

# **Economics of Sustainable Cities**

**Zareena Begum I**

**DISSEMINATION PAPER - 33**

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# **ECONOMICS OF SUSTAINABLE CITIES**

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# ECONOMICS OF SUSTAINABLE CITIES

## 1. INTRODUCTION

Numerous challenges threaten the ability of cities to become viable pillars of sustainable development. Unequal access to, and inefficient use of, public services, as well as financial fragility and the harm inflicted by natural hazards, demand an integrated and coordinated response at the local, national and international levels. The predominance of small- and medium-sized cities provides an opportunity to invest in green infrastructures, bypassing old energy technologies, and in social development, before social inequities become unsustainable. Rural development is critical for an integrated approach to sustainability and for reducing poverty. Ensuring wider and inclusive access to public services can reduce rural/urban inequalities, disaster risk and food insecurity, as well as strengthen networks between cities and villages (Camagni et al., 1998). Building sustainable cities requires investment in renewable energy sources, efficiency in the use of water and electricity, design and implementation of compact cities, retrofitting of buildings and increase of green areas, fast, reliable and affordable public transportation and improved waste and recycling systems. Cities in poor countries need resources to support green technology transfer, and capacity development, and to improve access to soundly constructed housing, water and sanitation, electricity, health and education.

Cities and towns have become the primary human living space. Since 2007, more than half of the world's population has been living in urban areas and the figure is estimated to exceed 70 per cent by 2050. This is a hallmark of the transformation of humans' economic base and social structure, inasmuch as, previously, populations lived and worked primarily in rural areas. Cities can provide many socioeconomic benefits (Dassen et al., 2013). By concentrating people, investment and resources (a process known as agglomeration), cities heighten the possibilities for economic development, innovation and social interaction. More specifically, cities also make it possible to lower unit costs so as to provide public services such as water and sanitation, health care, education, electricity, emergency services and public recreational areas. Cities

also face challenges that threaten their efforts to achieve sustainability, for example, through improvement of access to, and efficiency in the use of, public services, as well as reduction of their ecological footprint and financial fragility, and the building of resilience against the adverse impact of natural hazards.

Cities have become the focal points of these components as major consumers and distributors of goods and services. However, many cities tend to be large consumers of goods and services, while draining resources out of external regions that they depend on. As a result of increasing consumption of resources, and growing dependencies on trade, the ecological impact of cities extends beyond their geographic locations.

## **2. SUSTAINABLE CITIES**

At this present juncture, the world is urbanizing at a rapid pace. By 2050, more than 2 billion additional people will be living in cities — about two-thirds of the global population. Moreover, the vast majority of this growth will be concentrated in developing countries, with nearly 90 percent of the increase from cities in Asia and Africa. Cities are therefore the best place to start addressing three mega-trends that drive global environmental degradation: urbanization, a rising middle class and population growth. As engines of economic growth, cities already produce 80 percent of the world's gross domestic product (GDP). They consume over two-thirds of global energy supply, and generate 70 percent of greenhouse gas emissions. Cities are also uniquely vulnerable to climate change: 14 of the world's 19 largest cities are located in port areas. So before proceeding with the grave task of upgrading our task of converting Cities to sustainable cities let us elaborate what sustainable cities are.

A sustainable city, or eco-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 - CO<sub>2</sub>, methane, and water pollution (Finco and Nijkamp, 2001). The key features of future Sustainable Cities that will make a difference not only by making a cleaner greener environment but in the long run benefitting us (Segnestam, 2002).

## **Finance and auditing**

*Joined-up action.* Departments need to talk to each other so that, for a properly joined-up sustainability strategy, say, the Transport Department is not working against the interests of the planning department and so on.

*CEO buy-in.* This means that the chief executive needs to be on board with sustainability agenda and have hardwired it into all the other departments, with the absolute essential inclusion of the finance department.

*New economics.* Finance departments need to have the ability to successfully make the financial case for the investments required to deliver sustainability and regeneration by factoring in the financial aspects of ancillary benefits of measures to be taken, such as: job creation, reducing inequalities, reducing crime and congestion, and improving citizen health and well-being.

*Modelling and auditing.* Life-cycle analysis, carbon accounting, or ecological-foot printing need to be applied consistently across the board so that different strategies can be properly compared and to maximise overall environmental, carbon and cost savings. Targets must be monitored and properly phased, with rewards.

*Networking.* It's very important that influencers within city administrations are able to travel to other cities or network with them online to see what they have done and bring back the best innovatory practices so that they become embedded everywhere. That's partly what this website is for.

*Training.* All the above implies a great need for constant program of in-service training to keep personnel up-to-date with the latest techniques, thinking and technologies.

## **Transport**

*Promoting cycling and walkability.* There is more and more awareness of the need to plan for walkability and cyclability in cities. The spread of cycle hiring facilities such as the schemes in London and Paris, and recognition of the needs of cyclists are important because cycling and walking have numerous benefits in terms of reduced congestion, improved air quality, promoting health and reducing health costs.

*Planning for local hubs.* As cities spread we need to think of hubs, and how local services can be provided at these hubs. This reduces the need to commute or travel in the first place. Being able to situate people's homes near to their jobs and the things they need helps to keep it local and reduce congestion and carbon emissions.

*Congestion charging.* This helps because it puts a price on diesel and petrol-fuelled personal travel. It actively encourages more sustainable travel modes.

*Extensive provision of electric vehicle charging points.* This encourages their uptake, especially if electric scooters and other small vehicles are facilitated for what are, after all, the majority of journeys: short ones. Hire schemes for small electric vehicles, like those schemes mentioned for bikes above, allow people to use one for a journey, and leave it where they are going for someone else to use.

*Seamless travel.* Properly joined-up public transport systems allow people easily to hop from bus to Metro/subway to train using the same payment method and without having to wait very long. Being able to take a bike on a train or even the Metro/subway is desirable.

*Smart cities and crowd-sourcing.* Tapping the wisdom of crowds, i.e. the people who live there, to get them to tell you what they think will make their cities more liveable has great potential however, with or without the use of social media or open data. We should be asking them: how can we make the best of what we've got? This is especially true of cities in developing countries where there is a danger of favelas and shantytowns being bulldozed for unsustainable developments, instead of helping the people who live there to help themselves and supporting them in what they need. They are no different from people in developed world cities, in wanting to improve their community and quality-of-life and having the skills to do so.

*Collaborative partnerships.* Successful sustainable projects happen when those at the top, in government, and those at the grassroots work together instead of against each other.

## **Buildings**

*Remote monitoring and management.* Wireless building energy monitoring systems allow all existing buildings to be remotely monitorable and controlled to minimise energy use and identify hot spots for action. If energy usage is made public in real time to employees together with its degree of alignment with reduction targets, everybody is enabled to get on board the efficiency agenda.

*Densification.* Dense cities are more sustainable because the impact per unit is less, up to a limit. Accommodation will become more affordable, in general, as a result. Land use should be mixed, with light industry interspersed with retail, office and workshop space and services to create local jobs and social diversity, part of the art of placemaking.

*Climate resilience:* It should go without saying these days that planning requirements for the built environment include protection from weather extremes: overheating, flooding and storms.

## **Energy**

*Local energy:* community energy and district heating schemes, combined heat and power, heat pumps (whether ground or water source), should all be encouraged.

*Solar energy:* The ability to use dye-sensitive PV coatings on building cladding to generate electricity is being pioneered in Swansea by Tata Steel for instance, and will become available and cost effective in just a few years. The advantage is that surfaces do not need to point at the sun to be efficient and the panels don't take up land space. Solar coling will become more widely available, together with Passivhaus construction.

*Anaerobic digestion.* More power will come from anaerobic digestion of organic and green waste to produce natural gas that may be injected into the mains, used in local network combined heat and power plants or to power transport, with the digestate being used as a fertiliser.

## **Food**

*Urban growing.* On the individual level of city dwellers, after energy consumption, food consumption is the biggest source of carbon emissions, then transport, consumables and housing. Urban growing can include: rooftop and vertical gardens, allotments, teaching children to grow food in schools, community-supported agriculture, farmer's markets, and, on the horizon, growing food intensively indoors, both traditional and novel (engineered) foodstuffs.

*Making space for nature:* if space is to be made for the natural environment – to improve biodiversity and local air quality, reduce the 'heat island' effect, and improve well-being – why should the plants and trees not be edible: nuts, fruit, herbs, decorative brassicas, and so on? Let's see an end to the use of plants just for 'low-maintenance green cover' and have more useful plants managed by community groups.

If managed well, compact, resilient, inclusive and resource-efficient cities could become drivers of the green economy, contributing to both local liveability and global public goods. If managed poorly, sprawling urban areas will degrade land, strain ecosystems and essential infrastructure services, increase levels of air and water pollution, and increase the size of vulnerable populations. The targeted areas for building sustainable cities are: -

### **2.1 Land Use & Planning:**

Land use was once considered a local environmental issue, but it is now recognized as a force of global importance. In the course of providing food, water and shelter for more than six billion people worldwide, we inflicted significant damage to the planet's forests, farmlands, waterways and air. According to World Wildlife Fund (WWF) International's Director-General James Leape, the earth's regenerative capacity can no longer keep up with demand - people are turning resources into waste faster than nature can turn waste back into resources. Our challenge today is to manage trade-offs between immediate human needs and the long-term ability of the planet to provide for future generations. Land use policy necessarily touches on every aspect of local government concern. Sustainable land use planning involves

decisions on crosscutting and multi-layered issues that affect air quality, water quality, access to transportation options, economic vitality, and quality of life. It is critical to promote the creation and development of communities containing an array of types and uses of buildings and spaces to meet the diverse needs of residents' daily lives.

Sustainability Principles associated with Land Use include:

- Open Space
- Sustainable Water Sources
- Walk ability and Connectivity
- Integration of Diverse Community Features
- Strong Sense of Place.

Sustainable Strategies introduce three key approaches to the development of environmentally sustainable communities:

- Sustainable Urbanism
- Integrating Land Use & Transportation Decision-making
- Regional Planning Approach

## **2.2 Buildings & Energy:**

Buildings have an extensive impact on the environment in terms of energy use, water consumption, electricity consumption, and carbon dioxide emissions. Traditional approaches to new construction, renovation, deconstruction, and operations and maintenance of buildings will do little to improve these statistics. However, education within the industry can influence positive change (Evans and Fenton, 2006). The vast majority of current research shows that a focus on integrated design, setting environmentally sustainable goals, a focus on materials reuse and recycling, and using full-cost accounting to measure return on investment are the crucial issues for successful green building projects - not a bigger budget.

Local governments have a growing role in the decision-making process related to their energy systems. These municipal systems include both sources of energy supply (utility plants, generators, etc) and sources of energy demand (transportation systems, buildings, etc). Environmentally-friendly

municipal energy strategies require balancing the need for appropriate selection of energy sources based on a hierarchy of sustainable practices, increased decentralization of the local energy grid, affordable pricing based on full-cost accounting methods, and lessening the vulnerability of communities that are overly-dependent on a single energy source.

### **2.3 Transportation:**

In both developed and rapidly urbanizing countries, transportation exists at the foundation of any functioning city, providing mobility and access to jobs, amenities and resources. As a result, transportation systems are a vital component of building sustainable cities, both domestically and globally (Houghton and Hunter, 1994). They also have a profound impact on both the global and local environment. Sustainable transportation options can serve to attract and accommodate the varied needs and desires of urban residents, and are often part of a long-term strategy that includes the integration of various systems, both across geographies and modes of travel. A sustainable transportation system is one that allows the basic access and mobility needs of all individuals to be met safely; is affordable; provides multiple transport options and supports both public health and a vibrant economy; limits emissions; and minimizes consumption of non-renewable resources. Although personal vehicles can be part of a sustainable transportation system, there is an increased emphasis on public, non-motorized, and multi-modal transportation options.

Sustainability Principles include:

- Holistic transportation and land use planning
- Planning with the environment in mind
- Accessibility
- Affordability
- Connectivity
- Sustainable Strategies include:
  - Development around transit hubs
  - Demand management
  - Traffic calming

## 2.4 Water

Municipal water systems are organized around three major water uses: drinking water, wastewater, and storm water systems. All three systems share a common infrastructure based on watershed geography. Indeed, a watershed management approach has emerged as best practice across the country. Other key elements in municipal water systems include sources and treatment processes.

Sustainable water policy at the local level addresses the need for cross-jurisdictional collaboration, maximizing non-potable water for uses other than human consumption, promoting decentralized rain harvest practices, protecting water sources from pollution, and limiting impervious surfaces.

Municipal water customers - residential, commercial, industrial, and agricultural - have water needs. These water needs are met by traditional approaches like:-

- Drinking (Potable) Water
- Wastewater
- Storm Water
- Sustainability Principles include:
- Develop a comprehensive plan that integrates water use and watershed management
- Create cross-jurisdictional partnerships as needed
- Link land use and water management plans
- Promote innovation, efficiency, and conservation in water use

### Sustainable Strategies

- This provides an overview of the dominant best management practice in municipal water systems, the Watershed Management Approach.
- Define and prioritize water problems by entire watersheds (including sub-watersheds, and drainage basins).
- Coordinate strategies, programs and initiatives with other agencies and jurisdictions affected by shared watersheds.

- Track performance through shared systems for data collection and monitoring.
- Leverage resources among partner agencies and jurisdictions to avoid redundancies and realize cost savings.

## **2.5 Green Infrastructure**

Green infrastructure is a land use planning concept that emphasizes the benefits of natural systems including clean water, healthy soils, clean air, shade, urban heat island reductions, etc. This type of planning approach typically seeks to protect and/or preserve natural areas through ordinances and other regulatory mechanisms. Green infrastructure planning can be used as a conservation tool to be integrated into a city's comprehensive planning process, and may also be used to create aesthetic and open space amenities that balance developed areas of city. It creates aesthetic and open space amenities that balance developed areas of a city. In order to counter pressures on the municipal sewer system, cities are turning to ecosystem based storm water management projects that are cost-effective, aesthetically pleasing, and beneficial to public health (Haapio, 2012). Many cities are adopting these alternative, "green infrastructure" strategies to reduce the amount of water needing treatment while conserving precious water resources.

Sustainability Strategies include: -

- Identify and inventory elements of your community green infrastructure network and develop mechanisms to acquire and build components of your green infrastructure network.
- Ensure emphasis on developing a green infrastructure network is reflected in both comprehensive policy documents and local ordinances and regulations.
- Identify public and private partners, programs, and a plan to finance and maintain long term green infrastructure projects and programs.
- Conduct public education and awareness programs that quantify the value of green infrastructure to the community.
- Sustainability principles include: -
- Integrate Green Infrastructure Elements within Municipal Plans

- Prioritize Environmentally Sensitive Land and Natural Resources for Green Infrastructure Functions
- Integrate Green Infrastructure Elements within the Built Environment
- Ensure Accessibility for All

## **2.6 Equity & Engagement:**

Community engagement is the organized, interactive partnership between a government and its citizens. It is more than just a democratic ideal; community involvement is essential to the effective implementation and maintenance of government-initiated sustainability programs. Citizen participation fosters a sense of ownership, increasing the level of investment in a program's successful outcome. An inclusive approach to policymaking utilizes the broad diversity of ideas and abilities a population offers. It anticipates roadblocks, allowing for proactive, constructive solutions (Llacuna, 2015). Taking the time to cultivate authentic community engagement will deliver "triple bottom line" results: sustainability that impacts economic prosperity, environmental quality and social equity.

Sustainability Principles associated with Community Engagement include:

- Actively solicit the community's input throughout the planning and implementation process.
- Open discussions and events to the entire community.
- Provide meaningful opportunities for involvement.
- Continue to serve in the leadership role while engaging the broader community.
- Prove a commitment to the long-term process.
- Report success and acknowledge community contributions.
- Sustainable Strategies leading to successful community engagement include:
  - Communicate - Provide access to the information that citizens need to both get involved and to benefit from sustainability.
  - Participate - Engage the community in a variety of specific activities where they are directly involved.
  - Celebrate - Reward the community and incentivize them for future efforts.

## **2.7 Climate Adaptation & Resilience:**

Climate change has become a critical issue for many city officials and planners around the world as cities continue to experience a greater incidence of increased water temperatures; an increased frequency and intensity of hurricanes or other extreme weather events. Many scientific indicators suggest that today's climatic experience is markedly different from conditions that prevailed as little as one hundred years ago. For example, the average annual temperature, globally, has risen by 1.5 degrees Fahrenheit over the course of the last century. In the United States alone, the year 2012 was characterized by numerous heat waves, historic drought conditions, multiple intense storm events, and registered as the hottest overall year since record keeping began in 1895.

Local governments are increasingly concerned about the impacts of climate change upon their existing transportation, energy, and water infrastructure which, in many instances, is ill-prepared to meet the challenges of these extreme and unanticipated weather and climate conditions. For many cities, climate change and extreme weather has translated into steep economic costs to public safety, public health, food security, and emergency management (Bithas and Christofakis, 2006). While the causes of climate change may be more commonly attributed to human or natural activity depending on the point of view, few deny that cities and local governments must increasingly find ways to plan for and implement sustainable responses to climate change and extreme weather.

Local governments are actively embracing climate adaptation and resilience as strategies to alleviate the long term costs of climate change. While there are some notable examples of cities on the cutting edge, using climate science and technology to implement local policy responses to climate change, other cities are early in the process of understanding climate vulnerabilities and implications on their city services.

## **2.8 Materials Management:**

Materials management requires active examination of routine purchasing, use and disposal decisions in ways that reflect their

interrelatedness and their impact on the environment. A materials management program includes elements related to procurement, operations and maintenance, reuse and recycling, and disposal.

Sustainability Principles include:

- Establish Environmentally Sustainable Procurement Policies
- Implement Effective Operations and Maintenance (O&M) Programs
- Seventy Percent or More Landfill Diversion Rate
- Institute Full-Cost and Life-Cycle Accounting Practices
- Sustainable Strategies include:
  - Integrated Waste Management
  - Comprehensive Waste Stream Analysis
  - Extended Producer Responsibility Policies and Contracts

## **2.9 Food Systems:**

The food system consists of all stages, processes and activities from food production all the way to consumption, and eventually disposal of food products. While issues pertaining to community food systems have not always been seen as a matter for local government intervention, cities and towns are increasingly recognizing the far-reaching impacts and opportunities contained within these various stages (Nijkamp, 1999). For example, community food systems directly connect to public health goals such as reducing hunger or obesity; the protection and conservation of natural resources including energy, water and soil; and supporting or facilitating local economic growth. A sustainable food system is one that:-

Ensures that all residents have access to healthy, affordable food options;

- Minimizes the environmental impact of food production and transport;
- Facilitates and encourages local food production and processing;
- Creates local jobs that provide fair working conditions and a living wage;
- Benefits local economies by supporting local food producers, retailers and businesses;
- Maximizes resources through collection and reuse of organics (compost) and other food related by-products (i.e. fats, oils, grease)

Sustainability principles include:

- Actively solicit the community's input throughout the planning and implementation process.
- Open discussions and events to the entire community.
- Provide meaningful opportunities for involvement.
- Continue to serve in the leadership role while engaging the broader community.
- Prove a commitment to the long-term process.
- Report success and acknowledge community contributions.

### **3. The challenges associated with building sustainable cities**

For city governments, the challenges include securing the necessary resources for investment in disaster-proof public infrastructure, and renewable sources of energy, and providing incentives to the private sector to create decent employment for large urban populations that are underemployed and have limited access to good housing conditions, clean water, sanitation, drainage and schools. Upper middle income and high-income countries with urban populations that already have access to basic public services face the challenge of becoming more efficient in the use of energy and water, reducing the generation of waste, and improving their recycling systems (Levine, 2012). Growth of cities has often gone hand in hand with an increased use of natural resources and ecological systems, driven by economic growth and changes in the economic structure—in terms of a shift from agriculture to manufacturing and then to services. While wealthier cities and people, in particular, may have well-managed resource systems, they also have a greater ecological impact through drawing resources from larger areas. For example, wealthier residents in New York City, Los Angeles and Mexico City contribute greatly to the demand for freshwater from distant ecosystems, whose capacities are consequently affected and whose use generates significant levels of pollution and greenhouse gas emissions at the national and global levels. Thus, urbanization can be an important contributor to high resource use and waste generation, both with ecological effects at the local, regional and global levels.

Socioeconomic Inequalities between rural and urban areas as well as within urban areas have been features of development and urbanization in developing countries. The gap between rich and poor neighbourhoods can imply significant differences in access to job opportunities and basic public services such as water and sanitation, electricity. Social, economic and environmental challenges exert direct and indirect effects on cities and the lives of people in both developing and developed nations. Inequalities in access to basic services between rural and urban areas as well as within urban areas have been typical features of urbanization in developing countries. Many urban residents in developing countries suffer to varying degrees from environmental health issues associated to inadequate access to clean water, sewerage services, and solid waste disposal (Nixon, 2009). In many cities of developing countries, adequate water and sanitation services are primarily channelled to upper- and middle-class neighbourhoods, while low-income neighbourhoods often depend on distant and unsafe water wells and private water vendors who charge higher prices than the public rate for water delivery. The poor often live in highly overcrowded dwellings in shacks which lack basic infrastructure and services. On the whole, less than 35 per cent of cities in developing countries have their waste water treated, while globally, 2.5 billion and 1.2 billion people lack safe sanitation and access to clean water, respectively

Small cities with less than 500,000 inhabitants experience a different type of vulnerability. Although there is much diversity in their economic structure, many small cities in developing countries have very weak economies and inadequate communication with more economically dynamic cities. These cities tend to have inadequate infrastructure for provision of basic public services, which may be of low quality. Access may be time consuming, costly and risky (in the case, for example, of public transportation). Poor land management and weak urban planning capacities are part of the problem. The deficiencies in urban governance, institution-building and adjustment to changing land development conditions have reduced real possibilities for improving urban planning.

Access to cleaner sources of energy is intrinsically linked to development, and vice versa. Countries with higher gross domestic product

(GDP) per capita (e.g., above US\$ 4,000) are associated with the use of electricity by above 60 per cent of the urban population, and the use of wood and charcoal for cooking by a low proportion of urban households (e.g., 20 per cent or less).

The use of cheap fuels implies increased deforestation, pollution, health risks, energy cost and time burden. Poor people often have to spend a lot of time for travelling to purchase or gather those fuels. In contrast, regular electricity supplies would often be cheaper and safer, and could be used for household appliances (e.g., lights needed by children when doing their homework and for reading) and home enterprises.

The adverse impact of social inequalities on human health and the environment is multiplied when we factor in the adverse effects of “natural” disasters. Natural hazards linked to climate change events have also increased in intensity and frequency. Most disasters tend to occur in developing countries and the human cost in terms of both the number of persons affected and the loss of human lives is much higher in these countries. Yet, some developed countries have also started to be affected despite their generally greater resilience. Middle-income countries such as China, India, Indonesia, the Philippines and Viet Nam had the highest number of floods and storms combined during 2000-2009. Cities located along the west Coast of Africa and the coastlines of South, East and South-East Asia have been affected by sea-level rise, flooding and salt intrusion in river flows and groundwater, compromising the quality of clean water. Endemic morbidity and mortality due to diarrhoeal disease are projected to increase in these regions. The reduction of the Andean Effects of climate change deepen the vulnerabilities of cities in poor nations and threaten the resilience and adaptation capacities of cities in richer nations. Stronger storms and saltwater intrusion in water systems have weakened adaptive capacities in coastal cities of both developed and developing countries. The damages to infrastructure in the former and the weakening of resilience in the latter threaten their policy space for taking effective adaptation measures and developing capacities for rebuilding. The integrated effects of the challenges described above threaten the economic resilience of cities and heighten their vulnerabilities. Cities have to start

perceiving those challenges as opportunities for investment and building cities to serve as the main pillars for a sustainable world.

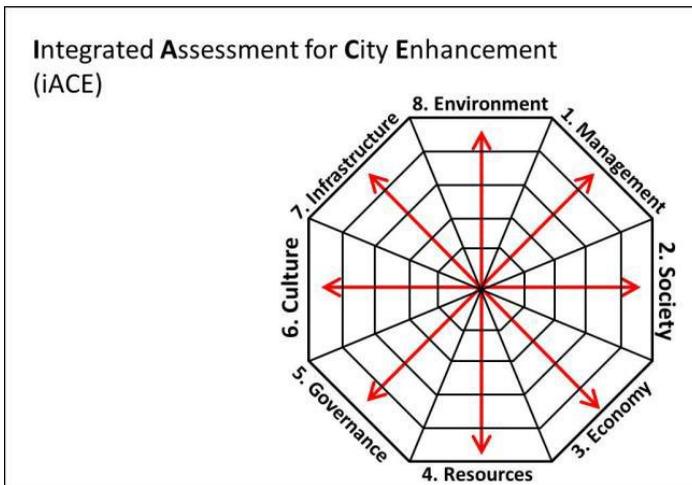
#### **4. Integrated Approach for City Enhancement (iACE): A Toolkit Introduction**

One common approach to planning is the use of Key Performative Indicators (KPIs) or KPI systems that are often used by city managers to track the information related to sustainability of the city. According to Fitz-Gibbon, KPI system is a performance measurement system. And it can help us to evaluate the performance of the city (when applied in planning) and apply a management framework. Therefore, its nature of evaluation and measurement can be used as the foundation of city assessment for the purpose of enhancement. KPIs are often used at various levels and scales, such as, improvement of local governance for specific measures like transport or waste management. Moreover, there are effective approaches to ‘City Prosperity Index’, linking indicators, analysis and policy, as well as STAR (Sustainability Tools for Assessing and Rating system) that are considered as part of evaluating various approaches to achieving KPI system frameworks.

The downsides of KPIs, however, are mainly based on two factors of ‘lacking integration between indicators’ and ‘complication in breaking down the indicators in practice’. Also, most current assessment toolkits do not provide a KPI-based system that allows for a holistic evaluation and measurement of performance of the city in various dimensions. On the other hand, it is argued that sustainability assessment *‘can only be realistically applied for the purpose of land-use planning in this wider geophysical perspective’*. Therefore, this partially undermines how sustainability assessment can be expanded in a holistic approach. As a result, in this paper, we argue that the combination of assessment toolkit and KPI system is a solution for defining and managing the city’s growth and development patterns. This has led to the development of Integrated Approach for City Enhancement (iACE) toolkit, which aims to support development of holistic frameworks or/and transition patterns of cities. Cheshmehzangi (2016) introduced iACE toolkit.

The key structure and dimensions of iACE toolkit –

Divided into eight dimensions, iACE provides a comprehensive evaluation of city performance (Figure 1). And it also pairs up each two dimensions as to break down the traditional setting of individual dimensions. The pairing up is done based on the commonalities between each two key dimensions, where more than 50% of the indicators are shared between two dimensions. The eight dimensions are under the holistic themes of ‘Management’, ‘Society’, ‘Economy’, ‘Resources’, ‘Governance’, ‘Culture’, ‘Infrastructure’ and ‘Environment’. While keeping the four key pillars of social, environmental, economic and governance, it also comprises new dimensions that are often less improved or not comprehensively evaluated in practice. Furthermore, each dimension includes four elements, and each element is divided into four sub-elements or indicators; concluding at 128 quantifiable measures. The method undertaken is through evaluation of dimensions and indicators based on city labelling frameworks (smart, green, eco and etc.) and a variety of KPI systems. Having a large body of indicators is due to city’s complexity for growth and development. Hence, comprehensive approach is a necessity.



**Figure 1: Framework of the Integrated Assessment for City Enhancement (iACE)**

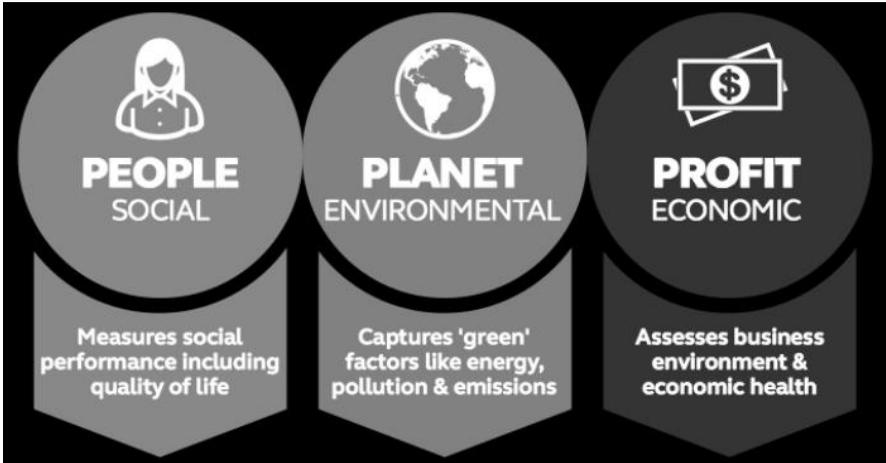
In the framework for sustainable city, the consideration of resources is often considered as an element under the environmental dimension. In rapidly developing cities, however, this cannot be thoroughly applied. While the environmental dimension of iACE covers four wider elements of climate, pollution, ecology and waste, ‘resources’ dimension appears to be equally important and highlight four elements of natural environment, water, energy, and efficiency. Indeed, investment in new technologies is needed. But this can only resolve part of the problems of contemporary city development. In a long term, issues of resource use and resource efficiency have direct impact on environmental issues. This is already witnessed in cities where environmental degradation is widespread and resource use is fragile. Furthermore, infrastructure and transportation are usually combined together under one theme. Nevertheless, iACE introduces transportation as one of the four elements under the infrastructure dimension. Other three elements are public facilities, building industry and resilient facilities. And these four fully cover all aspects of physical infrastructure in the city development.

Similarly, many planners are confused about the differences between “urban ecology” and “green/blue infrastructure”. This can cause major problems when it comes to planning the cities. As a result, we have many [so-called] green corridors in cities that are merely functioning as green spaces and also cannot be considered as part of the green infrastructure. Also, while agriculture is part of the green infrastructure system in planning, it is often not considered as an independent element for the purpose of food production. In addition, city planners often do very little to solve issues of biodiversity and eco-system preservation. And there is often no distinguish between the natural environments and the ecological infrastructure of cities. These are primary factors– and no longer secondary by any means - that need to be addressed in city planning. All of these are explicitly addressed in iACE to fulfil the interdisciplinary requirements of city growth and development. iACE provides the nadir of integrated assessment for each of these elements in order to offer possibilities for scientific solutions and new directions to city enhancement. This can only be applied in a context -specific approach rather than mere prototyping. Unlike KPI systems, iACE works with grading and valuing systems. And it can assess the standards of any of the 128 indicators, from

extremely low to very high in terms of performance and sustainability. The target users of this toolkit are city planners and policy makers. These remain as main body of decision makers for changing the nature of city's growth and development.

### 5. Cities with Successful sustainable stories

To begin with the success stories lets ponder on the Sustainability Index to measure Sustainable Cities.



**People (social):** The people pillar looks at quality of life, assessing areas such as health, education and work-life balance.

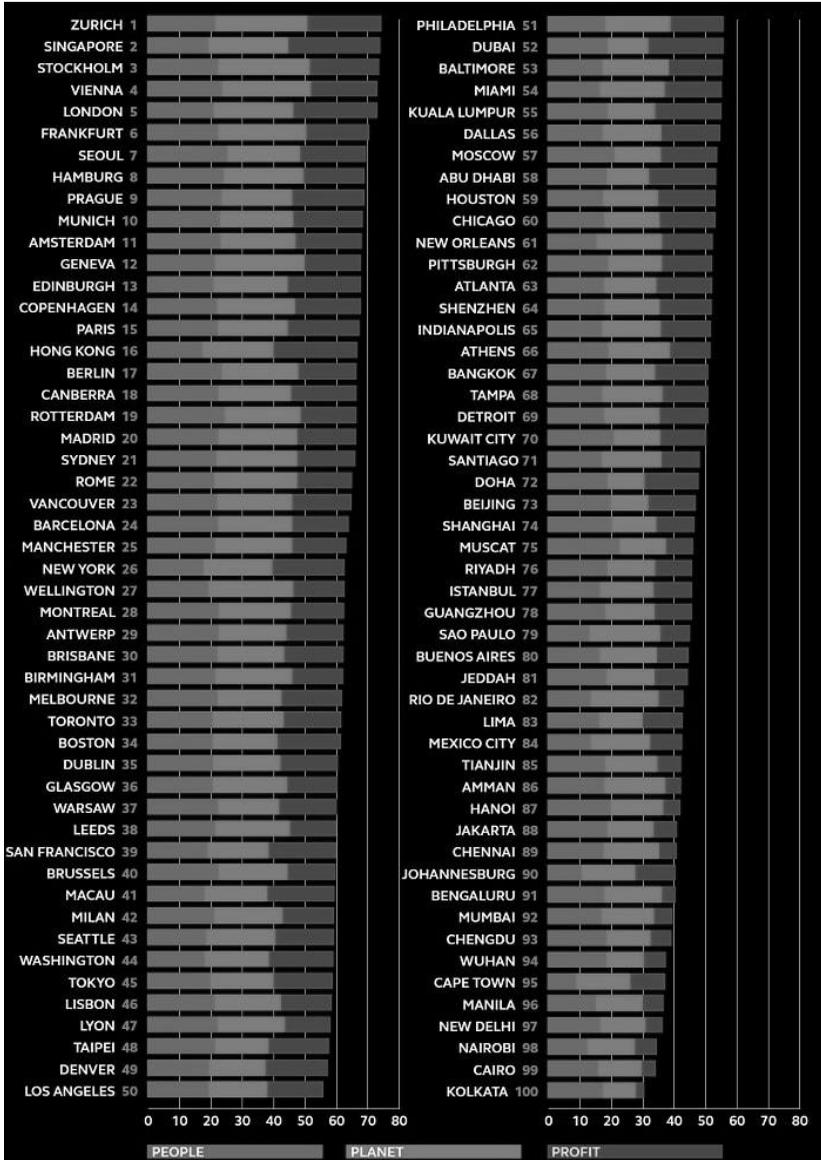
**Planet (environmental):** This pillar examines areas including energy consumption, renewable energy share, and green spaces.

**Profit (economic):** The economic pillar looks at environment and economic health of the city. Sub-pillars include ease of doing business, GDP per capita and connectivity.

<b>Sustainable Cities Index</b>		
<i>People</i> <i>(Social Aspect)</i>	<i>Planet</i> <i>(Environmental Aspect)</i>	<i>Profit</i> <i>(Economic Aspect)</i>
<p>The People sub-index rates:</p> <ul style="list-style-type: none"> <li>• health (life expectancy and obesity)</li> <li>• education (literacy and universities)</li> <li>• income inequality</li> <li>• work-life balance</li> <li>• the dependency ratio</li> <li>• crime, housing and living costs.</li> </ul> <p>These indicators can be broadly thought of as capturing “quality of life”.</p>	<p>The Planet sub-index ranks:</p> <ul style="list-style-type: none"> <li>• cities on energy consumption and renewable energy share</li> <li>• green space within cities</li> <li>• recycling and composting rates, greenhouse gas emissions</li> <li>• natural catastrophe risk, drinking water, sanitation</li> <li>• air pollution.</li> </ul> <p>These indicators can broadly be thought of as capturing “green factors”.</p>	<p>The Profit sub-index examines:</p> <ul style="list-style-type: none"> <li>• performance from a business perspective, combining measures of transport infrastructure (rail, air and traffic congestion)</li> <li>• ease of doing business</li> <li>• tourism,</li> <li>• GDP per capita, the city’s importance in global economic networks,</li> <li>• connectivity in terms of mobile and broadband access</li> <li>• employment rates.</li> </ul> <p>These indicators can broadly be thought of as capturing “economic health”.</p>

The index rests on what Arcadis says are "the three pillars of sustainability": **People**, **Planet**, and **Profit**. A score for each is developed via an analysis of 32 different indicators, weighing factors such as income inequality; education; crime; affordability; energy use; potable water; sanitation; green space; transportation; economic development; and employment.

The Sustainable cities according to Sustainability Cities Index Report 2016:



Source: ARCADIS (2016)

## **6. Lessons from Best Performers**

### **ZURICH**

Zurich, the number one city in the Sustainable Cities Index, has a strong reputation as a liveable, contemporary city known for its strong focus on environmentalism as well as world-renowned financial institutions. Despite leading both the overall ranking and the planet sub-index, and ranking 5th in profit, Zurich appears 27th on the people sub-index; affordability and work-life balance are the primary causes of this disparity. Topping the planet sub-index, the city pioneers the long-term goal of becoming a 2000-watt society by 2050. The 2000-watt society is Zurich's approach to tackling climate change and resource scarcity: a goal for its people to use 2000 watts of energy per capita (the global amount established as 'sustainable' energy use).

Commitments include investment and focus on energy efficiency and renewable energies, sustainable buildings, mobility for the future and an effort to increase public awareness, including events such as annual environment days and the Zurich Multimobil action day. Public transit in the city is highly regarded as a sustainable model for other cities. Trams, trains, buses, light rail and more are highly coordinated, making mobility simple, quick and affordable. As a global economic hub, the city is not only able to attract business but also people, with a good quality of life, attractive educational and employment opportunities as well as a leading health ranking on the Index (McKinsey and Company, 2011). Various innovative businesses and industries, both small and large, form an important basis of the Zurich economy. In addition, high productivity levels and low non-wage labour costs make production costs lower than competing economies around the world. All in all, this makes Zurich an attractive place to invest, live and work.

### **LONDON**

London is one of the world's foremost economic powerhouses, ranking third in the profit sub-index and fifth in the overall index. Sitting at the centre of global finance, London's heavyweight position, combined with a long history of cultural and economic evolution, means it is well equipped to reap the long-term benefits of its status as a true world city. However, if the capital

is to maintain its long-term competitiveness, there are a number of issues that still need to be addressed. With an environmental ranking of 9, there is a commitment to improving environmental performance of the city through, for example, low emission buses, environmental clean-up programs, infrastructure such as the Thames Tideway Tunnel and volunteer actions from its citizens. Ranking only 37 on the people sub-index, the mobility and housing needs associated with a densely populated, growing metropolis are at the forefront of the city's challenges. With London's population projected to reach 10 million people by 2030, improving infrastructure capacity and providing the right number and type of homes that will enable all people to live and work is critical. 28% of the city's population are living below the poverty line, and addressing income inequality and the high cost of living will do much to improve London's people score and its overall rankings. London has reached a tipping point, as the large differential between its people and profit rankings demonstrates. Yet, in the aftermath of Brexit, the Mayor needs to persuade global businesses that London's infrastructure priorities have not changed and that the capital remains just as viable outside of the EU.

## **SEOUL**

Seoul, an up-and-coming global cultural capital, tops the people sub index and ranks seventh in the overall list. Health and education rankings propel Seoul to the top, with programs such as the 2030 Seoul Plan focusing on five core issues: "a people-centred city without discrimination", "a dynamic global city with a strong job market", "a vibrant cultural and historic city", "a lively and safe city" and "stable housing and easy transportation, a community-oriented city". The program also includes urban planning policies to strengthen the city's identity, global competitiveness, development direction and innovation in the living environment for citizens. It has 139 projects in 13 districts that plan to transform the urban metropolis into a "safe, warm, dreaming, breathing city". Seoul's leaders have taken serious steps towards city sustainability with projects like the Cheonggyecheon urban renewal and river restoration project. This previously polluted area has been transformed into a public recreation space in the heart of the city. Restoration not only spurred economic development but also provided much-needed flood

protection for the downtown area, boosting Seoul’s economic, environmental and social sustainability (McManus, 2012). Seoul’s 2030 plan will positively impact all three sustainability areas in the Index. In addition, Seoul is active in the C40 and 100 Resilient Cities initiatives, actively participating in these knowledge exchanges and global initiatives.

## **7. CONCLUSION**

The creation of a policy framework for responding effectively to the challenge of financing the sustainability of cities requires multilayered cooperation among local national and global communities, including the development of partnerships to harness public and private resources for the purposes described above. Financing investment in public infrastructure, including adaptation to and mitigation of climate change, is a daunting task, one that often demands large sums of upfront finance and an acceptance of the fact that returns will be seen mainly in the medium and long terms. Regulatory measures, including market and non-market mechanisms, are important for determining pricing structures, taxes and subsidies for households and industry, e.g., for the development of compact neighbourhoods and the retrofitting of buildings. Various types of taxes—included, for example, in lower fares for public transportation—can be used to finance the gap between the financial outlay and the actual cost of services. Thus, for cities in poor and rich countries alike, part of the financing would have to be directed towards limiting the damaging effects of climate change on the environment, biodiversity and the livelihoods of present and future generations. In this sense, the principle of common and differentiated responsibilities can guide the establishment of an international cooperation framework capable of supporting the development and resilience of poor countries. Oil-exporting and emerging economies experiencing relatively high economic growth but with urban settlements vulnerable, for example, to sea-level rise, storms and droughts, should use part of the resources generated to finance cities’ risk reduction strategies and improved infrastructure for adaptation, mitigation and provision of public services.

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## **Centre of Excellence in Environmental Economics**

The Ministry of Environment and Forest, Government of India has designated Madras School of Economics as a Centre of Excellence in the area of Environmental Economics. The Centre carries out research work on: Development of Economic Instruments, Trade and Environment, and Cost-Benefit Analysis. The Centre is primarily engaged in research projects, training programme and providing policy assistance to the Ministry on various topics. The Centre is also responsible for the development and maintenance of a website (<http://coe.mse.ac.in>), and for the dissemination of concept papers on Environmental Economics.

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