Review Article

Abatement of Pollution through Smart and Environment-Friendly Cities

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Abstract

Rapid urbanization and industrialization have not only contributed to a more degraded and polluted environment but also made the city life more complex and unhealthy. As the rapid transition from a primarily rural to a primarily urban population becomes a global phenomenon, the concept of "Smart cities" has emerged in the last decade to create ecofriendly and efficient cities, which can provide better functioning cities with healthy living conditions for the people, through innovative and digital technology-based management of urban services.

The growing urban population in Indian cities has exerted and continues to exert considerable pressure on basic services such as water supply, sanitation, wastewater, integrated solid-waste management, etc. Efficient management of urban services is crucial for ensuring healthy living conditions to its citizens while safeguarding the natural heritage. Recently, the Government of India has proposed to set up 100 smart cities across the country with all modern amenities, education and employment opportunities. It is believed that a smart city in urban region will be highly advanced in terms of overall infrastructure, sustainable real estate, communications, and market viability. Information technology will be the principal infrastructure and the basis for providing essential services to residents. It will provide a high quality of life, better economic opportunities, safety and good health. It will also enable optimum savings in energy, cost of transport, buildings, etc. Efficient governance will create a self-sustainable habitat with wiser use of natural resources, reduced pollution levels and low carbon print. The challenge for Indian cities is not solely to make these basic services available to all citizens, but also to ensure that these services are of an acceptable quality.

An effort has been made in the present article to highlight the various challenging issues related to the development of smart cities which is expected to not only resolve key problems of cities but also to play an important role in the abatement of pollution.

Keywords: Urbanization, Pollution, Smart cities.

Introduction

The concept of smart cities originated at the time when the entire world was facing one of the worst economic crises. The concept of "100 smart cities" started in 2014 (*Times of India, 23rd July 2014*) and now, wishing to smart cities is no longer a matter of choice but a necessity due to increase in urbanization and the load on rural land. Out of 100 smart cities, 98 cities have already been identified till date. Many of these cities will include special investment regions or special economic zones with modified regulations and tax structures to make them attractive for foreign investment. This is essential because much of the funding for these projects will have to come from private developers and from abroad.

All over the world, many new titles have been coined in the recent past like Smart Cities, Green Cities, Eco Cities, Future Cities, Healthy Cities,

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Vibrant Cities, Environment-friendly Cities, Progressive and Working Cities, Safe, Secure and Resilient Cities, Inclusive and Humane Cities, Integrated and Self-Contained Cities, etc. and these cities are located all over the world, e.g., Australia, Cameroon, Canada, China, Denmark, Germany, Hong Kong, Ireland, Kenya, Korea, Malaysia, New Zealand, Portugal, Sweden, United Arab Emirates, United Kingdom, United States of America, etc.

In India, the concept of smart city is not without challenges since success of such a city depends on residents, entrepreneurs and visitors becoming actively involved in energy saving and implementation of new technologies. There are many ways to make residential, commercial and public spaces sustainable by way of technology and minimum energy use. Such cities can potentially take anything between 20 and 30 years to build.

In a smart city, economic development and activity is sustainable and rationally incremental by virtue of being based on success-oriented market drivers such as supply and demand. Smart city is a city designed with consideration of environmental impact, inhabited by people dedicated to minimization of required inputs of energy, water and food, and waste output of heat, air pollution and water pollution. They will benefit everybody, including citizens, businesses, the government and the environment. Smart city in the country should have sewage and drainage network, wide roads, hospitals, parks, proper transportation and metro connectivity. A smart and sustainable city should be able to feed itself with minimal reliance on the surrounding countryside, and power itself with renewable sources of energy.

The crux of this is to create the smallest possible ecological footprint, and to produce the lowest quantity of pollution possible, to efficiently use land; compost used materials, recycle it or convert waste to energy, and thus the city's overall contribution to climate change will be minimal, if such practices are adhered to. Smart city will be efficient and faster in identifying and solving basic essential city issues and will find prior consideration of all the pollution abatement issues. It will be meticulously connected by wireless devices and a network of sensors, cameras, data centers and analytics to assess the problem and resolve the issues in no time.

Rapid Economic Growth vis-à-vis Rapid Population Growth

Rapid economic growth as well as rapid population growth is the major issue expressing the challenge of sustaining its rapid economic growth. The opportunities for education, employment and entertainment are considered to be the key factors which force people to migrate from rural areas to urban towns and cities. The cities are facing the challenge of rapid population growth where existing infrastructure did not keep pace with the increased requirements. The State of the World's Cities report brought out by UN-Habitat has indicated that more than half of the world's population currently lives in cities and is projected to increase to 75% by 2050. Thus, the world's future prosperity largely depends on the ability of cities to reduce risk and build resilience to both natural and man-made disasters. It is estimated that it will need about 500 new cities to accommodate the influx.

India and the developing countries have been witnessing a major demographic boom, with strong and irreversible trends in urbanization. The Indian population is set to double from 28 crore in 2001 to 56 crore in 2025. Cities have been contributing to more than 70% of GDP for vibrant economic development. In the coming decades, the urban sector will play a critical role in the structural transformation of the Indian economy and in sustaining the high rates of economic growth. However, deficiencies in urban infrastructure, citizen services, as well as governance mechanism for making cities safe and livable life are crucial and, in many cases, it has reached crisis level situations. Urbanization in India poses an urgent and difficult challenge, too often characterized by widespread poverty, poor urban infrastructure and environmental degradation. This requires us to act fast or we will have to deal with social and environmental crisis of disastrous proportions. Thus, the question arises: What is the vision we can have for our cities in the future? The problems the world presently faces in the realms of environment, poverty, and health demand that Indian cities craft a vision of an entirely new developmental model. The manner in which cities have grown in the past thousand years has been acceptable up till now. But now, we are at a critical juncture and we need to choose a new path.

Integrated Townships

Due to limited land available and with the booming population, the gap between the demand and supply for individual plots, apartments, or sites is increasing, with the result, a new concept of developing integrated townships in sub-urban areas is taking place. Integrated townships will reduce pressure on city infrastructure. Integrated township means residential township should be integrated with commercial and entertainment, corporate space including educational as well as industrial areas besides green and open spaces.

We need to conserve land desperately and avoid converting hundreds of acres of farmland into development zones. Multi-layered high-density towers are the best way to ensure compact urban centers. However, high-rises of the future should be differently designed. They should be small cities in themselves with multiple levels of gardens, parks and farms in the sky.

Basics of Smart Cities

Smart cities are a developed urban area that creates sustainable economic development and high quality of life by excelling in multiple key areas like economy, mobility, environment, people, living styles and the government. Excelling in these key areas is required since strong human capital, social capital and/or ICT infrastructure are involved. Against the background of economic and technological changes caused by the globalization and the integration process, most cities face the challenge of issues of urban quality, e.g., housing, economy, culture, and social and environmental conditions.

A smart city should have smart people (qualified, affinity to learn, flexible, creative, cosmopolitan, open-minded, social and ethnic plurality), smart environment (affinity towards nature, knowledge of sustainable use of natural resources, pollution, protection of environment), smart living (good housing, education, cultural facilities, social), smart mobility (efficient transport system, information technology facilities, infrastructure), smart economy (innovative, entrepreneurship, productivity, economics), and smart governance (social, public participation, interaction with government), etc.

Problems Associated with Implementation of Smart City Programs

Before we discuss about smart cities, we should be aware of existing several pollution-related problems in the cities of India which are responsible for many diseases, health issues and long-term livelihood impact. The pollution problem is worsening day by day in spite of standards, legislations and policy for the abatement of pollution.

Land Acquisition

Acquiring land from public/villagers in many parts of the country is very difficult nowadays and will need satisfactory settlement in spite of well-established rehabilitation and resettlement policy. Land required for smart cities may be agricultural land, pastures, grassland, open land, wetland, etc., being converted into land for construction. Master Plans have to be prepared and approved by the concerned authorities. Xeriscaping (garden and landscape design for water conservation) needs to be necessarily included.

Figure 1.Cities of the Future

Pollution from Construction Projects

The pollution from construction projects, use of natural resources from the vicinity, tapping of the local surface and ground water resources have to be examined seriously since groundwater is going down year after year and has to be used carefully. The construction activities contribute to air pollution due to generation of dust during land clearing and demolition, etc. PM_{10} generated during construction activities may cause respiratory illness, asthma, bronchitis, and cancer.

Air Pollution

Air pollution is a serious major issue due to use of fuel wood, biomass burning, fuel adulteration, use of DG sets, vehicle emissions, and traffic congestion. Delhi has been described as the most polluted city on the earth due to release of $PM_{2.5}$ which is responsible for lung and respiratory diseases.

The air pollution is caused during construction activities, operation of diesel engines and working with toxic materials which may consist of CO, HC, NO_X and CO_2, soot, sulfates, silicates, noxious vapors from oils, and glue used on construction sites. Air pollution can be reduced by taking proper care during construction and following norms for DG sets.

Water Pollution

Discharge of untreated sewage is mainly responsible for surface and ground water pollution in India. Most of the small scale industries do not have wastewater treatment facilities and discharge untreated wastewater. Sources of water pollution on building sites include diesel and oils, paints, solvents, cleaners and other harmful chemicals along with construction debris and dirt.

Silt and soil generally finds way into natural waterways blocking the proper drainage, turning drains turbid, restricting sunlight filtration and destroying aquatic life.

Surface water run-off may also carry other pollutants from the site, e.g., diesel and oil, toxic chemicals, and building materials like cement affecting water life and also drinking water supply. If pollutants from construction sites find way into the groundwater, it is much more difficult to treat ground water than surface water.

Solid Waste Pollution

Most of the time, trash and garbage are not disposed of properly and generally canals and rivers are used as garbage dump yards. Many land filling sites are poorly managed and overflow and become breeding grounds for disease vectors besides discharging greenhouse gases. Proper handling of solid/hazardous waste and its proper treatment and management is necessary.

Noise Pollution

Noise pollution due to vehicles, temples, mosques, marriage parties, festivals is increasing day by day. Permissible noise levels for the rural and urban areas have been notified by the Government of India but have to be followed.

Construction sites also produce a lot of noise, mainly from vehicles, heavy equipment and machinery. Excessive noise can lead to hearing loss, high blood pressure, sleep disturbance and extreme stress. High noise levels also disturb the natural cycle of animals and reduce their usable habitat.

Vehicular Pollution

Vehicular pollution accounts for two-thirds of the air pollution in India resulting in higher levels of SPM and SO_X. Due to increase in number of vehicles since 2005, levels of SPM, RSPM and NO_X have risen steadily. In 2000, there were about 35 lakh vehicles in Delhi. In just eight years, the number grew by 20 lakh. Most of these vehicles are diesel vehicles, emitting huge quantities of SO_2 and RSPM.

Undoubtedly, all the problems mentioned above need immediate attention by all the stakeholders including government, non-government organizations, public, policy planners and implementers while considering building smart cities.

However, all these aspects need to be emphasized and properly addressed in the proposed smart cities. Development of suitable guidelines for the smart cities and their strict follow up is necessary.

Building Smart Cities

We need drastic changes in our way of thinking, life style and living while building environment-friendly smart cities.

Following may be kept in mind while building smart cities:

Sustainable Architecture

Buildings provide infrastructure for a functioning city and should adopt sustainable architecture during phases of building including the planning, building and restructuring. Sustainable architecture promotes a sustainable approach toward development of smart growth, walkability, architectural tradition and classical design.

Eco-industrial Parks

The eco-industrial parks should be developed in all the smart cities, which involves contribution of a number of firms and organizations to work together to decrease their environmental impact by using resources such as natural systems, water flows, materials, efficient use of energy and should be built to fit into their natural settings in order to reduce environmental impacts through plant design, landscaping, and choice of materials. Efforts should also be made to use natural and recycled materials in the industrial park. The landscaping should include native trees, grasses and flowers, and landscaping design should act as climate shelter for the facility. Provision of renewable energy such as wind and solar power should also be included. To create more efficient water flows in industrial parks, the processed water from one plant can be reused by another plant and the parks infrastructure can include a way to collect and reuse storm water runoff. In terms of material flows, an eco-industrial park may have common waste treatment facilities, a means for transporting by-products from one plant to another.

Energy

Most of the world currently relies on outdated electric generation like coal and oil that are extremely inefficient and dirty. We need to redesign the current system, transition to renewable energy sources and implement 21st century solutions to help cities become more sustainable. Instead of just using energy, Indian cities should also be producing energy. In essence, the cities of the future should increase the resources of our planet instead of reducing them. It is estimated that energy consumption in buildings can be reduced by 30 to 80% using proven and commercially available technology. Investment in building energy efficiency provides significant direct and indirect savings. Thus, sustainable buildings or green buildings result in healthier and more productive environment.

Cities of the future should make a total shift to renewable energy. Right now, thin-film solar technology is being used in a limited way. Windows can be used as solar panels and awnings or aluminum sidings can be coated with thin film solar technology that captures and generates electricity. Further, cities will use the next generations of this solar technology on a widespread scale and this technology will be integrated within the architecture of new buildings and retrofitted into older buildings. Further, cities should also rely on wind farms on the outskirts of the city for power.

Figure 2.Indira Paryavaran Bhavan, New Delhi

Digital Infrastructure

Installation of digital infrastructure of sensors, networks and data analytics is necessary as meticulously as the physical infrastructure of buildings, road and utilities to perform most of the work on-line using digitization facilities. Digitization of most of the work will not only save time and money but also transportation and air pollution. Working from residence than office, using digitization system, will not only save time in travelling to office but also solve transportation and air pollution problem.

Green Buildings

Globally, buildings are responsible for one-third of greenhouse gas emissions. In the USA, the impact is even greater, with nearly 40% of all carbon dioxide emissions coming from commercial and residential buildings. Main reasons for such a large contribution of greenhouse gas emissions from the buildings are: relying on dirty energy sources for their power and not using energy efficiently by the buildings. Through simple efficiency and design improvements to buildings, we can reduce those emissions drastically. To realize that vision, cities need to update ordinances, switch to performance-based building codes, and improve financing options. Green buildings should involve practical and climate-conscious approach. Various factors like geographical location, prevailing climatic conditions, use of locally available and low-embodied energy materials should be considered. Four main areas in green buildings, namely, material efficiency, energy efficiency, water efficiency and reduction of solid waste should be seriously considered. Recently constructed Indira Paryavaran Bhavan, New Delhi, is the best example of material efficiency, energy efficiency, water efficiency, reduction of solid waste, and use of solar energy.

Water and Wastewater Management

Due to rapid urbanization, cities are facing problems in supply of adequate quantity of water for all purposes. The cities of the future should conserve every drop of water. Pilot studies are required to reduce loss of water during intake, treatment and discharge since it is possible to minimize water loss and make the water supply more efficient by adopting appropriate technological options. Green structures and water system should be used for cooling instead of energy-consuming air conditioning.

Sanitation and wastewater management are major problems in most Indian cities as per the estimate by the Center for Science and Environment in 2011. 70% of the 920 L water supplied per household per day is consumed for kitchen use, shower and laundering. This wastewater can be trapped and used for toilet flushing, gardening and firefighting; instead, this wastewater is drained along with sewage. Non-collection of wastewater and discharge of untreated wastewater into low-lying areas on various water bodies causes severe water and land pollution problem. All sources of water for all aspects, covering generation, segregation, transfer, segregating, treatment, recovery and disposal should be done in an integrated manner with emphasis on maximizing resource use efficiencies. Sustainable urban drainage systems (SUDS) should be planned and implemented.

Solid/ Hazardous Waste Management

Proper segregation, treatment and disposal of solid/ hazardous wastes is necessary. The disposal of electronic gadgets after their useful life is a growing problem as these contain hazardous substances, metals and non-metals that cause pollution in the soil due to e-waste dump on or under the ground and their mixing with the ground water. Change in the minds of people regarding disposal of e-waste from computers, mobile phones, etc. is required.

Transportation

Transportation is the fastest growing source of greenhouse gas emissions worldwide, three quarters of which come directly from road vehicles. To reduce these emissions and the resulting smog, we need to improve standards, increase public transportation options, invest in alternative transportation and improve city walkability and bikeability. Urban environment has deteriorated due to unsustainable urban transport system. We should move toward a low-carbon economy (LCE), an economy that has a minimal output of greenhouse gases (GHG) emissions due to the environment biosphere. As a first steps toward LCE, cities can switch to greener and sustainable building and transportation choices. Sustainability experts recommend carbon-neutral cities full of electric vehicles and

bike-sharing schemes, with greatly improved air quality.

There is an urgent need for reduction in energy consumption and carbon emission from transport sector in India. It is necessary to understand what cities can do to reduce the carbon footprint of their travel activity. The public transport system including metro system should be developed to reduce CO_2 emission from transport sector.

Smart Cities and Climate Change

Nowadays, climate change represents a catastrophic threat to the society in urban living and also to the agriculture and farming in rural areas. However, risk to climate change can be reduced by using low-energy products, energy-efficient buildings, low-emission transport facility, recycled and recyclable energy products and energy from renewable sources. Climate change agenda mainly should include water, waste, forestry, renewable, transportation, buildings, lighting, energy, etc.

State Action Plan for Climate Change (SAPCC) beyond 2012 is being prepared by all the states and Union Territories on the lines of National Action Plan for Climate Change (NAPCC), launched by Prime Minister of India in 2008 with eight missions including sustainable habitat which is further extension to the climate change agenda, as per the frame work of Ministry of Environment, Forests & Climate Change of India.

Benefits from Smart Cities

The simultaneous attainment of financial, environmental and social sustainability of urban services is an important requirement of development. Cities around the world should become more sustainable and reduce their carbon footprint. These smart cities can be achieved through various means; for example:

Social Interactions

It is estimated that over 50% of the world's population now lives in cities and urban areas. Humans are social creatures and thrive in urban spaces that foster social connections. Because of this, a shift to more dense, urban living would provide an outlet for social interaction and conditions under which humans can prosper. Contrary to common belief, urban systems can be more environmentally sustainable than rural or sub-urban living. With people and resources located so close to one another, it is possible to save energy and resources such as food transportation and mass transit systems. Finally, cities benefit the economy by locating human capital in one relatively small geographic area where ideas can be generated. This not only gives economies of scale but also allow for infrastructure to be more efficient.

Walkable Urbanism

Walkable urbanism should be adopted while housing for a diverse population, walkable streets, positive public space, integrated civic and commercial centers, transit orientation and accessible open space. It also advocates for density and accessibility of commercial and government activity.

Urban Farming

Urban farming is the process of growing and distributing food, as well as raising animals, in and around a city or in urban areas and is different from rural agriculture because it is integrated into the urban economic and ecological system. Such linkages include the use of urban residents as laborers, use of typical urban resources (like organic waste as compost and urban wastewater for irrigation), direct links with urban consumers, direct impacts on urban ecology (positive and negative), being part of the urban food system, competing for land with other urban functions, being influenced by urban policies and plans, etc. In urban agriculture, in the context of creating a sustainable city, method of food cultivation saves energy in food transportation and saves costs. In order for urban farming, cities must allot a common area for community gardens or farms, as well as a common area for a farmers market in which the foodstuffs grown within the city can be sold to the residents of the urban system.

Agriculture

Small-scale/private farming plots or larger-scale agricultural systems should also be located within the city or suburbs. This will reduce the distance food has to travel from field to fork.

Renewable Energy

Maximum use of renewable sources, such as solar panels, wind turbines, bio-gas created from

sewage should be ensured. Zero-energy buildings and other energy conservation systems/devices should also be used.

Reduction in Energy Consumption

Various methods to reduce the need for air conditioning (a massive energy demand), such as planting trees and lightening surface colors, natural ventilation systems, an increase in water features, and green spaces equaling at least 20-30% of the city's surface. These measures counter the "heat island effect" caused by an abundance of tarmac and asphalt, which can make urban areas several degrees warmer than surrounding rural areas-as much as 6 °C during the evening.

Certification of Individual Buildings

There are three primary rating systems in India that are applied to assess buildings: GRIHA, IGBC and BEE. GRIHA stands for green rating for integrated habitat mental design) ratings for green buildings devised in the United States, in India. The Bureau of Energy Efficiency (BEE) launched a star rating program in 2009, for office buildings in order to accelerate the energy-efficiency activities in commercial buildings. The program developed by the Bureau of Energy Efficiency, BEE, is based on actual performance of a building, in terms of specific energy usage (in KWh/sq m/year).

All the buildings in smart city should also follow Leadership in Energy and Environmental Design (LEED), an internationally recognized green building certification system. LEED recognizes whole building sustainable design by identifying key areas of excellence, e. g., sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, locations and linkages, awareness and education, innovation in design, and regional priority. In order for a building to become LEED certified, sustainability needs to be prioritized in design, construction, and use. Most credits are rewarded for optimizing energy performance. This promotes innovative thinking about alternative forms of energy and encourages increased efficiency.

Emphasis on Proximity

The concept of urban proximity should be an essential element of current and future sustainable city transportation system. This requires that cities be built and added onto with appropriate population and landmark density so that destinations are reached with reduced time in transit. This reduced time in transit allows for reduced fuel expenditure and also opens the door to alternative means of transportation such as bike riding and walking. Employees should be encouraged to stay close to their offices so that they can also ride a bike or just walk to their offices, which will certainly reduce vehicular congestion on the road and also air pollution.

Furthermore, close proximity of residents and major landmarks will also allow for the creation of efficient public transportation by eliminating long sprawled out routes and reducing commute time. This in turn decreases the social cost to residents who choose to live in these cities by allowing them more time with families and friends instead, by eliminating a part of their commute time.

New Urbanism

Walkable urbanism is the New Urbanism. This will certainly reduce environmental impacts by altering the built environment to create and preserve smart cities which support sustainable transport. Residents in compact urban neighborhoods will drive fewer miles and have significantly lower environmental impacts across a range of measures, compared with those living in sprawling suburbs. The concept of circular flow land use management can also be introduced to promote sustainable land use patterns that strive for compact cities and a reduction of green field land take by urban sprawl.

Car Free City

The concept of car free cities or a city with large pedestrian areas should be part of the design of a sustainable city. A large amount of the carbon footprint of a city is generated from cars; so, it is often considered being an integral part of the design of a sustainable city.

Public Transport

Improved public transport and an increase in pedestrianization are necessary to reduce car emissions. This requires a radically different approach to city planning, with integrated business, industrial, and residential zones. Roads may be designed to make driving difficult.

Optimal building density should be adopted to make public transport viable but avoid the creation of urban heat islands.

Transportation

Smart cities should focus on sustainable transportation to reduce city's reliance and use of greenhouse emitting gases by utilizing eco-friendly urban planning, low-environmental impact vehicles and residential proximity to create an urban center that has greater environmental responsibility and social equity.

Due to the significant impact that transportation services have on a city's energy consumption, we should emphasis on sustainable transportation by developmental experts. Currently, transportation systems account for nearly a quarter of the world's energy consumption and carbon dioxide emissions. In order to reduce the environmental impact caused by transportation in metropolitan areas, sustainable transportation should be utilized to create more healthy and productive urban centers.

Diversity in Modes of Transportation

Sustainable transportation emphasizes the use of a diversity of fuel-efficient transportation vehicles in order to reduce greenhouse emissions and diversity fuel demand. Due to the increasingly expensive and volatile cost of energy, this strategy has become very important because it allows a way for city residents to be less susceptible to varying highs and lows in various energy prices.

Among the different modes of transportation, the use of alternative-energy cars should be encouraged. Also, the creation of centralized bike and walking paths remains a staple of the sustainable transportation movement.

Transportation Access

Smart cities while implementing sustainable transportation must include access to transportation by all levels of society. Due to the fact that car and fuel costs are often too expensive for lower-income urban residents, emphasis should be given to efficient and accessible public transportation. In order to make public transportation more accessible, the cost of rides must be affordable and stations must be located no more than walking distance in each part of the city. This accessibility creates a great increase in social and productive opportunity for city residents. By allowing lower income residents cheap and available transportation, it will allow individuals to seek employment opportunities all over the urban center rather than simply the area in which they live. This in turn reduces unemployment and a number of associated social problems such as crime, drug use and violence.

Conclusion

As per EIA Notification, 2006, all the construction activities involving more than 50,000 sq. m area have been kept in Category 'B' and require environment clearance from the State-level Impact Assessment Authority/State-level Expert Appraisal Committee (SEIAA/SEAC) which have been constituted in most of the States/Union Territories. All such proposals are appraised by the SEIAA/ SEAC and are accorded environment clearance with specific and general conditions.

Awareness should be created among general public about three key elements-buildings, energy, and transportation, and campaigns should be organized to help cities accelerate their transition to a cleaner, healthier and more economically viable future through improvements in efficiency, investments in renewable technology, and regulation reform. We should also educate public about each element of green cities and organize events. We can also create a smart city network and organize grassroots efforts to improve local codes, ordinances and policies mobilize support for appropriate policies; and generate concrete commitments for innovative and replicable initiatives that will help cities become model green cities.

The world's energy infrastructure is ripe for improvement and should be made use of. Most of our electricity is generated in dirty fossil fuel power plants, which pump greenhouse gases into the air and contribute to climate change. The electricity is then distributed through thousands of miles of inefficient and unreliable power lines which should be avoided at any cost. Transforming outdated electricity grid into a cleaner, cheaper, and more reliable energy system is a critical step toward securing a sustainable future. Small-scale renewable energy sources should replace centralized, fossil fuel-burning power plants.

Smart grids will regulate energy flow, ensure energy efficiency, and immediately diagnose problems.

To create greener buildings, we need to improve energy and water efficiency, reduce waste and pollution, transition to renewable energy sources, and use sustainable building materials. These strategies can reduce energy consumption in buildings by 30-80 percent.

If the right investments are made in energy, transportation and green buildings, the cities of the future could look very different from the cities of today. Our communities could be cleaner and more sustainable. Our quality of life could be better.

Although there is no international policy regarding sustainable cities and there are no established international standards, we should make an effort to promote a more sustainable society. With education and political will, we can make this energy use a reality in future, but we must start now. A cheaper and more sustainable future awaits. The future is bright, if cities are green.

Acknowledgment

Author is thankful to Prof. (Mrs.) Neel Kamal Rastogi, Centre for Advanced Study in Zoology, Banaras Hindu University, Varanasi, U.P., for critically reviewing the manuscript.

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