



Department of Civil Engineering

Name of Subject: - **ENERGY CONSERVATION & GREEN BUILDING (ECG)**

Course Code: - **315316**

Scheme:- **CE-5K**

Semester:- **Fifth**

Unit No. 01

Fundamental of Green Building and Energy Conservation

CO1 - Justify the need of Energy Conservation and Green building

Unit	Unit Title	Aligned COs	Learning Hours	R-Level	U-Level	A-Level	Total Marks
I	Fundamental of Green Building and Energy Conservation	CO1	4	4	4	0	8

THEORY SYLLABUS CONTENT

Unit - I Fundamental of Green Building and Energy Conservation

- 1.1 Introduction to Energy Conservation: Global energy consumption scenario, Energy conservation: Definition, objectives and Importance.
- 1.2 Salient features of Energy Conservation Act – 2001
- 1.3 Introduction to Green Building: Definition and Importance of green building concept, History and evolution of green building construction practices, Role of Green Building in sustainable development
- 1.4 Overview of Sustainable construction: Environmental, economic, and social developmen

Subject Incharge

Mr. D. B. Wagh

Unit-01

Fundamental of Green Building and Energy Conservation.

Introduction:-

* In today's word, saving energy (energy conservation) is very important because cities and industries are growing fast, and they use a lot of energy - especially buildings.

* Buildings use around 30% of the world's energy, which puts pressure on natural resources and adds to climate change.

* To reduced this problem, we should start saving energy from the beginning - during the planning, designing, construction, and use of buildings.

* What is Energy conservation?

a) It means using energy in a smart way

b) The goal is to reduce waste and improve efficiency without reducing comfort.

* Examples:-

- ⇒ Use natural sunlight instead of electric lights during the day.
- ⇒ Use good insulation to keep the building cool or warm.
- ⇒ Install energy-efficient fans, lights, and machines.



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* Green Buildings and Energy Saving :-

a) Green buildings are made to save energy, water, and materials.

b) They also improve the health, comfort, and work performance of people inside

c) These buildings are good for both people and the environment

⇒ Changing our Thinking :-

a) Energy conservation is not only about using modern technology.

c) Everyone should be aware of how much energy they use and make better choices.

* Why is this Important

⇒ Saving energy in buildings helps us:-

- save money
- protect the environment.
- fight climate change
- create a better future for the next generation.

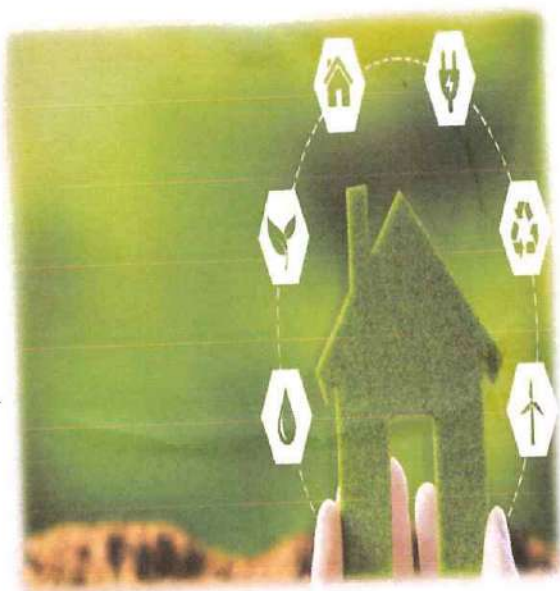
* Types of Energy sources :-

A] Primary and secondary Energy.

B] Commercial and non commercial Energy.

A] Primary and Secondary Energy.

i) primary energy sources are found in nature like coal, oil, natural gas, biomass, nuclear energy, geothermal and gravitational energy.



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- i) These can be used directly or converted into secondary energy like electricity or steam.
 iii) some are also used as raw materials in industries (e.g. coal in fertilizer production)

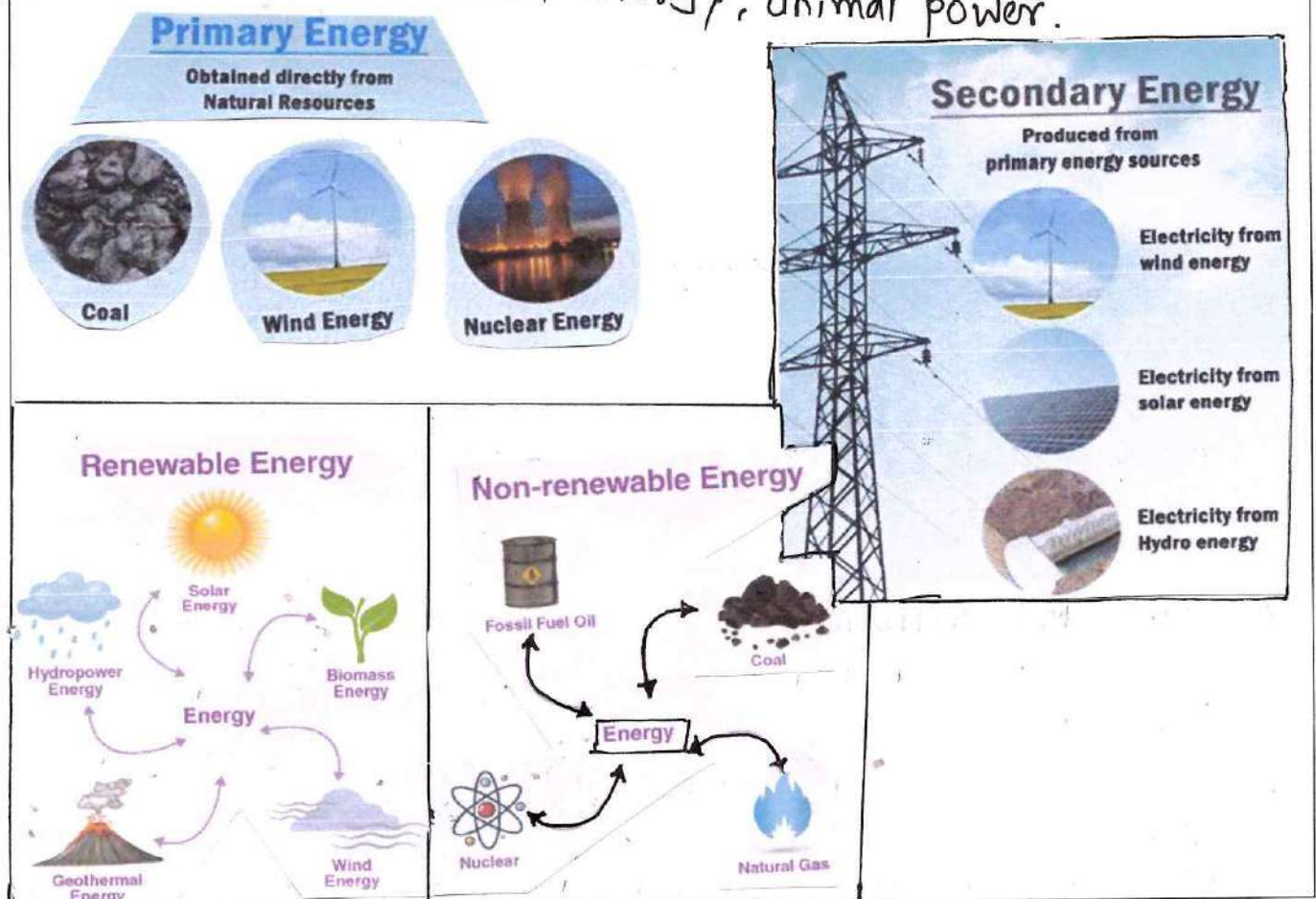
B] Commercial and non commercial energy

→ commercial energy

- i) Energy available in the market for a price.
 iii) Widely used in industries, agriculture, transport, and homes in developed areas.
 - Examples :- Electricity, coal, light, oil, natural gas.

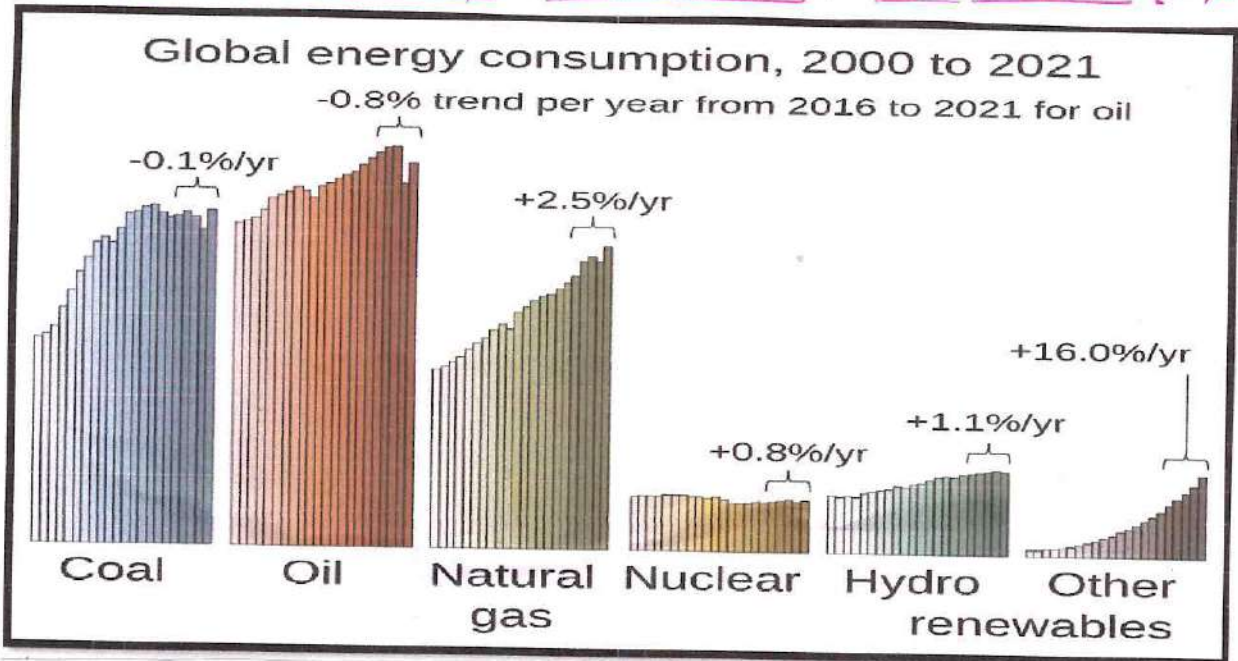
→ Non-commercial Energy

- i) Free or traditional sources not sold in markets.
 ii) Mostly used in rural areas for cooking, heating, transport, and irrigation.
 - Examples :- fire wood, crop waste, animal dung, solar and wind energy, animal power.



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* Global Energy Consumption Scenario :->

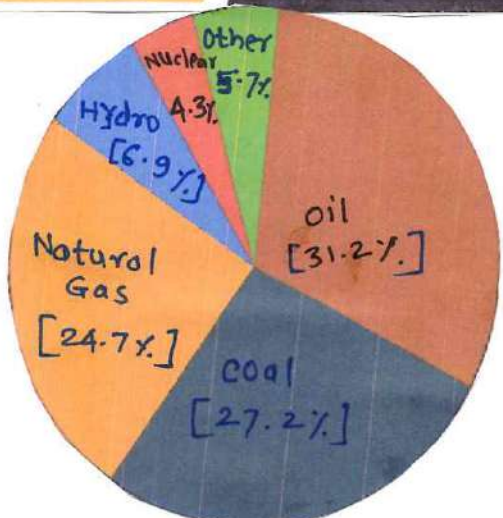


ALL INDIA COAL PRODUCTION



* Primary Energy mix (2020)

- Oil - 31.2 %
- Coal - 27.2 %
- Natural Gas - 24.7 %
- Hydropower : 6.9 %
- Nuclear : 4.3
- other Renewable : 5.7 %



* Trends and Statistics:-

- In 2022, global electricity consumption was 24,398 TWh - almost triple compared to 1981
- fossil fuels still constitute around 80% of primary energy sources.
- Growth in renewable is fastest among all sources, yet fossil fuels

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remain dominant.

Challenges:-

- High greenhouse gas emissions: energy sector accounted for 36 Gt CO₂ in 2021
- Environmental and health impact from fossil fuel use.

→ Energy Conservation

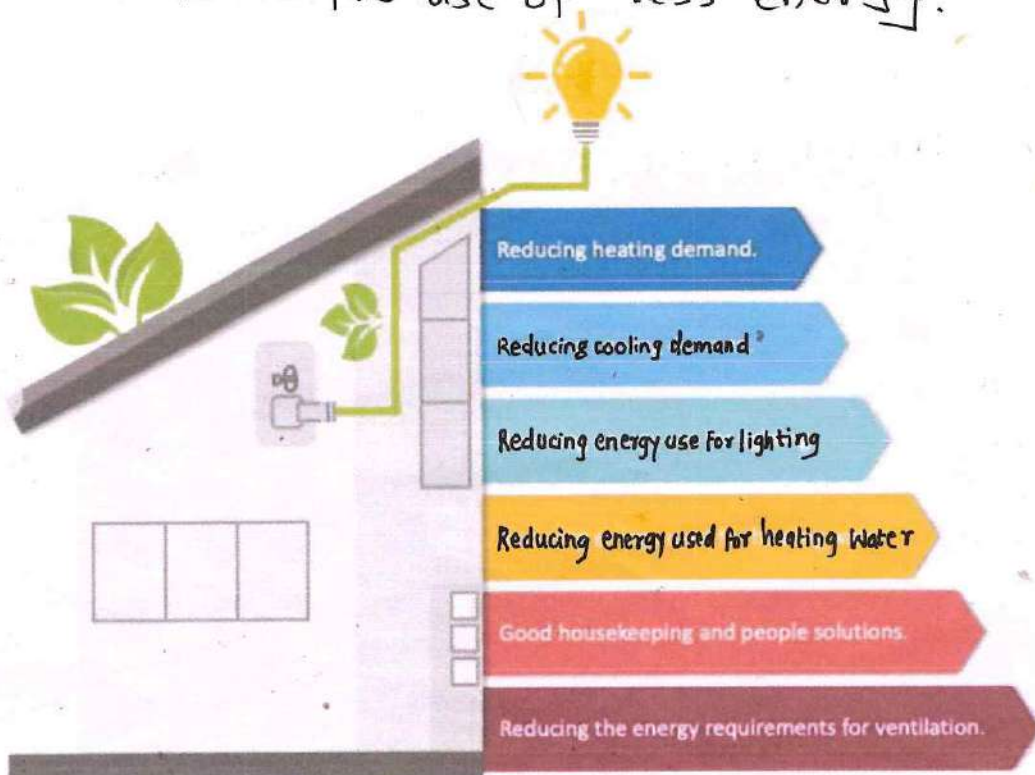
Definition:- Energy conservation refers to the practice of reducing energy consumption through either using less energy enhancing efficiency, or substituting with lower-energy alternatives.

⇒ As per International Energy Agency (IEA) :-

"Energy conservation is the effort made to reduce the consumption of energy by using less of an energy service."

⇒ As per U.S. Department of Energy :-

"Energy conservation is ~~the effort~~ any behaviour that results in the use of less energy."



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* Objectives of Energy Conservation *

- Environmental protection: By reducing energy consumption, particularly from fossil fuels, conservation helps lower greenhouse gas emissions and air pollutants.
- Reduce energy consumption in all sectors (residential, industrial, transport).
- Minimize environmental impact, including reduction in greenhouse gases and pollutants.
- Enhance energy efficiency to extract more useful work per unit of energy.
- Ensure energy availability and affordability by managing demand.
- Support national and global climate goals, such as achieving net-zero emissions.

* Importance of Energy conservation *

1) Climate Change Mitigation:-

- Energy use cause large amounts of CO₂ emissions.
- In 2023, energy-related emissions reached 37.4 billion tonnes, showing the urgent need to reduce energy use to meet climate goals.

2) Saves Natural Resources:-

- fossil fuels (coal, oil, gas) are limited.
- Conservation helps extend their use and supports the shift to renewable energy.

3) Improves Urban Living:-

- Reduces pollution, heat islands, and stress on city infrastructure, making cities healthier and more sustainable

4) Increases Energy Access:-

- In low-income areas, saving energy can help redirect it to important needs like schools and hospitals.

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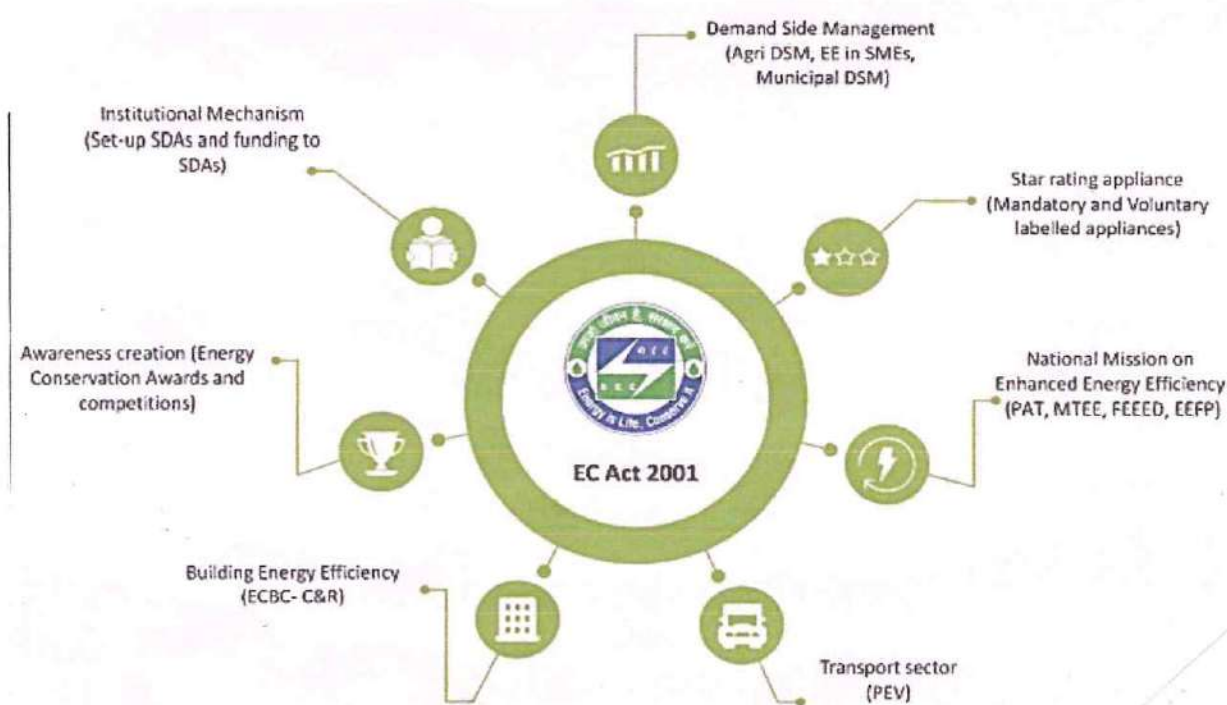
5) Support for Renewable Integration :-

- Lower energy demand makes it easier to manage electricity supply from solar and wind, which can vary throughout the day.
- 6) Reduces Electricity bills
- 7) Reduces Pollution and protects the Environment
- 8) Conserve fossil fuels.

* Energy conservation Act - 2001

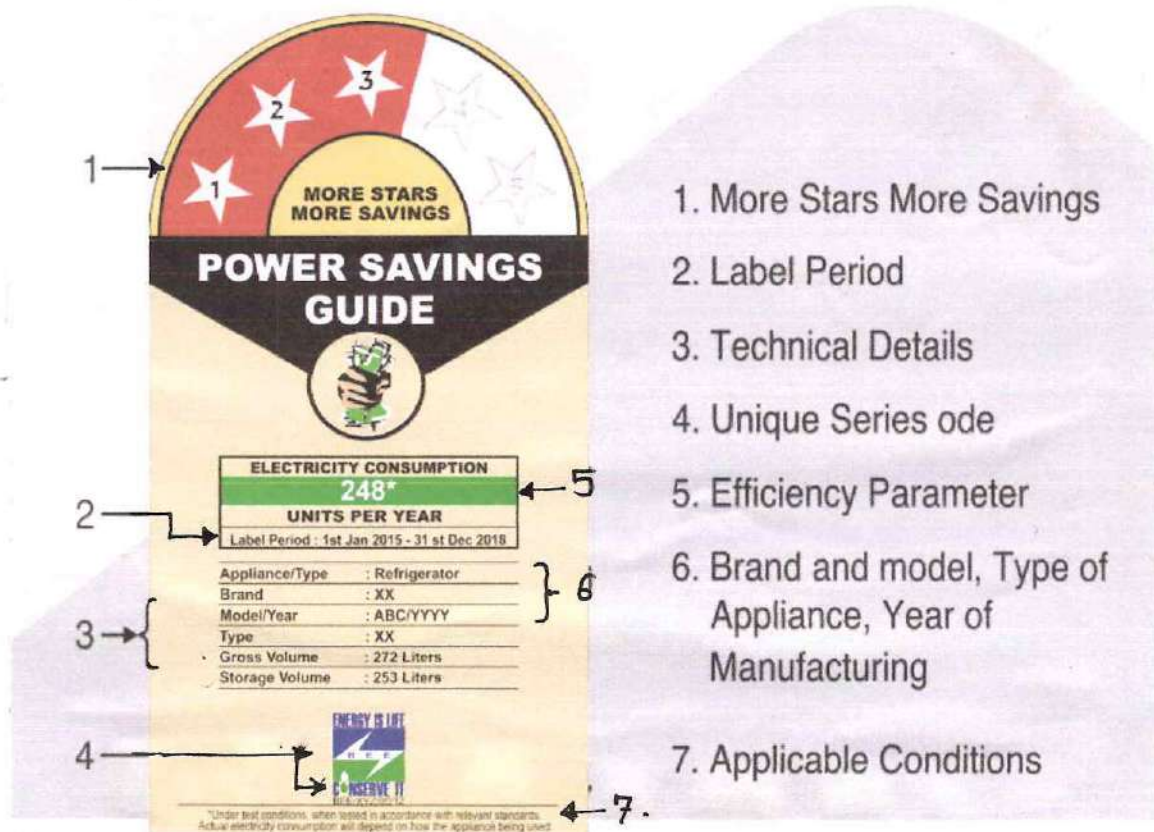
* Background and Need for the act:-

- a) The Energy conservation act was passed in 2001 and came into effect on 1st March 2002.
- b) It aimed to create rules and systems to improve energy efficiency in India.
- c) India needed this act due to growing energy demand and dependence on fossil fuel imports.
- d) At that time, India's energy use per unit of GDP was higher than global averages, so energy-saving was made a national priority.



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* Salient features of Energy conservation Act - 2001



1) Establishment of Bureau of Energy Efficiency (BEE)

- a) A statutory body under the ministry of power.
- b) functions setting standards, conducting studies, creating awareness.

2) Energy consumption standards :

- a) Industries must comply with specified norms.
- b) Examples: Energy norms for cement, aluminium, steel sectors

3) Energy Audits:

- a) compulsory for designated consumers like large industries
- b) External certified energy auditors required.

4) Energy managers and Auditors :

- a) compulsory appointment in Industries consuming large energy
- b) certification through BEE examinations.

5) Energy Labeling :-

- Star Labelling for appliances like air conditioners, refrigerators, lighting.

6) Energy conservation Building code (ECBC)

- Specifies energy efficiency standard for new commercial buildings (>100kW connected load).

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7) Promotion of Energy Efficiency Services Companies (EESCs)

- provides performance-based energy saving solutions.

8) Penalties for Non-compliance

- Monetary fines Industries violating conservation norms

Energy Conservation Act-2001

The EC Act framework :-

- ⇒ The EC act framework operates under the ministry of power, With the Bureau of energy efficiency (BEE) as the key implementing body responsible for driving energy efficiency across sectors.
- ⇒ BEE formulates and enforces policies targeting Industries, mandates energy labelling for appliances to energy-efficient buildings practices, thereby promoting sustainable energy use nationwide.

Amendments to EC Act (2022) :-

- Introduction of carbon credit Trading scheme.
- Renewable Energy purchase obligations.
- Enhanced role for state Energy conservation funds

Institutional framework ! Bureau of Energy Efficiency (BEE)

A major feature of the act is the formation of BEE in march 2002, under the ministry of power, BEE act as the nodal agency for coordinating energy efficiency and conservation policies and programs.



Functions of BEE Include :-

- Developing energy efficiency codes and labelling.
- supporting capacity-building initiatives.
- certifying energy auditors and managers

iv) promoting research and development.

v) creating public awareness through campaigns and training.

Introduction to Green Building



Definition of Green Building :-

Green Building is a structure designed, built, renovated, operated, or reused in an ecological and resource-efficient manner. It focuses on minimizing the building's impact on the environment and human health.

Formal Definitions :-

By US Green Building council (USGBC) :-

"Green building is the practice of creating structures and using processes that are environmentally responsible and resource efficient throughout a building's life cycle"

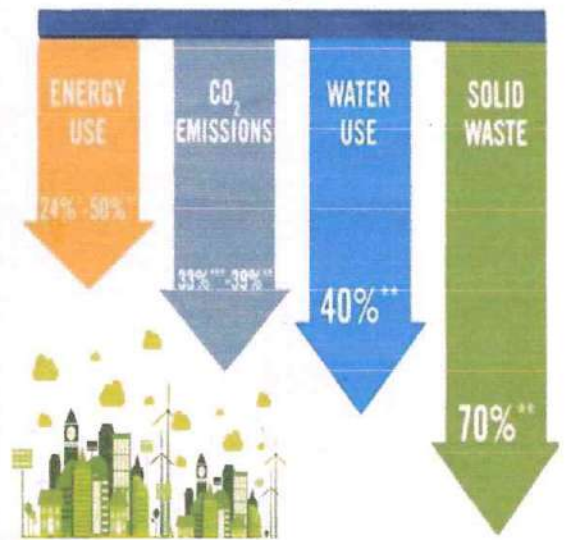
By Indian Green Building council (IGBC) :-

"A green building uses less water, optimizes energy efficiency, conserves natural resources, generates less waste, and provides healthier spaces for occupants"

* Importance of Green Building :-

- i) Efficient use of energy, water and materials.
- ii) Achieving the sustainable goal by site selection and development &
- iii) Minimization of waste
- iv) Improve Indoor air quality.
- v) Green buildings use 30-50% less energy and 20-40% less water, use sustainable materials, have lower operating cost, and offers a healthier indoor environment.

Green Buildings Can Reduce



History and Evolution of Green Building practices

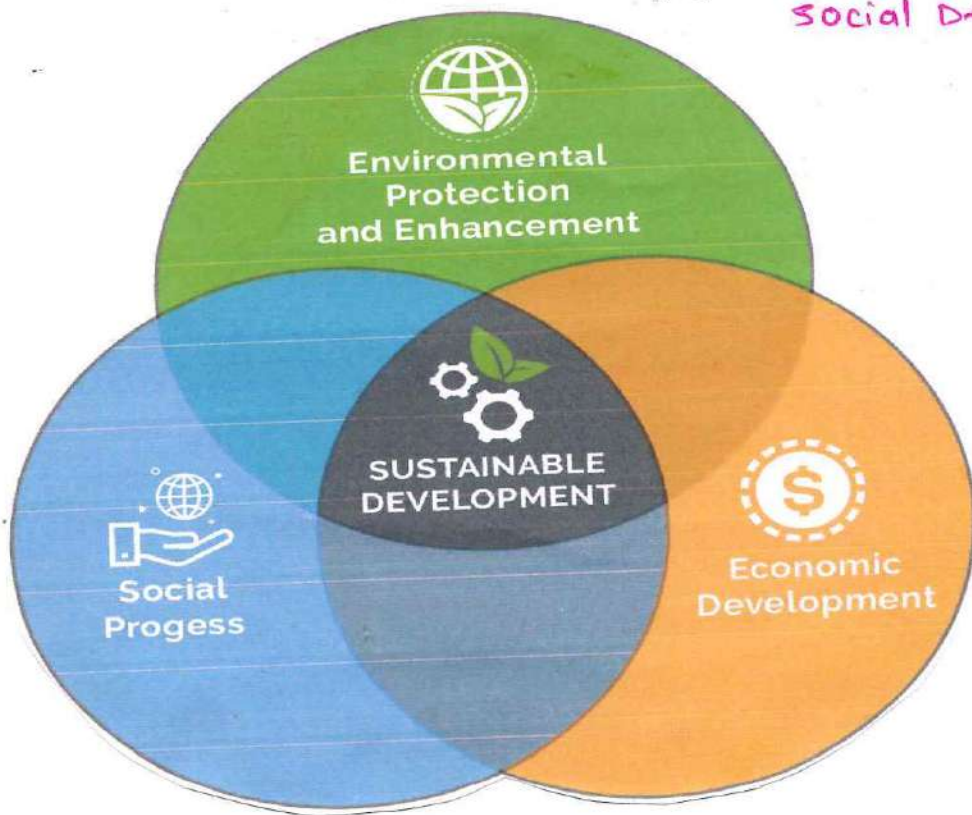


* Role of Green Buildings in sustainable Development :-

- a) Green Buildings follow eco-friendly practices at all stages - design to demolition.
- b) They save energy and water, reduce pollution and use sustainable materials.
- c) Economic benefits: Lower cost, higher property value and more green jobs
- d) Social benefits:- Improve health, comfort and productivity of people
- e) They support environment care, economic growth and social well-being helping achieve sustainable development goals (SDG's)



overview of sustainable construction: Environmental, Economic and Social Development



1) Environmental sustainability :-

- a) Green buildings reduce pollution and environmental harm.
- b) Use energy-efficient system (like LED lights, solar panels, and efficient HVAC)
- c) Save 20-50% energy and reduce carbon emission.
- d) Use eco-friendly materials (recycled steel, reclaimed wood)
- e) conserve water using low-flow taps and rainwater harvesting
- f) Minimize waste through recycling and green roofs that support biodiversity.

2) Economic sustainability :-

- a) Lower electricity and water bills through energy- and water-saving technologies.
- b) Reduce maintenance costs with durable - long-lasting materials
- c) Increase property value and attract tenants due to green certifications like LEED.
- d) create green jobs in construction, design and renewable energy
- e) provide long-term financial stability for building owners.

3) Social sustainability :-

- a) Improve health and comfort of people using features like:
 - i) fresh air ventilation
 - ii) Non-toxic materials (low VOCs)
 - iii) Natural lighting
- b) Reduce health problems (e.g. allergies, respiratory issues) by up to 40%.
- c) Boost productivity by 5-15% and improve student performance
- d) Include public green spaces and affordable housing to support all communities.

Unit NO. 1

Fundamental of Green Building and Energy conservation.

Important questions

- Q.1 - Define Energy conservation (W-25)
- Q.2 - Define Green Buildings (W-25)
- Q.3 - State any two benefits of green buildings. (W-25)
- Q.4 - Explain the salient features of energy conservation Act - 2001 (W-25)
- Q.5 - Explain the role of green building in sustainable development (W-25)
- Q.6 - Explain the current global energy consumption scenario.
- Q.7 - What are the objectives of Energy conservation
- Q.8 - Explain Importance of green buildings.
- Q.9 - How do green buildings contribute to sustainable development
- Q.10 - List social aspects associated with sustainable construction.
- Q.11 - What is the energy conservation.
- Q.12 - State Types of Energy sources and explain one of them.
- Q.13 - Importance of Energy conservation
- Q.14 - Explain the Energy conservation act 2001
- Q.15 - Draw flow chart of EC act 2001 (framework chart).