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# Sensitivity Analysis and Feasibility Analysis of Renewable Energy Project

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***Abstract:*** ***RE projects face difficulty in there technical and financial analysis; RE projects are indeed sensitive to the input parameters produce many constraints which hamper the financial analysis of the projects .And thus we need to analyze the things with help of different parameters together with which we termed as Sensitivity Analysisfinancial analysis techniques which are having different advantages and benefits and all these techniques are used in the 1. Simple payback period 2. Return on investment, 3. Net present value 4. Internal rate of return. and given the model based approach for financial analysis of RET.***

***Keywords:*** **RE, IIR, NPV, SPV, ROI, MNRE, NEL.**

## I. INTRODUCTION

Changing Global Scenario and increasing gap between demand and supply gave boost to the non-conventional projects all over the world .But the intermittent nature of the renewable energy projects makes them less reliable .In the country like India where natural resources are abundant and we come up with effective and non-conventional methods of using the available natural resources like the sunlight , wind and solar ,hydro, but we are facing problem with the reliability and feasibility of the projects

At the same time RE projects face difficulty in there technical and financial analysis ; RE projects are indeed sensitive to the input parameters produce many constraints which hamper the financial analysis of the projects .And thus we need to analyze the things with help of different parameters together with which we termed as Sensitivity Analysis .

**Financial analysis and financial analysis techniques :** Payback is a measure of how long it will be before the investment makes money, and how long the financing term needs to be. Return on Investment (ROI) and Internal Rate of Return (IRR) is a measure that allows how long the financing terms needs to be Net Present Value (NPV) and Cash Flow: A measure that allow financial planning of the project and provide the company with all the information needed to incorporate energy efficiency projects in to the corporate financial system. Following are the **financial analysis techniques** which are having different advantages and benefits and all these techniques are used in the

**1. Simple payback period**
**2. return on investment,**
**3. Net present value**
**4. Internal rate of return**

1. **simple payback period :** Simple Payback Period (SPP) represents, as a first approximation; the time (number of years) required to recover the initial investment (First Cost), considering only the Net Annual Saving:

The simple payback period is usually calculated as follows:

$$\text{Simple payback period (SPP)} = \frac{\text{First Cost}}{\text{Yearly Benefits} - \text{Yearly Costs}}$$

Simple payback period for a solar panel in a corporate office that costs Rs.60 lakhs to purchase and install, Rs.1.5 lakhs per year on an average to operate and maintain and is expected to save Rs. 20 lakhs by reducing steam consumption may be calculated as follows:

**Spp= 60/(20-1.5)= 3 years and 3 months**

**Time Value of Money**

- Project usually has capital costs and series of annual costs and/or cost savings (operating, energy, maintenance etc.) throughout the life
- To assess project feasibility, all present and future cash flow must be equated to common basis.
- Problem equating cash flow at different times is that value of money changes with time
- Method by which different cash flow is related is called discounting or present value method
- If money is deposited in the bank at 10% interest, then a Rs.100 deposit will be worth Rs.110 in one year's time. Thus the Rs.110 in one year is a future value equivalent to the Rs.100 present value.
- In the same manner, Rs.100 received one year from now is only worth Rs.90.91 in today's money (i.e. Rs.90.91 plus 10% interest equals Rs.100). Thus Rs.90.91 represents the present value of an Rs.100 cash flow occurring one year in the future. If the interest rate were something different than 10%, then the equivalent present value would also change. The relationship between present and future value is determined as follows:

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$$\text{Future Value (FV)} = \text{NPV}\,(1+i)^n \quad \text{or} \quad \text{NPV} = \text{FV} / (1+i)^n$$

*Where*

*FV = Future value of the cash flow*
*NPV= Net Present Value of the cash flow*
*i = Interest or discount rate*
*n = Number of years in the future*

## II. RETURN ON INVESTMENT (ROI)

1) ROI expresses the annual return from project as % of capital cost.
2) This is a broad indicator of the annual return expected from initial capital investment, expressed as a percentage

$$\text{ROI} = \frac{\text{Annual Net Cash Flow}}{\text{Capital Cost}} \times 10$$

## III. LIMITATIONS OF ROI

- It does not take into account the time value of money
- It does not account for the variable nature of annual net cash flow inflows

**Net present value (NPV**) The net present value (NPV) of a project is equal to the sum of the present values of all the cash flows associated with it. Symbolically

Discount rate (κ ) employed for evaluating the present value of the expected future cash flows should reflect the risk of the project

$$NPV = \frac{CF_0}{(1+\kappa)^0} + \frac{CF_1}{(1+\kappa)^1} + \cdots + \frac{CF_n}{(1+\kappa)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+\kappa)^t}$$

Where NPV = Net Present Value
$CF_t$ = Cash flow occurring a
of year 't' (t=0,1,....n)
n = life of the project
κ = Discount rate

***ADVANTAGES OF NPV***

- It takes into account time value of money
- It considers the cash flow stream in its project life

***Internal rate of return (IRR)***

- Calculates rate of return that an investment is expected to yield
- IRR expresses each alternative in terms of interest (compound interest rate)
- The expected rate of return is the interest rate for which total discounted benefits become = zero
- Criteria for selection among alternatives is to choose investment with the highest rate of return
- The internal rate of return (IRR) of a project is the discount ratewhich makes its net present value (NPV) equal to zero

***Advantages of IRR***

- It takes into account the time value of money
- It considers the cash flow stream in its entirety
- It makes sense to businessmen who prefer to think in terms of rate of return and find an absolute quantity, like net present value, somewhat difficult to work with.

***Limitations of IRR***

- The internal rate of return figure cannot distinguish between lending and borrowing and hence a high internal rate of return need not necessarily be a desirable feature.

Above all the financial technique having some limitation which are the major constraint in proper analysis of the project like wind solar hydro and biomass. As all these RE projects have differing input parameters and different policies.

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***Sensitivity Analysis***

- Almost all the cash flow methods involve uncertainty
- Sensitivity analysis is assessment of risk
- Recommended for projects whose feasibility is marginal
- Assesses how sensitive the project to changes in input parameters
- What if one or more factors are different from what is predicted?
- Use of spreadsheets (with built-in what if?) is recommended

**Micro factors that are considered for the sensitivity analysis are**…

- Operating expenses (various expenses items)
- Capital structure
- Costs of debt, equity
- Changing the project duration

In our project we have done sensitivity analysis of wind energy project with following parameters and assumption And all the values considered are according to MNRE and NEL policies and norms we have calculated the pack back period of the wind energy project.

## IV. CONCLUSION

Above all discussed the financial technique having some limitation which are the major constraints in proper analysis of the project like wind solar hydro and biomass. As all these RE projects have differing input parameters and different policies .We need to implement new type of analysis which will give us the precise picture for techno – economic feasibility of specially grid connected DDG's **Sensitivity Analysis** Recommended for projects whose feasibility is marginal

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APPENDIX

| | Wind Power Project | | | | |
|---|---|---|---|---|---|
| S. No. | Assumption Head | Sub- Head | Sub- Head(2) | Unit | Assumptions |
| 1 | Power Generation | Capacity | | | |
| | | | Installed Generation Capacity | MW | 1 |
| | | | Capacity Utilization Factor | % | 19% |
| | | | Useful Life | Years | 25 |
| 2 | Project Cost | Capital Cost/MW | Power Plant Cost | Rs Lacs/MW | 800 |
| | | | | | |
| 3 | Sources of Fund | | | | |
| | | | Tariff Period | Years | 13 |
| | | | | | |
| | | Debt:Equity | Debt | % | 70% |
| | | | Equity | % | 30% |
| | | | Total Debt Amount | Rs Lacs | 560 |
| | | | Total Equity Amount | Rs Lacs | 240 |
| | | Debt Component | | | |
| | | | Loan Amount | Rs Lacs | 560 |
| | | | Repayment (incld. Moratorium) | years | 10 |
| | | | Interest Rate | % | 12.87% |
| | | Equity Component | | | |
| | | | Equity Amount | Rs Lacs | 240 |
| | | | Return on Equity for first 10 years | % p.a | 19.00% |
| | | | RoE Period | Year | 10 |
| | | | RoE 11th Year onwards | % p.a | 24.00% |
| | | | Discount Rate | | 15.61% |
| 4 | Financial Assumptions | | | | |
| | | | | | |
| | | Fiscal Assumptions | Income Tax | % | 32.445% |
| | | | MAT Rate (for 1st 10 years) | % | 20.008% |
| | | | 80 IA benefits | Yes/No | Yes |
| | | Depreciation | | | |
| | | | Depreciation rate for 1st 10 years | % | 7.00% |
| | | | Depreciation rate 11th year onwards | % | 1.33% |
| 5 | Working Capital | | | | |
| | | For Fixed charges | | | |
| | | O & M charges | | Months | 1 |
| | | Maintenance Spare | (% of O & M expenses) | | 15% |
| | | Receivables for Debtors | | Months | 2 |
| | | Working Capital Requirement | | | 5% |
| | | Interest on working capital | | % | 13.37% |
| 6 | Operation & Maintenance | | | | |
| | | Power Plant (FY 12-13) | | Rs lakh | 8.12 |
| | | Total O & M Expenses Escalation | | % | 5.72% |

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| Year | Profit | Depreciation(Book depn) | Cash Flow | Cumulative Cashfow | Total Investment |
|---|---|---|---|---|---|
| 1 | 69.51 | 36.32 | 105.83 | 105.83 | 800 |
| 2 | 43.85 | 36.32 | 80.17 | 186.00 | |
| 3 | 46.71 | 36.32 | 83.03 | 269.03 | |
| 4 | 53.47 | 36.32 | 89.79 | 358.82 | |
| 5 | 61.64 | 36.32 | 97.96 | 456.79 | |
| 6 | 69.83 | 36.32 | 106.15 | 562.94 | |
| 7 | 78.04 | 36.32 | 114.36 | 677.30 | |
| 8 | 86.25 | 36.32 | 122.57 | 799.87 | |
| 9 | 94.48 | 36.32 | 130.80 | 930.67 | |
| 10 | 102.73 | 36.32 | 139.05 | 1069.71 | |
| 11 | 109.98 | 36.32 | 146.30 | 1216.02 | |
| 12 | 82.84 | 36.32 | 119.16 | 1335.18 | |
| 13 | 81.51 | 36.32 | 117.83 | 1453.01 | |
| 14 | 80.20 | 36.32 | 116.52 | 1569.53 | |
| 15 | 78.90 | 36.32 | 115.22 | 1684.75 | |
| 16 | 77.61 | 36.32 | 113.93 | 1798.69 | |
| 17 | 76.34 | 36.32 | 112.66 | 1911.35 | |
| 18 | 75.08 | 36.32 | 111.40 | 2022.74 | |
| 19 | 73.83 | 36.32 | 110.15 | 2132.89 | |
| 20 | 72.59 | 36.32 | 108.91 | 2241.81 | |
| 21 | 71.37 | 36.32 | 107.69 | 2349.50 | |
| 22 | 70.16 | 36.32 | 106.48 | 2455.98 | |
| 23 | 68.96 | 36.32 | 105.28 | 2561.25 | |
| 24 | 67.77 | 36.32 | 104.09 | 2665.35 | |
| 25 | 66.60 | 36.32 | 102.92 | 2768.26 | |
| **TOTAL** | 1860.26 | 908.00 | 2768.26 | 35583.25 | 800 |
| | | | | | |
| | **Payback Period** = | | **110.73** | **7.22** | **YRS** |