Promoting Sustainable Cities – Suggestive Approach for Planning and Designing Energy Efficient Urban Settlements

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Population Scenario- India-2011
- Population of India reached 1000 million in 1951
- 200 million in 1961 (10 yrs. Later)
- 377 million in 2011- (73% towns)
- Metropolitan centres(>500k): 53 (2011-68)
- 10 m plus- nct (1951)- 3 (2011)- 6 (2031)
- Urban India for first time added more persons(91m) as compared to Rural India(90m) in last decade.
- Massive shift of population not simply a shift of demographics
- Shift places cities and towns at centre of India’s development trajectory
- Increased population requires - More education/housing/sheilding/other institutions
- More commercial space

Population Scenario- World
- World population recorded:
  - 1 Billion in 1804
  - 2 Billion in 1927 (123 yrs. Later)
  - 3 Billion in 1960 (33 yrs. Later)
  - 4 Billion in 1974 (14 yrs. Later)
  - 5 Billion in 1987 (13 yrs. Later)
  - 6 Billion in 1999 (12 yrs. Later)
  - 7 Billion in 2010 (11 yrs. Later)
- UNO population projection ranges from 8.9-10.9 billion by 2050:
  - China and India have population over 1 billion
  - India to become most populated country by 2036.
  - Tokyo largest Urban Agglomeration with 26.4 million residents in 2001
  - 26-456 Urban Agglomerations with - 10 million

Population Distribution- India-2011
- Urban Pop. Distribution(2011)377 m (31.1 %)
- Mega Cities with Pop. > 10m - 4% of total pop
- Cities with Population 5-10m - 3%
- Cities with Population 1-5m - 6%
- Cities with Population 0.1-1m - 9%
- Cities with Population < 0.1m - 9%

** Rural Pop Distribution(2011) 833 m (68.9%) -
- Very large (>10k), large villages(>5k)-17%
- Medium villages (2-5k) - 24%
- Small villages (1-2000) - 17%
- Hamlets (< 50-100) - 3%
- Small Hamlets(< 50) - 3%
- Every 3rd Indian lives in cities/towns
- Every 8th Urbanite lives in Mega city
- 7 out of 10 urbans are residing in cities.
- Large and medium villages house 60% rural pop.

Indian Urbanisation-II
- Urbanization perceived both as determinant and consequence of economic development.
- Two factors: level of economic development and level of urbanization
- Urban growth & economic growth go hand in hand
- Cities called engines of economic growth for large contribution made to national wealth.
- Economic well being of country hinges on productivity of urban settlements.
- Building good cities critical to boosting rural economy by improving urban consumption
- Urban centers need to be planned & developed to
  - Attract investment
  - Provide Employment
  - Ensure quality of life.
  - Make them more Sustainable, Productive, Livable, Human and Eco-friendly
- Lack of serious policies to manage. Urban India will jeopardize growth besides risking employment generation.

India Urbanisation-2030
- India Urban Awakening: Building Inclusive Cities-Report- April, 2010 projects that by 2030:
  - 350 M to live in Urban India: twice the todays population
  - 70% GDP generated by cities
  - 80% Revenue generated by cities
  - 4 fold increase in per capita income
  - 5 times the number by which GDP would multiply
  - 270 million net increase in working age group
  - 70% of new jobs(170 m) generated in cities
  - 91 m urban households will be middle class - up from 22 m
  - 68 Cities will be Metropolitan.Europe has 35 only
  - $ 1.3T capital needed to meet projected infrastructure demand
  - 700-900 million sqmts of residential commercial area needed annually- a new Chicago to be created
  - 2.5 b sqmts roads paved-20km created in last decade
  - 7400km (350-400 km/year) of metro needed -20km created in last decade
  - 200 m Rural Indians to benefit, living close to top 70 cities
  - 75%urban India to live in bottom segment, earning Rs 80 per day

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Urban area are important because they are:
- Areas of future concentration of population.
- Providers of large employment.
- Areas of large investment.
- Housing major infrastructure & services.
- Hub around which entire economy gravitates.
- Promoters of higher order of productivity

- Makers of large contribution to the national wealth/GDP
- Providers of large employment.
- Concentration of activities.
- Hub around which entire economy gravitates.
- Providers of large employment.
- Urban centres, the hub around which entire economy gravitates.
- Lower down quality of life
- Higher level of urbanization
- Energy consumption in developing world low
- Developed world major consumer of energy

**ENERGY CONSUMPTION PATTERN**
- Developed world: major consumer of energy.
- Industry: Energy consumption in developing world: low.

**ENERGY CONSUMPTION PATTERNS**

- Building: 52%
- Agriculture: 1%
- Industry: 14%
- Transport: 33%
- Developed world: 22%
- Developing world: 78%

**Urbanisation Issues**
- Despite distinct advantages, Urban centers poorly managed and governed.
- Fall to meet the challenges of urban dynamics.
- Haphazard/unplanned pattern of development.
- Enormous growth of slums.
- Poor quality of life.
- Failure to meet basic needs of shelter.

**Human settlements fast emerging as large consumers of energy due to:**
- Concentration of population.
- Concentration of activities.
- Increasing size of cities.
- Increasing travel demand.
- Increasing travel distance.
- Increased use of personal vehicles.
- Construction of large number of buildings.
- Cooling/heating spaces for comfortable living/working.

Energy consumptions levels are rising rapidly due to:
- Increasing income level.
- Higher car ownership.
- Travel becoming a habit.
- Designing buildings without caring for energy implications.
- Increasing level of living comfort.

Considering multiple impact, there is urgent need to make cities sustainable converting existing GREY CITIES to GREEN CITIES.
**SHAPING CITIES**

- Human settlements have undergone numerous changes in form, functions, shape, size, population with major forms:
  - THE COSMIC (OR HOLY) CITY
  - THE PRACTICAL CITY
  - THE ORGANIC (OR WALKING) CITY
  - THE TRANSIT CITY
  - AUTOMOBILE CITY

- Operating human settlements have large energy implications:
  - Energy consumption within cities can be reduced by:
    - Making cities more compact.
    - Evolving Master Plans / Development Plans with energy conservation as focus.
    - Adopting shape / size of cities involving minimum travel / length of road network.
    - Avoiding grid iron pattern—where used super imposed by diagonals road network.
    - Using city shapes which promote minimum travel and mass transportation.
    - Using mechanism of low rise high density pattern.
    - Promoting city size between 3 to 5 lakh considering the travel infrastructure cost and sustainability.

**Sustainable Urban Planning**

- Looking at the solutions:
  - Garden City
  - Linear City
  - Industrial City
  - Vertical Cities
  - Compact Cities
  - Radiant Cities

- Looking at the concepts in terms of:
  - Planned cities
  - Inclusive Cities
  - Sustainable Cities
  - Green Cities
  - Intelligent Cities

- City Planning needs to be based on energy as basic criteria to make cities more cleaner, more greener & sustainable—ensuring appropriate quality of life.

**Two Plans Compared - Chandigarh**

**Sustainability - Urban Planning**

- For making cities sustainable:
  - Pattern of City growth to be rationalized
  - Changing options for city Planning
  - Changing options for Land use Planning
  - Avoiding Metropolitization
  - Promoting small & medium Towns
  - Rationalizing approach to preparing Master Plans/Development Plans
  - Evolving Better Master Plans
  - Critically reviewing Planning tools to make them more effective & efficient.
  - Promoting Decentralization & mixed land use
  - Promoting self-contained communities.

**TRANSPORTATION & PEDESTRIANISATION**

- Traffic & Travel worst gifts of Urbanization
- Travel emerged as integral part of Human living
- Transport emerging major consumer of energy.
- Rapid growth of Vehicles
- Major cities—population growth 1.9 times vehicular growth—7.75 times during 1981-2001
- Travel becoming more expensive for poor with elimination of pedestrians and bicycles
- Travel becoming risky with accidents increasing from 1.6 lakhs to 3.9 lakhs during 1981-2001
- With expansion of cities travel distances increased
- Trip length and travel demand increased
- Increase in vehicular pollution
- Vehicular congestion and traffic jams becoming order of the day

**TRANSPORTATION - OBJECTIVES**

To ensure safe, affordable, quick, comfortable, reliable and sustainable mobility
- To be achieved by:
  - Making transportation important parameter of the urban planning
  - Integrating land use and transport planning to minimise travel
  - Bringing more equitable allocation of road space
  - Planning for people, rather than vehicles as focus
- Encouraging greater use of public transport and non-motorized modes
- Establishing quality focused multi-modal well integrated public transport systems
- Avoiding wastage through various modes
- Establishing effective regulatory and enforcement mechanisms
TRANSPORTATION - OBJECTIVES

• Raising finances, using land as resource, for developing urban transport infrastructure
• Promoting use of cleaner technologies involving private sector
• Taking pilot projects to demonstrate the best practices in sustainable urban transport
• Promoting Transit oriented Planning
• City planning to focus on
  ➢ Minimizing travel
  ➢ Reshaping the cities form and size
  ➢ Re-ordering the transport priorities
  ➢ Minimizing number of vehicles
  ➢ Minimize use of personal transport.
  ➢ Minimizing Pollution
  ➢ Promoting Pedestrianization
  ➢ Promoting Bicycles
  ➢ Equitable allocation of space-reserving exclusive lanes/corridors for public transport, and Non-motorised transport: cycles, pedestrians

TRANSPORTATION & PEDESTRIANISATION

• Promoting use of Bicycle as mode of travel being
  ➢ Most inexpensive
  ➢ Environmental friendly
  ➢ Non-polluting/Zero Energy
  ➢ Occupying minimum road space
  ➢ Reduced Parking Space
  ➢ Promoting National Economy
  ➢ Promoting Human Health
  ➢ Reducing depletion of Non-renewable resources
  ➢ Best option for travelling over short distance

TRANSPORTATION & PEDESTRIANISATION

• Creating Express Cycle tracks for encouraging travel by Bicycles.
• Creating Exclusive Walkways for encouraging Pedestrianization.
• Shifting people from Personalized to Public transport.
• Changing priority in planning with order of preference:
  ➢ Pedestrian.
  ➢ Cycle.
  ➢ Public transport.
  ➢ Private vehicles.

Cycle Parking in Tokyo Railway Station

Bikeway in Lima

Tricycles in Peru
USING INFORMATION TECHNOLOGY

- IT/ITES revolutionized human living, working/ thinking.
- IT/ITES has considerable potential for impacting planning, growth, development / management of cities.
- City patterns likely to undergo qualitative change.
- Unfortunately use of IT in urban planning and designing buildings has been minimal.
- Extensive use of IT required for reducing energy consumptions at building / settlement level.
- IT/ITES leveraged for evolving software to assess Energy implications of:
  - Master plans/layout plans.
  - Building design.
  - Building material.
  - Structural systems.
  - Structural designs.
  - Construction technologies.
  - Planning, designing tools.
  - Building bye-laws/Building regulations.
- IT can help in making cities / buildings green.

DESIGNING GREEN BUILDINGS

- Built environment has significant impact on environment and consumption of resources, accounting for:
  - 16% of world’s fresh water withdrawal.
  - 25% of wood harvested.
  - 30% of consumption of raw material.
  - 50% of global energy consumption.
  - 35% of world’s CO2 emission.
  - 40% of Municipal solid waste.
  - 50% of Ozone depleting CFC’s still in use.
  - 30% of the residents having sick building syndrome.
- 66% of global warming is the outcome of built environment.
- Majority of existing buildings have low concern with energy conservation.
- Considering the enormous quantity of existing built space / space to be added the energy environment implications can be critical.
- Buildings need to be designed with utmost care and consideration for energy sustainability.

GREENING CITY

- Landscaping at city/building levels can be effectively used for making Cities Energy Efficient.
- Vegetation outside: 
  - Lowers daytime temperatures
  - Reduces heat emission during night for balancing temperatures
- During the precipitation: 
  - 1/3 of free water is absorbed
  - During dry periods water is evaporated
- Green areas: 
  - Reduces noise level up to 15 dB
  - Thick vegetation cover reduces –
  - temperature up to 3.5°C
- Greening cities through: 
  - Strategic plantation
  - Massive plantation
  - Extensive landscaping
  - Greasing city locales
  - Greening cities helps in
  - lowering overall temperature
  - Shifting climate change in similar tools to non
  - reducing energy requirements
DESIGNING GREEN BUILDINGS

- Considerable options available for minimizing energy conservation - Green Buildings
- Adapting integrated approach to building design for reducing energy in buildings involves:
  - Site planning - planning with nature making use of site potentials
  - Evolving minimum energy consumption building envelope design
  - Promoting higher order of building efficiency
  - Integration of renewable energy sources to generate energy on site
  - Selection of ecologically sustainable/low energy materials
  - Using eco-friendly construction methodologies
  - Effective water and waste management
  - Innovative options used for heating, cooling, lighting and ventilation.

- Role of Architects, Engineers, Structural Engineers, Builders critical in evolving Energy Efficient buildings
- Town Planners to contribute to energy reduction by:
  - Evolving layout plans with energy as focus
  - Making best use of sun and wind

Green Building is a building which has minimum impact on the immediate and global environment so that its construction and its subsequent operation has minimum adverse impact on ecology where it is placed.

Green Buildings create environment with following attributes:
- Reduced energy consumption without sacrificing comfort levels
- Reduced depletion of natural habitats and biodiversity
- Reduced air and water pollution with efficient use of water
- Limited waste generation due to recycling/reuse
- Reduced pollution loads
- Effective Controls and Building Management System
- Use of Non-Toxic & Recycled Materials
- Effective use of existing Landscape
- Adoption of Cost-effective and environment friendly technologies
- Increased user productivity

Design principles

- Minimize east and west facades as these are usually exposed to large amount of direct solar radiation in summer.
- Maximize north and south facades as effective sun control is relatively simple on these sites. Maximize floor area exposed to good day lighting
- Minimize the ratio of wall surface to floor area but only after day lighting considerations.
- Provide vertical external shading to any exposed east and west windows maximize the area of shaded north facing glass.

Integrated Design Process

- Lighting & Power
- Orientation & Configuration
- Site Design
- Envelope Design
- Heating & Cooling
- Materials & Finishing
- Ventilation

EFFECT OF CEILING HEIGHT

- DAY LIGHTING
- EFFECT OF ROOM DEPTH
- INTELLIGENT LIGHTING CONTROLS
Courtyards provide natural light / air into the building and create a high degree of cross ventilation.

Courtyards make buildings safe from large intake of heat and glare.

- Landscaped courtyards promote cooling / act great moderators in creating a micro-climate

- Courtyards with water columns considered as great environmental columns keeping the building at ambient temperatures throughout the day.

- Terraces are similar to courtyards.
- Perform functions like courtyards.
- Can be used for promoting heat gain & heat loss.

- Terraces control quality / quantity of light and heat by orientation, vegetation & other devices.
- Work efficiently for providing natural light / ventilation to the neighboring built up areas.

Water Efficiency

Use of low-flush toilets, water less urinals, sensors control taps for washbasin and water conserving system to minimize the waste of water.

Recycling of grey water

Rain Water Harvesting

The overhead plumbing system in which used water can be recycled for flushing, toilets and drain water can be used for irrigation and gardening purposes.

Elements of Energy Efficient Building Design - 1

- Photovoltaic generation
- Rooftop planting
- Improving insulation
- Restriction of sunlight
- Rainwater utilization systems
- High-efficiency heating equipment

Elements of Energy Efficient Building Design - 2
Green Building Vision - India @75

<table>
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<th>Green buildings - 5-8% costlier than conventional buildings</th>
<th>Green buildings to be less costly than conventional buildings</th>
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<td>Horizontal landscape</td>
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<td>Green buildings will be energy positive, exporting power to grid</td>
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<td>Power driven air-conditioning systems</td>
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<td>High Dependency on municipal water</td>
<td>Minimum dependency on municipal water</td>
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INTELLIGENT BUILDINGS

- Buildings are, "machines for living".
- Intelligent buildings use technology and processes to create buildings which are Safe.
  - More productive for occupants
  - More operationally efficient for the owners.
- In intelligent building - building fabric, space, services and information system respond in an efficient manner.
- Intelligent buildings aim at
  - Reducing operational cost.
  - Optimizing energy use/ Resources
  - Improving employees productivity.
  - Providing highest degree of safety.
  - Optimizing indoor environment.
  - Providing high degree of sustainability.
  - Minimizing adverse environmental impact.

INTELLIGENT BUILDINGS

- Intelligent buildings are the products of
  - Growth of information technology
  - Expectation for better building performance
  - Maximizing economy in buildings.
  - Minimizing maintenance.
- Intelligent buildings are the synthesis of
  - Innovative building designing (with nature).
  - Use/integration of technology.
  - Use of natural resources.
  - Skilled management.
  - High degree of automation.
- Convergence of green and intelligent buildings to provide optimum solution for
  - Safe Ambient work/living areas.
  - Creating highly sustainable productive buildings.

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HIGH RISE BUILDINGS:

- Have enormous capacity to create large volume of built space sparing large ground space for non-urban uses.
- Provide optimum solutions for housing large population/activities using minimum area.
- Offer opportunities for pedestrianizing cities.
- Make cities more humane & eco-friendly.
- Make cities more compact.
- Reduce the need of long travels.
- Create well knit & close communities.

Looking Forward - Reshaping Cities

- Providing work space & amenities within/near the buildings helps in reducing travel within cities.
- High rise buildings connected by efficient means of mass transportation minimize use of personalized vehicles.
- Cities would look more green, open and eco-friendly.

Future Cities - Conceptual

Ultima Tower - 2Mile High Sky City

- Location: Any densely populated urban environment
- Date: 1991
- Cost: $150,000,000,000
- Population: 1,000,000 people
- Exterior surface area of building: 150,000,000 sq ft.
- Total enclosed volume: 53,000,000,000 cubic feet
- Total enclosed acreage: 39,000 acres
- Elevator speed: 20 feet per second (13 miles per hour) 3 minutes and 40 seconds to reach the top floor from the ground floor.
- Dimensions: Height-10,560 feet;
- Diameter at the base-6000 feet;
- Number of stories-500;

Mile-High Tower - Jeddah, Saudi Arabia

- Location Jeddah, Saudi Arabia
- Cost US$2.5 billion
- Height 1 mile (1,600 m; 5,200 ft)
- Antenna spire 1,600 m (5,200 ft)
- Floor area 3,530,000 m2 (38,000,000 sq ft)
- Capacity 80,000 people

- The tower will have -275 floors
- Lobby up to 9th floor
- Offices 6-50 floors
- Five-star hotel & Conference halls 51-75 floors
- Deluxe residential units 76-195 floors and retail facilities 196-275 floors
- Alternate Energy Generation 196-275 floors
- Status of the project: Already under construction since 2008
PEARL RIVER TOWER - GUANGZHOU, CHINA
NET ZERO ENERGY BUILDING

- Location – China
- Year of Completion - 2011
- Site Area - 10635 SQ.M.
- Project Area - 214,100 SQ.M. (2.3 MILLION SQ.FT.)
- No. of Stories - 71
- Height of Building - 309M

Energy efficiency achieved through:
- Solar Panels
- Photo Voltaic Cells
- Wind Turbines
- Day Light Harvesting
- Double Skin Curtain Walls
- Chilled Ceiling Water
- Under Floor Ventilation

Earth Scraper – Mexico City

- Location - Mexico City
- Depth - 300 mtrs. Below ground
- Designed as Inverted Pyramid
- Glass floor to cover 240 mtrs X 240 mtrs. hole in cities main square to filter natural light
- Preserve the cities historic centre and the heritage buildings surrounding the square.
- Interior of the building to look natural.
- Building to be the city’s top retail destination.

Earth Scraper Mexico City - Conceptual Model

- No. of floors 65.
- Residential 10
- Shopping 10
- Museum 10
- Offices 35

Approaching - Green Cities

Green Cities to strike balance between managing current needs without compromising with city/environment in future through:
- Green urban planning
  - Environment focus
  - Using Non-renewable Energy Sources
  - Generating energy from green sources.
  - Designing Green buildings
  - Promoting Green Transportation options
  - Promoting Green living (parks, open spaces)
- Challenge for urban areas to be green
  - High volume of people.
  - Traffic congestion
  - High degree of waste
  - High Energy consumption
Approaching Green Cities

- In 1990 industrial countries resolved to check global warming/ultimate change.
- Kyoto Protocol signed to minimize climate change through reduced greenhouse gas emission by 5% (2008-2012) from 1990 level.
- Options to be used included:
  - Adoption of renewable energy sources - solar/wind power.
  - Promoting Green cities
  - Promoting Sustainable agricultural practices
  - Promoting energy efficiency
  - Green Innovations/Leadership

Amazing Green Cities of World – Vancouver-Canada

- Population 5,60,000
- Named world’s most livable city
- Canada’s model for using Renewable Energy Sources.
- Launched 100 year plan for clean/green living.
- Leads the world with hydroelectric energy – making 90% of the power supply.
- Plans to reduce greenhouse gas emission by 20% (1990 level).
- High investment in Wind, Solar, Wave and Tidal energy systems.
- Investment in energy efficient plans using latest technologies.
- Extensive use of solar powered trash compactors (reduces waste to 1/5) with fewer garbage trucks on roads.

Amazing Green Cities of World – Portland, Ore

- A city of 5,00,000 people
- Model of sustainable living-mixing urban indoor and outdoor spaces.
- Known for integrating green spaces in Urban Planning.
- Demolished a six lane highway to develop a waterfront park.
- City has 92000 acres of green spaces.
- 74 miles (119 Kms.) of biking, hiking and running trails.
- Enacted urban growth boundary to contain urban landscape & protect 25 million acres of forest farm.
- City has large green buildings
- Pedestrian & bike friendly with 25% commuters biking to work.
- Set goals of supplying 100% of energy from renewable sources including solar powered parking meters.

Amazing Green Cities of World – Reykjavik, Iceland

- Smallest amazing city
- 1,15,000 people living in city out of 3 lakhs of entire nation.
- Plans to unplug its dependence on fossil fuel by 2050 to become hydrogen economy.
- City gets energy for heat, hot water and electricity from hydropower and geothermal resources which are renewable and free from greenhouse gas emission.
- City has vehicles running on hydrogen including buses.

Amazing Green Cities of World – Malmo, Sweden

- Home for 2,80,000 people - 3rd largest city.
- Leadership in Green Electric Solutions- Nuclear & Hydropower.
- Plan to reduce CO2 emission by 25% using techniques of:
  - Sourcing 100% renewable energy from sun, wind & hydropower.
  - Bio fuels generated from Organic waste.
  - Building constructed with sustainable material.
  - Building designed to be energy efficient.
  - Streets made pedestrian and cycle friendly.
  - 40% of commuters & 30% all travel by bike.

- Restoration of old areas as eco-friendly through green energy sources- Solar, wind, power, bio-fuel.
- Using green roofing-botanical roof garden which offer benefits similar to garden/parks at GF.
- Reduce run off
- Add insulation/vegetation.
- Using first world’s emission free electric street train.
- Installing dozen recycling houses processing 70% of collected waste.
Green and Blue Network Planning

Master Plan can be summed as

Prior to the development of the Eco-city, Tianjin has total land area of 30 sq. km. When fully completed in around 2020, it will have a population of 350,000 residents. The start-up area is scheduled for completion by end-2013. Prior to the development of the Eco-city, site comprised mainly salt pans, barren land and polluted water bodies including a 2.6 sq km large wastewater pond.

- Site selected was a derelict area with shortage of drinking water.

Amazing Future Cities - TIANJIN
ecocity - China

- City developed as joint effort between China and Singapore Governments.
- Located 40 kms from Tianjin city centre and 150 KMS from Beijing city.
- Tianjin Eco-city has total land area of 30 sq. km. When fully completed in around 2020, it will have a population of 350,000 residents. The start-up area is scheduled for completion by end-2013.

Computer-aided design and simulation of the city layout.$\text{2007}\quad \text{2011}$

Amazing Future Green Cities of the world - Musdar - Abu Dhabi- UAE

- Large number of cities working to reduce energy consumption.
- Adapting environmental friendly urban development practices.
- Embracing green living life style.
- Future Green Cities - Musdar, Abu Dhabi, UAE
- 15 billion enterprise to built eco-friendly emerald city.
- Making progressive use of sustainable renewable resources.
- Solar, wind power and bio-fuels for energy/ water purification, underground light rail transportation.
- Planned in 2008 to be completed in 2016.
- Aim is to create: Zero Carbon, Zero Waste, Zero Emission community with about 40,000-50,000 residents and 1000 business activities. A wastewater pond rehabilitated /transformed into a clean/beautiful lake.
- 4 districts
- 3 centres
- 11 key feature in transport planning of the Eco-city. The aim is to increase trips via public transport and non-motorised modes of transport such as via bicycles and walking, within the Eco-city.

3. Green and Blue Network Planning - City planned with extensive green (vegetation) and blue (water) networks to provide quality living / working environment. The green network will comprise a green lung at the core and eco-corridors emanating from the lung to the other parts of city. Water bodies linked for water circulation to enhance ecology provide attractive environment/recreational activities. A wastewater pond rehabilitated transformed into a clean beautiful lake.

4. Master Plan can be summed as 1 axis - 3 centres - 4 districts.

Amazing Future Green Cities of the world - Musdar – Abu Dhabi - UAE

- City area: 2.3 sq. mile (6 sq. km)
- Zero Emission community with about 40,000-50,000 residents and 1000 business
- City to be Zero Carbon, Zero waste.
- Using cutting edge technology of sustainable design –... 
- City Aims at: 
  - using Thermal Power by building Solar Thermal Power Plant
  - Rooftops used for Photovoltaic arrays to generate solar power.
  - Hydrogen Power Plant to provide additional electricity clean sources producing much lower CO2 emission.
- Minimizing energy needs to keep city cool - planning city buildings to take advantage of natural sea breeze.

Amazing Future Green Cities of the world - Musdar – Abu Dhabi- UAE

- No cars in Musdar to eliminate CO2.
- Electric powered light rail on elevated track to permit easy transport between Musdar and Abu Dhabi.
- For intra-city travel people to use electric powered light rail on elevated track
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We commit ourselves as members of the world's architectural and building design professionals, individually and through our professional organization, to:

- Place environmental and social sustainability at the core of our practices and professional responsibilities;
- Develop and continually improve practices, procedures, products, curricula, services and standards that will enable the implementation of sustainable design;
- Educate our fellow professionals, the building industry, clients, students, and general public about the critical importance and substantial opportunities of the sustainable design;
- Establish policies, regulations, and practices in government and business that ensure sustainable design becomes normal practice;
- Using all existing and future elements of the built environment – in their design, production, use and eventual reuse / up to sustainable standards.

Our approach to promoting urban sustainability should essentially be based on and revolve around:

- Making cities compact - to make them more humane, livable, productive and environment friendly
- Minimizing travel and re-ordering transportation with order of preference placed as Pedestrianization, Cycling, Mass transportation and individual transport
- Promoting sustainable mass transportation based on use of electricity/ CNG
- Green Cities/Buildings planned / designed by using natural elements of SUN, SPACE AND VERDURE and materials based on waste.
- Minimizing energy consumption in all human operations/ endeavors.
- Energy to be Clean energy - Hydro power, wind/ geothermal/solar/bio-mass/energy generated from waste.

Water/Land - treated as national resources with focus on optimum use.
- For water - focus to be SLOW THE FLOW & Reduction/Recycling & reuse
- In case of land – approach based on using land on 24x7 basis
- Promoting Landscaping – based on native plants with minimum water requirement.
- Avoiding Metropolitization – promoting small & medium towns
- Involving citizens – in decision making / promoting transparency.
- Planning tools revisited on the altar of energy efficiency
- Master plans prepared with energy efficiency as prime focus.
- Making optimum use of IT and IT ES.
- Making sustainability an essential aspect of living, and way of planning
- Making sustainability an integral part of education system and human learning.

CONCLUSIONS

- The Radiant City
  - An organism capable of housing the works of man of machine-age society.
  - Placed under the masterful government of natural conditions:
    - Sun
    - Space
    - Greenery
  - And its mission is the service of mankind:
    - To live
    - To work
    - To cultivate body and spirit
  - In this order and obeying this hierarchy.

AND SEARCH FOR PROMOTING URBAN SUSTAINABILITY THROUGH CITIES/BUILT ENVIRONMENT CONTINUES AS A CHALLENGE TO THE PROFESSIONS AND PROFESSIONALS.