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Swiss Agency for Development and Cooperation SDC

GUIDEBOOK FOR AWARENESS GENERATION

ON ENERGY EFFICIENT AND THERMALLY COMFORTABLE BUILDINGS

BEEP
BUILDING ENERGY EFFICIENCY PROJECT

CMS
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About the Manual

The manual has been developed as a toolkit for journalists interested in writing stories on different aspects of Building Energy Efficiency. It has been designed as a resource for training working journalists as well as journalism students. It has been developed by the Centre for Media Studies (CMS), New Delhi for BEEP.

Foreword

The building and construction sector must be at the forefront of our battle to create sustainable societies and to address climate change. First, because the building and construction sector is responsible for a staggering 40% of total man-made CO2 emissions, and the amount of emissions is expected to grow under the combined effect of urbanization, demography, economic growth, and evolving lifestyles. Second, because the building and construction sector needs to provide a habitat that is desirable and adapted to population needs in a changing climate.

While India presents a wide diversity of climatic zones, a large proportion of the population lives in a hot and humid climate where vast amounts of energy arerequiredto cool buildings.With rising incomes, the desire for better thermal comfort, and the wider use of air-conditioners, the amount of energy used for cooling is set to increasemanifold in the coming future. This in turn leads to challenges for households and communities in terms of energy production and consumption, costs, air pollution and CO2 emissions. Although there is no 'one size fits all' solution, practical, logical and inexpensive solutions do exist. They have been developed and documented; they now need to be communicated to a wider publicin order to be effective.

This manual is part of the Media Engagement Programme on Energy Efficient Buildings, which was conceptualised and launched in 2019 to inform media professionals on key issues regarding energy efficiency and technically sound ways of reporting them. The programmehas been specially curated through the Indo-Swiss Building Energy Efficiency Project (BEEP), a project supported by the Swiss Agency for Development and Cooperation's (SDC) in India. One of the objectives of the BEEP project is to raise awareness on environment-friendly or 'green' buildings that consume less energy. This brochure illustrates in plain language and through numerous concrete examples and figures the extent of the issue, existing tools solutions, and how it is possible to design and construct buildings that consume less energy while providing better thermal comfort to its users.

Media have a fundamental role to play in disseminating knowledge so that best practices are widely known and adopted across India. Past experience and the success of this media engagement programme have shown that medias are essential in informing and encouraging behaviour change among citizens. It is heartening to see thatthis programme has already led to more than 40 stories and articles being published by distinguished journalists in leading media outlets;and it is our hope that many more will follow…

I would like to congratulate the BEEP and CMS teams on the success of this programme and for developing this informative manual for journalists. I hope these will be useful tools for them to report on the built environment, energy efficiency and "green" buildings and to contribute to a sustainable future.

Dr. Jonathan Demenge
Head of Cooperation and Counsellor,
Swiss Cooperation office India, Embassy of Switzerland, New Delhi

About CMS

Established in 1991, CMS is an independent, not-for-profit organisation dedicated to multi-disciplinary research-driven initiatives that enable policy makers to take informed decisions on development and social change to improve quality of life. CMS has been engaged in Research, Advocacy and Capacity building in Social Development, Environment, Communication, Transparency and Governance issues at local and national policy levels.

About BEEP

The Indo-Swiss Building Energy Efficiency Project (BEEP) is a bilateral cooperation project between the Federal Department of Foreign Affairs (FDFA), of the Swiss Confederation and the Ministry of Power (MoP), Government of India. The implementation agencies of the project are Bureau of Energy Efficiency (BEE) on behalf of the MoP while the Swiss Agency for Development and Cooperation (SDC) is in chargee on behalf of the FDFA. Started in 2011, the project's central focus is to help India mainstream energy-efficient and thermally comfortable (EETC) building design for both commercial and residential buildings. BEEP works with building industry, policy makers, and building owners to catalyse adoption of EETC building design and technologies.

Preface

We track local weather forecasts daily, observe unseasonal or unusual trends in weather patterns, and are reminded how the weather is impacted by climate change, whenever we face or read about rising drought or floods.

However, how and what does the weather or climate outside got to do with the buildings we live in, with our lights and air-conditioners that make life comfortable for us inside? There are plenty of links. For example, the buildings and building construction sectors combined are responsible for over one-third of global final energy consumption and nearly 40% of total direct and indirect CO2 emissions.

The topic requires more focused attention given India's rapid urbanization, the new government programs for buildings, and a general rise in construction. India's stock of buildings is projected to increase by three times by 2030, of which 60% is yet to be built. Buildings, therefore, are projected to become the single largest consumer of electricity in India by then. The Government of India has undertaken several initiatives for designing buildings that minimize energy consumption – called 'energy efficient buildings'.

One such key initiative is the Indo-Swiss Building Energy Efficiency Project (BEEP), bilateral cooperation between the Ministry of Power (MoP) under the Government of India, and the Federal Department of Foreign Affairs (FDFA) of the Swiss Confederation. One of the objectives of the BEEP program is to raise awareness on environment-friendly or 'green' buildings that consume less energy through media under Media Energy Efficiency Program, as media plays an important role in flagging the topic, informing, and raising awareness.

For the BEEP Media Program on Energy Efficient Buildings, CMS has developed two manuals on the subject one for the media persons and others for trainers of journalists. The aim of developing this manual for media persons especially journalists writing on the environment; science and energy sectors is to report on energy-efficient buildings with more insights, accuracy, and understanding. The overall Media Program on Energy Efficient Buildings includes training workshops and fellowship grants for media professionals.

This manual has been designed to cover the major aspects like the need and importance of conserving energy in the construction of housing and commercial buildings, the role of buildings in climate change. It also includes a section to provide the tools and techniques of reporting on the subject.

We acknowledge the strategic guidance and support received from Dr. Jonathan Demenge, Head and Counsellor, SDC, Dr. Anand Shukla, Senior Thematic Advisor, SDC, Mr Abhay Bakre, DG-BEE and Mr. Saurabh Diddi, Director, Bureau of Energy Efficiency. The manual could not have taken this shape without the technical inputs received from Dr. Sameer Maithel, Head, Indian Project Management & Technical Unit; Indo-Swiss Building Energy Efficiency Project (BEEP) and Ms. Vernica Prakash, program officer, BEEP.

We hope that this manual proves to be a useful tool for the journalists covering environment, energy and building sector which otherwise is considered to be a niche and somewhat technical subject.

Dr Vasanti Rao
Director General, CMS
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01 Introduction

We track local weather forecasts daily, observe unseasonal or unusual trends in weather patterns and are reminded about how the weather is impacted by climate change whenever we face or read about more frequent and intense droughts or floods. What has the weather or the air outside got to do with the buildings we live in, with our lights, fans and air-conditioners that make life comfortable for us inside? It turns out that there are plenty of links.

The buildings and buildings construction sectors combined are responsible for over one-third of global final energy consumption and nearly 40% of total direct and indirect CO2 emissions

The buildings and buildings construction sectors combined are responsible for over one-third of global final energy consumption and nearly 40% of total direct and indirect CO2 emissions.[1] In India, the building sector accounts for over 30% of the total electricity consumed in the country and is second only to the industrial sector as the largest emitter of GHGs. By trapping and preventing the escape of heat back from the Earth into the atmosphere, GHGs lead to a long-term shift or change in regional or global weather patterns such as temperatures and rainfall over a long a period of time. Climate change is the long-term change in the average weather patterns.

The link between buildings and climate change has necessitated greater attention in view of India's rapid urbanization, new government programs for buildings, and a general rise in construction. India's stock of buildings is projected to increase by three times by 2030, of which 70% are yet to be built.

Buildings, therefore, are projected to become the single largest consumer of electricity in India by 2030. The consumption figure rose to about 260 TWh in 2016-17 from about 55 TWh in 1996-97, i.e, an increases by more than four times in 20 years, according to the Central Electricity Authority.[2] Projections by the National Institution for Transforming India (NITI) Aayog's 'A Report on Energy Efficiency and Energy Mix in the Indian Energy System (2030), Using India Energy Security Scenarios, 2047' show that India's electricity demand in the residential buildings sector will rise from 175 Terra Watts hour (TWh) in 2012 to 480 in 2022 to 842 in 2030 and 1840 in 2047. Similarly the country's electricity demand in the commercial building sector will rise from 86 TWh in 2012 to 142 Twh in 2022 to 238 and in 2030 to 771 Twh in 2047.[3]

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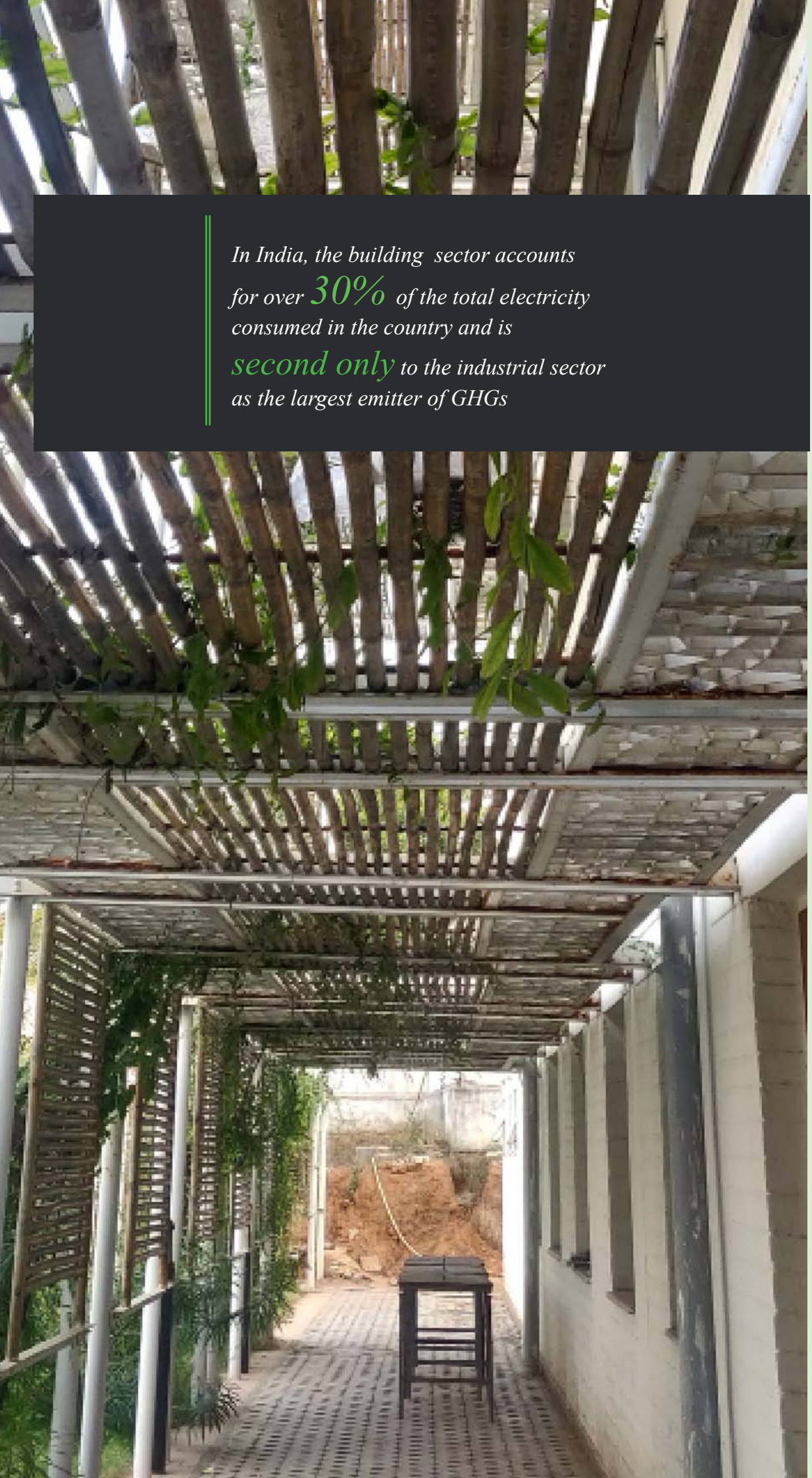
[1] https://www.iea.org/topics/buildings.

[2] Central Electricity Authority (CEA). 2017. *Growth of Electricity Sector in India from 1947-2017*. New Delhi: CEA, Government of India.

[3] A Report On Energy Efficiency And Energy Mix In The Indian Energy System (2030), Using India Energy Security Scenarios, 2047

INTRODUCTION



In India, the building sector accounts for over **30%** *of the total electricity consumed in the country and is* **second only** *to the industrial sector as the largest emitter of GHGs*

Projections also show an exponential growth in the use of room air conditioners. Increased penetration of air conditioners would require an additional 150 GW electricity generation capacity. India would need to re-examine building design to minimize energy consumption in buildings and, thereby, contribute to mitigating climate change.

Significant energy savings can be achieved by designing climatically appropriate buildings to help minimize the seasonal periods and daily durations when light, fans and air conditioners are used. More efficient design; selection of efficient common area equipment such as lifts, pumps and lighting; as well as improving the efficiency of space-cooling equipment can help save electricity.

This will also have a second benefit – vastly improve our thermal comfort which is the condition of mind that expresses satisfaction with the thermal environment,[4] increase productivity, and cut our electricity bills. A win-win situation for all.

The key aspect that needs to be factored in while designing is the 'building envelope', which comprises the roofs, walls and windows. The building envelope is the interface between the indoor spaces of a building and the outdoor environment.[5] And given that the degree of thermal comfort varies in India's different climatic zones that can range from the very arid to the very humid and from very cold to very warm/hot – there is no 'one size fits all' approach while designing buildings that consume less energy.

The Government of India has undertaken several initiatives for designing buildings that minimize energy consumption – called 'energy efficient buildings'. These include the National Building Code (NBC) 2016; the Energy Conservation Building Codes, ECBC 2017 for commercial buildings; and the Eco-Niwas Samhita 2018 (Part 1: Building Envelope) for residential buildings. These are in tandem with international initiatives such as the Global Alliance for Buildings and Construction (GABC) and the International Energy Agency's Energy Efficiency in Emerging Economies (E4) programs.

One such key initiative is the Indo-Swiss Building Energy Efficiency Project (BEEP), a bilateral cooperation between the Ministry of Power (MoP) under the Government of India, and the Federal Department of Foreign Affairs (FDA) of the Swiss Confederation. The project aims to reduce energy consumption in new buildings through energy-efficient design, construction, innovative technologies and capacity building; and to disseminate the best practices. The project contributes to strengthening and broadening the Bureau of Energy Efficiency (BEE) building energy conservation program.

One of the objectives of the BEEP program is to raise awareness on environment-friendly or 'green' buildings that consume less energy.

Media plays an important role in flagging the topic off, informing and raising awareness. This manual has been developed to help journalists report on energy-efficient buildings with more insights, accuracy and understanding. A companion manual will serve as a guide for media trainers conducting workshops for journalists.

[4] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6298492/

[5] Design Guidelines for Energy-Efficient Multi-Storey Residential Buildings Composite and Hot-Dry Climates, Ministry of Power, Government of India

02 Understanding Energy-Efficient Buildings

Globally the building sector accounts for more electricity use than any other sector – over 40%, -- given that most of us spend more than 90% of our time in buildings, either in office or at home. With increasing urbanization, especially in developing countries, the number and size of buildings in urban areas will increase, resulting in an increased demand for electricity and other forms of energy commonly used in buildings.[6]

[6] UNIDO: *https://www.unido.org › sites › default › files › Module18_0*

The increased electricity consumption necessitates measures to reduce energy used in buildings for heating and cooling; lighting, and domestic appliances such as washing machines and refrigerators. One obvious benefit is lower electricity consumption and, hence, lower costs and electricity bills. Energy-efficient homes are also more comfortable to live in; improve the sense of comfort of people and their wellness and work efficiency; and are more environmentally friendly.[7]

It is often possible to build energy-efficient homes without any additional investments. In some cases there could be a marginal increase of 1-2% of the total building project cost. However, these additional investmentscould help improve energy efficiency significantly, and homeowners will often recover these costs in a short period of time due to the reduced energy expenses. This payback time can be short, taking only a few years.[8]

The best time to focus on energy efficiency is when a building is first being built, as new construction offers opportunities to integrate measures to reduce energy consumption, compared to renovating or retro-fitting buildings that are already constructed.[9]

But before we discuss energy-efficient buildings, it is important to understand buildings themselves.

[7] J.M.K.C. Donev et al. (2015). Energy Education - Energy efficient building design [Online]. Available: https://energyeducation.ca/encyclopedia/Energy_efficient_building_design. [Accessed: September 13, 2019].

[8] International Energy Agency. (May 4, 2015). *Energy Efficiency Requirements In Building Codes* [Online]. Available: https://www.iea.org/efficiency/CD-EnergyEfficiencyPolicy2009/2-Buildings/2-Building%20Codes%20for%20COP%202009.pdf

[9] National Resources Canada. (May 4, 2015). *Energy Efficiency is Important for New Buildings* [Online]. Available: https://www.nrcan.gc.ca/energy/efficiency/buildings/eenb/4033

Key Components of a Building

From an energy efficiency perspective, the key components of a building which need to be addressed are the following:

1. **Building Envelope**
   a. Wall
   b. Window and Shading devices
   c. Roof
2. **Appliances/ Equipment**
   a. Air-conditioning equipment
   b. Lighting
   c. Fans
   d. Other electrical appliances such as lifts, pumps, transformers, etc.
3. **Renewable systems**
   a. Solar
   b. Wind

Thermal Comfort: Besides reducing electricity consumption, energy-efficient buildings play a key role in helping residents feel comfortable, that is, maintaining their 'thermal comfort'.The most widely used and accepted definition of thermal comfort is the one by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE), which defines thermal comfort as "the condition of mind that expresses satisfaction with the thermal environment.[10] Essentially, to maintain thermal comfort, heat produced must equal heat lost. Any heat gain or loss beyond this generates substantial discomfort.[11]

Indoor thermal comfort is essential for psychological well-being of humans. Thermal discomfort results in loss of concentration, nausea or irritability, muscle cramps or weakness, headache, and fatigue. The health of the occupants affected, children are unable to study, and there is loss of income due to poor productivity.[12]

In India, the majority (~90%) of the households do not have access to air-conditioning.The maximum air temperature limit for thermal comfort (with fan) is around 32-34 degrees C.[13] As room air temperature and the wall surface temperatures approach 35 degrees C, the ability of the human body to loose heat reduces drastically.[14]

Thermal comfort can be typically provided by active heating or cooling or a combination of both – this depends mainly on the local weather and the seasonal variations in each place. In the context of India, thermal comfort can be predominantly linked to cooling in buildings. Space cooling is, therefore, an important component of the total cooling requirement in the country.[15] Hence, while designing houses, care should be taken that the indoor temperatures do not exceed 32 degrees C during peak summer period. This is the basic strategy for curtailing the growing use of air conditioning to alleviate discomfort.[16]

Maintaining this standard of thermal comfort for occupants of buildings or other enclosures is one of the important goals of space conditioning for the design engineers. In the Indian context, most people will feel comfortable at room temperature, that is, a range of temperatures around 24 to 28 degrees C,[17] but this may vary greatly between individuals, depending on factors such as activity level, clothing, and humidity.

[10] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6298492/

[11] https://soa.utexas.edu/sites/default/disk/urban_ecosystems/urban_ecosystems/09_03_fa_ferguson_raish_ml.pdf

[12] BEEP

[13] National Building Code (NBC), 2016 Link: https://bis.gov.in/?page_id=117159

[14] Indo-Swiss Building Energy Efficiency Project (BEEP)

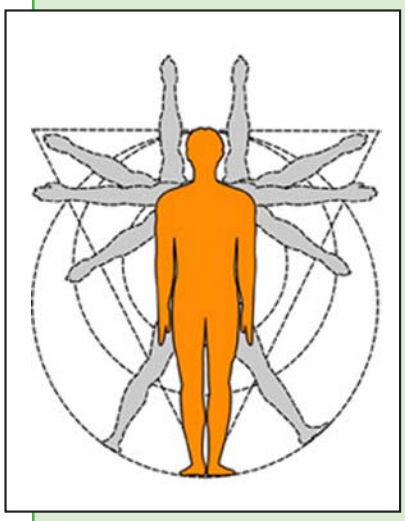
[15] *ozonecell.in/wp.../INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf (chapter 2)*

[16] BEEP

[17] ANSI/ASHRAE Standard 55-2017, Thermal Environmental Conditions for Human Occupancy; Wikipedia

Adaptive Thermal Comfort Model

Adaptive thermal comfort is a theory that suggests that humans can adapt to, and even prefer, a wider range of thermal conditions than is generally considered comfortable. The model is based on the theory that the thermal comfort of humans varies with the environment conditions of the place they live in, and that they can adapt up to a point to their local weather conditions. It means that we feel comfortable at a lower temperature during winter months and would adapt and can feel comfortable at higher temperatures during the summer months. The Centre for Advanced Research in Building Science & Energy (CARBSE) at the CEPT University (formerly known as the Centre for Energy Planning and Technology), Ahmedabad has developed an Indian Model for Adaptive thermal comfort.[18] (http://carbse.org/research/development-of-an-india-model-for-adaptive-thermal-comfort/)



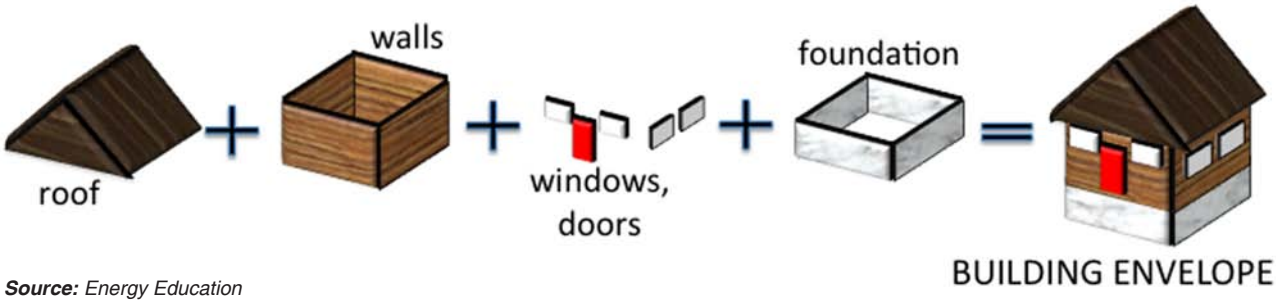
Source: Development of an India Model for Adaptive (thermal) Comfort, CARBSE Centre for Advanced Research in Building Science & Energy

The key to improving the thermal comfort of a building's residents and reducing electricity consumption is to focus on the three critical components – building envelope, appliances, and use of renewable energy. Thermal comfort can be achieved through a well-designed building envelope, which is the most crucial component and comprises the biggest chunk of the building construction project. The building envelope can last upto 50-60 years, compared to, for example, electric appliances and renewable systems that are often replaced in 10-20 years. For further enhancement efficient conditioning systems may be used. Together these measures will make the building energy-efficient and reduce electricity consumption. In order to make the building more sustainable and self-sufficient, renewable energy can be used.

Some of the effective ways in which changes in buildings by individuals can help contribute to energy savings at the household level include: for example,

- insulating walls, a measure which is only possible in new construction or by a very extensive retrofit;
- putting reflective paint/tiles and/or insulation on the roof
- optimal size, location and number of windows
- using shading outside of their windows such as fixed shading such as chajjas or movable shading such as 'chicks', vertical screens, louvers and shutters;
- upgrading windows e.g. making windows leakproof when closed; changing window glazing from single pane to double glazing
- cleaning air conditioning filters and installing water-efficient showerheads;
- replacing current home appliances such as refrigerators, washing machines, and dish washers with high-efficiency models;
- installing a solar heated system for hot water;
- replacing incandescent light bulbs and compact fluorescent bulbs with light emitting diodes (LEDs)

[18] http://carbse.org/research/development-of-an-india-model-for-adaptive-thermal-comfort/



Source: *Energy Education*

Building Envelope: The building envelope acts as a thermal barrier and regulates the temperatures inside, and influences the amount of electricity required to maintain thermal comfort. The building envelope design should aim at reducing electricity used for cooling, improving thermal comfort, and providing adequate daylight in typical spaces such as bedroom, living room and kitchen.

Most of the cooling load in the residential buildings is from heat gains from the Sun and heat transmission through the building envelope. The building envelope has the highest impact on thermal comfort and energy use, and hence, special attention should be paid to reducing solar heat gains and heat transmission through the building envelope.

In residential buildings, therefore, cooling requirements arise from heat gains through the building envelope – for example, solar heat gain through roof, windows and walls. Reducing cooling loads thus requires a reduction in heat gains in the building from outside. In hot climates, a properly designed building envelope can help improve thermal comfort and reduce the energy required for cooling.

This could be achieved by orienting buildings and selecting a building shape to minimize exposure to the Sun on the vertical surfaces; and trying an arrangement in which buildings blocks mutually offer shade to each other.

The occupancy pattern of commercial and residential buildings varies. For example, day use office buildings operate at peak capacity during the day, during office hours from 9 AM to 6 PM in most cases. Conversely, usually residential buildingsin metropolitan cities are occupied fully from evenings to the next morning, that is, from 6 PM or 7 PM to 8 AM or 9 AM. The electricity consumption of the two types of buildings, therefore, varies accordingly.

Within residential buildings, most of the electricity used for space cooling is consumed in bedrooms which are occupied during the night, and in living rooms which are occupied during the day and evenings.

In 2017, there were an estimated 272 million households in India which will increase to 328 million and 386 million in 2027 and 2037 respectively. Census 2011 of the country breaks down the number of households in the following segments: non-exclusive room, one room, two rooms, three rooms, four rooms and five rooms and above. Approximately 60%-70% of all the households fall in one-room and two-room categories.[19]

The Covid19 pandemic has brought to the forefront the need for well-ventilated homes, especially for the weaker sections of the society. For residential buildings, this translates into optimum size of windows and its operation; while in the case of commercial buildings, it means centrally air-conditioned spaces that induce more fresh air. All these measures can lead to a thermally comfortable building.

[19] www.aeee.in › Building-Stock-Modeling-Revised-pager

An analysis, based on short surveys of the share of the total households for each category that have room air conditioners, as well as trends for appliances, showed that approximately 8% of the current households have room air conditioners. According to the India Cooling Action Plan 2019 by Ministry of Evnironment, Forest and Climate Change this is anticipated to rise to 21% and 40% in 2027-28 and 2037-38 respectively.

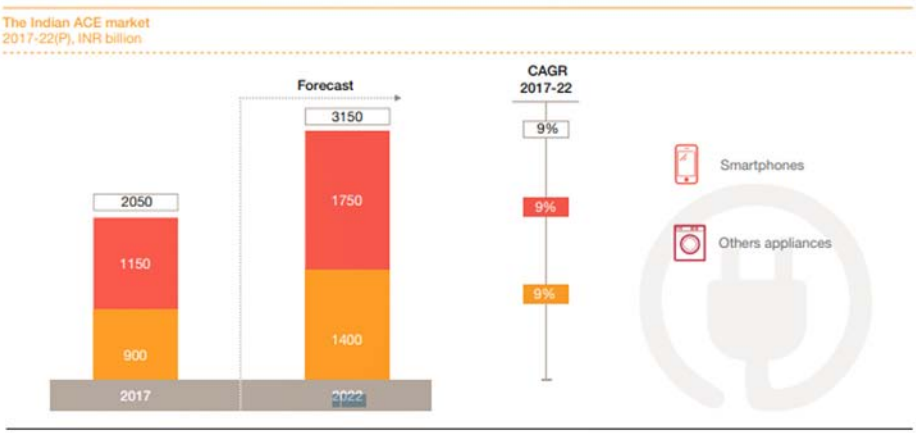
The main building envelope features that influence the cooling thermal energy demand and thermal comfort in a residential building are:

- Size and location of window opening
- External shading systems for windows
- Thermal properties of window glazing
- Insulation properties of wall
- Insulation properties of roof
- Color and finish of exterior and interior surfaces (walls and roofs)
- Natural ventilation
- Building air-tightness.[20]

Appliances

The choice of appliances too plays a key role in reducing electricity consumption. These include, air conditioners, lights, and other appliances such as lifts, pumps and transformers in building. In office buildings, there are additional cooling requirements due to internal heat gains – for example, from computers, lighting and people.

In India, the appliances that contribute to major part of electricity consumption are fans, lighting (incandescent bulbs and tube lights), refrigerators, ACs, air coolers, electric water heater, televisions, washing machines and stand-by power options. A 2019 report of the American Council for Energy Efficient Economy and Alliance for Energy Efficient Economy cites Price Water Cooper's 2017 projections that the appliance and consumer electronics market in India, pegged at INR 2050 billion in 2017, will grow to INR 3150 billion in 2022.[21]



Source: *Euromonitor, Crisil, Industry Estimates, PwC analysis*

[20] https://energyeducation.ca/encyclopedia/Building_envelope

Consumers often face a dilemma in selecting the least-electricity-consuming appliance, because of wide variation in energy consumption of products, and difficulties in obtaining or understanding the information on them. In May 2006, the Ministry of Power launched the Standards and Labeling programme (S&L), programme to provide the consumer an informed choice about energy savings, and reduce manufacture and purchase of inefficient equipment and appliances. The equipment and appliances covered under this program include refrigerators, room air conditioners, transformers, fans, geysers and computers. The equipment and appliances are given a star rating of 1 to 5, with 5 stars being the most efficient.

BEE recommends that higher BEE star-labelled energy-efficient equipment and appliances should be used for common services such as distribution transformers and tubular fluorescent lamps; and for space cooling, water heating and lighting in flats.[22]

[22] From BEEP's "Design Guidelines For Energy-Efficient Multi-Storey Residential Buildings – Composite and Hot-Dry Climates

Renewable systems such as solar and wind energy use

Renewable energy offers an attractive option for making the buildings low-carbon or contributing towards net zero energy buildings. Renewable energy produced from solar or wind energy plants can be integrated with the electricity supply system to buildings and help in making them low-carbon. This could also help reduce the transmission and distribution (T&D) losses of the electricity grid, which are very high (~23% in 2014–15) in India.

The potential for using renewable energy is huge – composite (mixed) and hot dry regions receive high-intensity sunshine, with most of the urban centres in these regions receiving 1500 to 2000 kilo Watt hours (kWh) of the Sun's radiation per square metre each year.

The Government of India has set a target of 175 GW of renewable energy capacity by the year 2022, which includes 100 GW from solar, out of which 40 GW is to be generated from roof top solar or onsite solar energy generation in buildings. Similarly, the target for solar thermal collectors' (mainly to be installed on buildings) installed area is set at 20 million square metres by 2022.

Examples of renewable energy technologies that are suitable for use in buildings include solar PV electricity generation and solar water heating, which have been used and accepted widely across buildings. The roof of the building is the best place to install solar systems. In composite and hot dry climates, the demand for hot water is usually limited to six months in a year, from October to March, with peak demand during December and January.

The BEE recommends that for highly energy-efficient residential buildings of up to four storeys, it is possible to generate sufficient electricity through rooftop solar PV (photovoltaic) systems covering upto 60% of the roof area.

Large quantities of organic waste generated in residential complexes, restaurants, hotels, hostels, industrial canteens, can also be converted into bio gas which can then be used either for producing heat or electricity; or for cooking in the case of restaurants and canteens.

Key questions that can be raised by the media

1) What kind of building envelopes are being developed in the country?
2) What are the impacts of improved building envelope on occupants' health and energy consumption on buildings?
3) What are the current building technologies, practices or appliances in use that increase electricity consumption?
4) What are the environmental impacts of the current technologies in use?
5) How much energy has been saved by adoption of new measures – at the city level, state level and country level?
6) What is the market for the new technologies for building envelope, appliances and renewable energy use in building sites?

03 Contribution of Buildings to Climate Change

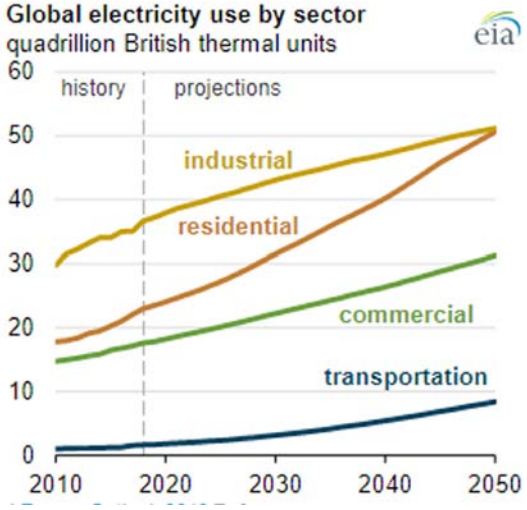
Buildings and Climate Change

Projections of electricity consumption in residential and commercial sectors and GHG emissions – global

The U.S. Energy Information Administration (EIA)'s *International Energy Outlook 2019* (IEO2019)[23] projects that world energy consumption will grow by nearly 50% between 2018 and 2050. EIA says that most of this growth comes from countries that are not in the Organization for Economic Cooperation and Development (OECD), and this growth is focused in regions where strong economic growth is driving demand, particularly in Asia.

Meanwhile, the Bloomberg New Energy Finance (BNEF) says in its September 2018 forecast[24] that global electricity demand will reach around 38,700 terawatt-hours by 2050 from 25,000 terawatt-hours in 2017, driving new investment in power generating capacity.

According to the US Energy Information Administration (EIA) Outlook 2019 report,[25] the global energy consumed in the buildings sector, which includes residential and commercial structures, will increase by 65% between 2018 and 2050, from 26,669 Twh (91 quadrillion British thermal units) to 40736 Twh (139 quadrillion Btu.) Some of the projections could be revised as global energy demand fell in 2020 due to the lockdown imposed by the Covid-19 pandemic. EIA's updated assessment of the immediate effects of the pandemic on the energy system shows expected falls in 2020 of 5% in global energy demand, 7% in energy-related CO_2 emissions and 18% in energy investment.In general, rising income, urbanization, and increased access to electricity lead to rising global demand for energy.



Source: *US Energy Information Administration (EIA) Outlook 2019 report*

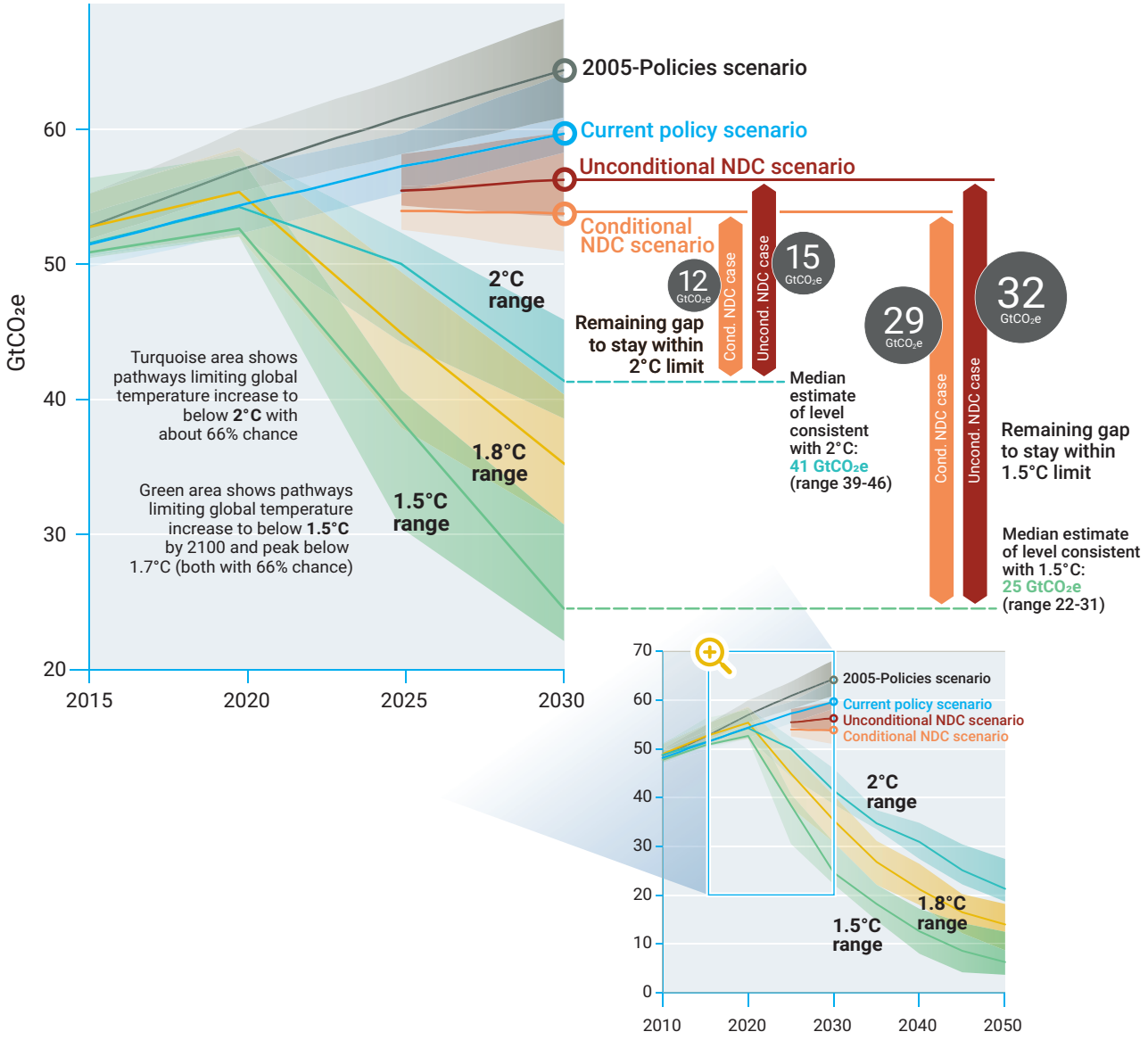
Electricity use is anticipated to grow in the residential sector as rising population and standards of living in non-OECD countries increase the demand for appliances and personal equipment. Electricity use is also expected to increase in the transportation sector as the number of plug-in electric vehicles and electric trains grows.

[23] https://www.eia.gov/todayinenergy/detail.php?id=41433

[24] https://about.bnef.com/blog/global-electricity-demand-increase-57-2050/

[25] https://www.eia.gov/todayinenergy/detail.php?id=41433

Global GHG emissions under different scenarios and the emissions gap by 2030



Source: *United Nations Environment Programme (2019). Emissions Gap Report 2019.*

The United Nations Environment Program (UNEP's) Emission Gap Report of 2019 estimates that with only current policies, GHG emissions are estimated to be 60 Giga tonnes (Gt, one Gt which equals one billion tons) carbon di oxide equivalent in 2030.

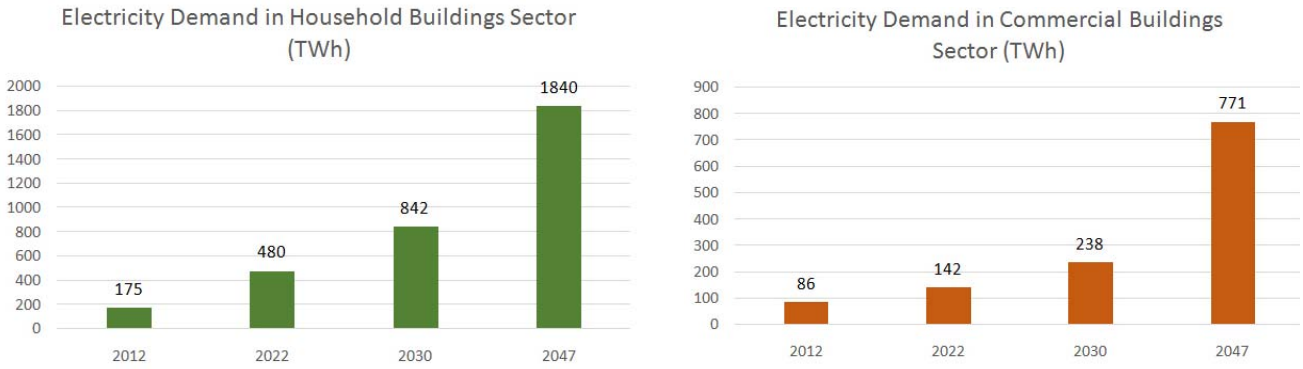
Projections of electricity consumption in residential and commercial sectors, and GHG emissions – India

The NITI Aayog has projected that India's energy demand will double from almost 600 million tonnes equivalent (Mtoe) in 2017 to 1200 Mtoe in 2042.[26]

Currently, buildings are the second largest energy consumers in India, after industries. Out of the total electricity consumed in the building sector, about 75% is used in residential buildings.[27] The gross electricity consumption in residential buildings has been rising sharply, by more than four times in 20 years, from about 55 TWh in 1996-97 to about 260 Terra Watts hour (one trillion Watts of energy consumed in hour or TWh) in 2016-17. Projections by NITI Aayog's

[26] India's Energy and Emissions Outlook: Results from India Energy Model

[27] Eco-Niwas Samhita 2018, Part 1: Building Envelope, Bureau of Energy Efficiency, Ministry of Power, Government of India



Source: *A Report on Energy Efficiency and Energy Mix in the Indian Energy System (2030), Using India Energy Security Scenarios, 2047, NITI Aayog*

show that India's electricity demand in the residential buildings sector will rise from 175 Twh in 2012 to 480 in 2022 to 842 in 2030 and 1840 in 2047. Similarly the country's electricity demand in the commercial building sector will rise from 86 TWh in 2012 to 142 Twh in 2022, to 238 Twh in 2030, and to 771 Twh in 2047[28]

According to The Energy Resources Institute (TERI), New Delhi, India's GHG emissions are expected to increase to a level of 4,469 - 4,570 million tonnes (Mt) carbon dioxide equivalent by 2030. India's GHG emissions more than doubled between 1990 and 2015, and that trend is expected to continue. The largest driver for overall GHG emissions in India is carbon di oxide emissions from energy. In India, these emissions have more than tripled since1990 mainly driven by power generation and industries.

Projections on increased construction (supported by govt. schemes such as PMAY)

Rapid urbanization and the launch of new government schemes to provide housing for all in India has led to a general rise in construction. The country's stock of buildings is projected increase by three times by 2030, of which the residential buildings expected to increase two times in terms of floor area by 2030.[29] The Prime Minister's Aawas Yojana (PMAY) launched in 2015, for example, aims to build 12 million new affordable homes in urban areas by March 2022.[30] Similarly, under national missions such as Housing for All and Smart Cities and Solar Cities, the country is witnessing significant increases in commercial and residential building stocks. These schemes would benefit by use of climate-appropriate and energy-efficient building design for construction of houses under economically weaker sections (EWS) and low income group (LIG) segments. This would also provide thermal comfort for all, reduce cooling load, and provide gains in terms of energy efficiency.[31]

The Covid19 pandemic has turned the attention of the building sector towards the need for well-ventilated homes, especially for the weaker sections of the society, through measures such as optimum size of windows for residential buildings, and centrally air-conditioned spaces that induce more fresh air in the case of commercial buildings.

Increased cooling demand and subsequent increase in electricity consumption

Projections of increased electricity consumption by the rising stock of buildings in India include increased requirements to cool buildings, as buildings represent a dominant share of India's overall cooling needs. Currently, households use ceiling fans, desert coolers and air conditioners (ACs) for cooling. The electricity consumption increases as households shift from fans and desert coolers to ACs, due to an improvement in their economic conditions. The demand for air-conditioning is expected to grow exponentially with improvement in household incomes.

[28] A Report On Energy Efficiency And Energy Mix In The Indian Energy System (2030), Using India Energy Security Scenarios, 2047

[29] Indo-Swiss Building Energy Efficiency Project

[30] Building Energy Efficiency Programme (BEEP) and https://en.wikipedia.org/wiki/Pradhan_Mantri_Awas_Yojana

[31] National Building Code (NBC), 2016 Link: https://bis.gov.in/?page_id=117159

The current penetration of room air conditioners in the country is low, indicating that most households rely on fans, air-coolers or passive cooling from ventilation and window shading for thermal comfort. However, with improved economic conditions and changes in life styles, people are shifting from fans to air-conditioners, and use of refrigerant-based air-conditioning will be the chief contributor to the increased energy consumption in residential buildings.[32]Projections show a parallel exponential growth in room air conditioners, which would require an additional 150 GW of electricity generation capacity. India would, therefore, require a re-examination of building design to minimize energy consumption[33] by reducing the time period during a season and during the day when air-conditioners are used; and selection of energy-efficient appliances.

The air conditioning demand and corresponding Energy Performance Index (EPI or the amount of electricity consumed per unit area per year in kWh/m2/year) in commercial buildings are significantly higher as compared to the residential buildings sector. On a cumulative basis, residential buildings with their large built-up area consume more electricity compared to commercial buildings, but the intensity of electricity consumption is higher in commercial buildings. The commercial sector has been classified under eight major segments: hospital, hotels and restaurants, retail, office buildings, educational institutions, assembly places, transits buildings & warehouses. The projections for commercial floor area and air-conditioned area is expected to grow around by 1.5-2 times in the next decade, and by 2.5-3 times by 2037-38.

The future of space cooling in buildings will hugely benefit from a two-pronged approach i.e. first reducing the need for active cooling in buildings using energy efficiency as a foundational building strategy, followed by meeting the reduced cooling demand using efficient cooling technologies. Significant amounts of energy can be saved by designing climatically appropriate buildings to minimize the seasonal periods (months) and daily duration (hours) when ACs are used.

The Bureau of Energy Efficiency has issued guidelines to all consumers of commercial buildings and suggests maintaining the internal temperature between 24-25 degrees C with appropriate humidity and airflow to conserve energy and for the health benefits of occupants, subject to operational and functional requirement on voluntary basis.[34]

Every increase of 1 degree C in temperature setting saves approximately 6% on one's electricity bill, according to BEE. If one runs one's air conditioner at 24 degrees C instead of 20 degrees C, one can save approximately 24% electricity and reduce the power bill by 24%

Key questions that can be raised by the media

1) How can one reduce and, in turn, minimize our dependence on external sources for cooling, and increase and utilise the natural ventilation potential?

2) What are the possible strategies to reduce electricity required for space cooling?

3) What are the anticipated future cooling technologies?

4) What is the latest update on star ratings of ACs and other appliances

[32] Design Guidelines for Energy-Efficient Multi-Storey Residential Buildings Composite and Hot-Dr Climates, Ministry of Power, Government of India

[33] Indo-Swiss Building Energy Efficiency Project

[34] Building Energy Efficiency Programme (BEEP) and https://en.wikipedia.org/wiki/Pradhan_Mantri_Awas_Yojana

04 Green Building Policy and Role of BEEP in mitigating Climate Change

At the international level and national level, countries have begun to form alliances and undertake programs to build green buildings that consume less energy. Following are some notable initiatives:

International Initiatives

A. **Paris Agreement –** The Paris Agreement is a landmark agreement arrived at the 21st annual international UN Conference of Parties on climate change (COP 21) in Paris, on 12 December 2015, by countries under the United Nations Framework on Climate Change Convention (UNFCCC) to combat climate change through faster actions and investments. The Paris Agreement for the first time brings all nations into a common cause to combat climate change and adapt to its effects. It also offers greater support to developing countries in their efforts to both mitigate and adapt to climate change.[35]

The Paris Agreement aims to strengthen the global response to the threat of climate change by keeping a global temperature rise by 2100 well below 2 degrees Celsius above pre-industrial (19th century) levels, and to pursue efforts to limit the temperature increase still further to 1.5 degrees Celsius. Additionally, the agreement aims to help countries deal better with the impacts of climate change, and make finance flows consistent with a low GHG emissions and climate-resilience. The Agreement also provides for an enhanced transparency framework for action and support.

The Paris Agreement requires all signatory countries to put forward their best efforts through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all signatory countries report regularly on their emissions and on their implementation efforts. There will also be a global stocktake every 5 years to assess the collective progress towards achieving the purpose of the agreement and to inform further individual actions by Parties.

The Paris Agreement opened for signature on 22 April 2016 – Earth Day – at UN Headquarters in New York. It entered into force on 4 November 2016, 30 days after the so-called "double threshold" (ratification by 55 countries that account for at least 55% of global emissions) had been met. As of January 2019, 197 countries have signed it and 189 have ratified it.[36]

Reports of the UNFCCC and annual climate change conferences of the UNFCCC are key sources for updates on the Paris Agreement.

[35] https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement

[36] https://www.britannica.com/topic/Paris-Agreement-2015

B. Global Alliance for Buildings and Construction (GABC)

The Global Alliance for Buildings and Construction (GABC) was launched at the UNFCCC's 21st Conference of Parties (COP21's) Buildings Day in Paris in December 2015 by the Government of France and the United Nations Environment Programme (UNEP). The alliance comprises the building and construction industry, countries and businesses.

The GABC works towards the Paris Agreement goals of limiting global warming to well below 2°C. It is hosted by UN Environment's Economy Divisionand aims to raise awareness and facilitate the global transition towards low-emission, energy-efficient buildings. Its motto is "Towards a zero-emission, efficient and resilient buildings.[37] https://www.globalabc.org/

The alliance believes that transforming the building and construction sector is vital to the success of the Paris Agreement's goal of limiting global warming to well below 2 degrees C. Its vision is a future-proof world in which all buildings – old and new – are zero emission, efficient and resilient.

The GABC has emerged as the leading global platform for governments, the private sector, civil society and intergovernmental and international organizations to increase action towards a zero-emission, efficient and resilient buildings and construction sector.

The alliance also brings out a range of global reports, roadmaps, guidelines, science-based performance standards, and cost-effective building energy policies; and is recognized as key influencer at international gatherings. It aims at addressing urbanization challenges and climate change, such the annual UN climate change conferences and the G20, an international forum for the governments and central bank governors from 19 countries, including India, and the European Union. It also builds local alliances in the buildings and construction sector, paired with Green Building Councils or other alliances on buildings.

The GABC's key goals include: raising ambitions to meet the Paris climate goals, both in retrofitting existing buildings and future-proofing the investments that go into new buildings over the next 15 years; mobilizing all stakeholders engaged with design to construction, operations and demolition in the private and public sectors; and encouraging policy frameworks that promote both uptake of existing, cost-effective solutions and private sector innovation; and using sustainable public procurement as a lever to create markets and investor security.

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[37] *https://www.globalabc.org/*

The GABC has over 130 members, including 29 countries[38], 64 non-state organisations (sub-national, non-governmental organisations) and private sector.

The alliance organises activities around education and awareness; public policies; market transformation; finance; and building measurement, data and information. Its advocacy activities include organising the Buildings Day at each year's Conference of the Parties (COP) meeting under the UNFCC; side events at high level international gatherings, such as during G20 meetings; and regional roundtables for best practice exchange and raising ambition levels. These events are key sources of information for the media.

C. International Energy Agency (IEA)'s Energy Efficiency in Emerging Economies (E4) Programme

The Energy Efficiency in Emerging Economies (E4) Programme is a programme of the International Energy Agency (IEA), which works closely with six of the world's largest emerging economies – Brazil, China, India, Indonesia, Mexico and South Africa -- on energy efficiency.[39]These six countries together consume one third of the world's energy – which is expected to rise to 40% under current policy directions. The programme also works within two emerging regions, in ASEAN and Latin America, by supporting energy efficiency through established political and trading relationships. The collaboration with countries is highly flexible and is based on changing needs.

The E4 programme aims to understand the potential of energy efficiency in a country to enable a secure, sustainable energy system, set targets and track progress through energy efficiency indicators and policy evaluation; and develop strategies and design policies to deliver energy efficiency.

There are five main modes of collaboration:

1. **Support for policy development:** focusing on the day-to-day needs of officials responsible for delivering energy efficiency policies
2. **Thematic workshops** to bring together officials and experts from a range of countries to explore specific topics
3. **Policy training** or group training for officials and future leaders
4. **Webinars** or online seminars offering access to a range of experts on key policies or technologies
5. **Online training** based on self-paced learning on energy efficiency indicators

The E4 programme is currently in its second phase which started in 2018. The first phase of the E4 Programme, from 2014 to 2017, was supported by the Government of Denmark and the European Commission. The second phase is part of the IEA Clean Energy Transitions Programme (CETP), which aims to collaborate with partner country governments on all aspects of their clean energy transitions with support from a range of donors including Canada, Denmark, the European Commission, Germany, Italy, Japan, Sweden, Switzerland, and the United Kingdom.

The E4 Programme has regular analysis reports and publications, such as the Energy Efficiency Market Report, the World Energy Outlook, and Energy Technology Perspectives, which are key sources of information for the media.

[38] https://globalabc.org/about/about-globalabc

[39] https://www.iea.org/topics/energyefficiency/e4/

D. Kigali Cooling Efficiency Program

The Kigali Cooling Efficiency (K-CEP) is a philanthropic program to support the Kigali Amendment to the Montreal Protocol,[40] which was created in 2017 to help make cooling equipment more energy-efficient, thereby reducing the demand for energy from fossil fuels. It aims to phase put hydrofluorocarbons, which are strong greenhouse gases, and thereby protect the ozone layer and climate. According to its third year report, it works in 52 countries[41] and plans to expand its work to more countries, including India.

The K-CEP provides funding and guidance to organizations to support governments that want to integrate cooling solutions into their next round of their country's Nationally Determined Contributions (NDCs) which are expected to be submitted during 2020. It is funded by 17 foundations, including the Bill Gates Foundation and John D and Catherine T Mac Arthur Foundation, which have pledged $51 million to help increase the energy efficiency of cooling in developing countries. K-CEP and its grantees are partnering with 44 developing countries to help them transition to a more energy-efficient cooling equipment, phasing down the sue of hydrofluorocarbons sued as refrigerants and replacing them with newer, climate-safe coolants.[42]

The K-CEP has helped to develop 71 cooling efficiency proposals, and identified 35 potential investments and 45 business partnerships.[43]

National Initiatives:

A. Government programs

1. **Nationally Determined Contributions (INDCs):** India's intended nationally determined contributions (INDCs), announced by the Ministry of Environment, Forests & Climate Change in 2015, are the country's intended reductions in greenhouse gas emissions under the UNFCCC's Paris Agreement of 2015. All countries had to submit their climate action plans to the UNFCCC by 2015.

India's INDCs' goal is to reduce the emission intensity of its GDP— annual GHG emissions per unit GDP -- by 33%-35% by 2030, from the 2005 level. Through this the country expects to save 3.5 billion tons of carbon di oxide equivalent, compared to business-as-usual scenario. It has also pledged to increase the share of non-fossil fuels-based electricity to 40 % by 2030, increase its forest cover which will absorb 2.5 to 3 billion tonnes of carbon dioxide by 2030.

Enhancing energy efficiency is one the mitigation strategies listed in India's INDCs. This will be achieved through the Bureau of Energy Efficiency (BEE's) Standards and Labelling Programme and energy-efficient buildings through building code compliance. Other provisions include incorporating the adaptive thermal comfort model guidelines to heating, ventilation and air-conditioning (HVAC) operations in building code norms and its stringent compliance will help advance the country's international commitments.

From the energy perspective, as of September 2019, India is about halfway towards meeting its 175 GW by 2022 goal, with renewables capacity reaching 82.6 GW, representing nearly 23% of India's total installed capacity.Between April 2018 and March 2019, India added about 9.3 GW of renewable energy capacity to the grid. This is more than installed coal-fired and hydro capacity added (totalling 5.9 GW) during the same period.Investments in renewables in 2018 also exceeded those for fossil-fuel-based power generation.[44]

[40] https://www.unido.org/our-focus-safeguarding-environment-implementation-multilateral-environmental-agreements-montreal-protocol/montreal-protocol-evolves-fight-climate-change

[41] https://www.k-cep.org/year-three-report/

[42] https://www.k-cep.org/

[43] https://www.k-cep.org/year-three-report/

[44] International Energy Agency, World Investment Outlook 2019, https://webstore.iea.org/download/direct/2738?fileName=WEI2019.pdf

The country has also launched The India Action cooling Plan (ICAP) and updated its National Building Code and the Energy to reduce electricity consumption in buildings, details of which will be discussed later in the text.

Ministry of Environment, Forests & Climate Change website provides information on India's progress in INDCs.

2. India Cooling Action Plan:

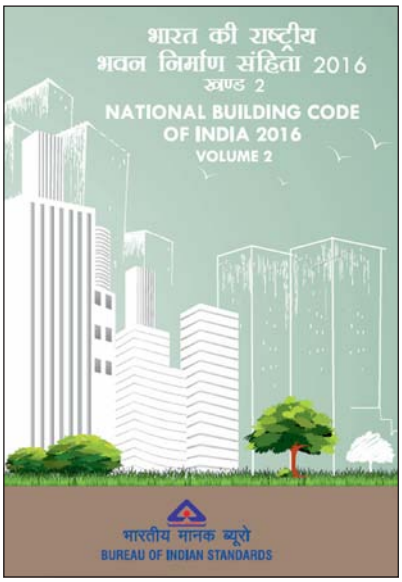
India's Ministry of Environment, Forests & Climate Change launched the India Cooling Action Plan (ICAP) in March 2019. The ICAP provides a 20-year perspective and outlines actions needed to provide access to sustainable cooling. India is one of the first countries to develop a comprehensive plan that addresses the cooling requirements across different sectors such as residential and commercial buildings, cold-chain, refrigeration, transport and industries;[45] make a transition to more eco-friendly refrigerants and enhance energy efficiency with better technology options. It also aims to provide sustainable cooling and thermal comfort for all, and reduce GHG emissions.[46]

The Plan seeks to reduce cooling demand across sectors by 20% to 25% by 2037-38; reduce refrigerant demand by 25% to 30% by 2037-38; reduce cooling energy requirements by 25% to 40% by 2037-38; recognise "cooling and related areas" as a thrust area of research under national Science and Technology Programme; and train 100,000 servicing sector technicians by 2022-23 under the Skill India Mission.

These actions are expected to have significant climate benefits.

India has committed to freeze hydroflurocarbons (HFC) based refrigerants at 2024 levels, starting reductions in 2028. In 2017, six of India's largest air conditioner manufacturers announced plans to leapfrog from outdated previous refrigerants to more climate-friendly and lower-global warming potential refrigerants.[47]

3. National Building Code (NBC) 2016



The National Building Code of India (NBC) is a comprehensive national code launched in 2016 by the Bureau of Indian Standards (BIS). It provides guidelines for regulating the building construction activities across the country. It serves as a model code for adoption by all agencies involved in building construction works, such as the Public Works Departments, other government construction departments, local bodies or private construction agencies. The code mainly contains administrative regulations, development control rules and general building requirements; fire safety requirements; stipulations regarding materials, structural design and construction (including safety); building and plumbing services; approach to sustainability; and asset and facility management.[48]

[45] *ozonecell.in/wp.../INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf* and http://pib.nic.in/PressReleaseIframePage.aspx?PRID=1568328

[46] The Road From Paris: India's Progress Toward Its Climate Pledge

[47] MoEFCC, "Environment Minister Launches Stage II of India's HCFC Phase Out Management Plan (HPMP)," *Press Information Bureau,* March 06, 2017, http://pib.nic.in/newsite/PrintRelease.aspx?relid=158868 (November 19, 2019); TERI, NRDC, and Institute for Governance and Sustainable Development, *Cooling with Less Warming: Improving Air Conditioners in India,* November 2018, https://www.nrdc.org/sites/default/files/cooling-india-air-conditioners-market-profile-2018-fs.pdf

[48] National Building Code (NBC), 2016 Link: https://bis.gov.in/?page_id=117159

The Code was first published in 1970 and revised in 1983. Thereafter, three major amendments were made to the 1983 version, two in 1987 and the third in 1997. This was followed by a revision in 2005, to which two amendments were issued in 2015.

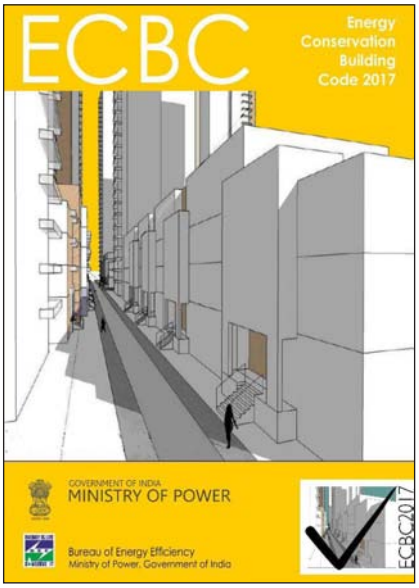
A project for comprehensive revision of the Code was taken up again, in view of large-scale changes in the building construction activities. These include change in the nature of occupancies, with prevalence of high rises and mixed occupancies; greater dependence on and the complicated nature of building services; development of new, innovative construction materials and technologies; greater need for preservation of environment; and recognition of the need for planned management of existing buildings and built environment.

As a culmination of the Project, a revised state-of-the-art Code has been brought out in 2016 as **National Building Code of India 2016** which reflects contemporary applicable international practices.

- The comprehensive NBC 2016 contains 12 parts, some of which are further divided into sections totalling 33 chapters. The major changes pertaining to energy efficiency, which were incorporated in 2016 Code, are as follows:
- Inclusion of new and energy efficient options of air conditioning, heating and mechanical ventilation, such as variable refrigerant flow system, inverter technology, district cooling system, hybrid central plant using chilled beams, radiant floor components, and geo-thermal cooling and heating.
- Thrust on envelope optimization using energy modelling, day lighting simulation, solar shade analysis and wind modelling software to optimize the air conditioning load.
- Heating, ventilation and Air conditioning, (HVAC) provisions considering adaptive thermal comfort conditions for energy efficiency.

4. Energy Conservation Building Code (ECBC):

The Energy Conservation Building Code (ECBC) is an initiative by Bureau of Energy Efficiency (BEE) that was launched in 2007to address energy management in large commercial buildings.[49] In 2017 the BEE updated the code, which now includes the principles of adaptive thermal comfort and provides a method for calculating operating temperatures for naturally ventilated, mixed mode and air-conditioned buildings.



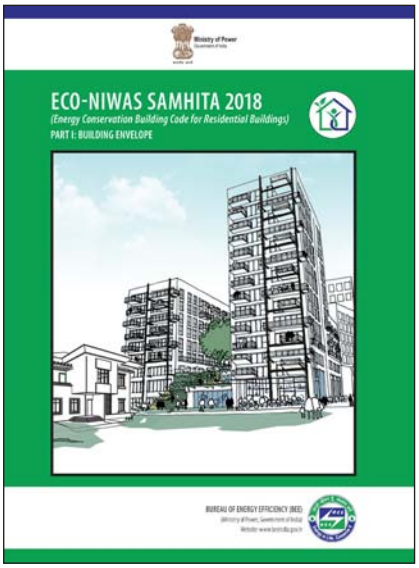
ECBC is currently a voluntary code and applicable only to commercial buildings with connected load greater than 100 kWh. The scope of the code extends to the building envelope, lighting systems and controls, HVAC systems and controls and, service hot water and electrical systems.

Telangana and Andhra Pradesh have implemented the mandatory ECBC code for commercial buildings in 2014. Telangana was the first state with an online ECBC compliance system. Other states that have notified the code (as of June 2019) include Haryana, Himachal Pradesh, Karnataka, Kerala, Odisha, Puducherry, Punjab, Rajasthan, Telangana, Uttar Pradesh, Uttarakhand and West Bengal. Uttar Pradesh and Himachal Pradesh are the only two states that have amended, revised, and notified the state code to adopt ECBC 2017.[50]

The website of ECBC (https://beeindia.gov.in/content/buildings) is a useful source of information

[49] https://beeindia.gov.in/sites/default/files/BEE_ECBC%202017.pdf

[50] NRDC and ASCI, *Towering Possibilities,* September 2019, https:// www.nrdc.org/sites/default/files/towering-possibilities-in-india-20190910.pdf



5. BEE's EcoNiwas Samhita Code and BEE Standards & labelling Program

a) Appliances Standards & Labelling

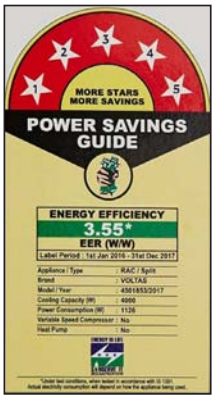
b) Star Label for Residential Buildings

c) Star Rating for Commercial Buildings

The Bureau of Energy Efficiency runs two initiatives – an Eco-Niwas Samhita code and a star-labelling program for residential buildings and commercial buildings.

BEE launched Eco-Niwas Samhita 2018 on 14thDecember 2018, a code for energy-efficient residential buildings, which prescribes the minimum energy performance through energy-efficient envelope design. Indo-Swiss BEEP provided technical assistance to BEE for the development of this code.

a) Appliances Standards & Labelling



The BEE has also launched a Standards and Labelling Programme for equipment and appliances to help consumers and buyers make informed choices about the energy saving and cost saving potential of equipment and appliances used in buildings. The scheme targets display of energy performance labels on high energy end use equipment & appliances and lays down minimum energy performance standards. The star label rates the energy performance of appliances in a scale of 1 to 5, with 5-star rated appliances considered the most energy-efficient. Currently the labelling scheme covers 22 appliances, of which 10 are mandatory and the remaining 12 voluntary. The 10 mandatory appliances include refrigerators, air conditioners, tube lights, colour televisions and electric geysers.[51]

b) Star Label for Residential Buildings

BEE's Star Labelling for Energy Efficient Homes Program provides benchmarks to compare the energy efficiency standards in the residential sector. A key objective is to create a transparent instrument over the energy performance of a home, which will gradually lead to an effective model that can be taken into consideration while deciding the home prices in the future. The indicator used to benchmark the building performance is Energy Performance Index (EPI) i.e the annual energy consumption per square meter of the built-up area, which will be calculated using this tool for the inputs provided by the users. The Star Labels will be awarded upon final scrutiny of the information by BEE.

The labelling program for residential buildings aims to provide information to consumers on the energy efficiency standards of the home; a benchmark to compare one home over the other on the energy efficiency standards; a consumer-driven market transformation business model for energy efficiency in housing sector; and to steer the construction activities of India towards international best practices.

The program is expected to save a large amount of energy through imparting energy efficiency to houses nationwide with annual savings of 90 BU in the year of 2030. The estimated cumulative energy saving potential through proposed labelling program is around 388 BU by year 2030 which is greater than the energy consumption in 2016 (250 BU). Moreover, a five star rated home will be 40% more energy efficient than one star rated home.

[51] BEE, Government of India, Mandatory Scheme, https://www.beestarlabel.com/Home/EquipmentSchemes?type=M, (October 25, 2019). The voluntary scheme includes induction motors, agricultural pumps, ceiling fans, LPG stoves, washing machines, computers, ballasts, office equipment, diesel generators, chillers, solid state inverters and microwave ovens, BEE, Government of India, Voluntary Scheme, https://www.beestarlabel.com/Home/EquipmentSchemes?type=V

c) Star Rating for Commercial Buildings

To create a market pull for energy efficient buildings, the Bureau of Energy Efficiency (BEE) has developed a voluntary Star Rating Programme for commercial buildings which is based on the actual performance of a building, in terms of energy usage in the building over its area expressed in kWh/sq. m/year. This is in contrast to GRIHA and LEED systems which are based on the design intent rather than actual performance. This programme rates buildings on a 1-5 star scale, with 5-Star labelled buildings being the most energy efficient. The different types of buildings that are rated include office buildings, hotels, hospitals, malls and IT parks. Buildings with 100kW load and above would be considered for a BEE rating scheme.

So far, about 150 buildings have been rated under various categories. The Reserve Bank of India's buildings in Delhi andBhubaneswar, the CII Sohrabji Godrej Green Business Centre and many other buildings have received BEE 5 star ratings.

A star labelling portal www.beestarlabel.com provides the information on the labelling scheme.

6. Building Energy Efficiency Project

The Indo-Swiss Building Energy Efficiency Project (BEEP) is a bilateral cooperation between the Ministry of Power (MoP), Government of India and the Federal Department of Foreign Affairs (FDA) of the Swiss Confederation.[52] It is one of the several bilateral or multilateral agencies working on building energy efficiency projects, such as the United Kingdom's Department for International Development (DFID), European Union (EU), Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), and the United States Agency for International Development (USAID).

BEEP is designed to complement the BEE's programme on building energy efficiency and is focussed on developing and mainstreaming new methodologies, codes , guidelines and tools to design energy efficient buildings; creating awareness and building technical capacities; and testing of new technologies/products. BEEP follow-up phase will specifically aim at outreach activities to mainstream the outputs of the project to achieve a larger impact on the reduction in energy consumption in buildings..

The project has four components:

A. Building Design

- Technical design assistance for energy efficient design
- Performing on-site monitoring of energy efficient buildings
- Awards for energy efficient buildings

B. Building Technology

- Promoting design innovation and market development of external movable shading system
- Developing competencies for testing and application of building insulation materials

C. Building Policy

- Technical support for the development of Eco-Niwas Samhita 2018*
- Support for implementation of the Eco-Niwas Samhita 2018 in 3 states (Rajasthan, Gujarat, and Andhra Pradesh)

D. Outreach & Awareness

- Annual BEEP Camp for graduate students and educators
- Training programmes for professionals and government agencies
- Outreach material- Films, tools, webinars, guidelines, manuals and case studies
- Media workshops and fellowships to facilitate informed reporting on building energy efficiency

[52] https://www.beeindia.gov.in/

7. Ratings Systems for green buildings

Internationally, voluntary building rating systems have been instrumental in raising awareness and popularizing green design. Rating systems are a type of building certification system that rates or rewards levels of compliance or performance; and are expected to benefit the community at large by improving the environment.[53]

In the case of India, there are three primary rating systems: Green Rating for Integrated Habitat Assessment (GRIHA) which evaluates the environmental performance of a building holistically over its entire life cycle, LEED (a US based rating system) and BEE (The Bureau of Energy Efficiency formed under the Energy Conservation Act of 2001).

A. GRIHA:

The Green Rating for Integrated Habitat Assessment (GRIHA) system was initially conceived and developed by The Energy & Resource Institute (TERI), New Delhi, as TERI-GRIHA which has been modified to GRIHA as a National Rating System by TERI and the Ministry of New and Renewable Energy (MNRE). The system was developed keeping in view of the Indian agro-climatic conditions and, in particular, the larger proportion of non-AC buildings. It is suitable for all kinds of building in different climatic zones of the country.

GRIHA takes into account the provisions of the National Building Code 2005, the Energy Conservation Building Code 2007, local bye-laws, other local standards and laws. It can be applied to new and existing building stock of varied functions – commercial, institutional, and residential.

Scoring points for GRIHA

GRIHA has a 100 point system consisting of some core points are mandatory and the rest optional points, which can be earned by complying with the commitment of the criterion for which the point is allocated. The innovation points are available over and above the 100 point system. The rating system is as follows:

★ 50–60 One star ★★ 61–70 Two stars ★★★ 71–80 Three stars

★★★★ 81–90 Four stars ★★★★★ 91–100 Five stars

(https://www.grihaindia.org/)

B. IGBC:

The Leadership in Energy & Environmental Design (LEED) was developed by the U.S. Green Building Council (USGBC) in 2000 to certify green buildings. The LEED framework assesses building performance against set criteria and standard points of references. The Confederation of Indian Industry (CII) formed the Indian Green Building Council (IGBC) in 2001, as a non profit research institution, which has licensed the LEED Green Building standards from the USGBC. Subsequently, the IGBC in 2014 developed its own rating system called IGBC ratings. The LEED India rating systems are available for new construction, green homes, green factory buildings, green special economic zones (SEZ) and green townships. The IGBC rating criteria vary according to the building considered, and the different certificates are 'Platinum', 'Gold', 'Silver' and 'Certified'.

More information on IGBC rating systems can be obtained from their website: https://igbc.in/igbc/redirectHtml.htm?redVal=showratingSysnosign#IGBC%20Rating%20Systems

[53] https://greencleanguide.com/three-primary-rating-systems-for-green-buildings-in-india/

Source: Brochure on Indo-Swiss Building Energy Efficiency Project

C. EDGE:

The Excellence in Design for Greater Efficiencies (EDGE) is an innovation of the International Finance Corporation, a member of the World Bank group, launched in 2014 for green building certification.[54] It aims to bring speed, market intelligence and investment focus to the next generation of green building certification in more than 170 countries. EDGE includes a cloud-based platform to calculate the costs of going green and utilities savings. The state-of-the-art engine has a sophisticated set of city-based climate and cost data, consumption patterns and algorithms for predicting the most accurate performance results. A global network of certifiers and accredited EDGE Experts support the collective ambition to mainstream green buildings and help fight climate change.

[54] https://edgebuildings.com/about/about-edge/

IFC helps to create a cycle of supply and demand in emerging markets for resource-efficient building design, construction and ownership through its Green Buildings Market Transformation Program (GBMTP). The aim is to set a metrics-driven definition of what constitutes a green building, reward property developers for building green, increase regulatory pull and promote direct investment. The GBMTP is part of IFC's strategy to steer construction in rapidly urbanizing economies onto a more low-carbon path.[55]

Key questions that can be raised by the media

1) How can you track a country's compliance with international programmes and goals?
2) How often are the rating systems updated in India?
3) Are there any incentives, or alternatively, disincentives, for not complying with use of the star-rated appliances?

The launch event of Media Engagement program on Energy Efficient Buildings held in New Delhi, September 09, 2019

Inaugural session of the Media Engagement Workshop on Energy Efficient Buildings held in Jaipur, Rajasthan, November 04, 2019

[55] https://edgebuildings.com/about/ifc-and-green-buildings/

05 Success Stories

Indira Paryavaran Bhawan, Delhi
The Indira Paryavaran Bhawan is the headquarters of the Ministry of Environment, Forests & Climate Change in Jorbagh in New Delhi. It is, in theory, a net zero building, meaning that it has zero net energy consumption where the total amount of energy used in the premises each year is more or less equal to the amount of renewable energy created on the site.

Effective ventilation has been achieved by orientating the building in an east-west direction, separating different blocks with connecting corridors and having a large central court yard. The design is such that 75 per cent of natural daylight is utilized to reduce energy consumption.

With an installed capacity of 930 kW peak solar power, the building has one of the largest roof top solar system among multi-storied buildings in India.

Green materials were used, for example, fly ash bricks, regional building materials, materials with high recycled content, high reflectance terrace tiles and rock wool insulation of outer walls.

According to a UNDP report,[1] the building achieved total energy savings of about 40% with an innovative and efficient air conditioning system.

67.3 per cent reduction in energy consumption as compared to GRIHA benchmarks has been achieved. This is a five-star GRIHA-rated building.

There are also several case studies of energy-efficient building design, under the BEEP project, which have helped reduce energy consumption. Some examples include:

Aranya Bhawan, Jaipur

Aranya Bhawan[56], the office building of the Rajasthan Forest Department in Jaipur, was one of the first projects under BEEP. It was implemented by the Rajasthan State Road Development Corporation Limited and inaugurated in March 2015.

In hot and composite climates, incorporation of simple energy-efficiency measures, such as, insulation of roof and walls, use of double glazed windows and efficient air-conditioning system, has the potential to reduce the energy consumption significantly. In the case of Aranya Bhawan, a reduction of 32% in the annual electricity consumption is estimated through the adoption of these measures.

The roof is insulated with polyurethane foam (PUF) to reduce heat transfer. A light-coloured terrazzo tile finish reflects some of the solar radiation falling on the roof slab. Extruded polystyrene (XPS) material is used in the cavity walls to reduce heat transfer.

And the windows use two panes of glass with an air gap in between, which acts as an insulation. The lower outer pane also reflects heat back to the outside.

The air-conditioning uses a centralized high-efficiency water cooled chiller, which uses less energy compared to an air-cooled system, the building. Treated waste water is used sued for this system.

Aranya Bhawan has installed a grid-connected roof-top solar photovoltaic system with net metering.

The building has achieved annual electricity savings of 3,40,000 kWh or 44% energy savings, with a mere 2% increase or an increase of Rs 60 lakhs in the cost at 30.6 crores sans the cost of solar photovoltaic system.

[56] Indo-Swiss Building Energy Efficiency Project (BEEP) Case Study: Aranya Bhawan, Jaipur

Jupiter Hospital, Pune

Jupiter Hospital[57], Pune, is a 350-bed multi-specialty hospital, which was completed in December 2016.

It uses 100 mm extruded polystyrene (XPS) insulation on roof and has walls built up of AAC blocks with better insulating properties, an energy-efficient air conditioning system with heat recovery, and other advanced features.

It is estimated to have 16% energy savings; 637920 kWatts hour annual electricity savings.

India International Institute of Democracy and Election Management (IIIDEM), New Delhi

[58]The India International Institute of Democracy and Election Management, New Delhi, is an advanced resource centre for learning, research, training, and extension for participatory democracy and election management.

In the institutional block, dry stone cladding with air gap and insulated glazing were used to reduce heat gain inside the building. Non-occupied spaces such as the staircase, machine rooms and toilets were to the south-west of the building. The complex uses high-performance water-chilled coolers; solar hot water generation for the kitchen and renewable energy generated through roof-top solar photovoltaics.

The building is estimated to have 28.5% energy savings or approximately 377460 kWh annual electricity savings.

[57] Indo-Swiss Building Energy Efficiency Project (BEEP) Case Study: Jupiter Hospital, Pune

[58] Indo-Swiss Building Energy Efficiency Project (BEEP) Case Study: India Internatonal Institute of Democracy and Election Management (IIIDEM), Delhi

Smart Ghar III, Rajkot

The Smart Ghar III project is part of an affordable green housing project in Rajkot under the Pradhan Mantri Awas Yojana, to be implemented by the Rajkot Municipal Corporation. Rajkot falls under the composite climate zone with peak summer daytime temperature reaching 41-43 degrees Celsius. Rajkot also has a good wind speed which can be utilized to achieve better thermal comfort at night.

The building project aims at reduced heat gains through the building envelope, i.e. the windows, walls and roofs; and to utilize the potential of natural ventilation for better cooling and light. The walls are constructed with 'autoclaved aerated concrete' (AAC) blocks which are light-weight blocks with better thermal insulation. Walls, especially those on the southern and western sides which are the hotter surfaces, have cavity walls, which are constructed with AAC blocks with air cavity. The roof has high reflective china mosaic finish, which reflects the sun's heat falling on it, thus reducing heat gains from the roof on the top floor. Instead of sliding windows, casement windows are used. The casement windows provide better natural ventilation, and enable 90% of the window area to be opened, compared to 65% in sliding windows. These windows are also partially glazed, instead of being fully glazed, to reduce solar heat gain through them while still providing adequate daylight inside. The window shutters are two-thirds opaque, which prevents heat from entering. In one of the towers of the project, an experimental assisted ventilation system has been installed by using the existing service shaft between two flats. The assisted ventilation system has a fan on top of the shaft, which creates negative pressure in the shaft, thus improving the air flow through the flats.

By adopting the energy efficiency measures it is estimated to reduce peak summer room temperature by >5°C, as well as increase the number of comfortable hours (those below 30°C) from ~2600 hours to ~6300 hours.

06 Reporting on Efficient, Comfortable and Affordable Buildings

Journalists are reporting more than ever on climate change, especially about its impacts, and ways to mitigate the impacts at national and local levels.

India's building sector is the second largest contributor to greenhouse gases that cause global warming and climate change, and yet the links with potential for climate change mitigation have not really captured the popular narrative or imagination.

Which is not to say that the building sector has not been reported on at all. The Indian media is reporting on buildings in a compartmentalised manner – that is, a particular aspect of buildings – but not connected the dots with climate change.

Examples of issues related to green buildings, even if in a disparate manner, reported on in the Indian media include:

- Impact of well-designed and comfortable buildings on the well-being and productivity of its occupants
- The Government of India's policies such as the national cooling mission, building code, or building energy conservation codes, model building bye-laws
- New Building Technologies: For example, resource efficient materials, new technologies (ventilation, shading, lighting, equipment, sensors & automation)
- Green construction technologies and sustainable development
- Green Buildings Ratings
- New incentives and initiatives on water and energy – use of renewable energy, especially solar energy in buildings, rain water harvesting, waste management, and improving air quality
- Role of Corporates – Corporate Social Responsibility and Sustainable Business Initiatives in the Construction Sector
- Stories of exceptional professionals
- Work of Educational and research institutes

There are several reasons for the limited and fragmented coverage of the topic in the media.

For one, while climate change is being reported widely in the media, the focus, understandably, has been on the sector that contributes the maximum emissions, which is the industrial sector in the case of India; the sector that is worst impacted, which is agriculture; and the topic that is visible to everyone for understanding, which is the shifting weather patterns. Buildings do not fit into these narratives, yet.

Another is the paucity of information on the sector.

A third is the technical – and dry – nature of the subject.

And there is also the difficulty in finding a human interest angle, apart from reducing one's electricity bills.

Pitching a news report on buildings will invoke varied levels of interest in a newsroom. In a typical newsroom, a building scam is of interest to news editors; as is a building collapse. Launch of a new building scheme may interest a few business sections, while the energy ratings of buildings is reported once in a while, usually by environment reporters.

The subject of energy-efficient buildings does not fall into a well-defined beat, but that could be turned to an advantage too. The topic thus offers scope for being reported from several perspectives – for example,

- environment, including impact on global warming by reducing greenhouse gas emissions; as well as heat island effect on cities
- energy savings and reduction in greenhouse gas emissions, all ultimately linked to mitigation of climate change.
- technology angle – new building materials, insulations materials, etc. as journalists can delve into their availability and their development.
- business story – new building programmes with novel, innovative features, real estate reports on demand for and sale of green buildings.
- policy angle – including building by-laws and their implementation and impact at the city or state level; energy codes, energy savings and certificates schemes
- interesting case studies of buildings and architects.
- construction sector and real estate angle, using new construction materials, technologies and designs and their cost implications and impact on the environment
- science and technology
- human angle, thermal discomfort during the summer months

5 General Tips for Reporting

Journalists can discuss energy efficient buildings in a variety of ways – short, focussed news item or new developments in the sectors; or lengthier features that present a larger picture, and present different angles, community voices, grass roots initiatives and data; or op-eds that offer scope for the journalist to explain his/her stand on the particular topic – for example, the need to reduce electricity consumption, or whether a government policy is working or not working and what the government or industry needs to do.

In addition to print media, broadcast media, especially the television, and online news publications with podcasts and videos; have broadened the scope for reporting. Today we live in a truly multi-media world where ideas, thoughts and stories are being conveyed not only through words but with pictures, sounds, video and graphics.

Irrespective of the nature of the news media, there are some generic issues relating to the challenges reporters generally face while reporting on green buildings.
Some of them are also relevant for gatekeepers in media organisations such as sub-editors and news editors.[59]

1 Simplifying Jargon

'Building energy efficiency' sounds highly dry and technical, bordering on jargon. So do the concepts and definitions that are included under this umbrella – such as thermal comfort and building envelope. Journalists should instead use simple words if possible, or combine them with explanations.

2 Acronyms

Acronyms may make sense to a person familiar with the subject but not to others. To those not familiar with the acronyms, their use may interrupt the flow of the narrative. In either case, it is the standard journalistic practice to always use the full form in the first reference – in this case, for example, Energy Conservation Building Code (ECBC) and National Building Code (NBC). If the second reference comes after a long gap, play safe and re-use the full form as the reader may have forgotten by then the full form.

3 Science and Technology

In a topic such as energy efficient buildings, journalists may often find themselves dealing with new building technologies and may be concerned that an excessive focus on technical aspects could not be of interest to readers. Sometimes too much science and technology can overwhelm readers or make a report dry and academic. One option is to simplify the technology and humanise it by adding a human interest angle to help readers identify with the situation. They need to do some fine-balancing – ensure that they do not lose track of the underlying science and technology or accuracy while offering the human angle.

4 Data

Sometimes journalists are bombarded with data, tables, charts, graphs and figures by building technology or policy experts and scientists. Pick the right data use to support or add value to the key point in the report. A graph or bar diagram can also help in visual presentation of the key point or a key trend to help the narrative.

In some cases, data itself may be so compelling that digging deep into it can yield a story – for example, data on increase or reduction in electricity bills; or rise in sale of air conditioners.

[59] #Write4Climate: Adapting to Climate Change in Rural India – A Manual for Media

5

Accessing resources

Building energy efficiency is a multi-sectoral topic that does not fit in the traditional 'beats' or subjects covered by journalists – for example, it deals with environment, power, construction and design sectors. Journalists may not find an all-in-one green building expert to quote, and one will have to depend on multiple sources of information and data; as well as multiple experts for comments. They can turn to available journals, databases of experts, list of conferences and meetings, or develop their own list, to write their reports.

- **Journals, newsletters, websites:** Keeping track of professional, peer-reviewed national and international journals' annual reports of the concerned research institutes and government departments and/or ministries; websites of all concerned organisations helps journalists with facts and figures on their subject of interest. It would be worthwhile to prepare a list of international, national, state and local organisations dealing with the subject. For example, the International Energy Agency, GABC, Ministry of Power, Bureau of Energy Efficiency and well-known architects and builders associations.

- **Conferences:** Conferences, lectures, seminars, symposia, and even exhibitions help journalists not only gain useful insights into a topic, but also help them connect with experts, scientists, technologists, policy makers, companies and grass-root organisations and non-government organisations. New research results; company initiatives and business development plans; and policy perspectives with pros and cons of a government initiatives often emerge from such fora.

- **Media training workshops:** Attending media training workshops on the specific subject of interest helps in several ways – gaining comprehensive overview of the subject, clues on possible news angles, and access to policy experts and resources.

- **Social media:** Social media, including Facebook, Twitter and Instagram, have emerged both as sources of news and vehicles for dissemination of one's own reports for wider reach. Several organisations, experts, government departments, officials, ministers, news outlets, research journals and international agencies use these platforms regularly to either gather or disseminate information on events, press conferences, release of new reports, experts to quote, as well as emerging debates on the topic. However, journalists should also guard against fake news spread through social media and do a fact-check if they are uncertain about the source of the information.

- **Networking:** The number of journalists covering green buildings globally and in India is growing and so joining as members of formal and informal networks helps. These could include mailing lists of national and environmental environment journalists groups, associations and federations. One could also consider forming a separate group devoted to discussions, and sharing tips and stories on green building issues. Examples of environment journalists associations include Society of Environment Journalists, Forum of Environment Journalists in India, International Federation of Environment Journalists, Earth Journalism Network.

Examples of reports on Green and Efficient Buildings

1) **Headline: Covid pandemic offer a chance to construct better buildings for the future. But will we?**

Source: India Today

Key message: The coronavirus pandemic has disrupted the world economy, but as countries devise revival strategies, they have an opportunity to think intelligently and follow a development path that is energy efficient, sustainable and climate friendly.

Link: https://www.indiatoday.in/news-analysis/story/coronavirus-pandemic-green-buildings-construction-energy-efficiency-climate-change-1733426-2020-10-20

2) **Headline: Around 60 per cent of energy efficiency expenditure helps create employment**

Source: Economic Times

Key message: The article cites a recent report of the International Energy Agency on energy efficiency and economic stimulus and then quotes an expert from The Energy Research Institute (TERI) who says that post COVID-19, India may focus on energy- efficient buildings, including retrofits, technology replacement and adoption of energy efficient appliances to create more jobs.

Link: https://energy.economictimes.indiatimes.com/news/power/around-60-per-cent-of-energy-efficiency-expenditure-helps-create-employment/75215135

3) **Headline: Cleaner, greener homes must be the top priority after Covid-19**

Key information from article: Upgrading existing homes and making sure new buildings are up to scratch are key to post-pandemic prosperity.

Link: https://www.businessgreen.com/opinion/4016950/cleaner-greener-homes-priority-covid-19

4) **Headline: Climate, Covid-19 and the economics of decarbonising buildings**

Key information from article: The coronavirus outbreak likely will force government and business leaders to rethink their strategic planning for real estate assets. There are significant net zero, electrification and decarbonization policies globally that can help direct innovative best practices in new construction in the post-COVID-19 era.

Link: https://www.greenbiz.com/article/climate-covid-19-and-economics-decarbonizing-buildings

5) **Headline: CII Indian Green Building Council announce plan to promote building energy efficiency in India**

Key information from article: The report provides some basic information plans to promote energy-efficient buildings in India and rating systems.

Link: https://www.thehindubusinessline.com/news/real-estate/cii-indian-green-building-council-announce-plan-to-promote-energy-efficient-buildings-in-india/article29314333.ece

6) Energy efficient buildings increase return on your realty investment

Key information from article: This article explains how it is possible to reduce one's electricity bills by adopting energy efficient measures. It explains how initial higher construction costs can be offset later by lower operating and maintenance costs in the long run. It has interviews with both a resident who bought an energy efficient flat without much knowledge of these concepts, and was pleasantly surprised with his savings; as well as interviews with those engaged in real estate business.

Link: https://economictimes.indiatimes.com/wealth/real-estate/energy-efficient-buildings-increase-return-on-your-realty-investment/articleshow/35554103.cms?from=mdr

7) Headline: Green buildings could be the solution to local and global problems

Key information from article: It is an example of an Opinion piece in which the author explains why the state of West Bengal should actively promote energy efficient buildings.

Link: https://www.telegraphindia.com/opinion/green-buildings-could-be-the-solution-to-local-and-global-problems/cid/1703498

8) Headline:Building a sustainable future: why energy efficiency is everybody's business

Key information from article: It offers good policy analysis and various certification schemes in the UK. Its key discussion points include different policies in the UK, which are aimed at improving the energy efficiency of commercial buildings and more in the pipeline.

Link: https://www.theguardian.com/sustainable-business/2014/nov/13/energy-efficiency-buildings-business

9) Headline: Inside Shanghai Tower: China's tallest skyscraper claims to be world's greenest

Key information from article: But most importantly, the 128-storey tower also claims to be the world's greenest skyscraper. Awarded the top green rating, LEED Platinum, the government is hailing the tower as a sign of China's growing green credentials.

The building collects rainwater and re-uses waste water, has a combined cooling and heating power system and uses 40 other energy-saving measures that developers claim cut 34,000 metric tonnes from its annual carbon footprint. The building is wrapped in two layers of glass for natural cooling and ventilation, and in total developers say a third of the site is "green space", including 24 sky gardens sitting between the two skins.

Link: https://www.theguardian.com/cities/2016/aug/23/inside-shanghai-tower-china-tallest-building-green-skyscrapers

10) Headline: In Singapore, a Home That's Naturally Green

Key information from the article: To generate more power than it consumes, B House catches the rays of Singapore's tropical sun with large rooftop solar panels. They can generate roughly twice the energy that a family of five requires, according to the project architect. Both five-bedroom homes are clad in reconstituted timber and use largely recyclable materials throughout. Swales on the home's periphery capture rainwater for lawn plants and toilets.

Link: https://www.nytimes.com/2016/04/01/realestate/in-singapore-a-home-thats-naturally-green.html

11) Using physics to design energy-efficient buildings

Key Information from article: It is a three-in-one science feature – profile of a senior professor who trained in physics and then moved to architecture, his work and explanation of how he uses natural light to illuminate the building interiors, and make them more comfortable and energy efficient.

Link: http://news.mit.edu/2018/mit-architecture-christoph-reinhart-using-physics-to-design-energy-efficient-buildings-0116

12) One Angel Square, Manchester, UK

Headline: Co-op's headquarters declared greenest building in the world

Key information from article: The eco-friendly features of the building, which was constructed by BAM, includes power generated from crops grown on the group's farms; the building has a rainwater harvesting and recycling system, a heat recovery system to collect and recycle waste heat, and 300,000 square feet of exposed concrete that acts as a thermal sponge.

Link: https://www.manchestereveningnews.co.uk/business/property/co-ops-headquarters-declared-greenest-building-6301000

13) Powerhouse, Kjorbo, Norway

Headline: Snøhetta's Energy Positive Powerhouse Kjorbo Opens its Doors

Key information from article: Snøhetta installed geothermal energy wells. These work year round to naturally draw warm and cold air to regulate temperatures in the building. New, tight fitting windows and exterior and interior sun shading will help to keep temperatures cool, naturally, in the summer, as well as permit natural daylighting. The office interior's modern face lift fosters a better working environment complete with spiral staircases that double as ventilation shafts.

Link: https://inhabitat.com/snohettas-energy-positive-powerhouse-kjorbo-opens-its-doors/

14) Olympic House, Lausanne, Switzerland

Headline: Olympic House becomes one of the most sustainable buildings in the world

Key information from article: One of the three certifications is LEED Platinum, the highest certification level of the international LEED green building programme. According to the U.S. Green Building Council (USGBC), the organisation that developed LEED, Olympic House has received the most points (93) of any LEED v4-certified new construction project to date. It signifies that a building is lowering carbon emissions and conserving resources while prioritising sustainable practices and creating a healthier environment. LEED Platinum is the highest level of certification possible.

Link: https://www.olympic.org/news/olympic-house-becomes-one-of-the-most-sustainable-buildings-in-the-world

Other suggested readings:

15) Headline: Covid-19 Stimulus Spending for Green Construction Means Building Back Better

Source: Guest article for the International Institute for Sustainable Development, Canada

Key information from report: The report says the global Covid-19 crisis provides a unique opportunity to shift the course of the building sector and earmark investments for green construction. By setting smart and effective criteria for green buildings, short-term stimulus packages can become a double tool for economic recovery and environmental sustainability.

Link: https://sdg.iisd.org/commentary/guest-articles/covid-19-stimulus-spending-for-green-construction-means-building-back-better/

16) Headline: The Covid-19 Crisis and Clean Energy Progress

Source: International Energy Agency

Key information from article: This report explains how economic stimulus efforts in the wake of the global Covid-19 crisis could help reshape the built environment to advance the clean energy transition and avoid locking in inefficient and high-emitting technologies. Governments can prioritise policies to promote highly efficient building construction methods and in-depth retrofitting, as these operations are particularly labour-intensive, provide long-term value, and steer activity in many equipment and material manufacturing domains.

Link: https://www.iea.org/reports/the-covid-19-crisis-and-clean-energy-progress/buildings

17) Headline: The case for green buildings in the Covid-19 recovery

Source: Euractive.Com

Key information from article: Europe's buildings are mostly old and inefficient, and the way we use them is changing as our economies and lifestyles shift in a world recovering from COVID-19.

Link: https://www.euractiv.com/section/energy/opinion/the-case-for-green-buildings-in-the-covid-19-recovery/

18) Headline:The Renovation Wave: An opportunity to scale-up real energy savings through energy management

Key information from article:After the worldwide COVID-19 crisis, which has heavily affected the European economy, Europe needs to find cost-effective solutions to achieve its 2050 climate targets. This has put an emphasis on the renovation wave that recognises that the building sector has a huge untapped potential in terms of both energy and emissions savings.

Link: https://www.euractiv.com/section/energy-environment/opinion/the-renovation-wave-an-opportunity-to-scale-up-real-energy-savings-through-energy-management-and-energy-efficiency-services/

Glossary

Adaptive Thermal Comfort: Adaptive thermal comfort is a theory that suggests a human connection to the outdoors and control over the immediate environment allow them to adapt to (and even prefer) a wider range of thermal conditions than is generally considered comfortable.

BEEP: The Indo-Swiss Building Energy Efficiency Project (BEEP) is a bilateral cooperation between the Ministry of Power (MoP), Government of India and the Federal Department of Foreign Affairs (FDA) of the Swiss Confederation.

Building Envelope: The building envelope is the interface between the indoor spaces of a building and the outdoor environment. The opaque components of the envelope consist of walls, roofs, slab on grade (in contact with the ground), basement walls, and opaque doors; the fenestration component comprises mainly windows and ventilators

Climate: Climate refers to the long-term regional or even global average of temperature, humidity and rainfall patterns over seasons, years or decades.

Global warming: Global warming refers to the long-term warming of the planet since the early 20th century, and most notably since the late 1970s, due to the increase in fossil fuel emissions since the Industrial Revolution. Worldwide since 1880, the average surface temperature has gone up by about 1 °C (about 2 °F), relative to the mid-20th-century baseline (of 1951-1980). This is on top of about an additional 0.15 °C of warming from between 1750 and 1880.

Climate change: significant changes from one climatic condition to another, commonly referring to the increase in Earth;s surface temperature caused by human activities.

Energy Efficiency: A reduction in the amount of energy needed to provide the same amount of heating, cooling or other energy service from different sources, appliances or systems (WWF Nature, Aus)

The Energy Efficiency in Emerging Economies (E4) Programme: It was established by the International Energy Agency (IEA) in 2014 to support emerging economies in their efforts to scale up and capture the benefits of energy efficiency. Energy efficiency offers all of the benefits of a clean, domestic energy source for emerging economies, including improved energy security, higher productivity, and enhanced economic development.

Energy Performance Index (EPI): It means the total energy consumed in a building over a year divided by total built up area in kWh/sq m/year.

Global Alliance for Buildings and Construction (GABC): The Global Alliance for Buildings and Construction (GlobalABC) is an international alliance that works towards the Paris Agreement Goals of limiting global warming to well below 2°C. It is *hosted by UN Environment's Economy Division.* Its motto is "Towards a zero-emission, efficient and resilient buildings.

Greenhouse Gas (GHGs): The greenhouse effect is the way in which heat is trapped close to the surface of the Earth to create a warm layer, much like a greenhouse that creates warmer conditions for plants growth. These heat-trapping gases, called greenhouse gases, include carbon dioxide, methane, sulphur and nitrous oxides.

National building Code (NBC) 2016: The National Building Code of India (NBC), a comprehensive building Code, is a national instrument providing guidelines for regulating the building construction activities across the country

Nationally Determined Contributions (INDCs): Intended Nationally Determined Contributions (INDCs) identify the post-2020 voluntary national climate targets, including mitigation and adaptation, which countries committed to and which will become a binding Nationally Determ

Paris Agreement: At the 21st annual international UN Conference of Parties on climate change (COP 21) in Paris, on 12 December 2015, the countries under the United Nations Framework on Climate Change Convention (UNFCCC) reached a landmark agreement to combat climate change and to accelerate and intensify the actions and investments needed for a sustainable low carbon future. The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2 degrees Celsius above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5 degrees Celsius.

Prime Minister's Aawas Yojana (PMAY): Pradhan Mantri Awas Yojana is an initiative by Government of India in which affordable housing will be provided to the urban poor with a target of building 20 million affordable houses by 31 March 2022.

Smart Cities Mission: The Smart Cities Mission, launched by the Government of India on 25 June 2015, aims to promote sustainable and inclusive cities that provide core infrastructure and give a decent quality of life to its citizens, a clean and sustainable environment and application of 'Smart' Solutions, and create a replicable model for other aspiring cities. Some of the core infrastructure elements in a Smart City would include adequate water supply, assured electricity supply, sanitation, including solid waste management, efficient urban mobility and public transport, affordable housing, especially for the poor, robust IT connectivity and digitalization, good governance, especially e-Governance and citizen participation, sustainable environment, safety and security of citizens

Thermal comfort: It is perceived as the comfort of human beings under given room conditions. It is the condition of mind that expresses satisfaction with the thermal environment, and is more of a subjective evaluation.

Thermal Insulation: Thermal insulation is the reduction of heat transfer between objects in thermal contact or in range of radiative influence. Thermal insulation can be achieved with specially engineered methods or processes, as well as with suitable object shapes and materials.

UNFCC (United Nations Framework Convention on Climate Change): an international treaty that requires world governments to avoid dangerous levels of climate change.

Weather: Weather refers to atmospheric conditions that occur locally over short periods of time—from minutes to hours or days. Familiar examples include rain, snow, clouds, winds, floods or thunderstorms.

Further Readings

Links to Important websites:

International Websites:

1) American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) -- *https://www.ashrae.org*
2) Effin'Art Sàrl, Lausanne -- http://www.effinart.ch/
3) Energy Efficiency in Emerging Economies (E4) program -- https://www.iea.org/topics/energyefficiency/e4/
4) Global Alliance for Buildings and Construction (GABC) -- https://www.globalabc.org/
5) International Energy Agency (IEA) -- https://www.iea.org/
6) International Partnership for Energy Efficiency (Building Energy Efficiency Task Group https://ipeec.org/cms/16-buildings-energy-efficiency-task-group-beet-.html and their buildinsg page: https://ipeec.org/workstream/5-buildings.html
7) Swiss Agency for Development and Corporation -- https://www.eda.admin.ch/sdc
8) United Nations Framework for Convention on Climate Change (UNFCC) -- https://unfccc.int/
9) United Nations Development Programme (UNDP) – Implementing Energy Efficiency in Buildings in India compendium www.undp.org/content/dam/india/docs/ICEEB%202015_Compendium.pdf
10) United Nations Industrial Development Organisation (UNIDO) – Energy Efficiency in Buildings https://www.unido.org/sites/default/files/2009-02/Module18_0.pdf
11) World Resources Institute – Building Efficiency Initiative -- https://www.wri.org/our-work/project/building-efficiency-initiative

Indian websites:

1) Alliance for Energy-Efficient Economy --https://www.aeee.in/
2) BEEP—Indo-Swiss Building Energy Efficiency Project -- https://www.beepindia.org/
3) Bureau of Energy Efficiency (BEE) -- https://www.beeindia.gov.in/ &http://www.econiwas.com/
4) Central Electricity Authority (CEA) -- *cea.nic.in/*
5) Energy Conservation Building Code (ECBC) -- *https://beeindia.gov.in/sites/default/files/BEE_ECBC%202017.pdf*
6) Energy Efficiency Services Limited (EESL) – Building Energy Efficiency Programme -- https://eeslindia.org/content/raj/eesl/en/Programmes/Energy-Efficient-Buildings/about-energy-efficient-building.html
7) Greentech Knowledge Solutions Pvt. Ltd., -- https://www.gkspl.in/
8) India Cooling Action Plan -- *ozonecell.in/wp.../INDIA-COOLING-ACTION-PLAN-e-circulation-version080319.pdf*
9) Ministry of Environment, Forests and Climate Change (MoEFCC) -- http://moef.gov.in/
10) Ministry of Power (MoP) -- https://powermin.nic.in/
11) Ministry of Statistics and Programme Implementation (MOSPI) -- *www.mospi.gov.in/*
12) National Building Code, 2016 (NBC, 2016) --*https://bis.gov.in/?page_id=117159&lang=en*
13) Pradhan Mantri Awas Yojana (Urban) (PMAY) -- *https://pmaymis.gov.in/*
14) Shakti Sustainable Energy Foundation -- https://shaktifoundation.in/
15) Smart Cities Mission -- *smartcities.gov.in*
16) The Energy and Resources Institute (TERI) – Buildings – *https://www.teriin.org/buildings*
17) Net Zero Energy Buildings-- https://nzeb.in/
18) Centre for Advance Research on Building Science & Energy-- http://carbse.org/
19) Indian Green Building Council-- https://igbc.in/igbc/
20) Green Rating for Integrated Habitat Assessment (GRIHA)-- https://www.grihaindia.org/

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