

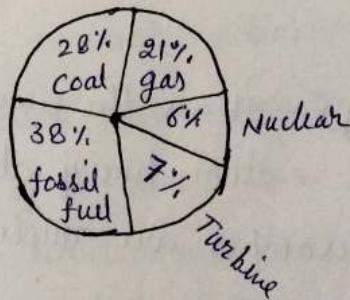


Unit 5 Energy science notes

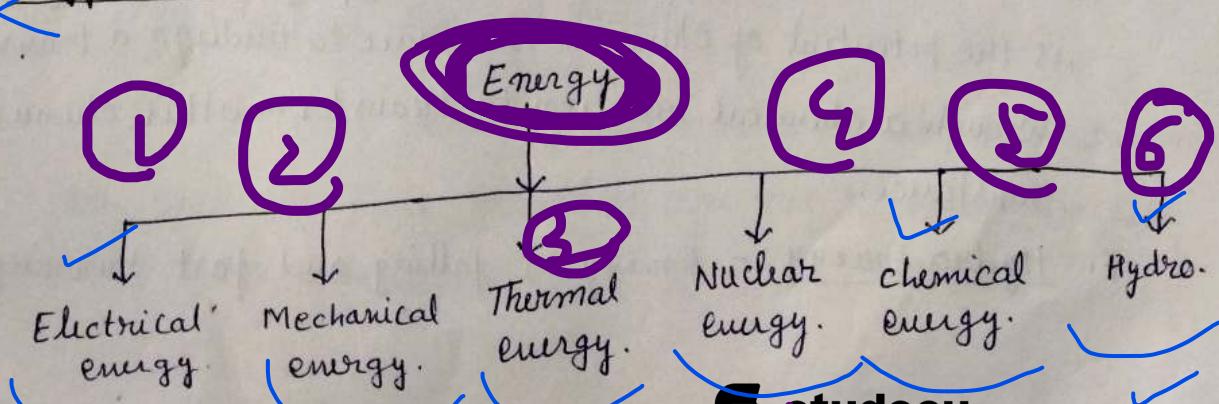
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Overview of World Energy Scenario :- Energy is a critical foundation for economic growth and social progress. Higher is the economic growth, higher is requirement of energy. Since fossil fuel are limited and created pollution in the environment, it is necessary to find the alternative so to protect our environment along with economic development. Renewable energy with the availability of its renewability and non-pollution will prove to be an effective and practical choice to guarantee the future development of the world.

In a recent finding total world energy came from 38% from oil, 28% from coal, 21% from gas, 7% from renewable (hydro + turbine) and 6% from nuclear.



Different form of Energy :-



1. Electrical Energy :-

Best form of energy, clean, non-polluting easily transferable and can be converted into other forms conventionally and efficiently.

2. Mechanical Energy :-

Energy of moving body is called Kinetic energy

$$K = \frac{1}{2}mv^2$$

Energy of position of body is called potential energy.

$$V = mgh$$

3. Thermal Energy :-

It is form of heat and used to raise the temperature of an object. It

can be converted into mechanical energy with the help of heat engine.

4. Nuclear Energy :-

It is the energy in the nucleus of an atom, heavy atoms like uranium, plutonium and thorium isotopes are nuclear fuels.

5. Chemical Energy :-

Intermediate stage between primary and usable energy form. Chemical energy is the potential of chemical substance to undergo a transformation through a chemical reaction to transform other chemical substance.

6. Hydro Energy

- Energy of falling and fast running water

Classification of Energy Resources

Based on utility

1. Primary Energy Resources

These resources are found in nature prior to undergo any human made conversions or transformations. These are available in nature in raw form so that known as raw energy sources e.g. coal, crude oil, sunlight, wind, running river and uranium.

Intermediate Resources

These are obtained from primary energy by one or more steps of transformations and are used as vehicles of energy

3. Secondary Resources

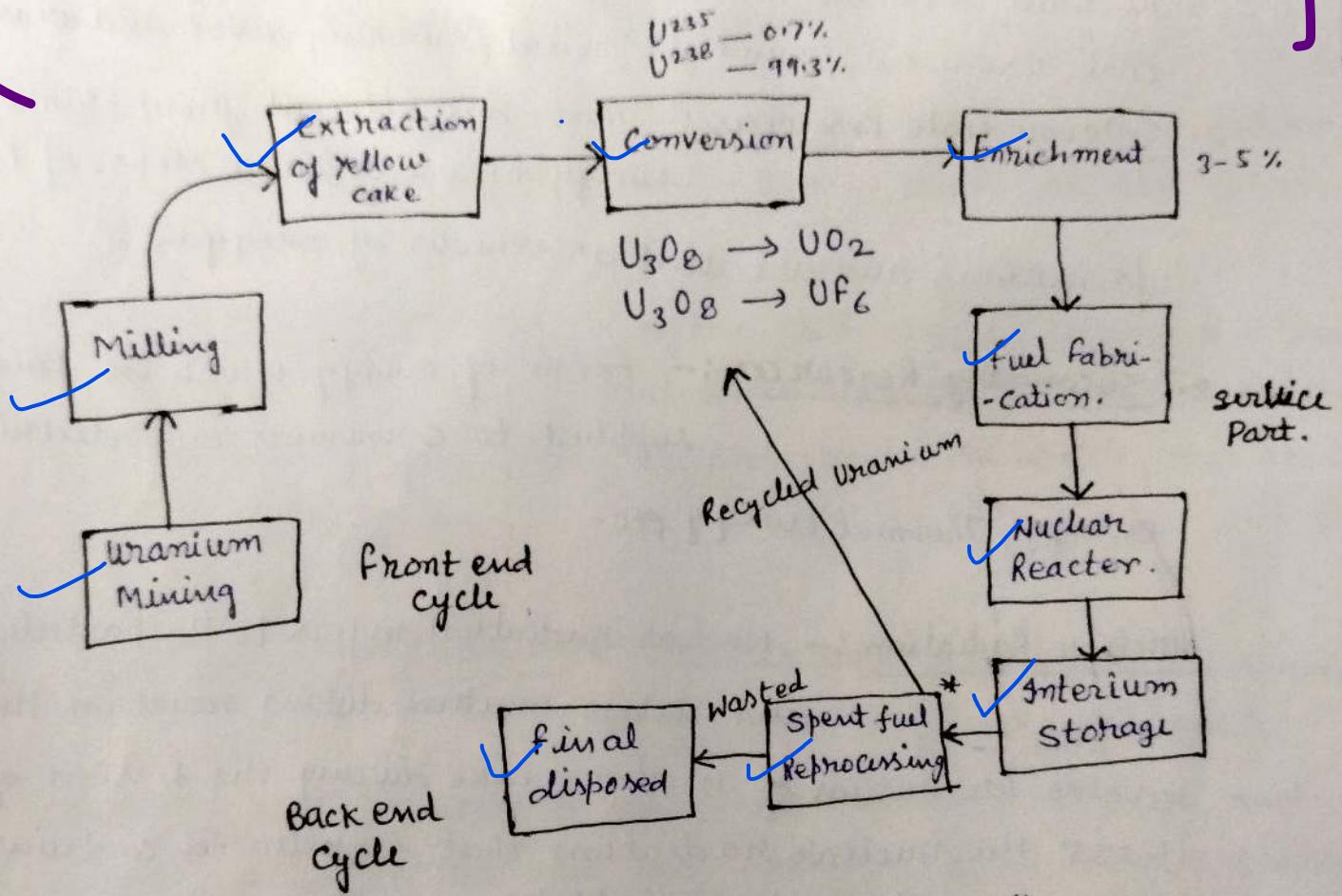
Form of energy which is finally supplied to consumers e.g. electrical energy, Thermal energy etc.

Nuclear Radiation

Nuclear radiation refers to the particles and photons emitted during reaction that involve the nucleus of an atom. Like during the fission of U-235 the nuclear radiation that is released contains neutrons and gamma ray photon. As radioactive material decays the energy released in environment has harming effect on a body that is exposed to it.

It can directly kill cells or it can mutations to DNA. If those mutations are not repaired, the cell may turn cancerous.

Nuclear fuel cycle :- The various activities associated with the production of electricity from nuclear reactions. In nuclear power plant used U-235 as a fuel. There are many steps involves in nuclear fuel cycles.

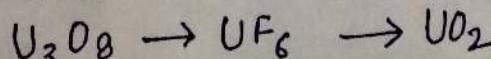


* Reprocessing are only in United States or other.

1. Mining :- Uranium can be extracted through conventional mining. (i) under ground mining (ii) open pit mining (iii) in place mining.

2. Milling :- The uranium is crushed into a fine powder and by reaction U is separated by other minerals.

3. U-conversion :- U_3O_8 (Milled uranium) $\rightarrow UO_2$



4. U-Enrichment :- UF_6 gas is sent to an enrichment plant where the individual Uranium isotopes are separated to produce enriched UF_6 which has 3-5% concentration of Uranium 235.

5. Fuel Fabrication :- In reactor UO_2 fuel is used in the form ceramic pellets. Pellets are used because it is difficult to manufacture a whole fuel rod from Ceramic.

6. Strontium Storage :- After their useful life of 3-5 years fuel assemblies are removed from the Nuclear Reactor. They are stored under the water near about 35 to 40 years.

Nuclear Proliferation :- Nuclear proliferation is the spread of nuclear weapons, fissionable materials and weapons applicable nuclear technology and information to nations not recognized as "Nuclear weapons states" by the treaty. The Non-proliferation of Nuclear Weapons, commonly known as the Non-proliferation Treaty or NPT. India, Pakistan, North Korea and Israel are not party to the NPT, although North Korea acceded to the NPT in 1985, but withdrew in 2003 and conducted announced nuclear test in 2006, 2009, 2013 and 2017.

Treaty recognizes 5 states as nuclear weapons country USA, UK, France, China, Russia. But India conducted nuclear test in 1974, 1998 and is also India is nuclear weapon state

Climate change :- Climate change is the average weather change in a given area over a long period of time (generally 30 years). Weather can

change from hours to hours, day to day, month to month and year to year. A climate includes information on, e.g. the average temp in different seasons, rainfall and sunshine.

Main cause of climate change :-

- (i) Human activity.
- (ii) Burning of fossil fuel.
- (iii) Declining water supply.
- (iv) Erosion in coastal areas.
- (v) Increased insect outbreak.
- (vi) Converting land from forest to Agriculture.

The 6 Major factors affecting climate (LOWERN)

1. Latitude :- It depends on distance from equator line if it is close to equator line then the colder it's temp. and if it is far to the equator then the hotter it's temp. Latitude is a key of strong factor affecting climate.

2. Ocean Current :- Certain ocean currents have different temperatures such that cold ocean current cool the land next of them and warm ocean current warm the land next to them.

3. Winds and air Masses :- Winds spread heat energy from equator to poles, this could cause melt the ice on the poles.

4. Elevation :- The temp. drops then you get higher and the temp rises then you get lower.

5. Relief :- High-lying area has more chance in rainfall and low-lying area has less chance in rainfall.

6. Nearness of Large Bodies of water :- The near you are on large body of water, the lower it's temperature. The further you are on large body of water the higher it's temperature.

Effect of climate change :-

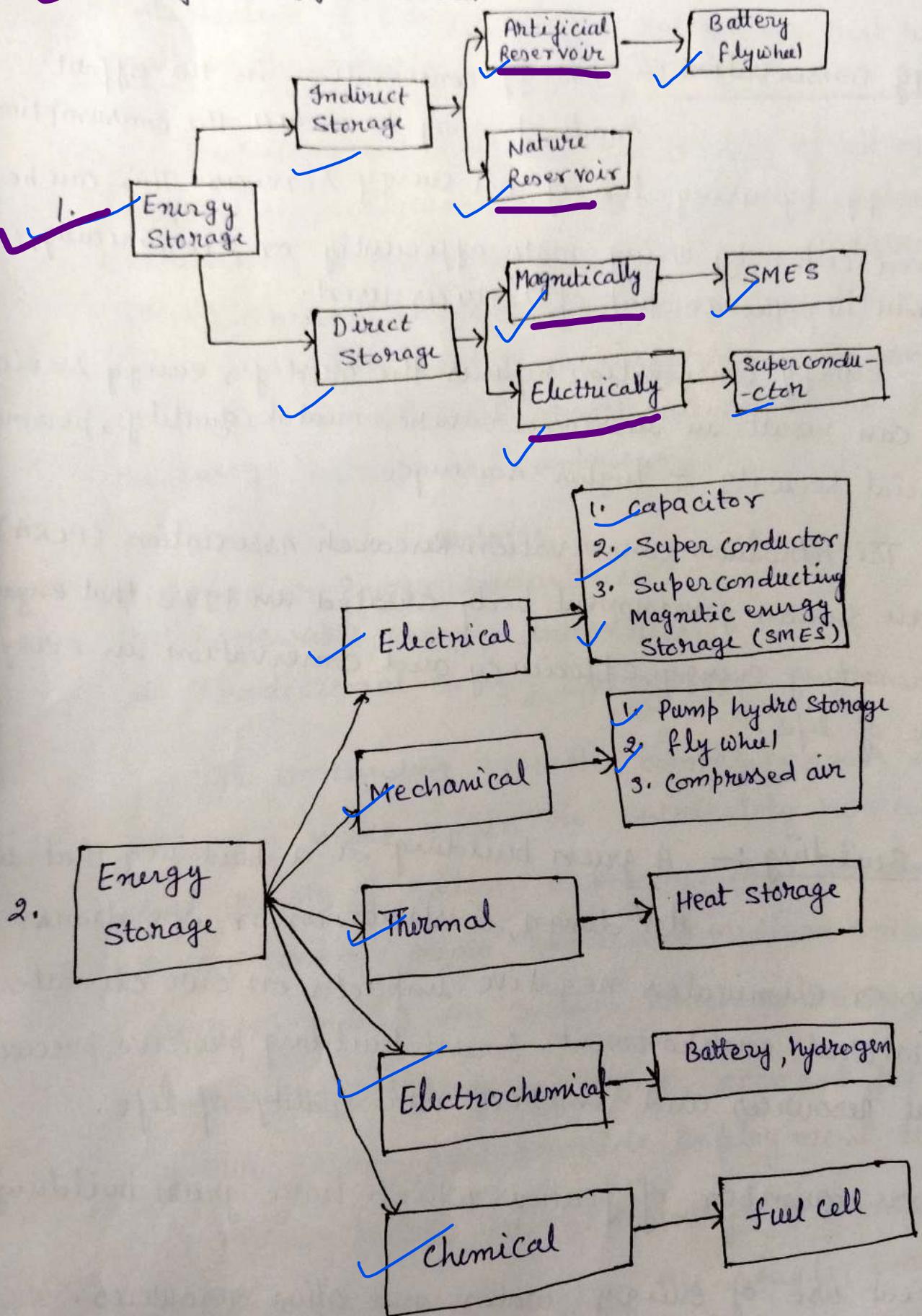
- (i) Rising maximum temperature.
- (ii) Rising ocean temperature.
- (iii) Rising sea levels.
- (iv) Shrinking glaciers.
- (v) An increase in heavy rain, hail (precipitation)

Energy Storage

Energy storage devices are system which store energy and produce at one time for use at a later time. A device that stores energy is generally called an accumulator or battery.

Energy comes in multiple forms including radiation, chemical, gravitational, potential, electrical, temperature, latent heat and kinetic energy, pressure, pump hydro; ~~fuel~~

Type of Energy Storage :-



Energy conservation :-

Energy conservation is the effort made of easy to reduce the consumption of energy by using less of an energy services. This can be achieved either by using more efficiently or economically, i.e by reducing the amount of services used.

Energy conservation reduces the need for energy services and can result in increased environmental quality, personal financial security & higher saving.

The Petroleum conservation Research Association (PCRA) is an Indian government body created in 1978 that engages in promoting energy efficiency and conservation in every walk of life.

Green Building :-

A green building is a building that in its design, construction or operations reduces or eliminates negative impacts on our climate and natural environment. Green building preserve precious natural resources and improve our quality of life.

There are number of features which have green building

- 1. Efficient use of energy, water and other resources.
- 2. Use of renewable energy use.
- 3. Good indoor environmental air quality.
- 4. Use of material that are more ethical & sustainable.

Identification of Energy related enterprises that represent the breadth of the industry and prioritizing these as candidates

The energy enterprise is the totality of all of the industries involved in production and sale of energy, including fuel extraction, manufacturing, refining and distribution. Modern society consumes large amounts of fuel and the energy industry is an important part of the infrastructure and maintenance of society in ~~all cont~~ almost all countries. In particular the energy enterprise comprises.

1. Fossil fuel industries.
2. Nuclear Power industries.
3. Renewable energy industries.
4. Traditional energy industries.

The continuing growth, competitiveness and well-being of MSME units is intricately related to the health and growth of Indian economy. There are about 44 million MSME units (Micro, small and medium Enterprises units Govt. of India) in India, which contribute 45% of India manufacturing output, account for about 35% of our exports and provide employment to more than 59 million people in the country. In many of the SME sectors energy is often the single largest operating cost and consequently energy productivity is key to their survival.

5.
6. However, large scale increases in energy conservation and in increased energy efficiency have been limited in MSME sectors. This is because of three major reasons. the limited time available to the entrepreneur to identify, contract and finance energy efficiency opportunities.

These suggests that the energy productivity enhancement processes have to be developed, standardized and demonstrated so that transaction cost are minimized and profitability for entrepreneurs, local service providers, technology suppliers and financial institutions derives large scale replication.

Indian SME sector consumes energy equivalent to about 50 million tons of oil equivalent annually, which is about 20 to 25 % of the energy consumptions by large industries. SME are involved in producing textiles, bricks, hand tools and metal casting etc. BEE interventions have shown that there is a vast potential to save energy in various msme industries of India. These lie both in thermal energy domain and electrical energy domain.

5. Pollution and waste reduction measures and enabling of reuse and recycling.

6. A design that enables adaptation to a changing environment.

⇒ Green Architecture :- Green architecture is an approach to building that minimize the harmful effect of construction projects on human health and the environment.

The green architect or designer attempts to safeguard air, water and earth by choosing eco friendly building materials and construction practices.

⇒ Leadership in Energy & Environmental Design (LEED)

LEED is the most widely used green building rating system in the world. Available for virtually all building community and home project types. LEED provides a frame work to create healthy, highly efficient and cost saving green buildings. Based on the number of points achieved a project, then earns one of four LEED rating levels.

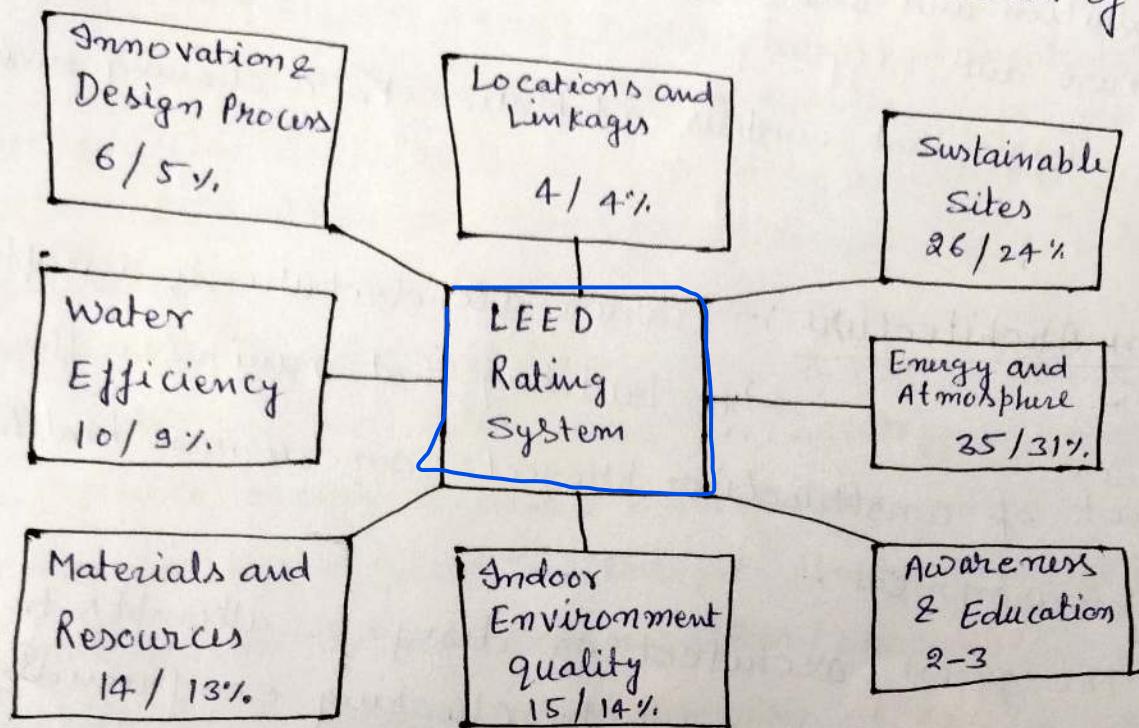
1. 40 - 49 points earned → certified LEED

2. 50 - 59 points earned → Silver level

3. 60 - 79 points earned → Gold level

4. 80 + points earned → Platinum level

LEED Rating Systems:- The point distribution of LEED categories



It is introduced in 2000. LEED Certified building are designed

Lower operating costs and increase asset value.

1. Conserve energy and water.
2. Reduce waste sent to land fills and use space more efficiently.
3. Reduce harmful greenhouse gas emission.
4. Be healthier and safer for occupants by improving indoor air quality.

Energy Audit :-

An energy audit is an inspection survey and an analysis of energy flows for energy conservation in a building. It may include a process or system to reduce the amount of energy input into the system without negatively affecting the output. In commercial and industrial and real estate, an energy audit is the first steps in identifying opportunities to reduce energy expense and carbon footprint. Energy audit is an official scientific study of energy consumption of an organisation / process / plant / equipment, aimed at reduction of energy consumption and energy costs without affecting productivity and comforts, suggesting the methods for energy saving and reduction in energy cost. It also needs market knowledge of the availability of energy efficient appliances / devices to suggest replacement / modification besides including awareness about energy conservation in our day to day operations.

The energy audit brings a detailed report which normally contains the following:

1. Analysis of energy use.
2. Identification of energy projects.
3. Cost benefit analysis.
4. Action plan to set implementation priority.

Embodyed Energy :-

It is the total energy required for extraction, processing, manufacturing and delivery of building materials to the sites. Energy consumption produces CO₂, which contributes to greenhouse gas emission so, embodied energy is considered an indicator of the overall environment impact of building materials and system. Does not refer to the building energy available or inherent in a material or product, e.g. the energy recovered by burying a product could be called "cumulative energy demand" the sum of all the energy inputs into a product system.

Major Points to reduce embodied energy :-

When selecting building materials, the embodied energy should be considered with respect to.

1. The durability of building materials.
2. Use local sources of materials.
3. Use of recycled materials
4. Avoid waste.
5. How easily materials can be separated.
6. Specifying standard sizes of materials.
7. Selecting materials that are manufactured using renewable energy sources.

Embodied energy diagram :-

