



## High-Performance Buildings (HPBs)

**For Prelims:** [High-Performance Buildings](#), [HVAC System](#), [Daylight Harvesting](#), [Green Walls](#), [Bureau of Energy Efficiency](#), [Carbon Emissions](#), [UNEP's 30% Efficiency Improvement Goal](#), Unnati Building, Indira Paryavaran Bhawan.

**For Mains:** Need for high-performance buildings in India in light of rising urbanisation and carbon emissions.

[Source: TH](#)

### Why in News?

In recent years, the importance of [high-performance buildings \(HPBs\)](#) have increased that promote **energy efficiency** and **healthier indoor environments**.

- HPBs means a building that **integrates and optimises** all major high-performance building attributes, including **energy efficiency, durability, life-cycle performance, and occupant productivity**.

### What are the Key Features of HPBs?

- **Energy Efficiency:**
  - **Maintain HVAC Systems (Heating, Ventilation, and Air Conditioning):** Regular maintenance, such as **replacing filters, cleaning coils, and calibrating sensors**, can help maintain their efficiency and reduce unnecessary energy consumption.
  - **Demand-Controlled Ventilation:** [IoT](#)-based **air quality sensors** can automatically adjust **ventilation systems** making buildings more efficient and responsive to environmental conditions.
  - **Lighting Systems:** [Energy-efficient LED](#) options can reduce energy consumption. [Daylight harvesting](#), which makes use of natural light, can further lower the need for artificial lighting.
  - **Invest in Insulation:** Adequate **insulation for walls, roofs, and floors** can reduce the need for heating and cooling by minimising heat transfer.
- **Healthy Indoor Environment:**
  - **Prioritise Indoor Air Quality:** It uses indoor [air filtration](#) systems to reduce pollutants.
  - **Sound and Acoustics:** **Sound-absorbing materials** and effective partitioning can help reduce noise pollution in buildings.
  - **Biophilic Design:** Incorporating natural elements, such as [green walls](#), **indoor plants**, and **water** features enhance the mental well-being of occupants.
- **Sustainability and Environmental Impact:**
  - **Sustainable Materials:** **Recycled steel**, sustainably-sourced timber, and **low-impact concrete** is key to reducing the environmental impact of buildings.
  - **Water Conservation and Efficiency:** Rainwater harvesting and [greywater recycling](#) systems enhance water conservation.

- **Waste Reduction and Management:** Reducing, recycling, and properly managing waste are essential for sustainable building operations.

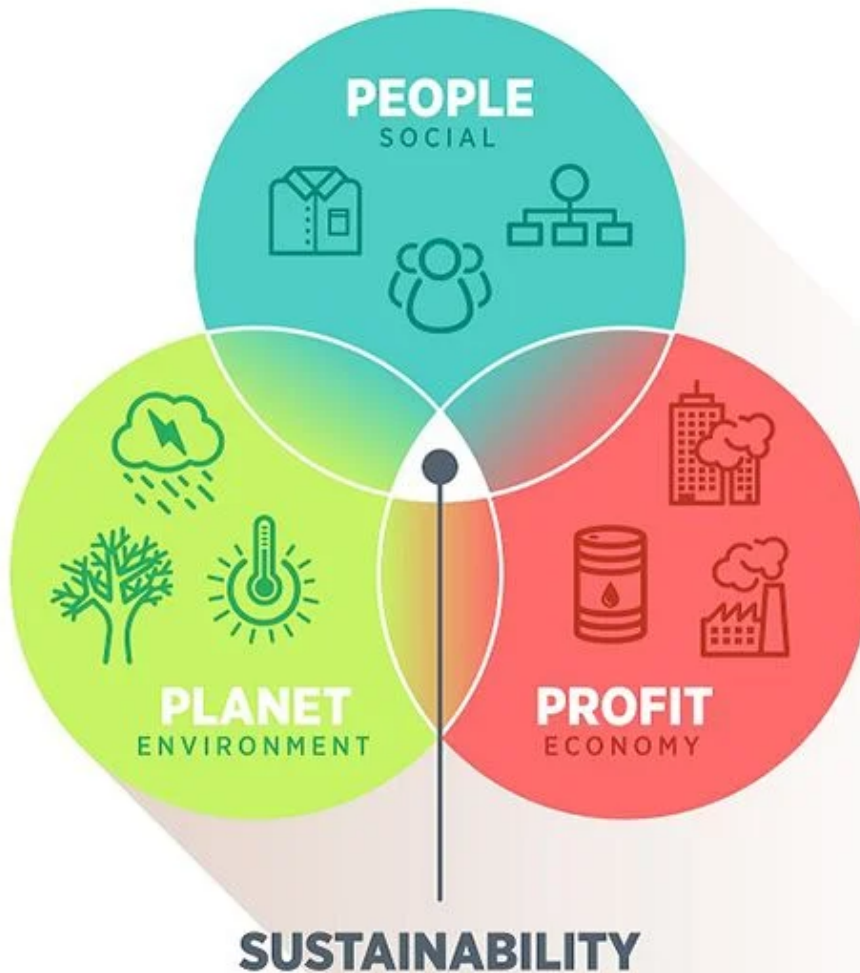
## What is the Need of High-Performance Buildings?

- **Carbon Emissions:** Globally, buildings account for **nearly 40% of total final energy consumption** over their lifespan.
  - It leads to approximately **28%** of energy-related **carbon emissions**.
  - According to the [Bureau of Energy Efficiency](#), in India, buildings account for more than **30% of the national energy use and 20% of its carbon emissions**.
- **Quadrupling Power System by 2040:** India's power system will need to **quadruple in size by 2040** to meet growing electricity demand.
  - Also, Indian buildings are experiencing a **surge in energy use** due to [higher urban temperatures](#), glazed facades, and higher occupant density.
  - HPBs can significantly reduce energy demands through **innovative solutions**.
- **Rising Urbanisation:** India's urban population is expected to **reach 600 million by 2030**.
  - As cities expand, the demand for new construction rises, and without intervention, the sector's [carbon footprint](#) is set to grow significantly.
- **Achieving Global Goals:** With increasing energy demand and a booming construction sector, India risks exceeding **global energy efficiency and carbon emission standards** for buildings set by the [International Energy Agency](#), building certification programs, and the EU's Energy Performance of Buildings Directive.
  - [UNEP's 30% efficiency improvement goal](#) emphasises that the global building sector must improve its **energy efficiency by 30% by 2030** to meet climate targets.
- **Lower Operating Costs:** HPBs optimisations can result in **23% lower energy use, 28% lower water use**, and 23% lower building operating expenses.
- **Improved Productivity:** Providing a healthy indoor environment has been linked to higher **occupant satisfaction**, increased productivity, and reduced absenteeism due to illness.

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## What are the Tools Associated With HPBs?

- **Ladybug:** It offers detailed **climate analysis** and data in **2D and 3D interactive graphics** to assess design options through view, sunpath, and radiation analysis.
- **Green Building Studio:** It is a **cloud-based service** that can run building performance simulations for energy optimisation.
- **Cove.Tools:** It allows architects and engineers to use data-driven design to achieve **sustainable design solutions**.
- **ClimateStudio:** It works best for simulations for **daylighting, energy efficiency, thermal comfort** and other measures of occupant wellbeing.

## Notable Examples of HPBs in India

- **Unnati Building in Greater Noida:** This HPB features a **façade** designed according to the **Sun's path to improve thermal comfort and energy efficiency**. The building uses high-performance glass with a low solar heat gain coefficient to reduce glare and enhance energy performance.
- **Indira Paryavaran Bhawan in New Delhi:** This building employs an **advanced HVAC system** that circulates **chilled water** through beams in the ceiling, utilising natural convection to reduce energy consumption.
- **Net-Zero and Grid-Interactive Buildings:** HPBs in India are also paving the way for **net-zero buildings**, which generate as much energy and water as they consume, and grid-interactive buildings that manage energy demand dynamically.

## What are the Challenges in Delivering High-Performance Buildings?

- **Operational Oversight:** Developers typically prioritise **initial project costs, schedules, and design scope**, overlooking the operational phase and long-term energy, waste management, and maintenance.
- **Diverse Building Typologies:** Office buildings vary greatly in terms of **types, costs, services, and comfort levels**.
  - Some buildings have **decentralised cooling systems** that are energy inefficient while some buildings are **centrally air-conditioned**, have high glazing, and come with higher energy consumption.
- **Split Incentives:** Energy savings projects often receive little support due to differences in who benefits from energy efficiency improvements. Eg, Maintenance by owners or tenants.
- **Erosion of Indigenous Knowledge:** Region-specific methods that are **cost-effective and well-suited to local conditions** are being lost due to **overreliance** on foreign technologies that may not be as efficient in the Indian context.
- **Siloed Building Systems:** Building design, construction, and operation are often treated in isolation. This **fragmented approach** prevents the integration of technologies that can improve overall building performance.

## What are India's Initiatives Regarding the Energy Efficiency in Buildings?

- [Eco-Niwas Samhita](#)
- [Energy Conservation Building Code \(ECBC\)](#)
- [Energy Conservation \(Amendment\) Act, 2022](#)
- [NEERMAN Awards](#)
- [Green Rating for Integrated Habitat Assessment \(GRIHA\)](#)

## How High-Performance Buildings Can be Promoted in India?

- **Envelope and Passive Systems:** Envelope strategies like **wall, windows, roof assemblies, reflective white surfaces and shading** can avoid exposures to solar heat gain and glare, and support natural ventilation where possible.
- **Integrated Approach:** A lifecycle performance assurance process that emphasises the **integration of building systems** should replace conventional and siloed methodologies.
- **Holistic Evaluation:** Adopt a **triple-bottom-line framework** that evaluates building technologies and systems based on **operational, environmental, and human benefits**.
  - This framework should consider energy savings, reduced carbon footprint, and improved occupant health and productivity.
- **Collaborative Energy Efficiency Initiatives:** Encourage collaborative initiatives between owners and tenants that align their interests in energy efficiency upgrades, creating a shared commitment to sustainability goals.
- **Tailored Strategies:** Advocate for **region-specific, climate-responsive** solutions such as high-performance envelope design, low-energy cooling strategies, and adaptive comfort techniques.
- **Heating Ventilation and Air Conditioning Systems (HVAC):** Separate the spaces that could be **naturally ventilated** and develop mixed-mode opportunities, rather than fully air conditioning all built spaces at all times.

### **Drishti Mains Question:**

Critically analyse the need for high-performance buildings in India, considering the challenges posed by rising urbanisation and carbon emissions.

## UPSC Civil Services Examination, Previous Year Questions (PYQs)

### **Mains:**

**Q.** “Investment in infrastructure is essential for more rapid and inclusive economic growth.” Discuss in the light of India’s experience. **(2021)**

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