TUTORIAL - 5

Importance of Energy Economics and Life Cycle Costing

1. Explain energy Economics.

Energy Economics is a broad scientific area which includes topic related to supply and use of energy in societies. Energy Economics is the field that studies human utilization of energy resources & energy commodities & the consequences of that utilization. Energy Economy also depends on the result of energy engineering, geology, political sciences & ecology.

Energy economics studies energy resources and energy commodities and includes:

- Forces motivating firms consumers to supply, convert, transport, use energy resources, and to dispose of residuals;
- Market structures and regulatory structures;
- Distributional and environmental consequences;
- Economically efficient use.

Energy economics recognizes the fundamental physical realities that:

- No energy is created or destroyed but that energy can be converted among its various forms, and
- Energy comes from the physical environment and ultimately is released back into the physical environment.

Thus, energy economics is the study of human activities using energy resources from naturally available forms, through often complex conversion processes, to forms providing energy services

Recent focus of energy economics includes the following **issues**:

- **Climate change & Climate policy**

Climate change is a significant & lasting change in statistical distribution of weather patterns over periods ranging from decades to millions of years. Climatic changes occurs due to biotic processes, variations in solar radiations, plane tectonics & volcanic eruptions. Also the human activities causes significance change in weather.

- **Risk analysis & security of supply sustainability**

It is the Technique used to identify & assess factors that may jeopardize the success of a project or achieving a goal.

- **Energy markets and electricity markets - liberalization, (de- or re-) regulation**

Markets that deal with the trade & supply of energy.

- **Demand Response**

Demand response is defined as changes in electric usage by end-use customers from their normal consumption patterns in response to changes in the price of electricity use at times of high wholesale market prices or when system reliability is jeopardize.

- **Energy policy**

It is the manner in which a given entity has decided to address issues of energy development including energy production, distribution 7 consumption.

- Energy and economic growth
- Economics of energy infrastructure
- Environmental policy
- Energy derivatives
- Forecasting energy demand

Economy is built on energy. Energy enables us to cook, heat, transport, and entertain. Most of our energy, electricity to power our TVs, gas for our cars, or heat for our homes, is derived from hydrocarbon fuels. The problem is hydrocarbon fuels emit carbon contributing to increasing levels of greenhouse gases and supply shortage and disruption that contribute to rising prices

Economy is related to energy so Energy consuming directly affects the economy of country. More you consume more it increases the economic wealth of any country. Energy conserving also leads to more effective impacts on energy. "More you save more you grow"

The rising cost of energy and the negative impact of CO2 in the atmosphere have major implications for our global economy. So we have to find for alternative energy sources along with declining prices and improving efficiencies. Government incentives for alternative energy sources along with declining prices and improving efficiencies translate into rapid growth for solar and wind energy systems. Conserving energy will increase the economy.

2. Explain payback period for energy conservation.

Simple Payback Period (SPP) represents, as 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:

$$\text{Simple payback period} = \frac{\text{first cost}}{\text{Yearly benefit} - \text{Yearly Costs}}$$

Example:

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:

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

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

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 favors 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

3. Explain life cycle costing.

Life cycle costing is the process of economic analysis to assess the total cost of ownership of a product, including its cost of installation, operation, maintenance, conversion, and/or decommission. Life cycle costing is an economic tool which combines both engineering art and science to make logical business decision. This analysis provides important inputs in the decision making process in the product design, development and use.

1. Life cycle costing for **product supplier**

   - By using LCC, product suppliers can optimize their design by evaluation of alternatives and by performing trade-off studies.

   - By using LCC, product suppliers can evaluate various operating and maintenance cost strategies (to assist product users).

2. Life cycle costing for **product customer**

   - By using LCC, customers can evaluate and compare alternative products.

   - By using LCC, customers can assess economic viability of projects or products.

The use of life cycle costing can be used as a management decision tool for synchronizing the divisional conflicts by focusing on facts, money, and time.

There are two cost elements for an equipment

1. **Initial Cost**

   Design & development cost, Investment on asset, or cost of equipment, Installation cost or erection & commission cost.

2. **Operation & Maintenance Cost**

Labor cost, Energy cost, Spare & maintenance cost, Raw material cost.

Steps for life cycle costing

Step1: Determination of life cycle of the product (i.e. equipment, in this case).

This Life cycle is not similar to conventional concept of Product Life Cycle. Conventional concept of Product Life Cycle implies to the time span based on demand of the product in the market, starting from launch of the product up to the time when company withdraw the product from the market. That is purely a marketing concept.

Step 2: Estimation of value

Estimate monetary value for each cost element. This estimated value will be incurred in every year. This value is basically future income at each year, which is estimated. To estimate the value, various source can be used; e.g. calculation based on facts and experience, MIS report for similar existing machines, etc.

Step 3: Net Present Value

Money has a time value. The present value of future income or future cost can be calculated by using discounting factor and inflation factor.

Step 4: Summation of PVs

PVs of each cost elements is calculated for an equipment (at every year). PVs of each cost element in a year are added. The process is done for every year over the life cycle, i.e. LCC is calculated for every year.

Step 5: Analysis

The data collected from LCC are analyzed. If one product has to be selected among multiple equipment's, then LCC is calculated for every product. Data for every product are analyzed, and the lowest LCC option become preferred. But lowest LCC option may not necessarily be implemented when other considerations such as risk, available budgets, political and environmental concerns are taken into account. LCC provides critical information to the overall decision-making process, but not the final answer.

4. Write note on

1. Internal rate of return

2. Life cycle costing

1) Internal rate of return

It measure that allow comparison with other investment options 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.

IRR of an investment is the discount rate at which the net present value of costs (negative cash flows) of the investment equals the net present value of the benefits (positive cash flows) of the investment.

It is also calculated from the formula of NPV.

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:

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

Where, CF_t = cash flow at the end of year "t"

κ = discount rate

n = life of the project

- **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 NPV.

- **Disadvantages:**

  • The internal rate of return figure cannot distinguish between leading and borrowing and hence a high internal rate of return need not necessarily be desirable features.

2) Life cycle costing

Life cycle costing is the process of economic analysis to assess the total cost of ownership of a product, including its cost of installation, operation, maintenance, conversion, and/or decommission. Life cycle costing is an economic tool which combines both engineering art and science to make logical business decision. This analysis provides important inputs in the decision making process in the product design, development and use.

i. Life cycle costing for product supplier

-- By using LCC, product suppliers can optimize their design by evaluation of alternatives and by performing trade-off studies.

-- By using LCC, product suppliers can evaluate various operating and maintenance cost strategies (to assist product users).

ii. Life cycle costing for product customer

-- By using LCC, customers can evaluate and compare alternative products.

-- By using LCC, customers can assess economic viability of projects or products.

The use of life cycle costing can be used as a management decision tool for synchronizing the divisional conflicts by focusing on facts, money, and time.

There are two cost elements for an equipment

i. **Initial Cost**

Design & development cost, Investment on asset, or cost of equipment, Installation cost or erection & commission cost.

ii. **Operation & Maintenance Cost**

Labor cost, Energy cost, Spare & maintenance cost, Raw material cost.

5. What is the importance and role of energy management?

Energy should be regarded as a business cost, like raw material or labor. Companies can achieve substantial reduction in energy bills by implementing simple housekeeping measures. Reduction and control of energy usage is vital for an organization as it:

- ***Reduces costs*:** Reducing cost is the most compelling reason for saving energy. Most organizations can save up to 20% on their fuel cost by managing their energy use;
- ***Reduces carbon emissions*:** Reducing energy consumption also reduces carbon emissions and adverse environmental effects. Reducing your organization's carbon footprint helps build a 'green' image thereby generating good business opportunities; and
- ***Reduce risk*:** Reducing energy use helps reduce risk of energy price fluctuations and supply shortages.

Regulatory requirements aiming to reduce carbon emissions and energy use require accurate energy data collection and effective management systems. Good energy management practices are compliant with these requirements and help fulfil regulatory obligations. Businesses worldwide are showing interest in appointment of a formal/informal energy manager to coordinate energy management activities. The main task of an energy manager is to set up a system to collect, analyses and report on energy consumption and costs which may involve reading electricity meters regularly and analysis of utility bills.

Carbon emissions from energy use dominate the total greenhouse gas emissions of most organizations. Sound energy management is rapidly emerging as an integral part of carbon management which in turn helps organizations in effective overall environmental management. In addition to financial benefits, energy management has other significant advantages for an organization such as:

- Organizations achieve stronger market position by demonstrating ‘green’ credentials. Energy management improves competitive advantage as most consumers prefer to source from socially responsible businesses;
- Organizations adopting energy management systems can influence supply chains by preferring suppliers who adopt environment management practices; and
- Energy management creates a better workplace environment for employees by improving working conditions.