



**ENERGY SAVINGS PERFORMANCE AND
MEASUREMENT & VERIFICATION
ONLINE TRAINING COURSE**

KRISHNAJI PAWAR, LEED AP BD+C, GSAS CGP, ISO 14001:2015, GCP
ENERGY SPECIALIST CURRICULUM





**PERFORMING FINANCIAL ANALYSIS+
FOR ENERGY PROFESSIONALS**

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WHAT SHOULD YOU LEARN





- Simple Payback Period
- Discounted Cash Flow Methods



SIMPLE PAYBACK PERIOD

This is the simplest technique that can be used to appraise a proposal. The simple payback period can be defined as 'the length of time required for the running total of net savings before depreciation to equal the capital cost of the project'.

In theory, once the payback period has ended, all the project capital costs will have been recouped and any additional cost savings achieved can be seen as clear 'profit'. Obviously, the shorter the payback period, the more attractive the project becomes.

The length of the maximum permissible payback period generally varies with the business culture concerned. In some companies, payback periods in excess of 3 years are considered acceptable.

SIMPLE PAYBACK PERIOD +

$$\text{Simple payback period (years)} = \frac{\text{Capital cost of the project (in Rs.)}}{\text{Net Annual savings (in Rs.)}}$$

$$PB = \frac{CC}{AS}$$

Where PB is the payback period (years), CC is the capital cost of the project (Rs.), and AS is the annual net cost saving achieved (Rs.).

The payback period can be calculated using the equation : The annual net cost saving (AS) is the least savings achieved after all the operational costs have been met. Simple payback period is illustrated in Example 4.

EXAMPLE 4

A new small cogeneration plant installation is expected to reduce a company's annual energy bill by Rs.4,86,000. If the capital cost of the new boiler installation is Rs.22,20,000 and the annual maintenance and operating costs are Rs. 42,000, the expected payback period for the project can be worked out as.

Solution

$$PB = 22,20,000 / (4,86,000 - 42,000) = 5.0 \text{ years}$$

DISCOUNTED CASH FLOW METHODS

The payback method is a simple technique, which can easily be used to provide a quick evaluation of a proposal. However, it has a number of major weaknesses:

- ❑ The payback method does not consider savings that are accrued after the payback period has finished.
- ❑ The payback method does not consider the fact that money, which is invested, should accrue interest as time passes. In simple terms there is a 'time value' component to cash flows. Thus Rs.1000 today is more valuable than Rs.1000 in 10 years' time.

In order to overcome these weaknesses a number of discounted cash flow techniques have been developed, which are based on the fact that money invested in a bank will accrue annual interest. The two most commonly used techniques are the 'net present value' and the 'internal rate of return' methods.

NET PRESENT VALUE METHOD

The net present value method considers the fact that a cash saving (often referred to as a 'cash flow') of Rs.1000 in year 10 of a project will be worth less than a cash flow of Rs.1000 in year 2. The net present value method achieves this by quantifying the impact of time on any particular future cash flow.

This is done by equating each future cash flow to its current value today, in other words determining the present value of any future cash flow. The present value (PV) is determined by using an assumed interest rate, usually referred to as a discount rate. Discounting is the opposite process to compounding. Compounding determines the future value of present cash flows, where discounting determines the present value of future cash flows.

NET PRESENT VALUE METHOD +

In order to understand the concept of present value, consider the case described in Example 3. If instead of installing a new cogeneration system, the company invested Rs.22,20,000 in a bank at an annual interest rate of 8%, then:

❑ The value of the sum at the end of year 1 = $22,20,000 + (0.08 \times 22,20,000) = \text{Rs.}23,97,600$

❑ The value of the sum at the end of year 2 = $23,97,600 + (0.08 \times 23,97,600) = \text{Rs.}25,89,408$

The value of the investment would grow as compound interest is added, until after n years the value of the sum would be:

$$FV = D \times (1 + IR/100)^n$$

Where FV is the future value of investment in Rs., and D is the value of initial deposit (or investment) in Rs., IR is Interest Rate and n is number of years.

EXAMPLE :

The future value of the investment made at present, after 5 years will be:

$$FV = 22,20,000 \times (1 + 8/100)^5 = \text{Rs.} 32,61,908.4$$

So in 5 years the initial investment of 22,20,000 will accrue Rs.10,41,908.4 in interest and will be worth Rs.32,61,908.4. Alternatively, it could equally be said that Rs.32,61,908.4 in 5 years time is worth Rs.22,20,000 now (assuming an annual interest rate of 8%). In other words the *present value* of Rs.32,61,908.40 in 5 years time is Rs.22,00,000 now.

The present value of an amount of money at any specified time in the future can be determined by the following equation.

$$PV = S \times (1 + IR/100)^{-n}$$

Where PV is the present value of S in n years time (Rs.), and S is the value of cash flow in n years time (Rs.).

EXAMPLE :

The net present value method calculates the present value of all the yearly cash flows (i.e. capital costs and net savings) incurred or accrued throughout the life of a project, and summates them. Costs are represented as a negative value and savings as a positive value. The sum of all the present values is known as the net present value (NPV). The higher the net present value, the more attractive the proposed project.

The present value of a future cash flow can be determined using the equation above. However, it is common practice to use a discount factor (DF) when calculating present value. The discount factor is based on an assumed discount rate (i.e. interest rate) and can be determined by using equation.

$$DF = (1 + IR/100)^{-n}$$

The product of a particular cash flow and the discount factor is the present value. $PV = S \times DF$

COMPUTED DISCOUNT FACTORS

Discount rate % (or interest rate %)											
Year	2	4	6	8	10	12	14	16			
0	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000			
1	0.980	0.962	0.943	0.924	0.905	0.887	0.877	0.862			
2	0.961	0.925	0.890	0.857	0.826	0.797	0.768	0.743			
3	0.942	0.889	0.840	0.794	0.751	0.712	0.675	0.641			
4	0.924	0.855	0.792	0.735	0.683	0.636	0.592	0.552			
5	0.906	0.822	0.747	0.681	0.621	0.567	0.519	0.476			
6	0.888	0.790	0.705	0.630	0.564	0.507	0.456	0.410			
7	0.871	0.760	0.665	0.583	0.513	0.452	0.400	0.354			
8	0.855	0.731	0.627	0.540	0.467	0.404	0.351	0.305			
9	0.837	0.703	0.592	0.500	0.424	0.361	0.308	0.263			
10	0.820	0.676	0.558	0.463	0.390	0.322	0.270	0.227			
11	0.804	0.650	0.527	0.429	0.350	0.287	0.237	0.195			
12	0.788	0.625	0.497	0.397	0.319	0.257	0.208	0.168			
13	0.773	0.601	0.469	0.368	0.290	0.229	0.182	0.145			
14	0.758	0.577	0.442	0.340	0.263	0.205	0.160	0.125			
15	0.743	0.550	0.417	0.315	0.239	0.183	0.140	0.108			
16	0.728	0.534	0.394	0.292	0.218	0.163	0.123	0.093			
17	0.714	0.513	0.371	0.270	0.198	0.146	0.108	0.080			
18	0.700	0.494	0.350	0.250	0.180	0.130	0.095	0.069			
19	0.686	0.475	0.331	0.232	0.164	0.116	0.083	0.060			
20	0.673	0.456	0.312	0.215	0.149	0.104	0.073	0.051			

The values of various discount factors computed for a range of discount rates (i.e. interest rates) are shown in Table 11.1. The Example 5 illustrates the process involved in a net present value analysis.

INTERNAL RATE OF RETURN METHOD

It can be seen from Example 5 that both projects returned a positive net present value over 10 years, at a discount rate of 8%. However, if the discount rate were reduced there would come a point when the net present value would become zero. It is clear that the discount rate which must be applied, in order to achieve a net present value of zero, will be higher for Project 2 than for Project 1. This means that the average rate of return for Project 2 is higher than for Project 1, with the result that Project 2 is the better proposition.

The discount rate which achieves a net present value of zero is known as the internal rate of return (IRR). The higher the internal rate of return, the more attractive the project.

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PROFITABILITY INDEX

Another technique, which can be used to evaluate the financial viability of projects, is the profitability index. The profitability index can be defined as:

$$\text{Profitability index} = \frac{\text{Sum of the discounted net savings}}{\text{Capital costs}}$$

The higher the profitability index, the more attractive the project.

Example 7

Determine the profitability index for the projects outlined in Example 5

$$\text{For Project 1: Profitability index} = \frac{10254}{30,000} = 0.342$$

$$\text{For Project 2: Profitability index} = \frac{10867}{30,000} = 0.362$$

Project 2 is therefore a better proposal than Project 1.

FACTORS AFFECTING ANALYSIS

Although the Examples 5 and 6 illustrate the basic principles associated with the financial analysis of projects, they do not allow for the following important considerations:

- ❑ The capital value of plant and equipment generally depreciates over time
- ❑ General inflation reduces the value of savings as time progresses. For example, Rs.1000 saved in 1 year's time will be worth more than Rs.1000 saved in 10 years time.

The capital depreciation of an item of equipment can be considered in terms of its salvage value at the end of the analysis period.

REAL VALUE

Inflation can be defined as the rate of increase in the average price of goods and services. In some countries, inflation is expressed in terms of the retail price index (RPI), which is determined centrally and reflects average inflation over a range of commodities. Because of inflation, the real value of cash flow decreases with time. The real value of sum of money (S) realised in n years time can be determined using the equation.

$$RV = S \times (1 + R/100)^{-n}$$

Where RV is the real value of S realised in n years time. S is the value of cash flow in n years time and R is the inflation rate (%).

As with the discount factor it is common practice to use an inflation factor when assessing the impact of inflation on a project. The inflation factor can be determined using the equation.

$$IF = (1 + R/100)^{-n}$$

The product of a particular cash flow and inflation factor is the real value of the cash flow.

$$RV = S \times IF$$

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