 4856.58 Crores

Up to the fourth year the total cost has not recovered but the total cash inflows for the fifth year are Rs. 5069 crores i.eRs 212.42crores more than the cost of the project. So the payback period is somewhere at the starting of fifth year. Assuming the cash inflows occur evenly throughout the year. The time required to recover Rs 751.35 Crores (Rs 4856.58 Crores – Rs 4105.23 crores) will be

$$= \frac{751.35}{963.76} \times 12$$

= 9.4 months

Hence the payback period is 4 years 9 months

5.3 Tawang-I HE Project

Table 3: Pay-Back PeriodCalculation for Tawang-I HE Project.

YEAR	CASH INFLOWS	CUMULATIVE CASH IN FLOWS
1	1297.68	1297.68
2	1267.87	2565.56
3	1238.48	3804.04
4	1209.53	5013.57
5	1181.05	6194.62
6	1153.06	7347.68

Cost of project:Rs 6072.56 Crores

Up to the fourth year the total cost has not recovered but the total cash inflows for the fifth year are Rs. 6194.62crores i.eRs 122.06 crores more than the cost of the project. So the payback period is somewhere between 4 and 5 years. Assuming the cash inflows occur evenly throughout the year. The time required to recover Rs 1058.99 Crores (Rs 6072.56 Crores – Rs 5013.57 Crores) will be

$$= \frac{1058.99}{1181.05} \times 12$$

= 10.8 months

Hence the payback period is 4 years 11 months.

5.4 Tawang-II HE Project

Table 4: Pay-Back PeriodCalculation for Tawang-II HE Project.

YEAR	CASH INFLOWS	CUMULATIVE CASH IN FLOWS
1	1663.92	1663.92
2	1625.76	3289.68
3	1588.13	4877.81
4	1551.08	6428.89
5	1514.62	7943.51
6	1478.80	9422.31

Cost of project: Rs 7784.76 Crores

Up to the fourth year the total cost has not recovered but the total cash inflows for the fifth year are Rs. 7943.51crores i.eRs 158.75 crores more than the cost of the project. So the payback period is somewhere between 4 and 5 years. Assuming the cash inflows occur evenly throughout the year. The time required to recover Rs 1355.87 Crores (Rs 7784.76 Crores - Rs 6428.89 Crores) will be

$$= \frac{1355.87}{1514.62} \times 12$$

= 10.7 months

Hence the payback period is 4 years 11 months

5.5 Teesta-IV HE Project

Table 5.Pay-Back PeriodCalculation for Teesta-IV HE Project

YEAR	CASH INFLOWS	CUMULATIVE CASH IN FLOWS
1	1049.08	1049.08
2	1025.44	2074.52

3	1002.13	3076.65
4	979.19	4055.84
5	956.63	5012.48
6	934.48	5946.96

TAWANG-I	4.11
TAWANG-II	4.11
TEESTA IV	5
KOTLIBHEL IA	4.9

Cost of project: Rs. 5004.60 Crores

Up to the fourth year the total cost has not recovered but the total cash inflows for the fifth year are Rs. 5012.48 crores i.eRs 7.88 crores more than the cost of the project. So the payback period is somewhere at the starting of fifth year. Assuming the cash inflows occur evenly throughout the year. The time required to recover Rs 948.76 Crores (Rs 5004.6 Crores – Rs 4055.84 crores) will be

$$= \frac{948.76}{956.63} \times 12$$

$=$ 11.9 Months
Hence the payback period is 5 years

5.6 Kotli Bhel-1A HE Project

Table 6: Pay-Back PeriodCalculation for Kotali Bhel1A HE Project.

YEAR	CASH INFLOWS	CUMULATIVE CASH IN FLOWS
1	473.08	473.08
2	461.64	934.72
3	450.34	1385.06
4	439.20	1824.26
5	428.23	2252.49
6	417.43	2669.92

Cost of project: Rs. 2154.38 Crores

Up to the fourth year the total cost has not recovered but the total cash inflows for the fifth year are Rs. 2252.49crores i.eRs 98.11crores more than the cost of the project. So the payback period is somewhere at the starting of fifth year. Assuming the cash inflows occur evenly throughout the year. The time required to recover Rs 330.12 Crores (Rs 2154.38 Crores – Rs 1824.26 Crores) will be

$$= \frac{330.12}{428.23} \times 12$$

$=$ 9.3 months

Hence the payback period is 4 years 9 months

6. PAY-BACK PERIOD

Cost of the project, cash inflows & cash outflows together decide the payback period of a particular venture after commissioning. Below Table 7 exhibits payback period of selected projects.
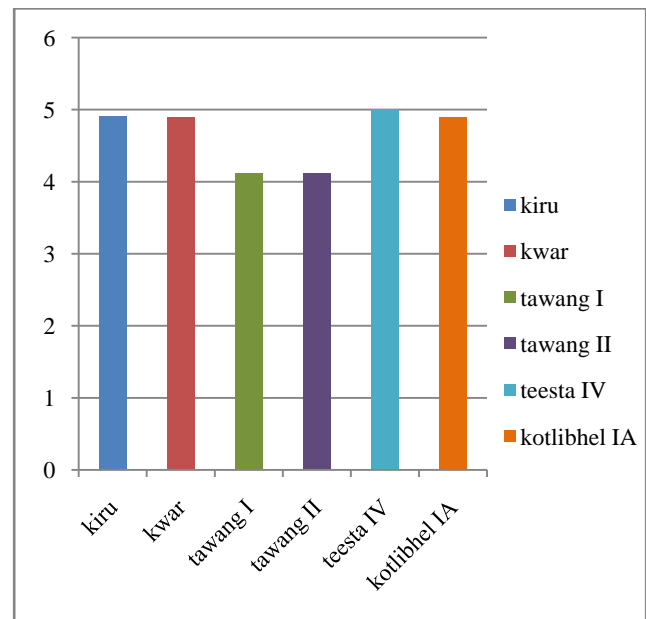
Table 7: Pay-Back Period Calculation Summary

PROJECT NAME	PAYBACK PERIOD (In years)
KIRU	4.9
KWAR	4.9

All the projects under study has a payback period ranging from 4.9 to 5 years.

7. PAY-BACK PERIOD

Graph 1: Pay-Back Period

Above graph exhibits payback periods of selected projects

8. CONCLUSION & RECOMMENDATION

- Assessment indicates that the **Payback period** of **Kiru**, **Kwar** and **Kotlibhel** IA is shortest i.e. 4 years 9 months. Whereas, **Teesta IV** project has a marginally longer payback period i.e. 5 years. It is established that the shorter the payback period sooner the organization can start making profits.
- Payback is a historical method, which is universally implemented by managements as project selection tool prior to development of the method of **Discounted cash flow (DCF)** for assessing investment decisions. However, payback method is recommended to be used by managements, who are obliged to settle numerous small capital expenditure decisions such as small routine replacement decisions where the cost of using more sophisticated methods may outweigh the benefits of possibly better choices among contending proposals.
- Additionally, it can be used in combination with either **Net Present Value**or**Internal Rate of Return** methods where the projects profitability is evaluated by NPV/IRR

and the payback is utilized to demonstrate to what extent initial investments will be at risk, i.e. payback serves as a risk indicator.

- Payback period ought to be ascertained on pre-tax basis. Payback period is easy to calculate however it may lead to wrong or undesirable investment decision, mainly because it disregards the principle of time value of money.

- The measure does not take in to account the total cash flows generated by the investment over the aggregate economic life.

- It represents cash flows till the payback time is reached and in this way penalizes investments with cash flows that increase over time.

- Payback method is thus biased against investments which essential for development of economy involving projects with long lead times.

- It is recommended to have negligible dependence on payback method in order to boost up long run growth prospects of the enterprise /economy in favour of greater liquidity in the immediate future.

REFERENCES

[1] Practice management(2015) *"Conducting a Feasibility Study"* American Speech–Language-Hearing Association

[2] Anna reginabjornsdottir(2010) *"Financial feasibility assessments building and using assessment models for financial feasibility analysis of investment projects"* Faculty of Industrial Engineering, Mechanical Engineering and Computer Science, University of Iceland.

[3] Aukerman, Haas & Associates llc(2004), *"Commercial services plan & financial feasibility evaluation"*, Bureau of Reclamation.

[4] BayuAdityaFirmansyah, AlinVeronika, and BambangTrigunarsyah(2006) *"Risk analysis in feasibility study of building construction project case study- pt. Perusahaan Gas Negara Indonesia"* The Tenth East Asia-Pacific Conference on Structural Engineering and Construction**.**

[5] Bauer Michael (2006) *"The Financial Feasibility of a Township Development"* GRIN Verlag

[6] KashyapSoni (2006), *"Capital Budgeting Practices in India"*, Dissertation submitted to Business School, The University of Nottingham.

[7] Hofstrand, D. and Holz-Clause, M., (2009a). **"F**easibility study outline"* Iowa State University.

[8] Hofstrand, D. and Holz-Clause, M., (2009b) *"What is a feasibility study?"* Iowa State University.

[9] Kierulff Herbert (2008) *"Modified internal rate of return: A better measure"*, School of Business and Economics, Seattle Pacific University.

[10] Matson, J., (2000) *"Cooperative Feasibility Study Guide"* USA: United States Department of Agriculture. Rural Business – Cooperative Service.

[11] Mun, J., (2006). *"Modeling risk – Applying Monte Carlo simulation, real options analysis forecasting and optimization techniques"* New Jersey: John Wiley &Sons, Inc.

[12] River Power Company, *"Hydropower feasibility studies - a general guide"**.**

[13] Thompson Alan (2005) *" Entrepreneurship and Business innovation : business feasibility study outline"*

[14] Holland Rob (1998) **"Break-Even Analysis"** Agricultural Development Center, University of Tennessee.

[15] Remer, DS. And nieto, AP, (1995) **"A compendium and comparison of 25 project evaluation techniques."** International journal of production economics