

MODULE 8: BEST PRACTICES IN BUILDING ENERGY MANAGEMENT AND CONSERVATION



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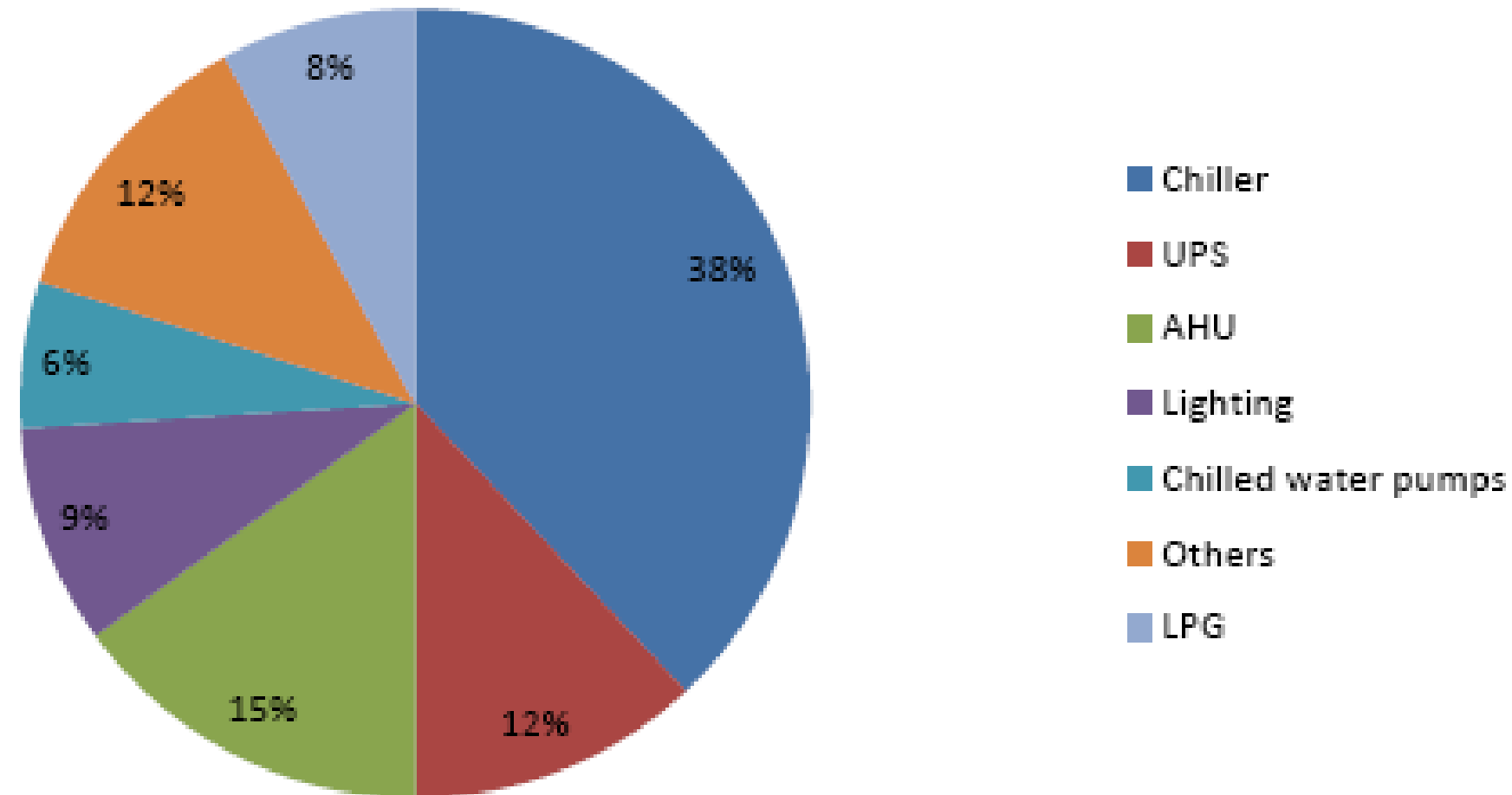
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INTRODUCTION

Energy Balance



- Large-scale urbanization and increasing income, and the construction industry growth rate in India is 10% as compared to the world average of 5.2%.
- Projected by 2030 that two-thirds of the buildings have yet to be built and 1 billion m² of new commercial buildings will be added.
- Commercial buildings are the third largest consumers of energy, after industry and agriculture.
- Buildings annually consume about 30–35% of electricity consumption in India.

GREEN BUILDING

- A Green building is one which uses less water, improves energy efficiency, conserves natural resources, generates less waste and provides healthier spaces for occupants, as compared to a conventional building
- A green building incorporates the following features:
 - Energy efficiency
 - Water efficiency
 - Better living conditions
 - Eco-friendly sustainable materials
 - Less transport use
 - Less waste
 - Habitat protection/restoration

- The various Green Building Rating Systems are BEE Star Ratings for buildings :
 - GRIHA:
 - ✓ Green Rating for Integrated Habitat Assessment (GRIHA)
 - ✓ The latest version of GRIHA is called GRIHA V – 2015. Buildings would be rated on a 1-5 star scale, with 5 star labeled buildings being the most efficient.
 - IGBC
 - ✓ IGBC Green Building Rating Systems have been developed by the Indian Green Building Council (IGBC)
 - USGBC based-LEED certifications.
 - ✓ LEED, which is Leadership in Energy and Environmental Design is a third party certification for design, construction and operation of a given building.
 - ✓ US Green Building Council (USGBC) has completed a comprehensive update of LEED which is called LEED v4

- IGBC Green Building Rating Systems have been developed by the Indian Green Building Council (IGBC) to suit the national context and priorities.
- The Rating System incorporates National Standards and Codes namely National Building Code (NBC), Energy Conservation Building Code (ECBC), Ministry of Environment & Forests (MoEF) and Central Pollution Control Board (CPCB) guidelines.
- National priorities addressed in this rating system include water conservation, waste management, energy efficiency, reduced use of fossil fuels and lesser dependence on usage of virgin materials. Different rating systems are developed for different building types: commercial, residential, cities, townships, schools, healthcare, data centres and several others.

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GRIHA

- Green Rating for Integrated Habitat Assessment (GRIHA) is the rating system jointly developed by TERI and the Ministry of New and Renewable Energy, Government of India.
- GRIHA is aimed at using best of traditional architecture and modern technology to build new buildings. The latest version of GRIHA is called GRIHA V – 2015. Buildings would be rated on a 1-5 star scale, with 5 star labeled buildings being the most efficient.
- GRIHA rating system consists of 31 criteria and points are assigned to different criteria which reflect current resource priorities of India.

- LEED, which is Leadership in Energy and Environmental Design, is a third party certification for design, construction and operation of a given building. US Green Building Council (USGBC) has completed a comprehensive update of LEED which is called LEED v4.
- Seven impact categories considered under LEED are as follows:
 - Reverse contributing to global climatic change
 - Enhance individual human health and well-being
 - Protect and restore water resources
 - Protect, enhance and restore biodiversity and ecosystem resources
 - Promote sustainable and regenerative resource cycles
 - Built a greener economy
 - Enhance social equality, environmental justice, and community quality of life



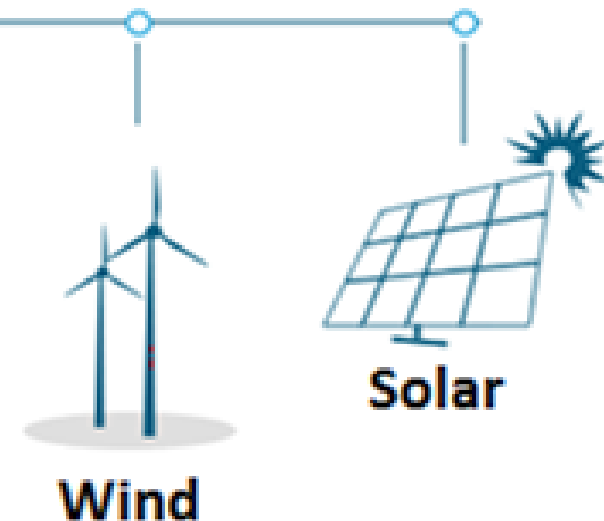
NET ZERO ENERGY BUILDING (NZEB)

1 Increase energy efficiency

Efficient building construction
Efficient systems and appliances
Operations and maintenance
Change in use behaviour




2 Address remaining needs with on-site renewable energy generation



NZEB Concept

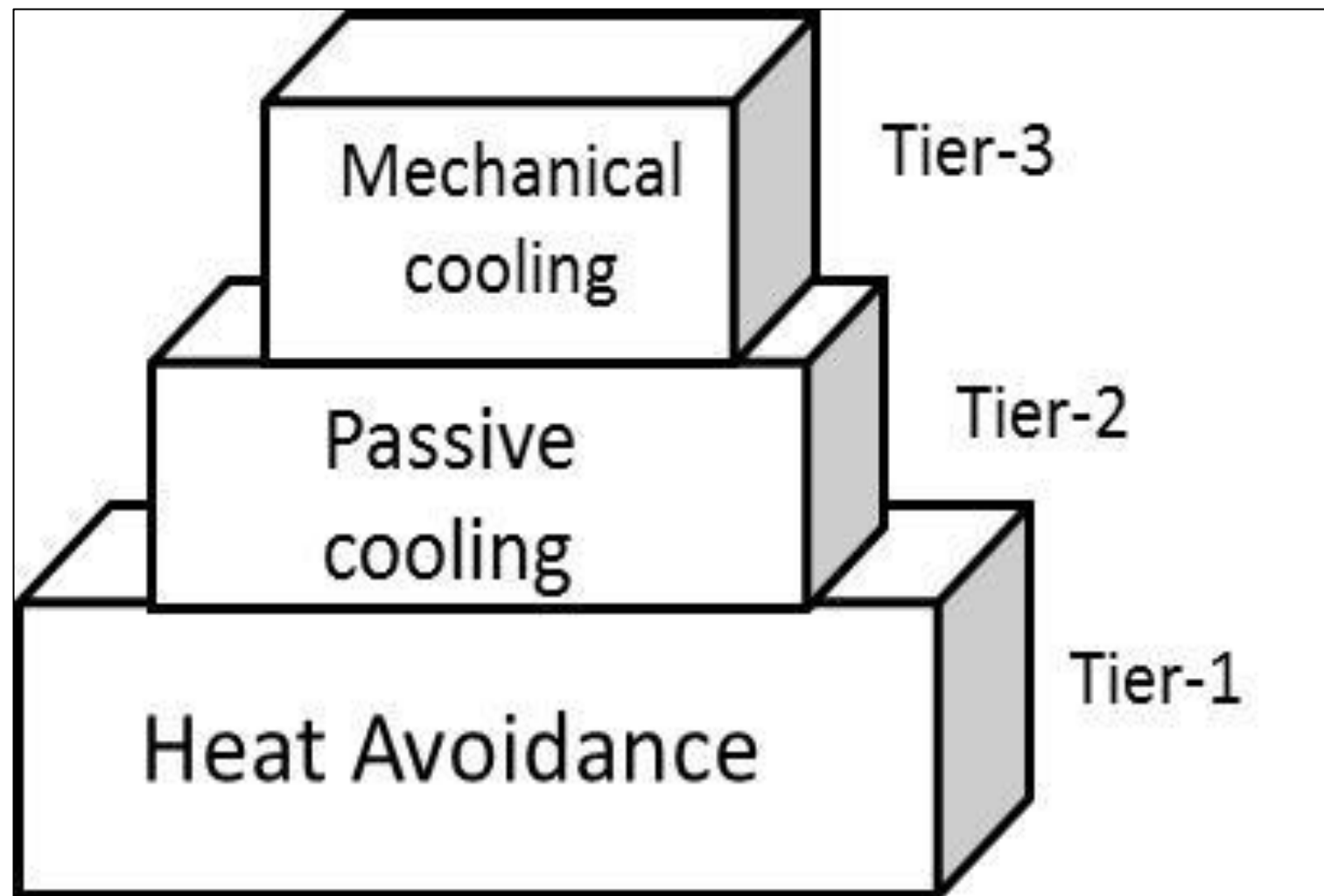
- In order to achieve their net zero energy goals, NZEBs must first reduce energy demand using energy efficient technologies, and then utilize renewable energy sources to meet the residual energy demand.
- NZEB is aimed at eliminating greenhouse gas (GHG) emissions associated with the operation of new buildings by 2030, and eliminate the GHG emissions from all buildings by 2050.



BUILDING AS AN ENERGY SYSTEM


4

Building Energy System



Sustainable Cooling Strategy

- The Energy Auditor needs to look holistically at the building when recommending efficiency measures to ensure that these energy interactions are taken into account.
- As using passive methods for cooling, the most sustainable approach would be adopting three-tier approach with heat avoidance being the first preference, followed by passive cooling, and mechanical cooling as shown in Figure



ENERGY SAVING APPROACHES FOR BUILDING

5

Energy Saving Approaches

- Some of the key Energy Efficiency Measures covering building envelope (Walls, Roofs, Windows), Heating Ventilation and Air Conditioning (HVAC) System, Lighting (indoor and outdoor), and Electrical Power and Motors are briefly described as follows:

5.1

Passive Designs

- Passive designs take advantage of local climates and reduce energy consumption for heating or cooling the building by optimizing insulation, ventilation, orientation, and shade of a building.
- Some Steps can be used Energy Saving Approach:
 - ✓ Form and Orientation
 - ✓ Minimizing Heat Gain through roofs
 - ✓ Fenestration
 - ✓ Low Energy Cooling

5.2

HVAC

- HVAC systems contribute to nearly 40% of the energy used by commercial buildings and over 50% of total energy consumption in IT buildings.
- The HVAC system types are broadly categorized as follows:
 - ✓ Centralized system: Central Chilled Water System (Air cooled and water cooled)
 - ✓ Distributed system (DX system): VRF, Duct able system, split air conditioners, unitary systems

5.2

HVAC

- Energy saving potential in HVAC System Design is shown in Table

Component	Cooling Load (kW/ton)		Improvement Potential
	Conventional Design	Optimized Design	
Chiller	0.75	0.50	33%
Air Distribution System	0.60	0.06	90%
Water Pump	0.30	0.04	87%
Cooling Tower	0.10	0.02	80%
Total	1.75	0.62	65%

5.2

HVAC

- High efficiency chiller: Chiller is the highest energy consumer in the HVAC system. Chiller efficiency is rated in kW/ ton or coefficient of performance (COP).
- Types of Chiller :
 - Water-cooled chillers
 - Chilled water storage
 - Ice Bank
 - Trigeneration System
- Energy-efficient pumps and fans (HVAC system): Pumps and fans which are used in HVAC system are designed to achieve higher efficiency benchmarks with use of IE3 and IE4 (most energy efficient motors)
- Air tightness
- Mixed mode ventilation System

5.3

Other Approaches

- Air tightness
- Mixed Mode Ventilation System
- Demand-Controlled Ventilation (DCV)
- Electronically Commutated Fans
- Low-temperature Variable Air Volume
- Heat Recovery Ventilation ('HRV') systems
- Solar Cooling
- Insulated roller doors
- Lighting
 - LED Lighting
 - Occupancy Detection
 - Daylight Dimming
 - Flexible Lighting Control

5.4

Renewable Energy

- Building integrated photovoltaic ('BIPV')
- Solar hot water systems

5.5

Other area

- Power factor correction
- Sub-metering systems
- Energy Efficient Appliances
- Electrical Energy Storage
- Building Energy Management System ('BEMS')
- Crystalline Water proofing

5.6

Emerging Trends

- BM Analytics
- Self-Learning Buildings
- Use of simulation for energy efficiency in building New Building
- Existing Buildings
- Green Leasing

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