HOW CAN WE MAKE OUR CITIES MORE LIVABLE & SUSTAINABLE?

Urban design solutions to the Triple challenge of Urban Development, Quality of Life and Urban Environment.

By Rohini Iyengar & Kavita Revankar
(Students of 2nd semester M.arch Habitat Design, BMSCA, Bangalore)

ABSTRACT

Currently, over half of the world's population resides in cities. This urbanization trend is expected to continue and more than 80% of humanity is expected to live in cities by 2050.To secure the ongoing prosperity and wellbeing of our communities; we must ensure that our cities meet the needs of current and future generations. We must aim for economic growth to sustain and increase without compromising the natural environment or our quality of life. This is the basis of a sustainable future. Choices made today on building design, waste management, urban ecosystem management, transportation, water, energy and food systems – and how well these choices integrate across sectors – will have critical implications for the future of cities across the world. Think globally, act locally this slogan stands for a new comprehensive and integrative approach which is the essence of sustainable & resource efficient development. Using flow analysis to validate and quantify the spatial impact of measurements for circularity and sustainability and using urban design to see how these measurements can be integrated in the context of the city. The paper focuses on the spatial impact of urban metabolism.

Keywords—*Sustainable, resource efficient, urban environment, urbanization, urban metabolism, design solutions*

I. Introduction

The growing middle class population & urbanization in developing countries like India, Asia & Africa will be home to 80% of global urban population in the near future. These cities will continue to house the urban population providing more employment, entrepreneurial opportunities and good quality of life. Urbanization is placing an environmental load on natural resources as cities account for 60–80% of energy consumption across the globe and for more than 70% of worldwide carbon dioxide emissions. Hence it becomes important to integrate & coordinate across different city sectors & scales to achieve city level sustainability & resource efficiency.

Carbon footprint is defined as the total set of greenhouse gas emissions caused by an individual, event, organization or a product. The direct carbon emissions are through fuels & transportation. The indirect carbon emissions are through food, textiles, materials & cement. Between 1990 and 2012, global emissions of carbon dioxide increased by over 50%. Our major cities generate around 80 per cent of our gross domestic product and employ 75 per cent of our national workforce. Cities are centers of economic activity where labor, industry and social institutions are concentrated.

The reasons why the urban environment must be improved are threefold: 1.The quality of life in cities is declining and urban pollution keeps increasing in terms of $C0_2$ emission, waste, noise, dirt, lack of greenery, depleting ground water level; 2.The demand for a good local environment is becoming increasingly loud and is therefore having a growing political impact; 3.Many modern activities seek to establish themselves in pleasant, non-degraded, non-polluted areas.

When urban metabolism is an integrated part of the design of the city. This means we take the theory of urban metabolism as a base and use design goals such as circularity and sustainability. To see how a city would look if circularity were to be implemented in the city being quantified and integrated in their real size. The spatial component is often lacking and –therefore the impact of urban metabolism on urban design is not well established. This paper focuses on bridging that gap.

This paper proposes a mix of strategies, incentives, and enforcement measures in a broad range of sectors at different levels to improve city sustainability, health, environment, ecology and resource efficiency.

II. Scenario in Developed Countries & Developing Countries

Understandably the developing countries want the right to economically expand the fastest ways they can, like developed nations have been doing for the past 100 years. Developing countries face a difficult decision, whether to sacrifice their economic development for protection against possible ecological problems in the near future. Many developing countries have neither the resources nor the technology to defend against rising sea levels, increased incidence and ferocity of tropical storms, and expansion of tropical diseases.

III. Our Cities, Our Future

With their high population densities and often historical centres, cities cannot currently supply their enormous resource demands within their own land areas. They depend on their hinterlands for the production of food, raw materials, and their energy supplies. Transitioning to circular and sustainable cities will partly depend on urban areas becoming more self - sufficient for their resource needs. Buildings and products should ideally be designed for full recovery of material resources at high value. Advanced reverse logistics chains will feed end of - life products into reuse, refurbishment, and recycling processes. These

products will ideally be reprocessed in or around cities, spurring the development of new, decentralized manufacturing industries. Beyond just having closed material cycles, circular cities will have intelligent systems for the management of renewable resources, like energy and water. The urban fabric will be designed in such a way that it integrates and supports native biodiversity, and creates a healthy and vibrant environment for diverse socio-economic activities.

Naturally, not all parts of a city are suited to all kinds of functions. Likewise, though the city as a whole should achieve broader sustainable goals, an important question emerges around the level of decentralization of essential functions like energy production or resource recovery. **Should every house be self-sufficient for its own energy and water needs? Or is this something better dealt with a neighbourhood, or even on a larger scale?** And how do we address the fact that certain parts of the city have different typologies and structures, suited to different kinds of activities.

a. What is Sustainability?

Sustainability is all about ecology economy and equity. Sustainability is the endurance of systems and processes. Our rapidly growing urban populations are intensifying pressure on the environment through increased demand for water, energy, land and other resources, and through the production of waste and pollution.We need to reduce the carbon pollution generated by our cities, produce environmental benefits, and become more resilient to future shocks, including the impacts of climate change.

For this there was an action plan Agenda 21 by the United Nations which aimed at sustainable Development. It is a comprehensive blueprint of action to be taken globally, nationally and locally by organizations of the UN, governments, and major groups in every area in which humans directly affect the environment. Cities will therefore have a major role to play not only in improving their own environment, but especially in improving the environment at the international & global level.

b. Planning a Sustainable City

Cities occupy 3% of surface But consume 75% of Global Resources & produce 60-80% of Global Greenhouse gas emission

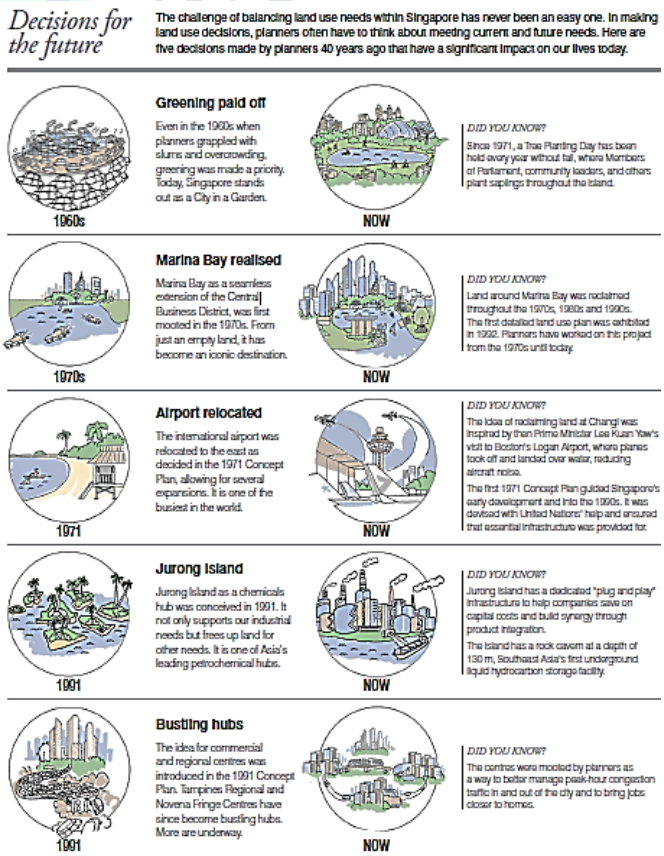
Cities as we know them today are already dramatically changing. Our living environments are reshaping the way we live. This new 'urban age' presents a unique opportunity for us to remake and reinvent our cities. How well we plan and design our living environments will matter. While our challenges today are vastly different from the 1960s, our priority remains the same: catering for economic growth and a good quality of life, maintaining a clean and green environment, and making the best use of our resources. What has constantly guided our approach to sustainable development is far-sighted, holistic, and comprehensive planning, which enables us to take into account future development needs through an integrated planning process. Our objectives are:

Economic: Sustain a robust and vibrant economy
Social: Provide a good quality of living and a sense of well-being for all
Environmental: Develop in an environmentally responsible manner
Land and sea: Optimize our limited land and sea space

IV. Example of a city which has adopted sustainability as their policy and also implemented: Singapore, Amsterdam

Singapore: By encouraging the adoption of innovative architectural design and energy-saving technologies, Singapore has emerged as a model of green building in Asia — an important development in a region that is urbanizing more rapidly than any other in the world. Singapore has established a series of long-term goals and 10-year plans to reconcile rapid economic development and environmental sustainability. It has pursued its vision of being a clean, green city using targeted policy portfolios and strong spatial planning. Singapore's meteoric economic rise launched a landscape of towering architecture in the compact city-state, but as the metropolis continues to grow, urban planners are weaving nature throughout—and even into its heights. New developments must include plant life, in the form of green roofs, cascading vertical gardens, and verdant walls.

The push to go green extends to construction as well—green building has been mandatory since 2008.



Amsterdam: The City of Amsterdam is determined to become a global leader in urban transition to a circular economy – an economy that is regenerative and waste - free by design. A circular approach to sustainable urban development promises lower dependency on virgin raw materials, greater value retention in buildings and infrastructure, and a healthier environment for residents, among many other benefits. To lay the groundwork for moving towards circularity, Amsterdam has completed studies, developed tools, and defined goals. Amsterdam continuously revises its development Ambitions, which are documented in a number of key Publications. The table below presents an overview of the most important goals set forward by the city in the realm of sustainability and circular economy.

MATERIALS	65% household waste separation by 2020[1]	YES	D
	New forms of circular production, distribution and consumption[1]	NO	
	Circular municipal procurement[1]	NO	
ENERGY	20% energy reduction[1]	YES	A
	20% renewable energy[1]	YES	A
	40% CO2 reduction by 2025[1,2]	YES	A
	81% CO2 reduction by 2040[4]	YES	A
ECOSYSTEMS	Making water accessible and enjoyable[5]	YES	B
	Growth by spreading recreation and tourism[5]	NO	
	Stimulate dynamic and sustainable use of water[4]	NO	
	Application of economic principles[4]	NO	
	Better resilience against heavy rain[4]	YES	B
SOCIO-CULTURAL	Develop Amsterdam as an inclusive city for and by everyone, and make space for economic diversity[7]	YES	C
	A greater extent than previously, the aim will be to create compact, mixed environments, in which spaces for living will be mixed with those for work and services. The buildings in which people work will have healthy climates. Large green projects in and around the city will add to the city's livability, air quality and attractiveness[7]	YES	B, C
HEALTH & WELLBEING	Nitrogen oxide reduced by 35% 2015-2025[1]	YES	E
	Soot reduced by 30% 2015-2025[1]	YES	E
	The Moving City gives ample space to the cyclist and pedestrian[8]	YES	B
	In the Moving City sport can be found around the corner[8]	YES	B, C
	The Moving City is a playground[8]	YES	B, C
	The Moving City does not sit idly by[8]	NO	
INFRASTRUCTURE & MOBILITY	Limit impact of cars to improve livability[6]	YES	B
	Improve and facilitate other means of transport[7]	NO	
	Be known as the best bicycle city[6]	NO	
ECONOMY & INNOVATION	Room to experiment and cultural initiatives[9]	NO	
	Talent development[9]	NO	
	Knowledge and innovation economy[9]	NO	
	Sustainable, innovative and creative activity as city's calling card[9]	NO	

V. Compact City

With limited land, planning for a compact city is critical. This strategy enables them to make the best use of the land, allow for more efficient provision of facilities, and maximize the use of the transport infrastructure. By building more homes and amenities around major transit corridors, residents can benefit from greater convenience to public transport and ready amenities nearby. This will translate to greater travel convenience, lower car usage, and more social interaction and bonding. More housing units of high storey's can be injected in vacant land around these corridors. Even though the living environments are likely to become denser, quality living environments will continue to be planned for. There will be more ground level open spaces and parks, and community spaces at intermediate levels to facilitate community bonding. Good design and landscaping can also offer visual relief.

VI. Sustaining Growth

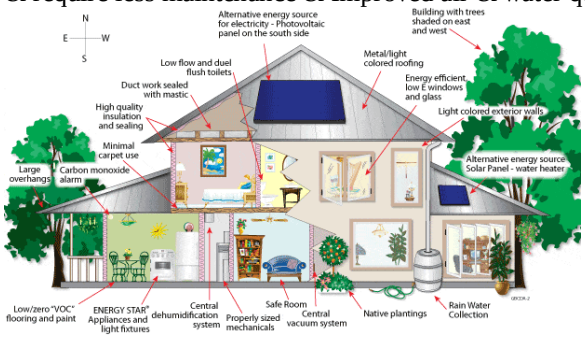
With limited resources, cities need to continue to sustain its economic growth to provide good jobs, maintain high living standards, and remain attractive to visitors and investors. Decentralization to reduce peak-hour congestion from traffic flowing in and out of the city-centre, regional and fringe centers outside of the city centre should be consider to bring jobs closer to home. Design of equitable street networks with green strategies employed will also help in reducing the carbon footprint of cities & help in developing sustainable cities

VII. Urban Design Solutions for a Sustainable Development

a. Green Buildings Strategy:

A Green building strategy is nothing but incorporating many sustainable techniques into making a building self-sustain and maintain itself. Green sustainable building incorporates and integrates a variety of strategies during the design, construction and operation of building projects. The use of green building materials and products, using sunlight through passive solar, active solar, and photovoltaic techniques and using plants and trees through green roofs, rain gardens, and for reduction of rainwater run-off represents some of the strategies in the design of a green home. Green building concepts can be used to reduce and ultimately eliminate the impacts of buildings on the environment and human health.

Use of naturally available resources at site & reducing the use of concrete in any building add to the building becoming sustainable. Techniques must be adopted to allow the recharge of ground water as well. Some of the benefits achieved by adopting Green building strategies in residences are: Lower utility costs, Improved occupant health & productivity, Reduced energy consumption, Materials are more durable reducing maintenance/replacement costs over the life of the home, Green homes have higher resale value & require less maintenance & Improved air & water quality



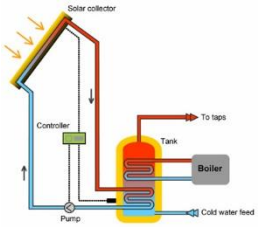
b. Solar panels:

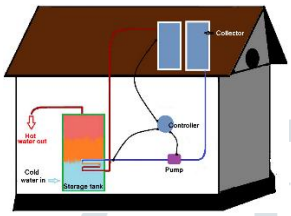
Active solar devices such as photovoltaic solar panels help to provide sustainable electricity for any use. Typical

efficiencies for commercially available PV panels range from 4% to 28%. The low efficiency of certain photovoltaic panels can significantly affect the payback period of their installation.

c. Solar water heating:

Solar water heaters-also called solar domestic hot water systems can be a cost effective way to generate hot water for a home. They can be used in any climate, and the fuel they use sunshine is free. There are two types of solar water systems- active and passive. An active solar collector system will cost approximately installed and produce about 80 to 100 gallons of hot water per day. The up-front cost of installing solar collectors is high, but with the annual energy savings, payback periods are relatively short.



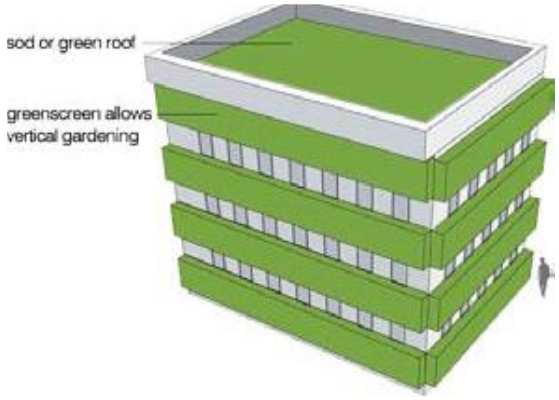


d. Wind turbines:

A wind turbine is a device that converts kinetic energy from the wind into mechanical energy. Developed for over a millennium, today's wind turbines are manufactured in a range of vertical and horizontal axis types. The smallest turbines are used for applications such as battery charging on sailing boats; while large grid-connected arrays of turbines are becoming an increasingly large source of commercial electric power. A small wind turbine can be installed on a roof. Small-scale rooftop wind turbines have been known to be able to generate power from 10% to up to 25% of the electricity required of a regular domestic household dwelling.

e. Sustainable materials:

Some examples of sustainable building materials include recycled denim or blown-in fiber glass insulation, sustainably harvested wood, Tress, Linoleum, sheep wool, panels made from paper flakes, baked earth, rammed earth, clay, vermiculite, flax linen, sisal, cork, expanded clay grains, coconut, wood fiber plates, calcium sand stone, locally obtained stone and rock, and bamboo, which is one of the strongest and fastest growing woody plants, and non-toxic low-VOC glues and paints.



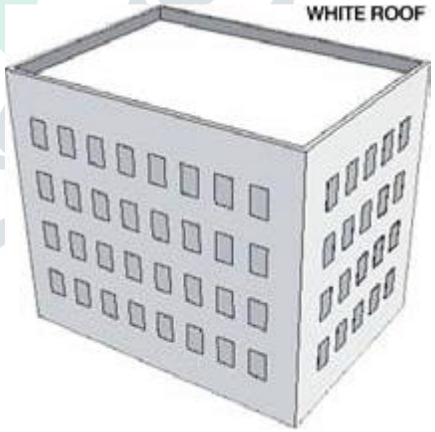
f. Waste management:

The management of waste is a key component in a business. Companies are encouraged to improve their environmental efficiencies each year. One way to do this is by improving a company's waste management with a new recycling service. Such as recycling glass, food waste, paper and cardboard, plastic bottles etc. There are a number of concepts about waste management which vary in their usage between countries or regions. Some of the most general, widely used concepts include:

- Waste hierarchy
- Extended producer responsibility
- Polluter pays principle

g. White Roof:

A physicist at the Lawrence Berkeley lab just released a study showing that the average American 1,000-square-foot white roof could offset 10 metric tons of CO2. According to his data, roofs constitute 20 to 25 % of urban surfaces, while pavement is about 40 %. Therefore, if all of those surfaces were switched to a reflective material (or color) in the 100 largest urban areas in America, his calculations show, this would offset 44 metric gigatons of CO2.

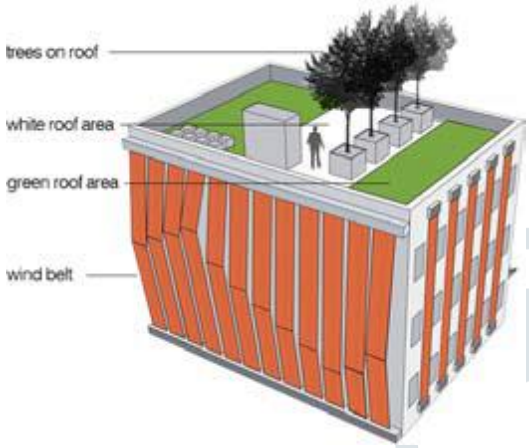


h. Green-Screen:

Green-screen is a type of metal structure that can be attached toexisting walls or used to create freestanding growing walls. Byintegrating more trees and photosynthesizing plants within the fabric of our existing cities, we harness the power of plants to absorb carbon from the atmosphere. The surface area of buildingsmultiplies the ground footprint of the city many times over, making vertical gardening and the integration of growing walls into our buildings an interesting practical solution. The roofs-cape of most cities is an area that is often forgotten but that could easily be used for the application of green technologies beneficial to all.

i. Wind-Belts and Green Roof:

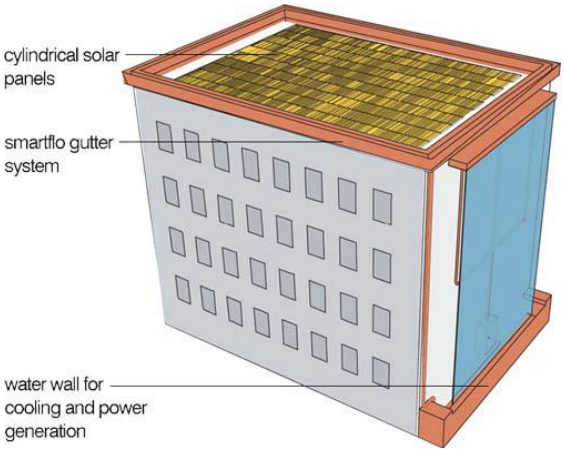
Wind belts are a recent technology which harnesses the power of the wind to generate electricity. They are relatively inexpensive and suitable for both developed and developing countries and are the first wind technology not to employ turbines; Wind-belts could be used on the facades and roofs of existing buildings as a sculptural element, taking advantage of the building envelope as an available surface upon which to attach. Trees may be planted on the roof by using either planters or by using a new Japanese soil substitute, which is much lighter than earth.



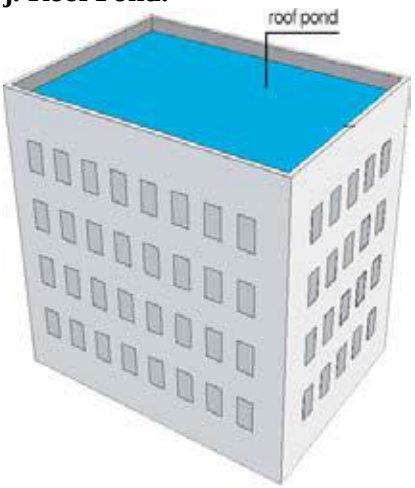
k. Water Wall and Solar Pipe:

It is well known that electricity can be generated from fast moving water. Here, we propose that a water wall be added to a blank facade on an existing generate the necessary flow. This water can also be used to flush toilets and for other non-potable applications. In addition, the water provides cooling to the building's inhabitants. The roof in this scheme is envisioned as a space in which the entire surface area is covered by solar coils.

building as a means of generating electricity. Water can be collected via a system of gutters on the building, and then can be piped and recycled to



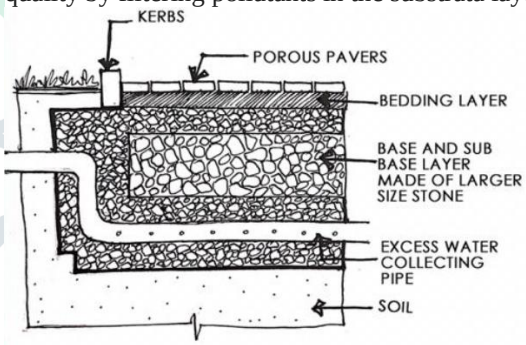
j. Roof Pond:



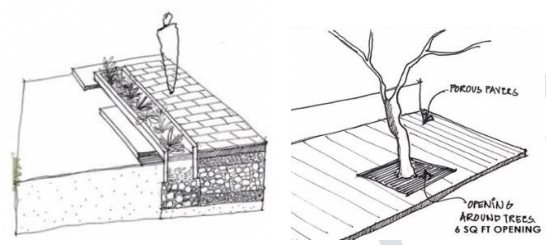
Roof ponds can be used for cooling in areas that are warm and not very humid. This technology has a lot of potential, but has been under used to date because of a fear of leakage on the part of architects and clients, however, if properly detailed it is a promising strategy and can help to reduce the heat island effect in cities. Insulating panels cover the roof and are heat of the sun, and at night, the panels are closed, allowing heat to radiate to the building's interior. In the summer, the process is revers

l. Using porous pavements, footpaths & parking areas to allow ground water recharge

Permeable paving is a method of paving vehicle and pedestrian pathways that allows for infiltration of fluids. Whether it is pervious concrete, porous asphalt, paving stones or concrete or plastic-based pavers, all these permeable paving systems allow storm water to percolate and infiltrate the surface areas, bypassing the traditionally impervious materials to the soil below. The goal is to control storm water at the source, reduce runoff and improve water quality by filtering pollutants in the substrata layers.



m. using Bioswales along foot paths



Bioswales are landscape elements designed to concentrate or remove debris and pollution out of surface runoff water. A common application is around parking lots, where substantial automotive pollution is settled on the paving and then flushed by the first instance of rain, known as the first flush. The Bioswales, or other type of bio filter, can be created around the edges of parking lots to capture and treat the storm water runoff before releasing it to the watershed or storm sewer.

VIII. Summary and Conclusion

- Global warming is the increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation.
- Addressing global climate change is a paramount challenge of the 21st Century. Since the beginning of the industrial revolution, atmospheric concentrations of carbon dioxide (CO_2), the chief heat-trapping greenhouse gas, have risen 35 %. This increase is primarily from the burning of fossil fuels and from deforestation
- There is no doubt that climate will continue to change throughout the 21st century and beyond, but there are still important questions regarding how large and how fast these changes will be, and what effects they will have in different regions.
- Buildings & roads alone are responsible for 25% of all human greenhouse gas emissions. It is the industrial sector which contributes the most to Climate Change.
- Sustainability is the key to a survivable future on Earth: we must find ways to conserve our resources, reuse the materials we have extracted from the Earth, and turn to alternate renewable resources for energy, while maintaining the balance between biological cycle and technical cycle for addressing human needs & fairly distributing resources without undermining the functioning of the biosphere or crossing any - planetary boundaries. The Perpetual economic growth is physically impossible on a planet with finite resources.

REFERENCES

1. Mr. Edward Mazria, "Understanding and Responding the Climate Change" United States, 2008
2. Smart sustainable cities: An integrated planning approach towards sustainable urban energy systems, India. Retrieved from: http://waset.org/ publications/10365/smart-sustainable cities- an-integrated-planning-approach towards- sustainable-urban-energy systems-India
3. Post-2015 sustainable development agenda. Retrieved from: www.undp.org/ content/undp/en/home/mdg over view/ post-2015-development-agenda.html
4. Sustainable, Resource Efficient Cities –Making it happen by UNEP
5. Laying the foundations for a smart, sustainable city by Ericsson White
6. Smart Sustainable Cities Definition and Challenges by Mattias Hojer and Josefin Wange
7. Connecting the dots Smart and sustainable cities by PWC
8. Making cities smart and sustainable by PWC
9. Citizen's engagement and value co-production in smart and sustainable cities by Walter Castelnovo
10. Transit Oriented Development by C40 Cities Climate Leadership Group
11. Working of Bioswales, Wikipedia
12. Underground water recharge concrete or asphalt pavers
13. Ellen MacArthur Foundation and McKinsey, 2011 Municipal Council of Amsterdam. 2015. *Sustainable* Amsterdam: Agenda for renewable energy, clean air, a circular economy and a climate-resilient city.