6. FINANCIAL MANAGEMENT

Syllabus
Financial Management: Investment-need, Appraisal and criteria, Financial analysis techniques-Simple pay back period, Return on investment, Net present value, Internal rate of return, Cash flows, Risk and sensitivity analysis; Financing options, Energy performance contracts and role of ESCOs.

6.1 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.

6.2 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.

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 environment

6.3 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
- **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.

Initially, when you can identify no or low cost investment opportunities, this principle should not be difficult to maintain. However, if your organization decides to fund a rolling program of such investments, then over time it will become increasingly difficult for you to identify opportunities, which conform to the principle. Before you'll reach this position, you need to renegotiate the basis on which investment decisions are made.

It may require particular thoroughness to ensure that all the costs and benefits arising are taken into account. As an approximate appraisal, simple payback (the total cost of the measure divided by the annual savings arising from it expressed as years required for the original investment to be returned) is a useful tool.

As the process becomes more sophisticated, financial criteria such as Discounted Cash Flow, Internal Rate of Return and Net Present Value may be used. If you do not possess sufficient financial expertise to calculate these yourself, you will need to ensure that you have access, either within your own staff or elsewhere within the organization, to people who can employ them on your behalf.

There are two quite separate grounds for arguing that, at least towards the later part of your energy management program, your organization could begin to apply a slower rate of return to its investments in energy efficiency than it applies elsewhere.

The benefits arising from some energy saving measures may continue long after their payback periods. Such measure does not need to be written off using fast discounting rates but can be regarded as adding to the long term value of the assets. For this reason, short term payback can be an inadequate yardstick for assessing longer term benefits. To assess the real gains from investing in saving energy, you should use investment appraisal techniques, which accurately reflect the longevity of the returns on particular types of technical measures.

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.

6.4 Financial Analysis Techniques

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

6.4.1 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:

$$Simple\ payback\ period = \frac{First\ cost}{Yearly\ benefits - Yearly\ costs}$$

Examples

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:

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

According to the payback criterion, the shorter the payback period, the more desirable the project.

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.

- It ignores cash flows beyond the payback period. This leads to discrimination against projects that generate substantial cash inflows in later years.

To illustrate, consider the cash flows of two projects, A and 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

The payback criterion prefers A, which has a payback period of 3 years, in comparison to B, 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 ***discountin***g, 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.

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:

Future Value (FV) = NPV $(1 + i)^n$ or NPV = 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

6.4.2 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:

$$ROI = \frac{\text{Annual Net Cash Flow}}{\text{Capital Cost}} \; x \, 100$$

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

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.

6.4.3 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,

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

Where NPV = Net Present Value
CF_t = Cash flow occurring at the end of year ‘t’ (t=0,1,….n)
n = life of the project
κ = Discount rate

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

Example

To illustrate the calculation of net present value, consider a project, which has the following cash flow stream:

Investment	Rs. (1,000,000)
Saving in Year	Cash flow
1	200,000
2	200,000
3	300,000
4	300,000
5	350,000

The cost of capital, κ, for the firm is 10 per cent. The net present value of the proposal is:

$$NPV = -\frac{1,000,000}{(1.10)^0} + \frac{200,000}{(1.10)^1} + \frac{200,000}{(1.10)^2}$$

$$+ \frac{300,000}{(1.10)^3} + \frac{300,000}{(1.10)^4} + \frac{350,000}{(1.10)^5} = (5,273)$$

The net present value represents the net benefit over and above the compensation for time and risk.

Hence the decision rule associated with the net present value criterion is: "Accept the project if the net present value is positive and reject the project if the net present value is negative".

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.

6.4.4 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:

$$0 = \frac{CF_0}{(1+\kappa)^0} + \frac{CF_1}{(1+\kappa)^1} + \ldots\ldots + \frac{CF_n}{(1+\kappa)^n} = \sum_{t=0}^{n} \frac{CF_t}{(1+\kappa)^t} \qquad (7.1)$$

where CF_t = cash flow at the end of year "t"
κ = discount rate
n = life of the project.

CF_t value will be negative if it is expenditure and positive if it is savings.
In the net present value calculation we assume that the discount rate (cost of capital) is known and determine the net present value of the project. In the internal rate of return calculation, we set the net present value equal to zero and determine the discount rate (internal rate of return), which satisfies this condition.
To illustrate the calculation of internal rate of return, consider the cash flows of a project:

Year	0	1	2	3	4
Cash flow	(100,000)	30,000	30,000	40,000	45,000

The internal rate of return is the value of " k " which satisfies the following equation:

$$100{,}000 = \frac{30{,}000}{(1+\kappa)^1} + \frac{30{,}000}{(1+\kappa)^2} + \frac{40{,}000}{(1+\kappa)^3} + \frac{45{,}000}{(1+\kappa)^4}$$

The calculation of "κ" involves a process of trial and error. We try different values of "κ" till we find that the right-hand side of the above equation is equal to 100,000. Let us, to begin with, try κ = 15 per cent. This makes the right-hand side equal to:

$$\frac{30{,}000}{(1.15)} + \frac{30{,}000}{(1.15)^2} + \frac{40{,}000}{(1.15)^3} + \frac{45{,}000}{(1.15)^4} = 100,802$$

This value is slightly higher than our target value, 100,000. So we increase the value of κ from 15 per cent to 16 per cent. (In general, a higher κ lowers and a smaller r increases the right-hand side value). The right-hand side becomes:

$$\frac{30{,}000}{(1.16)} + \frac{30{,}000}{(1.16)^2} + \frac{40{,}000}{(1.16)^3} + \frac{45{,}000}{(1.16)^4} = 98,641$$

Since this value is now less than 100,000, we conclude that the value of k lies between 15 per cent and 16 per cent. For most of the purposes this indication suffices.

Advantages

A popular discounted cash flow method, the internal rate of return criterion has several advantages:

- 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

- 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.

Example

Calculate the internal rate of return for a economizer that will cost Rs.500,000, will last 10 years, and will result in fuel savings of Rs.150,000 each year.

Find the i that will equate the following:

Rs.500,000 = 150,000 x PV (A = 10 years, i = ?)

To do this, calculate the net present value (NPV) for various i values, selected by visual inspection;

NPV 25% = Rs.150,000 x 3.571 – Rs.500,000
Rs.35,650

NPV 30% = Rs.150,000 x 3.092 – Rs. 500,000
= -Rs. 36,200

For i = 25 per cent, net present value is positive; i = 30 per cent, net present value is negative. Thus, for some discount rate between 25 and 30 per cent, present value benefits are equated to present value costs. To find the rate more exactly, one can interpolate between the two rates as follows:

i = 0.25 + (0.30-0.25) x 35650 / (35650 + 36200)

= 0.275, or 27.5 percent

Cash Flows

Generally there are two kinds of cash flow; the initial investment as one or more installments, and the savings arising from the investment. This over simplifies the reality of energy management investment.

There are usually other cash flows related to a project. These include the following:

- Capital costs are the costs associated with the design, planning, installation and commissioning of the project; these are usually one-time costs unaffected by inflation or discount rate factors, although, as in the example, installments paid over a period of time will have time costs associated with them.
- Annual cash flows, such as annual savings accruing from a project, occur each year over the life of the project; these include taxes, insurance, equipment leases, energy costs, servicing, maintenance, operating labour, and so on. Increases in any of these costs represent negative cash flows, whereas decreases in the cost represent positive cash flows.

Factors that need to be considered in calculating annual cash flows are:-

- Taxes, using the marginal tax rate applied to positive (i.e. increasing taxes) or negative (i.e. decreasing taxes) cash flows.
- Asset depreciation, the depreciation of plant assets over their life; depreciation is a “paper expense allocation” rather than a real cash flow, and therefore is not included directly in the life cycle cost. However, depreciation is “real expense” in terms of tax calculations, and therefore does have an impact on the tax calculation noted above. For example, if a Rs.10,00,000 asset is depreciated at 20% and the marginal tax rate is 40%, the depreciation would be Rs.200,000 and the tax cash flow would be Rs.80,000 and it is this later amount that would show up in the costing calculation.
- Intermittent cash flows occur sporadically rather than annually during the life of the project, relining a boiler once every five years would be an example.

6.5 Sensitivity and Risk Analysis

Many of the cash flows in the project are based on assumptions that have an element of uncertainty. The present day cash flows, such as capital cost, energy cost savings, maintenance costs, etc can usually be estimated fairly accurately. Even though these costs can be predicted with some certainty, it should always be remembered that they are only estimates. Cash flows in future years normally contain inflation components which are often "guess-timates" at best. The project life itself is an estimate that can vary significantly.

Sensitivity analysis is an assessment of risk. Because of the uncertainty in assigning values to the analysis, it is recommended that a sensitivity analysis be carried out - particularly on projects where the feasibility is marginal. How sensitive is the project's feasibility to changes in the input parameters? What if one or more of the factors in the analysis is not as favourable as predicted? How much would it have to vary before the project becomes unviable? What is the probability of this happening?

Suppose, for example, that a feasible project is based on an energy cost saving that escalates at 10% per year, but a sensitivity analysis shows the break-even is at 9% (i.e. the project becomes unviable if the inflation of energy cost falls below 9%). There is a high degree of risk associated with this project - much greater than if the break-even value was at 2%.

Many of the computer spreadsheet programs have built-in "what if" functions that make sensitivity analysis easy. If carried out manually, the sensitivity analysis can become laborious - reworking the analysis many times with various changes in the parameters.

Sensitivity analysis is undertaken to identify those parameters that are both uncertain and for which the project decision, taken through the NPV or IRR, is sensitive. Switching values showing the change in a variable required for the project decision to change from acceptance to rejection are presented for key variables and can be compared with post evaluation results for similar projects. For large projects and those close to the cut-off rate, a quantitative risk analysis incorporating different ranges for key variables and the likelihood of their occurring simultaneously is recommended. Sensitivity and risk analysis should lead to improved project design, with actions mitigating against major sources of uncertainty being outlined

The various micro and macro factors that are considered for the sensitivity analysis are listed below.

Micro factors

- Operating expenses (various expenses items)
- Capital structure
- Costs of debt, equity
- Changing of the forms of finance e.g. leasing
- Changing the project duration

Macro factors

Macro economic variables are the variable that affects the operation of the industry of which the firm operates. They cannot be changed by the firm’s management.

Macro economic variables, which affect projects, include among others:

- Changes in interest rates
- Changes in the tax rates
- Changes in the accounting standards e.g. methods of calculating depreciation
- Changes in depreciation rates
- Extension of various government subsidized projects e.g. rural electrification
- General employment trends e.g. if the government changes the salary scales
- Imposition of regulations on environmental and safety issues in the industry
- Energy Price change
- Technology changes

The sensitivity analysis will bring changes in various items in the analysis of financial statements or the projects, which in turn might lead to different conclusions regarding the implementation of projects

6.6 Financing Options

There are various options for financing in-house energy management
1. From a central budget
2. From a specific departmental or section budget such as engineering
3. By obtaining a bank loan
4. By raising money from stock market
5. By awarding the project to Energy Service Company (ESCO)
6. By retaining a proportion of the savings achieved.

Self-Financing Energy Management

One way to make energy management self-financing is to split savings to provide identifiable returns to each interested party. This has the following benefits:
- Assigning a proportion of energy savings to your energy management budget means you have a direct financial incentive to identify and quantify savings arising from your own activities.
- Separately identified returns will help the constituent parts of your organization understanding whether they are each getting good value for money through their support for energy management.
- If operated successfully, splitting the savings will improve motivation and commitment to energy management throughout the organization since staff at all levels will see a financial return for their effort or support.
- But the main benefit is on the independence and longevity of the energy management function.

Ensuring Continuity

After implementation of energy savings, your organization ought to be able to make considerable savings at little cost (except for the funding needed for energy management staff). The important question is what should happen to these savings?

If part of these easily achieved savings is not returned to your budget as energy manager, then your access to self-generated investments funds to support future activities will be lost. And later in the program, it is likely to be much harder for you to make savings.

However, if, an energy manager, has access to a proportion of the revenue savings arising from staff's activities, then these can be reinvested in:
- Further energy efficiency measures
- Activities necessary to create the right climate for successful energy management which do not, of themselves, directly generate savings
- Maintaining or up-grading the management information system.

Energy Performance Contracting and Role of ESCOS

If the project is to be financed externally, one of the attractive options for many organizations is the use of energy performance contracts delivered by energy service companies, or ESCOs.

ESCOs are usually companies that provide a complete energy project service, from assessment to design to construction or installation, along with engineering and project management services, and financing. In one way or another, the contract involves the capitalization of all of the services and goods purchased, and repayment out of the energy savings that result from the project.

In performance contracting, an end-user (such as an industry, institution, or utility), seeking to improve its energy efficiency, contracts with ESCO for energy efficiency services and financing.

In some contracts, the ESCOs provide a guarantee for the savings that will be realized, and absorbs the cost if real savings fall short of this level. Typically, there will be a risk management cost involved in the contract in these situations. Insurance is sometimes attached, at a cost, to protect the ESCO in the event of a savings shortfall.

Energy efficiency projects generate incremental cost savings as opposed to incremental revenues from the sale of outputs. The energy cost savings can be turned into incremental cash flows to the lender or ESCO based on the commitment of the energy user (and in some cases, a utility) to pay for the savings.

What is Performance Contracting?

The core of performance contracting is an agreement involving a comprehensive package of services provided by an ESCO, including:

- An energy efficiency opportunity analysis
- Project development
- Engineering
- Financing
- Construction/Implementation
- Training
- Monitoring and verification

Monitoring and verification, is key to the successful involvement of an ESCO in performance contracting where energy cost savings are being guaranteed.

ESCOs are not "bankers" in the narrow sense. Their strength is in putting together a package of services that can provide guaranteed and measurable energy savings that serve as the basis for guaranteed cost savings. But, the energy savings must be measurable. The Figure 6.1 shows ESCO Role.

What are performance contracts?

Performance contracting represents one of the ways to address several of the most frequently mentioned barriers to investment. Performance contracting through an ESCO transfers the technology and management risks away from the end-user to the ESCO.

For energy users reluctant to invest in energy efficiency, a performance contract can be a powerful incentive to implement a project. Performance contracting also minimizes or eliminates the up-front cash outlay required by the end-user. Payments are made over time as the energy savings are realized.

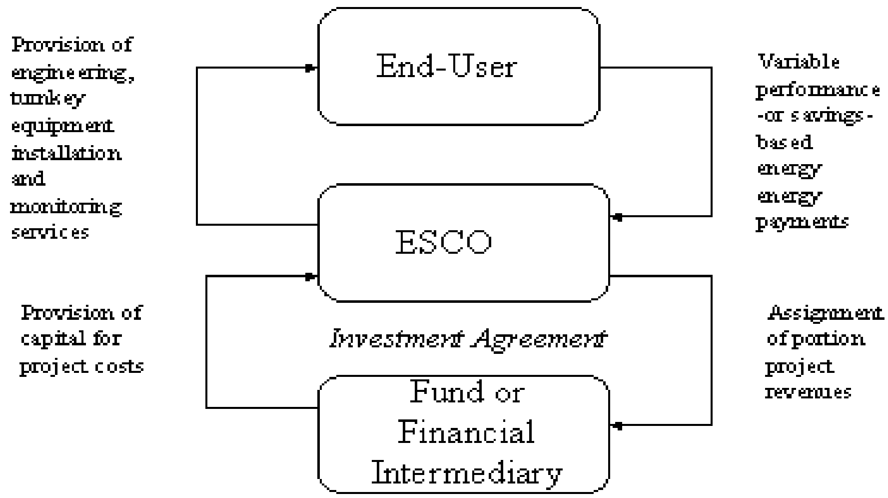

Figure 6.1 ESCO Role

QUESTIONS

1.	Why fresh investments are needed for energy conservation in industry?
2.	Name at least three selling points to top management for investing in energy efficiency over other competitive projects.
3.	Cost of an heat exchanger is Rs.1.00 lakhs .Calculate simple pay back period considering annual saving potential of Rs.60,000/- and annual operating cost of Rs.15,000/- .
4.	What is the main draw back of simple pay back method?
5.	Calculate simple pay back period for a boiler that cost Rs.75.00 lakhs to purchase and Rs.5 lakhs per year on an average to operate and maintain and is expected to annually save Rs.30 lakhs.
6.	What are the advantages of simple pay back method?
7.	A project entails an investment for initial cost of installation and series of annual costs and/or cost savings through out the life of project.. Recommend a suitable financial analysis techniques and explain.
8.	What do you understand by the term ” present value of money”?
9.	What do you understand by the term “ discounting”?
10.	ROI stands for (a) return on investment (b) rotating on investment (c) realization on investment (d) reality only investment?
11.	Define ROI .
12.	Investment for an energy proposal is Rs.10.00 lakhs. Annual savings for the first three years is 150,000, 200,000 & 300,000. Considering cost of capital as 10%, what is the net present value of the proposal?
13.	What are the advantages of net present value?
14.	Internal rate of return of a project is the discount rate which makes its net present value equal to zero. Explain
15.	What are the advantages of discounted cash flow method?
16.	What is the main limitation of discounted cash flow method?
17.	What is the objective of carrying out sensitivity analysis?
18.	Name at least three financing options for energy management.
19.	What is role of an ESCO?
20.	What is performance contracting?

REFERENCES

1. Financial Management, Tata Mc-Graw Hill – Prasanna Chandra.