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SMART CITIES

ENERGY SAVINGS PERFORMANCE AND

MEASUREMENT & VERIFICATION

ONLINE TRAINING COURSE

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

ENERGY SPECIALIST CURRICULUM

ENERGY EFFICIENCY SPECIALIST

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FINANCIAL MANAGEMENT

FOR ENERGY PROFESSIONALS

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WHAT SHOULD YOU LEARN



Investment-need, Appraisal and criteria,

Financial analysis techniques- Simple pay back period

Return on investment, Net present value

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INTRODUCTION

In the process of energy management, at some stage, investment would be required for reducing the energy consumption of a process or utility. Investment would be required for modifications/retrofitting and for incorporating new technology.

It would be prudent to adopt a systematic approach for merit rating of the different investment options vis-à-vis the anticipated savings.

It is essential to identify the benefits of the proposed measure with reference to not only energy savings but also other associated benefits such as increased productivity, improved product quality etc.

The cost involved in the proposed measure should be captured in totality viz.

- ✓ Direct project cost
- ✓ Additional operations and maintenance cost
- ✓ Training of personnel on new technology etc.

Based on the above, the investment analysis can be carried out by the techniques explained in the later section of the chapter.



INVESTMENT NEED, APPRAISAL AND CRITERIA

To persuade your organization to commit itself to a program of investment in energy efficiency, you need to demonstrate:

- ✓ The size of the energy problem it currently faces
- ✓ The technical and good housekeeping measure available to reduce waste
- ✓ The predicted return on any investment
- ✓ The real returns achieved on particular measures over time.

The need for investments in energy conservation can arise under following circumstances

- ✓ For new equipment, process improvements etc.
- ✓ To provide staff training
- ✓ To implement or upgrade the energy information system



CRITERIA

Any investment has to be seen as an addition and not as a substitute for having effective management practices for controlling energy consumption throughout your organization. Spending money on technical improvements for energy management cannot compensate for inadequate attention to gaining control over energy consumption. Therefore, before you make any investments, it is important to ensure that

- ✓ You are getting the best performance from existing plant and equipment
- ✓ Your energy charges are set at the lowest possible tariffs
- ✓ You are consuming the best energy forms - fuels or electricity - as efficiently as possible
- ✓ Good housekeeping practices are being regularly practiced.



CRITERIA +

When listing investment opportunities, the following criteria need to be considered:

- ✓ The energy consumption per unit of production of a plant or process
- ✓ The current state of repair and energy efficiency of the building design, plant and services, including controls
- ✓ The quality of the indoor environment - not just room temperatures but indoor air quality and air change rates, drafts, under and overheating including glare, etc.
- ✓ The effect of any proposed measure on staff attitudes and behaviour.



ENERGY PROPOSALS VS OTHER COMPETITIVE PROPOSALS

One of the most difficult problems which many energy managers face is justifying why their organization should invest money in increasing its energy efficiency, especially when there are other, seemingly more important priorities for the use of its capital.

- ✓ Organization typically give priority to investing in what they see as their core or profit-making activities in preference to energy efficiency
- ✓ Even when they do invest in saving energy, they tend to demand faster rates of return than they require from other kinds of investment.



INVESTMENT APPRAISAL

Energy manager has to identify how cost savings arising from energy management could be redeployed within his organization to the maximum effect. To do this, he has to work out how benefits of increased energy efficiency can be best sold to top management as,

- ✓ Reducing operating /production costs
- ✓ Increasing employee comfort and well-being
- ✓ Improving cost-effectiveness and/or profits
- ✓ Protecting under-funded core activities
- ✓ Enhancing the quality of service or customer care delivered
- ✓ Protecting the environmentn they require from other kinds of investment.



FINANCIAL ANALYSIS

In most respects, investment in energy efficiency is no different from any other area of financial management. So when your organization first decides to invest in increasing its energy efficiency it should apply exactly the same criteria to reducing its energy consumption as it applies to all its other investments. It should not require a faster or slower rate of return on investment in energy efficiency than it demands elsewhere.

The basic criteria for financial investment appraisal include:

- ✓ Simple Payback - a measure of how long it will be before the investment makes money, and how long the financing term needs to be

FINANCIAL ANALYSIS

- ✓ Return on Investment (ROI) and Internal Rate of Return (IRR) - measure that allow comparison with other investment options

- ✓ Net Present Value (NPV) and Cash Flow - measures that allow financial planning of the project and provide the company with all the information needed to incorporate energy efficiency projects into the corporate financial system.

PROTECTING ENERGY INVESTMENT

It is essential to keep a careful watch on your organization's maintenance policy and practices in order to protect any investment already made in reducing your organization's energy consumption. There is a clear dependence relationship between energy efficiency and maintenance. This operates at two levels:

- ✓ Initially, improving energy efficiency is most cost-effectively done in existing facilities through normal maintenance procedures
- ✓ Subsequently, unless maintenance is regularly undertaken, savings from installed technical measure, whether in new-build or existing facilities, may not be realized.

FINANCIAL ANALYSIS TECHNIQUES

In this chapter, investment analysis tools relevant to energy management projects will be discussed.

✓ **Simple Pay Back 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:

Examples $\text{Simple payback period} = \frac{\text{Firstcost}}{\text{Yearlybenefits} - \text{Yearlycosts}}$

Simple payback period for a continuous Deodorizer 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 (as compared to batch deodorizers), may be calculated as follows:

FINANCIAL ANALYSIS TECHNIQUES +

According to the payback criterion, the shorter the payback period, the more desirable the pro-

Simple payback period = $\frac{60}{20} = 1.5$
= 3 years 3 months

Advantages : A widely used investment criterion, the payback period seems to offer the following advantages:

- ✓ It is simple, both in concept and application. Obviously a shorter payback generally indicates a more attractive investment. It does not use tedious calculations.
- ✓ It favours projects, which generate substantial cash inflows in earlier years, and discriminates against projects, which bring substantial cash inflows in later years but not in earlier years.

LIMITATIONS

✓ It fails to consider the time value of money. Cash inflows, in the payback calculation, are simply added without suitable discounting. This violates the most basic principle of financial analysis, which stipulates that cash flows occurring at different points of time can be added or subtracted only after suitable compounding/discounting.

To illustrate, consider the cash flows of two projects, A and B:
The payback criterion prefers A, which has a payback period of 3 years, in comparison to B,

Investment	Rs.(100,000)	Rs.(100,000)
Savings in Year	Cash Flow of A	Cash flow of B
1	50,000	20,000
2	30,000	20,000
3	20,000	20,000
4	10,000	40,000
5	10,000	50,000
6	-	60,000

- ✓ It ignores cash flows beyond the payback period. This leads to discrimination against projects that generate substantial cash inflows in later years. which has a payback period of 4 years, even though B has very substantial cash inflows in years 5 and 6.
- It is a measure of a project's capital recovery, not profitability.
- Despite its limitations, the simple payback period has advantages in that it may be useful for evaluating an investment.

TIME VALUE OF MONEY

A project usually entails an investment for the initial cost of installation, called the capital cost, and a series of annual costs and/or cost savings (i.e. operating, energy, maintenance, etc.) throughout the life of the project.

To assess project feasibility, all these present and future cash flows must be equated to a common basis. The problem with equating cash flows which occur at different times is that the value of money changes with time. The method by which these various cash flows are related is called discounting, or the present value concept.

For example, if money can be 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.

TIME VALUE OF MONEY. +

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 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:

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

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

RETURN ON INVESTMENT (ROI)

ROI expresses the "annual return" from the project as a percentage of capital cost. The annual return takes into account the cash flows over the project life and the discount rate by converting the total present value of ongoing cash flows to an equivalent annual amount over the life of the project, which can then be compared to the capital cost. ROI does not require similar project life or capital cost for comparison.

This is a broad indicator of the annual return expected from initial capital investment, expressed as a percentage:

$$\text{ROI} = \frac{\text{Annual Net Cash Flow}}{\text{Capital Cost}} \times 100$$

ROI must always be higher than cost of money (interest rate); the greater the return on investment better is the investment.

RETURN ON INVESTMENT (ROI)+

Limitations

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

Net Present Value

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,

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

Where NPV = Net Present Value

CF_t = Cash flow occurring at the end of year 't' (t=0,1,...,n)

n = life of the project

k = Discount rate

The discount rate (k) employed for evaluating the present value of the expected future cash flows should reflect the risk of the project.

Advantages : The net present value criterion has considerable merits.

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

INTERNAL RATE OF RETURN

This method calculates the rate of return that the investment is expected to yield. The internal rate of return (IRR) method expresses each investment alternative in terms of a rate of return (a compound interest rate). The expected rate of return is the interest rate for which total discounted benefits become just equal to total discounted costs (i.e net present benefits or net annual benefits are equal to zero, or for which the benefit / cost ratio equals one). The criterion for selection among alternatives is to choose the investment with the highest rate of return.

The rate of return is usually calculated by a process of trial and error, whereby the net cash flow is computed for various discount rates until its value is reduced to zero.

The internal rate of return (IRR) of a project is the discount rate, which makes its net present value (NPV) equal to zero. It is the discount rate in the equation:

$$0 = \frac{CF_0}{(1+k)^0} + \frac{CF_1}{(1+k)^1} + \dots + \frac{CF_n}{(1+k)^n} = \sum_{t=0}^n \frac{CF_t}{(1+k)^t} \quad (7.1)$$

where CF_t = cash flow at the end of year "t"

k = discount rate

n = life of the project.

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