Green Technologies and Practices
for
Smart Sustainable Cities

V Suresh
President, FOCUS
Vice Chairman, National Building Code of India
Former Chairman, IGBC, Former CMD, HUDCO
Chairman, Housing and Planning Committee and
Member, Smart Cities Committee of BIS

WFEO-CIC International Webinar on 'Green Technologies: Precursor for Transition to Smart Sustainable Cities'

Hosted by
Institution of Engineers (India) in association with **Institution of Engineers, Malaysia**

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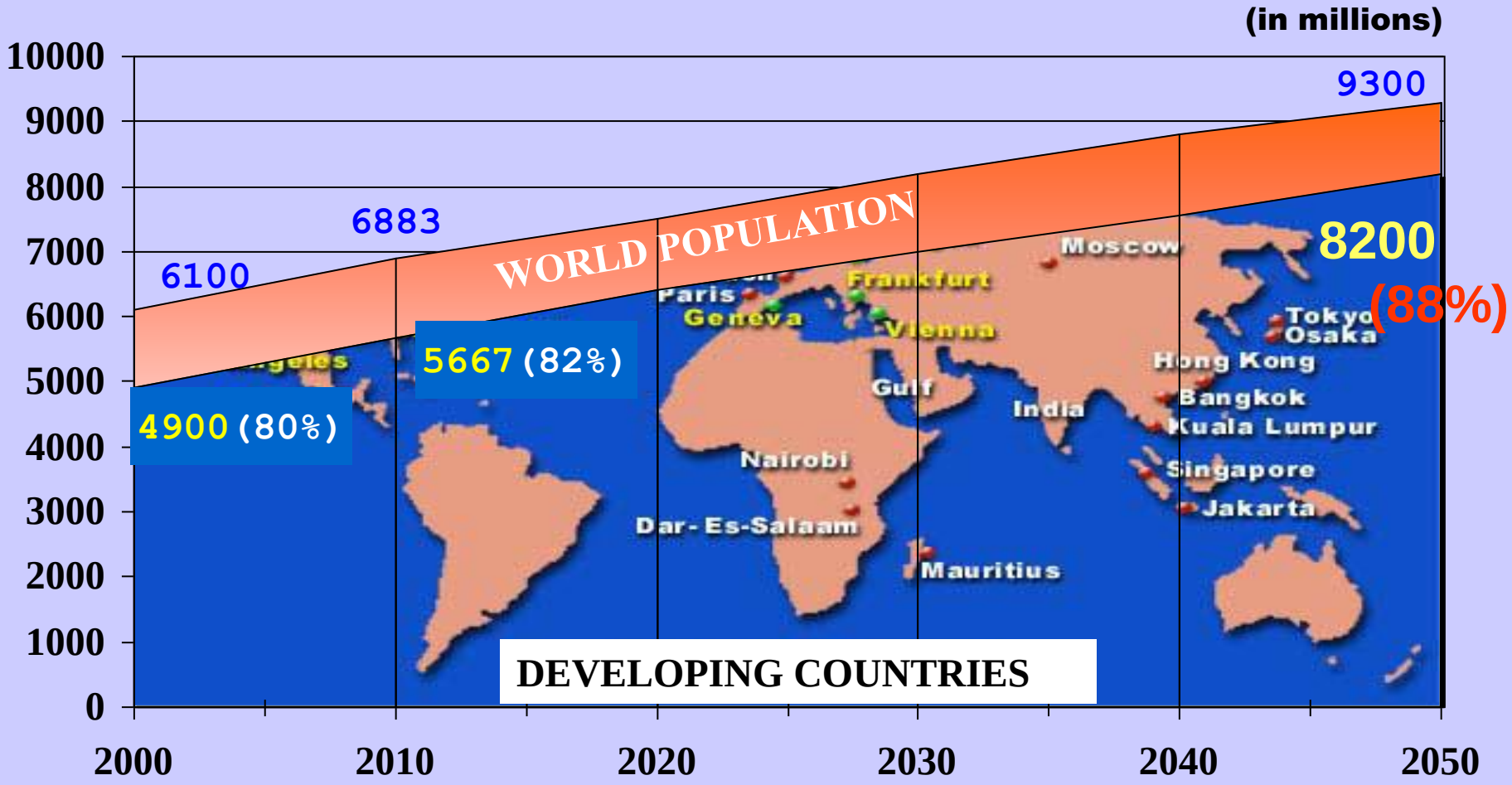
World Population Trends

Population in developing and lesser developed countries to be 88% of total population by 2050



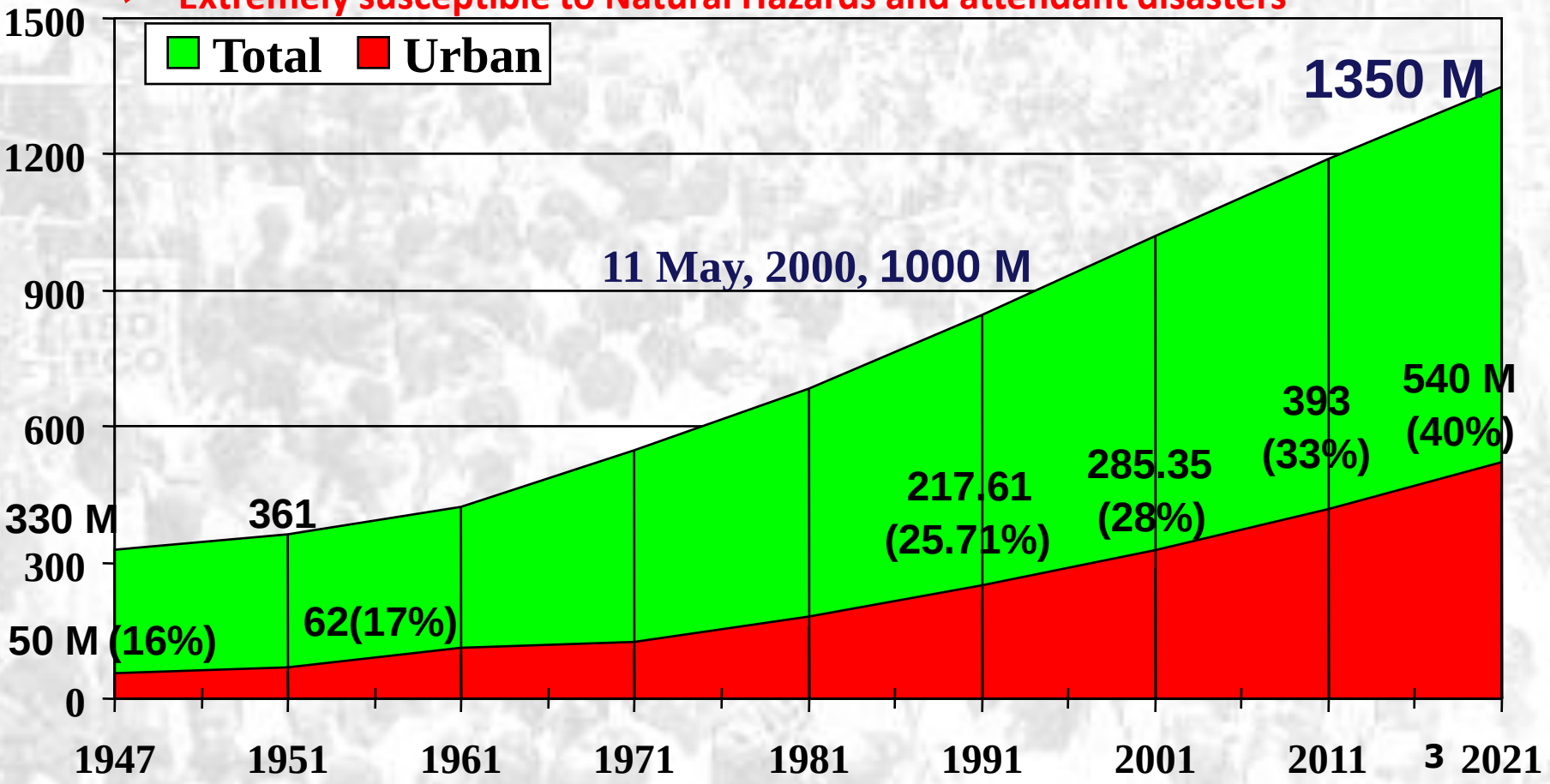
Source: UN Population Division; WORLD POPULATION PROSPECTS

Population Reference Bureau: WORLD POPULATION DATA SHEET

Urbanisation Scenario in India

Decadal Growth Rate of Population (1991-2001) **Urban:** 31.13% **Rural:** 17.97%

- ✓ 350 Million getting added in 2 Decades
- ✓ **Extremely susceptible to Natural Hazards and attendant disasters**



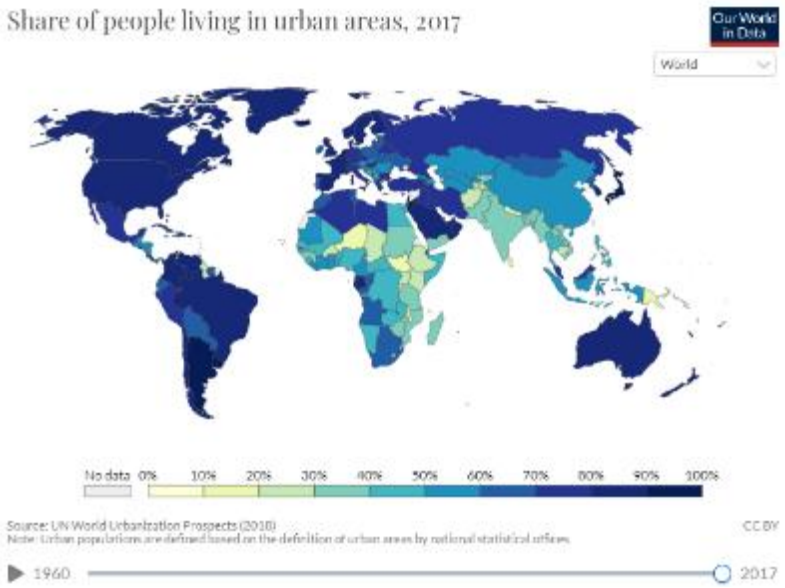
Cities and Growth Engines

- Recognised as cities make an important contribution to social and economic development at national and local levels.
- cities are important engines of economic growth – 70% GDP
- cities offer significant economies of scale in the provision of jobs, housing and services
- cities are important centres of productivity and social advancement

Green Buildings to 'Green Cities': The Need

❖ Global context

- ➢ **Migration to cities each year**
  - ❑ **70 million**
- ➢ **Increase in urbanization**
- ➢ **80% of Earth's population would be dwelling in cities by 2030**
  - ❑ **Asia, Africa, Latin America**



Source: www.indiabudget.gov.in/India on the Move and Churning: New Evidence

Source: ourworldindata.org/urbanization

IGBC

Confederation of Indian Industry

Green Buildings to 'Green Cities': The Need

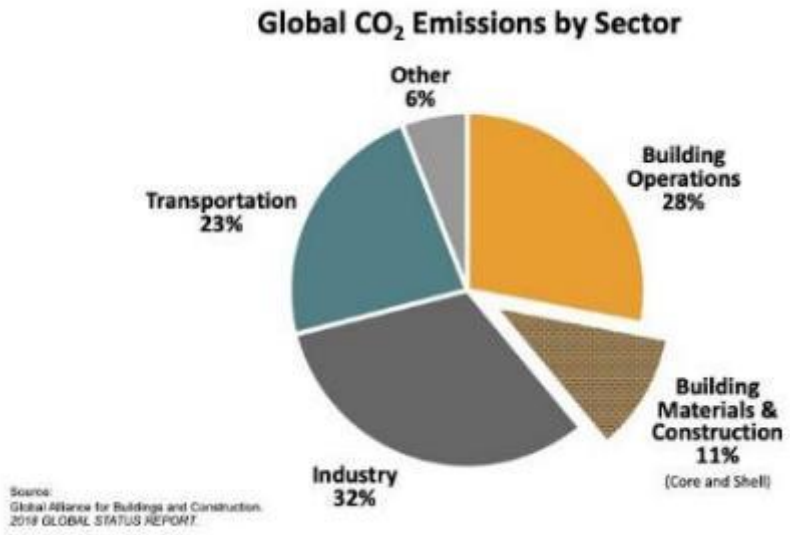
- **Indian context**
  - **35%+ of our current population live in urban areas**
    (Source: Ministry of Housing & Urban Affairs)
  - **Townships and Cities will increasingly grow**
    - **100 new cities by 2030 with population > 1 Million**
      (Source: India's urban awakening, McKinsey 2010)
    - **200 - 300 new townships expected in the next 10 years**

'70% of India is Yet to Be Built' in the next decade

For 590 million Urban population by 2030
(40 percent of India's population)

Building Construction sector contributing to GHG

- **Building & Construction sector a major contributor to global warming**
  - **25 – 40% of Global Energy Consumption**
  - **30 – 40% of Solid Waste Generation**
  - **30 – 40% of Global Green House Gas Emissions**
  - **20 – 30% of Water Pollution**



Thrust on Smart Cities

- The Government of India has launched the ambitious programme for 100 Smart Cities with funding from Government of India for Rs.48000 crores
- This would stimulate substantial Real Estate Development for residential, commercial and social infrastructure
- More importantly the physical infrastructure
- And Digital Infrastructure
- Total investments expected 1 trillion $

Imperatives for Promoting Resilient Construction

With a view to ensure that the massive financial resource investments for housing and other public asset buildings and infrastructure are safe, strong, durable and perform well during life cycle, it is essential that these are:

Flood protected

Cyclone
Typhoon resistant

Earth Quake Resistant

Land slide protected

Sea erosion protected
Tsunami protected

NBC of India 2016

Built around the philosophy of creating and maintaining Safe Built Environment for people and property by ensuring:

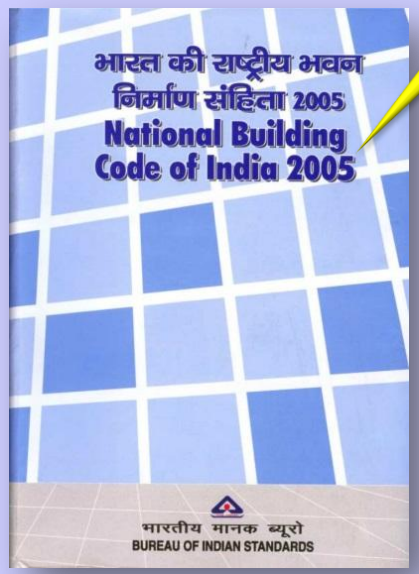
Structural Safety

(Part 2,3,6)

2016 version

Public Safety

(Part 3, 4)



Health Safety

(Part 3,9,10)

Life Safety

(Part 4,8)

Fire Safety

(Part 4)

Environment Safety

(Part 11)

Construction Safety

(Part 5,7,12)

Electric Safety

(Part 8)

Beyond Safety Consideration is the Green Movement

While the present Regulatory frame work deal with Built Environment for the three dimensional spaces and connected spatial development, these do not touch on:

- Environment
- Ecology
- Energy Consumption
- Quality of Life
- Sustainable Development

Enabling Framework in Part 11 of NBC of India 2016 - Approach to Sustainability

Indian Green Building Council (IGBC)

- **IGBC formed by CII in 2001**
  - CII - Apex Indian industry association formed in 1895
- **Vision of IGBC**
  - Enable 'sustainable built environment for all'
  - India to be one of the global leaders in sustainable built environment by 2025

The Key : Holistic Green Development in all forms of Built Environment

IGBC's *30 GREEN Rating Systems*

Commercial

1. IGBC Green New Buildings
2. IGBC Green Existing Buildings
3. IGBC Green Interiors
4. IGBC Green Data Centres
5. IGBC Net zero Energy
6. IGBC Net Zero Water
7. IGBC Green Resorts
8. IGBC Green Service Buildings

Residential

9. IGBC Green Homes
10. IGBC Green Residential Society
11. IGBC Green Affordable Housing

Transit

12. IGBC Green Metro Stations
13. IGBC Green Existing Metros
14. IGBC Green Railway Stations
15. IGBC Green High Speed Rail (HSR)

Built Environment

16. IGBC Green Campus
17. IGBC Green Cities
18. IGBC Existing Cities
19. IGBC Green Villages
20. IGBC Green Township
21. IGBC Green Landscape
22. IGBC Hill Cities

Education

23. IGBC Green Schools
24. IGBC Places of Worship

Industrial

25. IGBC Green Factories
26. IGBC Green SEZ
27. IGBC Logistics & Warehouses

Health & Wellbeing

28. IGBC Green Healthcare Facilities Rating (PC)
29. IGBC Healthy Building for Occupants
30. IGBC Net Zero Waste

Addressing the Holistic Approach :
Site, Water, Energy, Materials, Waste and Environmental Quality

*As on Dec 2020

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Green Building to Green Built Environment Movement in India since 2001

In 2001,
1 Green Building
20,000 sq.ft.

(7,120+ Green Projects)
8 Billion sq.ft.

10 Billion Square feet by 2022 (India @ 75)

90% of green buildings in India are facilitated by IGBC

IGBC

Rating programs **aligned with:**

MoEF
Government of India

BEE
Star Rating Programme

Energy Conservation
Building Codes (ECBC)

National Building Code
of India

Indian Green Building Council
Greening India since 2001

CII

Measurable Benefits in
IGBC Certified Green Projects across India

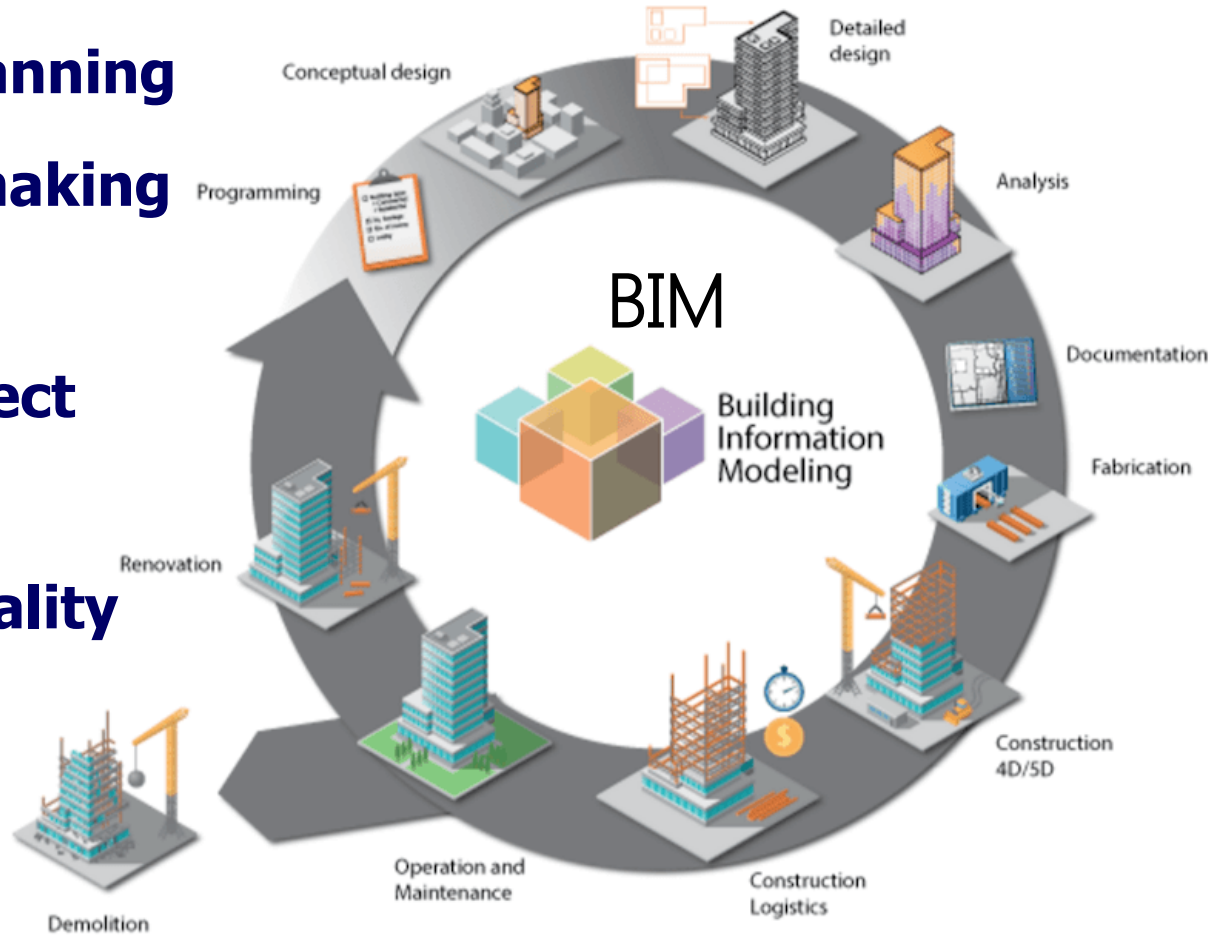
Environmental Benefit Category	Average Benefits /Million Sq.ft
CO_2 reduction	12,000 Tons
Energy savings	15,000 MWh
Water savings	45,000 KL
Construction waste diverted from landfills	450 Tons

Renewable energy, (Installed capacity*)	650 MW

*As on Dec 2021

Next generation of sustainable construction

- Highly Collaborative Approach
- Project Life-cycle planning
- Informed Decision making
- Right information at right time to all project stakeholders
- Improved overall quality
- Greater certainty over cost and time



Smart Solutions are an enabler for Sustainable Development

IGBC

'GreenPro' Certified Products and Materials

2100 + products certified

150+ companies registered

26 building product categories

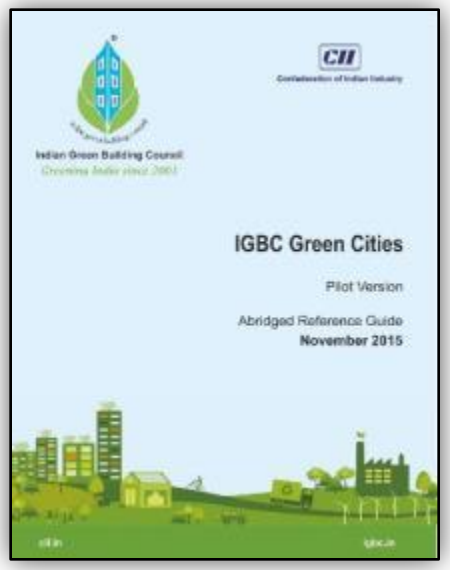
- **Sustainable**
- **Life-cycle enhancement**
- **Industrial & Agricultural waste based material**

International Accreditation: GreenPro Certification at par with global eco-labelling standards

Approach to Green Cities

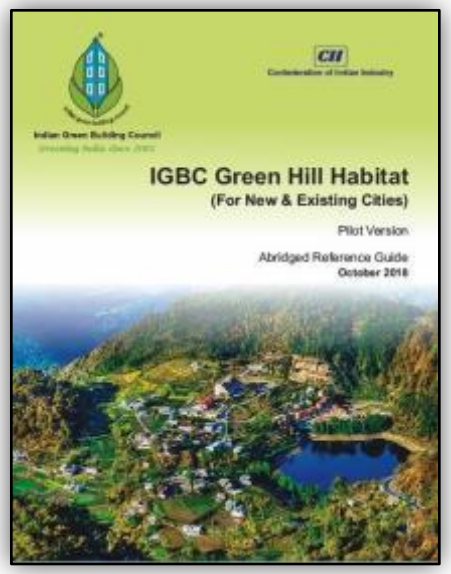
IGBC Green Cities Concept

- **Facilitate Indian cities to be converted to 'Green Cities'**
  - **Meeting national & international benchmarks for sustainable cities & communities**
- **To address national priorities**
  - **Land, Social, Transit, Air, Water, Energy, Waste,…**



For Greenfield Cities

For Existing Cities



For Hill Cities, Towns

IGBC Green Cities Rating is aligned with Govt. of India's Smart Cities Mission Objectives

Core infrastructure elements in a Smart City

- Adequate water supply
- Assured electricity supply
- Sanitation
- Solid waste management
- Efficient urban mobility & public transport
- Affordable housing
- Robust IT connectivity
- e-Governance
- Citizen participation
- Sustainable environment
- Safety and security of citizens
- Health and education

Smart Cities are also Green Cities !

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Green Cities Assessment Matrix

G R E E N

S M A R T

Safety & Security

- Citywide surveillance system
- Data Centre
- Cyber Security
- Disaster Recovery

E-Governance

- Command Control Centre
- Smart Parking
- Smart Bus Stops
- Smart Anti Hawking
- 24x7 Service Desk – Infrastructure monitoring

Smart Infrastructure

- Public Bike Sharing (PBS)
- Smart Bins
- Smart Irrigation system
- Smart Power Grid System
- Water SCADA

Citizen Services

- Common Payment Card
- Citizen Mobi-Connect
- Grievance Management
- Online provision of services
- Wi-Fi enabled public spaces
- Info Kiosks

Real-time performance tracking

- City Performance Dashboard
- Automatic vehicle tracking
- Real Time Travel Response
- Fleet Management

Key Features of IGBC rated Green Townships & Cities

1. Mixed use Development – Walk to Work

- **Mixed land use development (combination of commercial, Residential, retail , institutional etc.,)**
  - **To facilitate sharing of infrastructure and reduce urban sprawl**
  - **TOD**

2. Water Management

- **Invest on 100% Waste Water Treatment & Reuse**
  - **90% of treated water to be reused for Flushing, Public landscape irrigation & Agriculture.**

Purple lines to convey treated water

- **100% On-site Rainwater Harvesting**
  - **Reduces dependency on municipal water supply and improve water table**
- **ZLD**

Rain water harvesting Pond

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3. Towards 'Zero Solid Waste'

- **Solid waste management**
  - Home / community level
  - Recycle waste based on Waste management hierarchy
- **Waste to Wealth**
- **Trash to Cash**
- **Refuse to Resource**

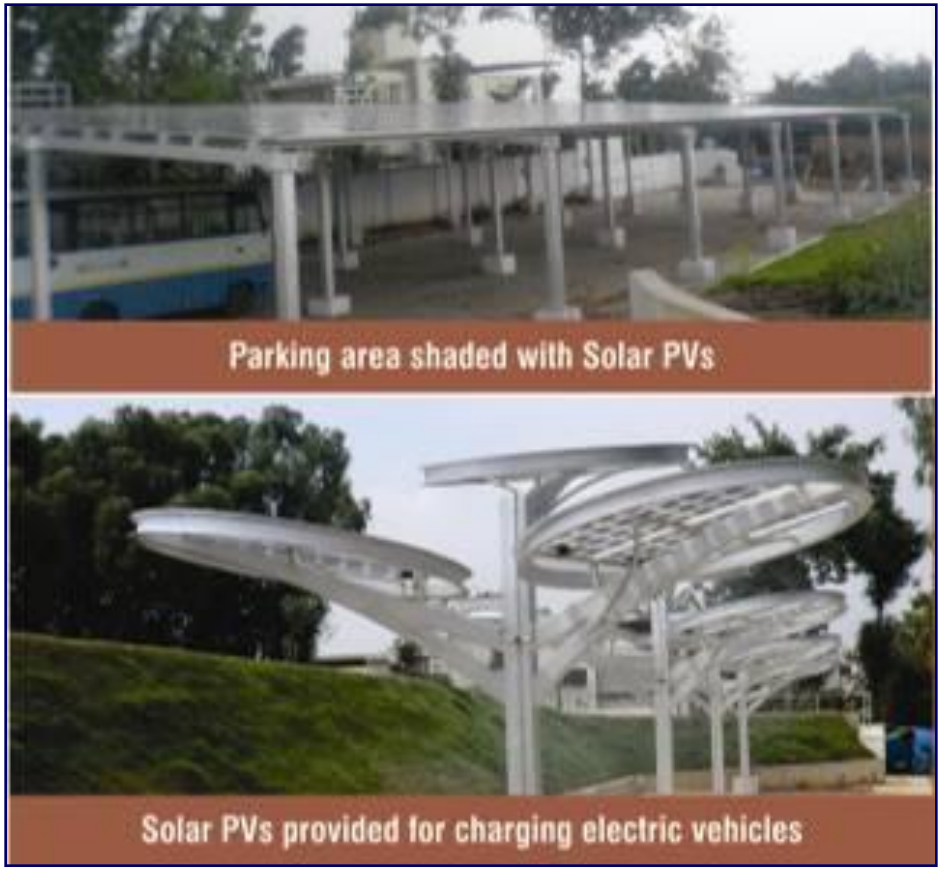
Segregation at source

Waste to Wealth, R

4. Sustainable Mobility

- Plan for BRTS/ Mono rail / Light rail / Metro rail or combination of above from day 'one'
- Develop World-class Non-motorized Infrastructure
  - Footpaths, Bicycle lanes etc.
- EV Ecosystem
- Fuel : Biodiesel, BioCNG, e-charging

Eco-friendly Commuting Practices



Mahindra REVA Factory

IGBC Platinum

Alternative Fuel Vehicle & Car pooling

Beary's Group Research Triangle

IGBC Platinum

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5. Design for maximum Green Cover

- **Develop Public Landscape Area of atleast 9 Sq.m per person**
  - **As per WHO standards**

National Park, Singapore

- **Dedicate space for Urban Agriculture to promote local food production**

Roof top Food production Courtesy: Biome

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6. Maximum Energy Efficiency

- **By regulation, 100% of buildings to be designed as energy efficient buildings**
  - **Energy Conservation Building Code (ECBC)**

7. Renewable Energy

- More than 15% of total electricity demand of city to be catered by Renewable energy
- By 2030, RE will take care of 50% of Energy needs – 550 GW
- National / International Example
  - Germany – 27% electricity demand met by renewable systems
  - Target for 2050 – 80% from renewable systems

Wind farm in Germany

Indian Green Building Council
Greening India since 2001

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Green Features in

Cities Going Green

IGBC® GREEN CITY
INDIAN GREEN BUILDING COUNCIL
Dholera SIR
Dholera Industrial City Development Limited
PLATINUM
2016

dholera
INDUSTRIAL CITY DEVELOPMENT LTD

India's First
IGBC Platinum
Green City

Dholera City : Sustainable Approach towards Evolution of a Low Carbon City

1. Green Infrastructure

Activation Area - 22.54 sqkm

ROADS – 58 KMS

DRAINAGE (Canal)- 3.5 km

PIPELINES – 400 KMS

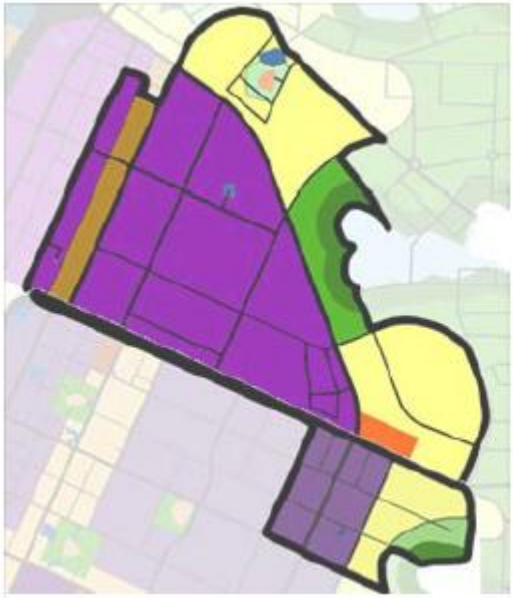
STP – 20MLD

CETP – 35MLD

BUNDS – 15 KMS

POWER TRANSMISSISON LINES – 38 KMS

ICT NETWORK – 300 to 400 kms



Trunk Infrastructure in AA Includes:

- Roads and Underground Services
- Potable Water: Desalination Plant
- Sewage: CETP and STP (Recycle Plants)
- Storm water: Collection and Disposal
- Flood: Adhiya River Training and Bunding
- Solid waste: Transfer and Disposal
- Power: Power Transmission and Substations
- ICT: Passive Network (Ducts + IOC/ City Surveillance/ Data Center / e-Gov /Intelligent traffic management system / City sensor network etc

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INDIAN GREEN BUILDING COUNCIL
Sri City
Andhra Pradesh
GOLD
2017

SRI CITY

An Integrated Business City

INDIA'S SECOND
Industrial City
IGBC Gold
Green City

Sri City : Vision to create a World Class Business Destination, with a perfect harmony between Industrial Growth & Sustainability

Indian Green Building Council

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1. Sustainable Water Management

Primary Source – Reservoir

- Annual government supply, 30,000,000KL
- (1 TMC) of water from Somasila-Kandaleru Reservoirs
- Buffer Storage Capacity of 2,400,000KL in three tanks at Sri City
- Rain-Water (Harvest) Storage in Many Tanks within Sri City Area
- Recycled Water for designated usages

Secondary Source (Backup Source in case of Drought)

- Ground Water
- Large Re-Charge area in and around Sri City. Over 50,000 acres
- of Reserved Forest area west of Sri City.

Tertiary Source

- Desalinated Water

2. Robust Utility Network connecting every plot

Water & Sewage Treatment Plants

- Water Treatment Plant of **77MLD** capacity supplies potable quality water to all units within Sri City
- 47 MLD Sewage Treatment Plant Capacity
- 100% recycling of sewage generated within Sri City

Robust Networks

- Robust utility network close to every plot
- Well planned and well-laid network for Water, Sewage, Storm water drainage, and Telecommunications
- Planned and designed by renowned urban infrastructure experts

3. Sustainable Community

Green Initiatives

8 MW Internal Solar Power Plant

100% Sewage recycling

First large scale industrial development in the country progressing towards a carbon neutral status

Solar street lighting and solar powered traffic control systems

Tens of thousands of trees planted

Mahindra WORLD CIT



Mahindra World City : Transforming Urban Landscapes by Creating Sustainable Communities

1. Social Infrastructure

MWC CLUB
India's 1st IGBC Gold Certified club
Offers options for Recreation , sports, Entertainment and Leisure

MAHINDRA WORLD SCHOOL
IGBC Platinum Rated Campus
Affiliated to CBSE; 2 ha (5 ac) campus
Class KG to XII; ~ 750 students;

HOLIDAY INN EXPRESS
4-star Business Hotel ; Consists of 140 rooms and other facilities including Restaurant and conference rooms

JEEVAN HOSPITALS
Currently offers OP Consultation, Pharmacy, Diagnostic and Ambulance services

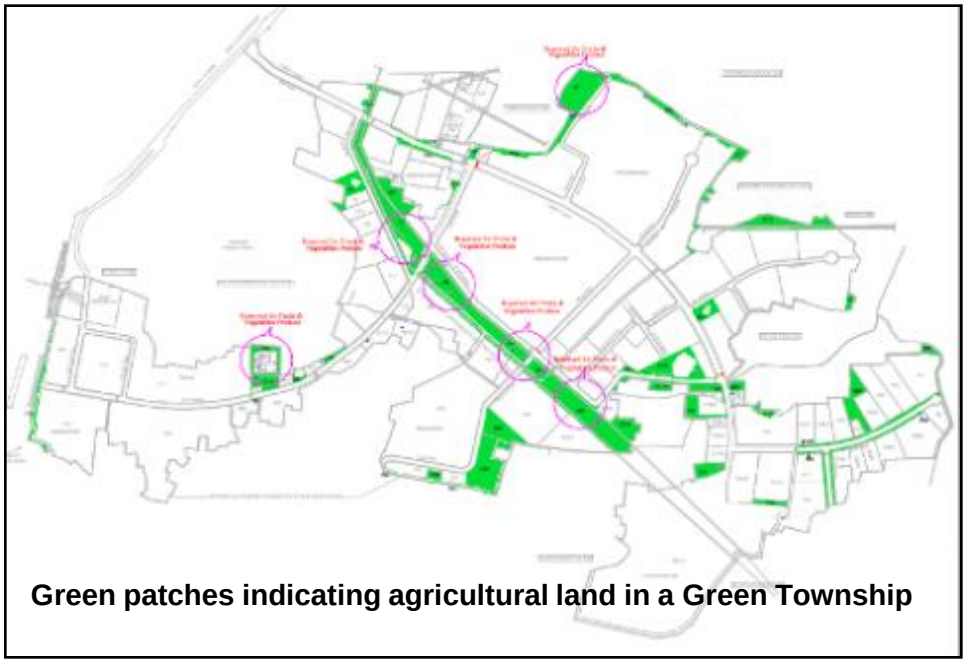
2. Preservation of Habitat

- **Conservation & Sustainable Management of existing lakes and water bodies**
- **Preservation of Existing Trees and Native plant species**
- **Development around the villages**

Restored Kolavai Lake by Mahindra World City

3. Food Security

- **Mahindra World City (MWC), Chennai**
  - **Sustainably meet Food Requirement at household level**
  - **Designated land for local fruit and vegetable produce**
    - **40 sq.m of land per dwelling unit**
    - **Caters to all 7,691 dwelling units in the city**



Green patches indicating agricultural land in a Green Township

A Sustainable Community

10 Tonne onsite Bio-gas plant

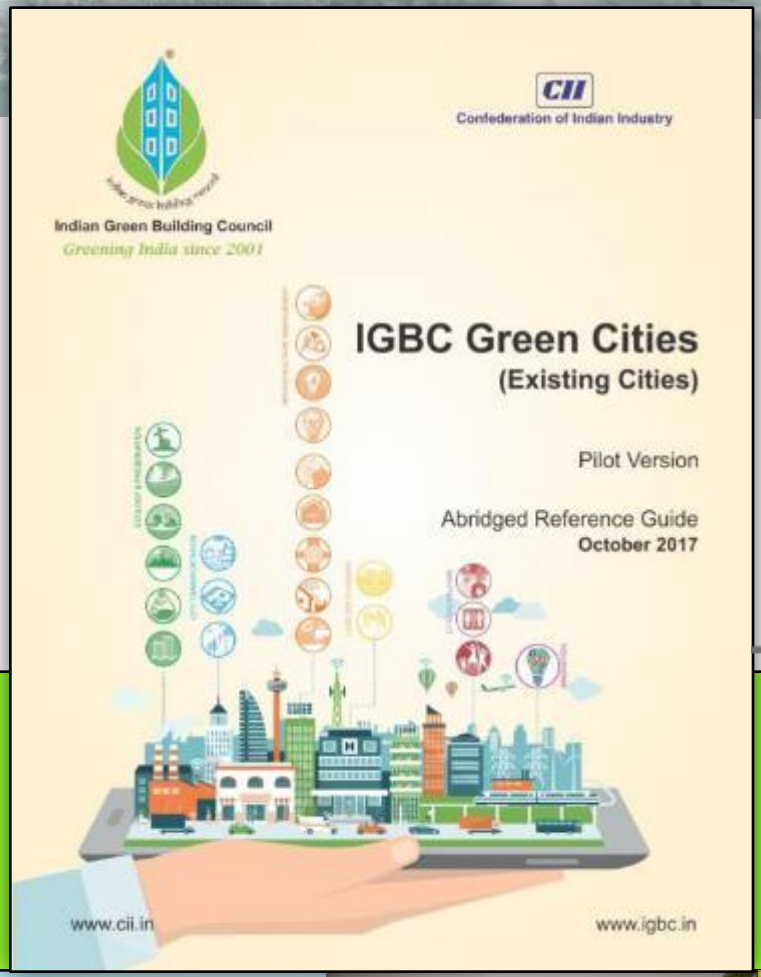
100,000 kwh of Solar Power Generated Annually

LED / Induction street lighting used

100% recycled water used for Landscaping

Over 500,000 kl waste water recycled annually

Rating for Green & Smart Cities



(For Existing Cities)

India One of the First few countries to develop Exclusive rating system





Green Cities Rating for Existing Cities

Focus Areas

Sl. No.	Category
1	Ecology & Preservation
2	Citizen Welfare
3	Land Use
4	City Transportation
5	Infrastructure Efficiency
6	Innovation in City

24 Green City Indicators to check the current status and improve upon!

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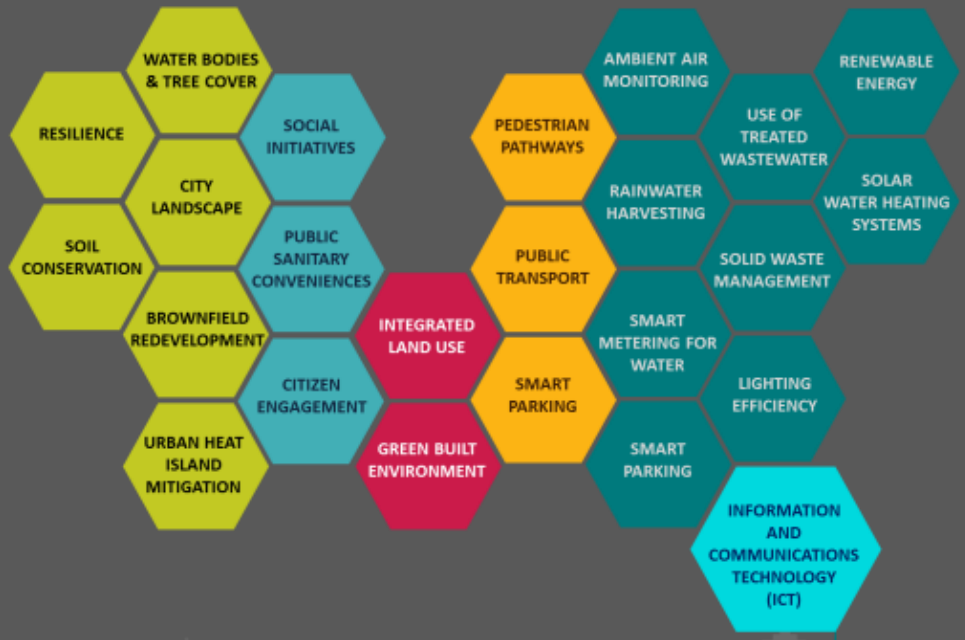
TOWARDS SDG GOALS 2030

Evaluating Sustainable Development in Cities

Green Cities Assessment Matrix

24 City level Indicators

All Existing Cities can Assess their Green Status based on the following Green City Indicators



IGBC GREEN CITY
INDIAN GREEN BUILDING COUNCIL
Rajkot Smart City
(Including Area Based Development)
PLATINUM
2020 - 2025

Smart City
MISSION TRANSFORM-NATION

RSCDL

INDIA'S FIRST
Smart City
IGBC Platinum
Green City

Rajkot Smart City's Vision :
Develop into a smart, liveable and iconic city of Gujarat with growth and sustainable development

Energy Savings : Approx. 65 Million kWh/ year

100%
LED Street Lighting
8.5 million kWh/year

Power from
Solar power plant
55.6 million kWh/ year

Waste to Energy plant
1.02 million kWh/ year

Blue & Green Infrastructure

Rajkot Smart City

IGBC Platinum rated Green Existing City

Treated Water Reuse : 27.9 Billion litres/ year

- 100% water supply coverage,
- 100% consumer metering,
- 24x7 supply through concept of District Metered Areas

Sewage Treatment Plant

95.5 MLD

- **Rejuvenation of Four lakes covering 4 kms catchment area : Increase in City's water table**

- **25% Green cover improved by tree preservation & plantation initiatives**

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Integrated Solid Waste Management

Rajkot Smart City

IGBC Platinum rated Green Existing City

Solid waste diversion from Landfill: 2,55,500 Tons/ year

Waste to Energy Plant

1000 TPD plant

for entire city

Waste to Compost Plants

5 TPD plant

in each of the 20 wards

Location	Bins
Private plots	Bigger RFID tagged community bins
Public places	Reverse vending machines
Street Sweeping	Truck Mounted vacuum sweeping machines
Greenways	Vacuum suction machines
Sidewalks	Solar Bins (200m alongside major and minor roads
Gated areas*	Underground bins (3 cu.m or 1.5 Ton)

Note: * Atal sarovar (3), Convention center (3), sports Arena (2), ICCC (1)

- **Disposal of only post treatment inert, domestic hazardous waste and non- recyclable waste to Nakravadi Site of RMC**

NAKRAVADI SITE

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NKDA

NEW TOWN KOLKATA

DEVELOPMENT AUTHORITY WEST BENGAL

IGBC GREEN CITY
INDIAN GREEN BUILDING COUNCIL
New Town
Kolkata
PLATINUM
2020 - 2025

INDIA'S FIRST
Green Satellite City

IGBC Platinum
Green City

New Town: Future ready global services hub attracting the best talent with a fine work-life balance

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1. Pedestrian Friendly Streets

Cycle Lanes

Public Spaces along streets

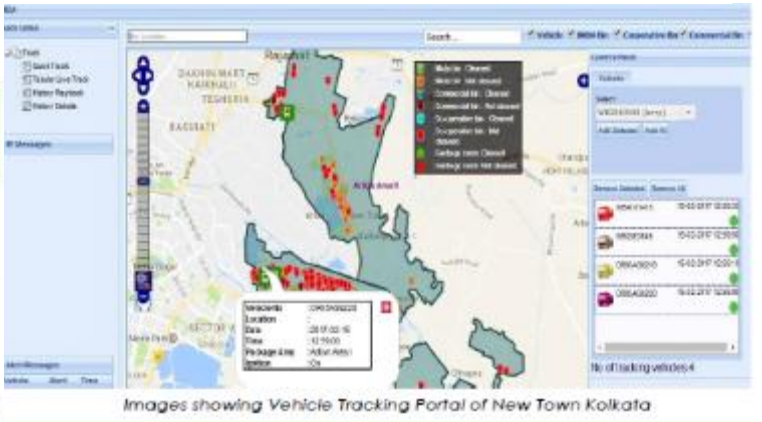
Shaded Roads

1. Pedestrian Pathways
2. Road Crossings
3. Public Buildings
4. Public Toilets
5. Recreational Areas

Barrier-free design for All

Bus Stops : Real time information of arriving buses

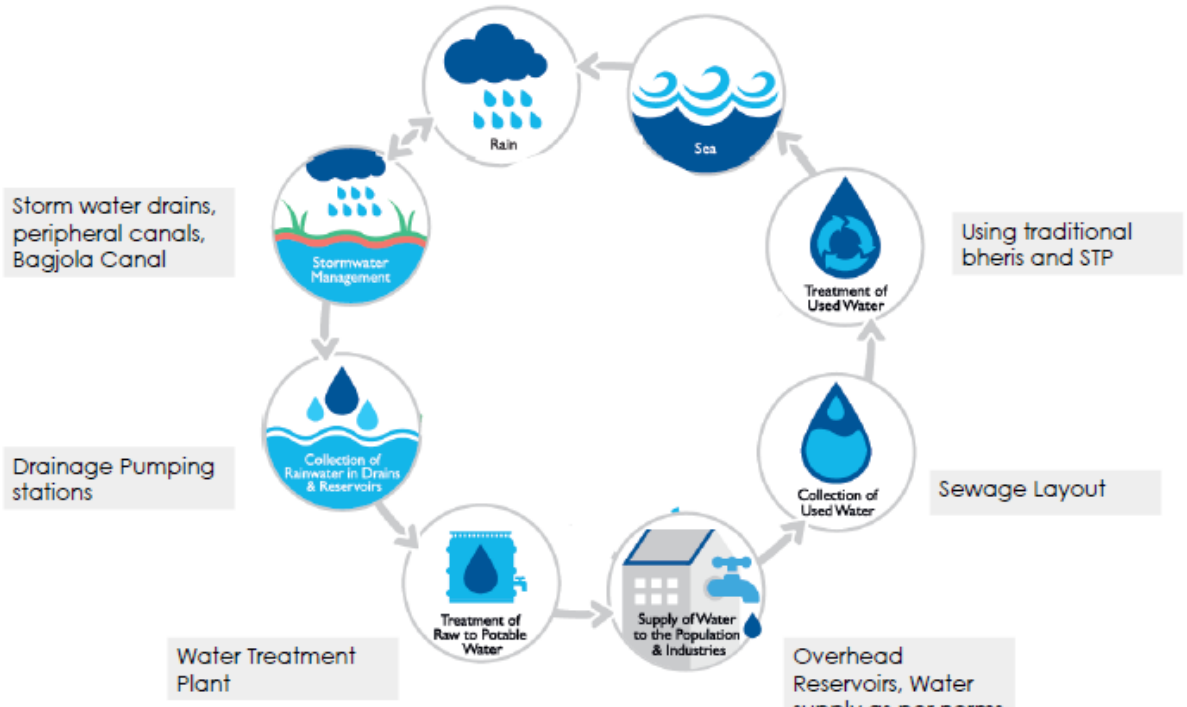
Bicycle Station with Kiosk: At Meto stations/ Bus stations

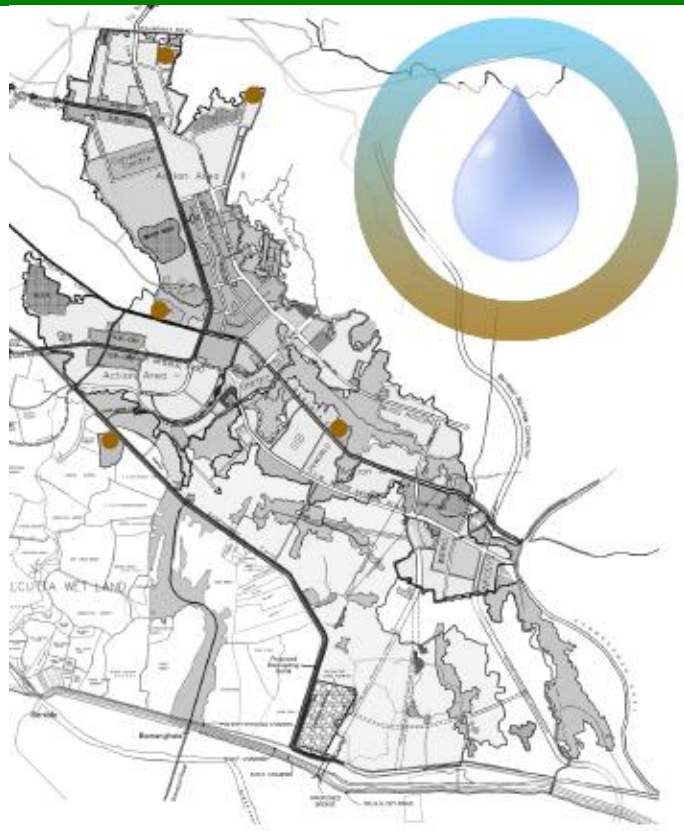


Images showing Vehicle Tracking Portal of New Town Kolkata

Solid Waste Transport Vehicles : Vehicle Tracking Portal

2. City Water Management





City water cycle

7.2 million litres per day of Rain water can be utilised during monsoon period

City level water storage capacity of150 million gallons

100% Waste Water Treatment

Waste Water Treatment & Reuse

Capacity of 145 MLD

(136 Million Litres waste water generated/ day

Treated & Reused for gardening applications in New Town Kolkata

3. E- Mobility

E-Mobility : Charging Infrastructure is the Key

- **Public Transport :** Operational e-buses as part of Bus fleet
- **Last-mile connectivity :** e-three wheelers (battery operated rickshaws)
- **Building level provisions:** Amendment in byelaws to include norms to mandate 2% of the car parking spaces to be reserved for electric vehicle charging points.

E-Mobility infrastructure in city include:

- bus bays
- charging stations
- maintenance office
- workshop
- maintenance pit

Indian Green Building Council

Smart Cities can adopt : 3 Pronged Approach

- **The Rating can be considered to explore improvement under 24 City level Indicators :**
  - **In a pan city manner**
    (Cities can plan for implementation of green measures for entire city infrastructure and take policy interventions)
  - **By selecting a Specific Activation Area (Area Based Development)**
    (Cities can define a notional boundary under which it can go for improvemental green measures)
  - **Specific Application Measures**
    (Cities can plan for implementation of select measures. Eg., Solar thermal, LED Lighting, Cool Roof, etc.,)

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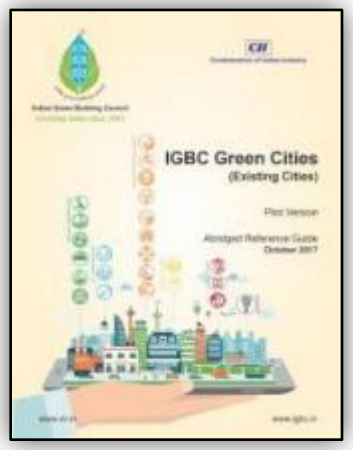
Key Benefits to the City and People

- **Air Quality Improvement**
  - PM2.5, PM10, CO2, Nox, Sox
- **Increased Urban Green Cover**
  - Atleast 9 sqm per capita (WHO Standard)
- **Reduced Energy Demand by 30-50%**
  - 2 – 2.5 MW per Million Sq.ft of Green Buildings
- **Enhanced Water Efficiency by 30-40%**
  - 45 litres to 30 litres per person per day (Commercial)
  - 135 litres to 100 litres per person per day (Residential)
- **Waste Segregation & Recycling**
  - Develop Recycling industry
- **e-Governance, BIM, BMS , IoT, ICCC**
  - Ease of Transactions
- **Citizen Participation**



Ultimately … Enhanced quality of life

Bright Green Future by 2050

Need for sustainability in construction and green product market transformatiion

2040

100 Billion Sq.ft.

2020

40 Billion Sq.ft.

Green Buildings

Major Growth in past 5 years

Annual Growth Rate : **8%**

2022

USD 360 Billion

Green Building Materials

Market Potential by 2022

USD 360 Billion

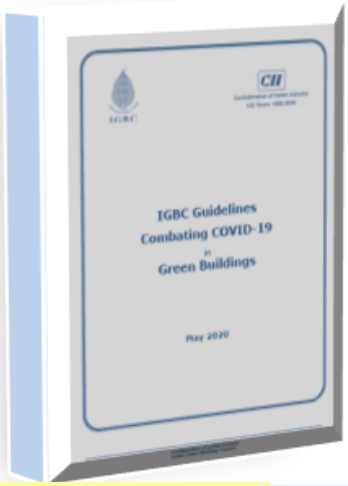
Source: www.grandviewresearch.com/

9.3 billion people will live on earth in 2050 (UN)

We would need three times more resources than we currently use

Build Back Better : COVID Guidelines

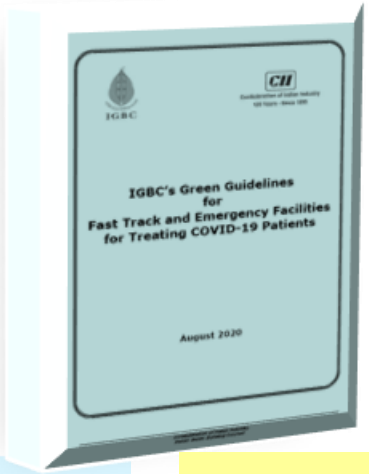
IGBC Guidelines Combating COVID-19 in Green Buildings



Aspects Addressed

- Hygiene in Buildings
- HVAC and related equipment
- Water and plumbing fixtures
- Measures at construction site
- People transit

IGBC Green Guidelines Fast Track and Emergency Faciiliitiies for Treating COVID-19 Patiients



Appropriate measures for

- ❑ **Existing Buildings**
- Before Starting Operations
- ❑ **Retrofit projects by design**
- ❑ **During Construction**
- Construction Workers Welfare

IGBC Green Healthcare Facilities Rating Version 1.0

Broadly addressing 10 Areas of Concern

- Layout
- Site Selection for Greenfield Facility
- Modular Structures for Temporary Facilities
- Hygiene Practices
- Ventilation Parameters
- Energy Efficiency
- Water Conservation
- Waste Management
- Interior Furnishings
- Facilities for Health Workforce

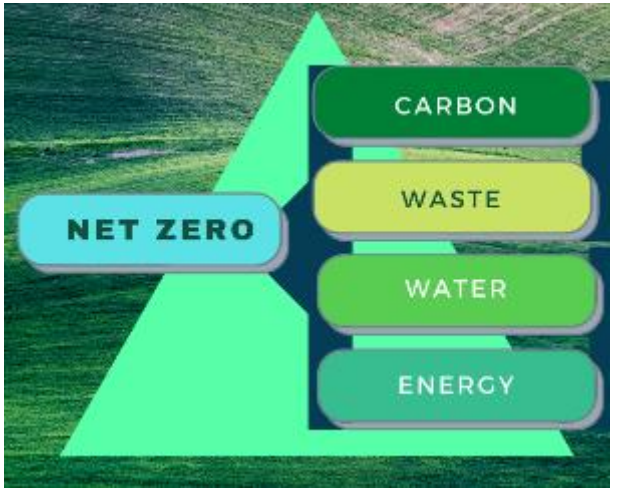
Stay Safe! Stay Protected!!

IGBC

IGBC Leading
The NET ZERO Movement In India

Net Zero Buildings aim to reach a regenerative future, focusing on 4 main areas –

- **Net Zero Energy – already tried & tested at Building level**
- **Net Zero Water – Need of the hour and especially in many cities**
- **Net Zero Waste – Important for minimizing landfills**
- **Net Zero Carbon – Next generation of sustainability**



WORLD GREEN BUILDING COUNCIL

Confederation of Indian Industry

IGBC MISSION ON NET ZERO

IGBC

22 April 2021 (World Earth Day)

320+ COMPANIES ARE NOW **SIGNATORIES** OF IGBC MISSION ON NET ZERO

VISION

INDIA TO BECOME ONE OF THE FOREMOST COUNTRIES IN TRANSFORMING TO 'NET ZERO' BY 2050

IGBC

deration of Indian Industry


NET ZERO CARBON BUILDINGS
AND BUILT ENVIRONMENT
ARE THE FUTURE!
INDIA AT 2070

To Sum Up

- **Indian building sector would undergo a paradigm shift in embracing new smart & green concepts**
  - **Innovative, Integrated & Coordinated design approaches**
  - **Green products and equipment to be used**
  - **Green and Clean Technologies would play a major role**
  - **Policy and Advocacy**
  - **Green Education - Multidisciplinary**
  - **Awareness and Dissemination leading to People's Movement**

This would definitely charter and pave way for

India to demonstrate World class Infrastructure

Aspiration : 10 Billion Sq.ft by 2022 (India@75)

India to become Global Leader in Green Building Footprint

IGBC

CII

Mantra for the decade

Take the Green Path with Resilient and Sustainable Technologies and Practices – The Only Sure Way Forward!

www.igbc.in

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Confederation of Indian Industry