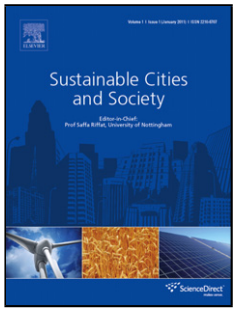

Title: Greening the Economy: A Review of Urban Sustainability Measures for Developing New Cities

Author: Addanki Sai Charan Hrishikesh Venkataraman

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Greening the Economy: A Review of Urban Sustainability Measures for Developing New Cities

Abstract— **With the advent of 21st century, over last 16-18 years, there has been an exodus of people moving to urban towns and cities, a phenomenon observed globally. This makes the cities not only extremely congested, but also very polluted and resource-scarce. With 50+ new cities and 100+ smart cities set to come up in South East Asia by 2030, it is extremely essential to plan the development of a city in such a way so as to be sustainable, accessible and eco-friendly. This paper presents a detailed survey and analysis of how the development of a city, particularly in India can be planned in the context of *sustainable urban transformation*, *climate change* and *future urban vision*. A detailed survey is provided on all three mentioned aspects by providing a comparison on different aspects with planned developments carried out globally. Further, the suitability of the existing solutions are analysed; along with a proposal on how to develop new cities. Finally, the paper addresses some of the challenges that need to be addressed in order to develop new sustainable, accessible, well-connected cities of future.**

Keywords: *Climate, Governance, Energy-efficiency, Future Urban Vision, Sustainability*

I. INTRODUCTION

Over the last 100 years, there has been a regular movement of people to urban areas. One of the main reason for movement is the increased opportunity. However, it is not the only reason. This movement/migration is also because of many other amenities and avenues; which include - good education, health services, higher wages, entertainment and better standard of living available in cities also pull the rural people towards them. The turning point has been around 2007 when nearly 33% of world's population was accounted to be living in cities [1]. As per the report of 2015, nearly 50% of world's population lives in cities [2]. This urbanization [3] is expected to continue and more than 80% of population is expected to live in cities by 2050. The conditions for city dwellers depend not only on how urbanization is planned and managed but also how cities source, process and significantly, use their resources. Sustainable development [4] is the ability to meet the needs of the present without compromising the ability of future generations to meet their own needs. The development of cities represent both a challenge and an opportunity regarding sustainable development [5]. Typically, though the movement to cities has been widely acknowledged for economic uplift, it puts enormous pressure on access to important services such as - housing, sanitation, education, traffic, fresh air and water, etc. [6]

Although all socio-economic classes are reflected in migration to cities, migrants from rural areas are not necessarily poor. It is an inadequate planning, often resulting from weak political and much weaker knowledge on how to counter them and use that as an opportunity for growth [7]. An extremely important point to be noted is that if this migration is administered and executed appropriately with development of new planned and sustainable cities taking care of future growth, this could result in considerable increase in both the quality of life in these cities and also in the countries' economy.

A Green Economy can be defined as an economy that results in improved human well-being and reduced inequalities over the long term, while not exposing future generations to significant environmental risks and ecological scarcities [8]. The critical aspects of '*Green Urban Economy*' [9] is to:
a) Support the locally appropriate development, promotion and deployment of green technologies and innovations.
b) Provide strategies and tools to explore, identify and apply green business and governance models in practice.
c) Support the identification and permeation of green business opportunities to the market.

Greening the urban economy requires a broad, all-encompassing socio-technical change. In this regard, the framework for sustainable urban transformation is a factor of both sustainable urban structures and the drivers of change. The sustainable structure is represented in Fig. 1

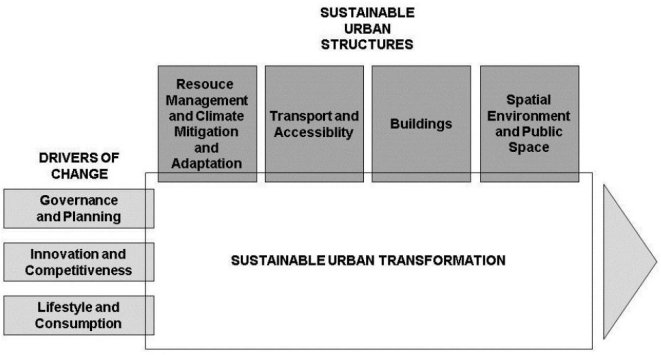

Fig. 1. Framework for Sustainable Urban Structure

Notably, planned urban cities need to be and importantly, can be planned to be more environmentally sustainable than rural or suburban living [10]. In this regard, the major focus of sustainable cities would be on sustainable transportation. This would include access to transportation by all levels of society. Due to the fact that car and fuel cost are often too expensive and results in unnecessary waste in the energy consumption, this requires efficient and accessible public

transportation [11]. A sustainable transportation forms the backbone of sustainable city and hence, is the first point of consideration in this paper. In a sustainable urban scenario, with people and resource located so close to one another, it is possible to save energy for transportation, mass transit systems and also multi-modal transportation, depending on the region and terrain [12]. However, this requires both a careful planning and implementation. Secondly, transforming an existing rural region or a reserved region to urban regions would not only cause a shift in the ecological balance, but also would result in significant climate change [13]. The study of the extent to which this climate change is acceptable is beyond the scope of this work. However, what is more important is to plan the development of urban regions, taking into account the potential climate change and also the best lifestyle and consumption pattern for the region, depending on the climate [14]. For instance, a hot, arid region would need to have different lifestyle activities as compared to a hot and humid weather; or compared to a cold yet humid weather. This would in-turn also depend on the terrain conditions. Hence, it is critical to take climate change and governance into account.

Thirdly, these to-be-developed urban regions should not only meet the current requirements, but also should be able to - attract people, industries, services, etc. for employment and inhabitation; and also serve as a model city for several decades to come [15]. A future-vision city advocates mix of use of the land resources for different activities [16]. Further, it advocates several other aspects including - walkable streets, positive public space, integrated civic and commercial centress, transit orientation, accessible open space etc.

Given the above reasoning, in this paper, the sustainability in cities is classified into three categories. These include:
1. **Sustainable Urban Transformation** - This includes: *Sustainable Cities*, *Energy-Efficiency*, *Urban Innovation* and *Transportation*.
2. **Climate** - This involves: *Climate Change* and *Governance*.
3. **Future Urban Visions** - which incorporates *Vision of Future Cities* and *Sustainable Life Styles*.

The paper is organized as follows. Section II describes sustainable urban transformation in detail. Subsequently, section III and section IV talks about climate and future urban visions respectively. Finally, Section V concludes the paper.

II. Sustainable Urban Transformation

Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs [17].Green Economy in the context of sustainable development is '*one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities*'. In its simplest expression, a green economy can be thought of as one which is low carbon, resource efficient and socially inclusive [18]. Cities across the world typically look solely at businesses, economy and to achieve that - *infrastructure development* and *real-estate* serve as tools for growth in businesses. While this is quite useful in terms of generating revenue, this offers only a one-dimensional growth without any forward-looking on the sustainability aspects. It should be noted that cities offer a great potential/ possibilities for sustainability, promoting active collaboration among diverse stakeholders and integrating different perspectives and bodies of knowledge and expertise. The concept of sustainable urban transformation places a strong emphasis on structural transformation processes. These processes can effectively direct urban development towards sustainability. However, these transformation process are broad, multi-dimensional and need few radical changes. The different aspects under sustainable urban transformation are described as follows.

A. Sustainable Cities

Sustainable cities involves making the city more efficient and providing people with a high quality living environment; without draining humongous amounts of natural resources. To begin with, buildings consume most of the energy in cities. In cold climates, buildings use a significant amount of energy for heating, while in warmer climates, air conditioning is a major consumer of energy. Hence, a key priority for cities is to encourage more energy-efficient buildings. Cities contribute 50% to 70 % of green house gas emissions from many sectors [19] such as infrastructure, old buildings, urban heat island and urban flooding. Adaptation in terms of green walls and mitigation in terms of renewable energy in the living places is the way forward to reduce emissions. There is another important aspect - this relates to retrofitting older buildings (that are not efficient in terms of insulation) with new technology so that they meet higher standards in terms of energy efficiency.

Resource efficient cities combine greater productivity and innovation with lower costs and reduced environmental impacts providing increased opportunities for consumer choices and sustainable lifestyles. In the report by *'Economist Intelligence Unit'* in 2008 [20], the average American was considered responsible for 18 metric tons of carbon dioxide per person, while the average Chinese was responsible for 5.3 metric tons. On the other hand, the top-ranked cities were all from Europe and were responsible for less than 1 metric ton of carbon dioxide per person. In 2009, the European Green City Index [21] - measured and rated the environmental performance of 30 cities from all European countries. Copenhagen stood out as the greenest major city in Europe, followed by Stockholm and Oslo.

Smart Sustainable City is a new paradigm that enables the decoupling of high quality of life and economic growth from resource consumption and environmental impact. The Smart Sustainable Cities rely on the Internet of Things (IoT) [22], a recently evolving technology platform that connects every device in the planet with any and every

other thing/device. Notably, the real time data generated by multiple sources will provide the opportunity for real-time feedback to support communication, interaction and decision by citizen. Significantly, the visualization of real-time feedback through different mobile platforms can allow citizens to make sustainable choices.

B. Energy-Efficiency

A sustainable, resource efficient city [3] can be defined as a city that is significantly decoupled from resource exploitation and ecological impacts and is socio-economically and ecologically sustainable in the long term. By contrast, a low-carbon growth contributes to achieving sustainability but does not guarantee sustainability in itself. A low-carbon city [23] is one where growth is significantly decoupled from carbon emissions. In a sustainable, resource efficient city, its sustainability programs may have significant low-carbon outcomes due to the emphasis on resource efficiency but will yield a broader range of outcomes. In cities, the energy can be used more intelligently and efficiently both at work and home. A case study - *'Rotterdam Energy Approach and Planning* was conducted [24], in which energy planning and urban planning were looked at in an integrated way in the city planning. For example, a swimming pool was built next to an ice hockey rink to exchange the energies by closing the energy loops to a certain degree of temperature. Another example is - the municipal strategy of 'The City Council of Almada' [25] wherein the waste water treatment service was started which today accounts for nearly 100% of waste water within the city. In the long-run, it aims to achieve total coverage of the drainage networks and treatment systems within Almadas territory. On similar lines, Living Planet [26] - a technology company based in Europe develops urban operating systems, which harness and create efficiency in cities. It tests urban technologies and finds new ways in which people can interact in urban spaces. Notably, a sustainable city should be highly energy-efficient and embrace a dramatic shift from fossil fuels to renewable energy. It should be noted that energy-efficiency is an important aspect in other aspects as well - including urban innovation, transportation and climate.

C. Urban Innovation

Urban innovation can be defined as *'A break from common practice to develop long lasting transformations in communities, neighbourhoods, and cities'* [27]. An Urban Living Lab [28] is a local-region centric experiment carried out in different parts of Europe to test new social and sustainable activities in combination with existing and emerging technologies. A living laboratory indicates that - subjects of experiments are represented by various forms such as streets, buildings, district, etc. There are five aspects defined by urban living labs, to be considered in the urban innovation [29]. These include:

1) Engaging people, organizations, Universities, Government and industries for multifaceted tasks.
2) Exploring different directions of a sustainable city.
3) Experiment i.e., to actually do things. Experimentation is the core of urban living labs in trying things out, testing them and learning from them.
4) Evaluate the performance of different tests - Universities could play a key role in evaluating the engagement, exploration and carrying experiments.
5) Involve entrepreneurs and socio-venture-capitalists and make them bring eco-friendly businesses.

A poignant example of urban innovation is the 'Malmo Western Harbor' [30] which incidentally never came officially under urban innovation lab, but fulfilled all criteria for being one. It had very ambitious goals to be a sustainable neighbourhood (100% renewable energy or energy-efficiency targets in its buildings). Its different features included:

1) Design competitions.
2) Experimentation, exploration and entrepreneurship.
3) Collaborative models through which Urban living labs could bring sustainability in different places with different people.

D. Transportation

Transportation is central to social and economic activity, yet current patterns of transportation activity based primarily on private motorized vehicles generate acute social, environmental and economic costs and externalities. A fundamental change in investment patterns is needed, based on the principles of avoiding or reducing trips through integration of land use and transportation planning; shifting to more environmentally friendly modes, such as public transportation and non-motorized transportation;promoting cleaner and more efficient vehicles [8].

The greening of the transportation sector calls for a paradigm shift in the way the it is set to develop in the coming years. This is particularly important for developing countries whose patterns of transportation will be shaped by the investment and planning decisions made today. In essence, investing in green transportation allows such countries to progress towards a sustainable path. Investment in green transportation could support countries by reducing congestion, air pollution and other costs by creating green jobs, particularly through the development of public transportation infrastructure and operations, cleaner and more efficient vehicles, and by alleviating poverty through increased affordability of transportation and improving accessibility to markets and other essential facilities.

Urban Infrastructure and Planning is extremely essential to make cities inclusive, environmental friendly, economically vibrant, culturally meaningful and safe for all. Continuous updation is necessary for planning. Infrastructure development is critical to support the delivery of housing, transportation, energy and water services. At the same time, eco-efficiency is a key criterion for the development of sustainable infrastructure. It can be measured using indicators that relate environmental impact (such as emissions of pollutants) or resource use (such as water or energy), to

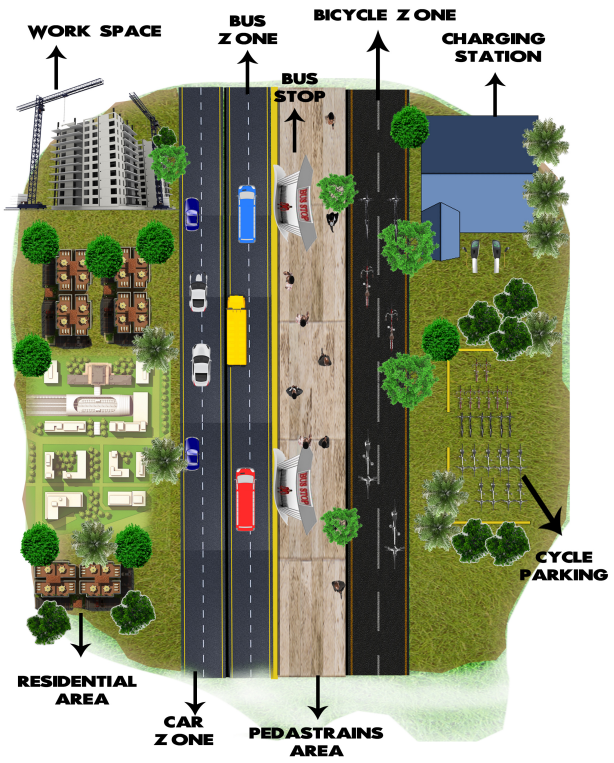

Fig. 2. Transportation Overview of a Sustainable City

the service or economic benefit provided (such as passenger kilometres, in the case of transportation infrastructure). In this regard, eco-efficient transportation system can deliver high-quality services with less use of resources and low negative environmental impact. These would require:

1) Promote cycling as primary mode of transportation in the city to deal with growing traffic congestion.
2) Promote use of trains and buses instead of cars; with the goal to not only improve space availability but also reduce fossil fuel consumption and improve the overall health of people.

Fig. 2 provides a transportation overview of a sustainable city; wherein electric cars and bicycles move on specific lanes. There are electric charging and cycle parking stations available at certain points along the road for the convenience of the road-users. Work-spaces are provided with basic workshop amenities such as air filling equipment, essential spare-parts etc., that could be used in case of emergency.

Creating awareness about public transportation and its importance is an important step in making people use public transportation efficiently and on regular basis. In this regard, Malmo, Sweden's third largest city, is a very good example of a coherent approach to sustainable transportation [31]. With the goal of ensuring mobility and access, Malmo combined city planning and densification with the development of public transportation, a progressive bicycle strategy, as well as communication projects for public outreach. In fact, there was a *'No Ridiculous Car Journey's Campaign'* [32] where a group of civil servants and volunteers dressed in orange and talked about how ridiculous it was to drive in car for short distances. The volunteers drove around the city, sang songs on use of public transportation, had interactive billboards and demonstrated why and how it is better to use the bicycle, in terms of both the environment and the health of the individual. It is estimated that [31] this resulted in nearly 33% increase in the use of public transportation.

Sorocaba city is a point for excellence in urban mobility with over 100 km of bicycle paths. It started a free bike sharing program, IntegraBike [33] promoted a change in utilization of transportation modes, and also improved the quality of life among Sorocaba's citizens by contributing to the reduction of greenhouse gas emissions. The idea of smarter parking management [34] has been introduced at San Francisco park, which aims to provide real-time parking availability data to each available slot to drivers. This approach helps to increase mobility of the traffic and decrease air pollution from vehicles cruising for parking space. In the city of Oslo in Norway, [35] over 5000 electric vehicles ply since 2013. These are powered by hydroelectricity, in turn resulting in low emissions, improved air quality and less noise. Significantly, the city council made innovative policies and created additional infrastructure to help grow the numbers of electric vehicles by providing free charging stations in the city. Electric vehicles were encouraged and the rules were formulated; so as to allow the electric vehicles to use bus transit lines. Furthermore, national level taxes were levied on fossil fuels to discourage people from buying it; and also road charge exemptions were provided for electric vehicles. Another remarkable instance of sustainable transportation is in the city of Copenhagen - where the civic authorities have been implementing sustainable structural transformation for 60+ years. In 1950's and early 60's, the city civic officials focused on planning the design of city infrastructure that would support rapid increase in the car traffic. However, in the early 1970s, the civic officials decided to take cars out of the main streets of the city; to decongest the roads and to provide people with a better air quality. A 2011 census [36] indicate that, 37% of people in Copenhagen commute to work in the city every day by bike, in comparison with just 27% by car.

III. Climate

Climate change [37] is an exponentially increasing concern globally, with extensive implications for life on the planet Earth. The ecosystem and biodiversity of the planet, on which depends the entire human existence - is increasingly facing multiple anthropogenic stresses caused by macro and micro climate change. Cities - as aggregators of human activities require energy in a variety of forms. Much of the primary energy sources transformed to be available to most of the cities around the world are still fossil-based, resulting in global climate change. Cities depend on their sur-

rounding bio-physical landscape, utilizing goods and services provided to urban populations from ecosystems. The health of the ecological system within and surrounding the city influences the health of the city itself. UN Environment [38] recognizes that building the resilience of urban populations depends on how climate and non-climate drivers are tackled together. The management of urban and surrounding Peri-urban ecosystems has the potential to contribute significantly to the overall resilience of the city to climate change and other pressures.

A. Climate Change

Cities in developing countries are extremely vulnerable to the impacts of climate change - due to development challenges, weak infrastructure, environmental degradation, limited resources and capacity constraints. Climate change affects a wide range of urban activities including town planning, mobility, buildings, energy, health, waste management and food security. In order to ensure that climate change does not severely spoil the eco-balance of the society, it is required to have a global standardization efforts that will publish guidelines and standards for building a smart and sustainable city that can manage climate change.

With regard to climate change; in 2010, the city of Uppsala in Sweden, initiated the 'Uppsala Climate Protocol' [39] with the goal of securing the city's long term climate and energy goals through the involvement of local and regional decision makers. The participants of the protocol are organizations with the successful track record, climate and energy efficiency activities. Exploration and experimentation is essential for the estimation of climate change. Dortmunds redevelopment initiative [40] suggests that small scale projects such as increasing the number of parks and gardens, maintaining and restoring natural pathways for civilian use, can build resilience and improve quality of life for its inhabitants. Cities can work towards climate change mitigation, increased water supplies, and greater city-wide resiliency by paying more attention on improving the water management. Similarly, in Kalmar, an another city in Sweden, there was a project named 'Climate Pilots' [41] where 12 households were given 12 climate tasks, each month for 12 months. The participating households lowered their carbon dioxide emission by 32% on the average, without having any negative effects on their quality of life, comfort or economy. Climate Pilots received a great deal of media coverage, and has since been replicated in other municipalities in Sweden and abroad. The project has been followed with the Climate Pledge Campaign - a cooperation between 12 municipalities in the Kalmar region whose aim is to support inhabitant's transition to a climate-friendly lifestyle.

B. Governance

The role of governance is closely connected to planning as well as to innovation, collaboration and socio-technical transitions [42], [43]. Planning is recognized as a key method for governing and implementing sustainable urban transformation [44]. The planning process and the concept of governance highlight the critical roles of collaboration and engagement of stakeholders, particularly residents in urban areas [45].

When it comes to urbanization, the interests and agenda of a wide array of urban stakeholders significantly contradict with the ecologist and the environmentalist. In order to ensure that the eco-balance of the society is not destroyed due to rapid and excessive urbanization, there is a need for the Government to create awareness in the society. A pro-active role by the Government is required to counter the disparate actors with contrasting interests and to make sure that proper processes are followed and not deviated.

It should be noted that, globally over the last few years, be it in Turkey, Gulf countries, Europe, South East Asia, etc. many cities have had to increasingly deal with new governance challenges. These include - stirs and social agitation related to social and environmental concerns, development pressures on green areas and natural habitat, resource consumption and waste generation in urban environments, etc. Such challenges contest traditional models of city governance and highlight the need for innovative city governance modes. Notably, some new modes have emerged across European cities, built on citizen empowerment, participation of all relevant stakeholders and innovative use of social and institutional capital. For instance, the creative and cultural industry can be used as a tool within the governance model to push urban regeneration. A prime example being - the City of Berlin wherein a Governance model was introduced within the 'Socially integrative city' [46] programme by involving cross-policy actors and stakeholders of all kinds. This was done to improve living and housing conditions in socially deprived neighbourhoods. The strategy involved several aspects:

1) Cross-departmental municipal co-operation with an integrated action plan.
2) Setting up new structures for directing neighbourhood management operations; enabling co-operation between all relevant actors and stakeholders, thus extending the scope of local policies.

It should be noted that, across all cities, countries and continents, local Governments have humongous power to implement ideas - since they are close to the people actually getting affected. Notably, Governing modes can be classified into four types [47].

1) Self-Governing mode - Municipality is the Governor of its own activities.
2) Governing by Enabling - The Municipality is just a facilitator while the society becomes the authority [48].
3) Governing by Provision - The local municipality provides all the infrastructure and also serves as the Guardian of the infrastructure provided.
4) Governing by Authority - The local municipality acts

as the complete regulator of all infrastructure, policy, regulations and actions carried out in the society.

Finally, in terms of Governance, an extremely important aspect required for structural transformation and efficient administration is the strong political will and strong administrative commitment and collaboration between local and national Government.

IV. Future Urban Visions

In order to have a city that can remain sustainable for several decades, there needs to be a vision of how sustainable cities will look like in the future. Particularly, future Urban Visions are vital for transforming cities into smart sustainable Cities. For policies and messages on sustainable lifestyles to have positive impacts, aspects like - perceptions of sustainability, values and expectations for the future must be taken into account. The benefits of integrated environmental, economic and social development need to be well communicated, through solutions and opportunities for sustainable lifestyles that can offer positive visions of progress [49].

A. Vision of Future Cities

Long-term visions are underlying foundation for achieving sustainable urban transformation. A future city would need to have sustainable channel/medium for transportation and new types of intelligent/energy-efficient buildings. For example, vertical green houses are being developed in Sweden. Further, Green roofs are being used to reduce the negative impacts of heavy rain, and provide insulation to cool down buildings in summer and keep them warmer in the winter [50], [51]. This is a particularly good example already existing in one city which can serve as the basis in developing the vision for other cities. Another instance is about New York City - where in collaboration with Danish firm Gayle Architects, New York civic officials experimented with the access and feel of city squares. In 2009, they closed Times Square to cars and developed it into an open area with cafes and bicycle lines. Having received a positive feedback from the society, the city continues to refine Times Square as a new sustainable space in the center of city.

Another important program under the global future vision of having a sustainable city was *'The Earth Hour City Challenge'* [52]. The Earth Hour City Challenge is a global program where cities report carbon footprint reduction commitments and actions. As of date, there are 166 cities from 17 countries that participate in the Earth Hour challenge by switching off the use of electricity for 1 hour and measure the difference in the carbon footprint. The difference in the carbon footprint is reported to 'Carbon Platform'; through which the global environmental authorities estimate how much carbon reduction can be achieved by applying a particular action. The vision of the above program is to not only create awareness among the people but also introduce several energy-consumption programs over the years.

B. Sustainable Urban Life Styles

A Sustainable Lifestyle [49] is a way of living that is enabled both by efficient infrastructures, services and products, and by individual choices and actions to minimize the use of natural resources, emissions, wastes and pollution while supporting equitable socio-economic development and progress for all and conserving the Earths life support systems within the planets ecological carrying capacity. It includes activities like interpersonal relationships, leisure activities, sports, education and material consumption. Lifestyles are based on past/current consumption, production patterns, etc. and are intricately interwoven with choices and practices of people.

It is vital for the cities to create solutions that help citizens live sustainable. Promotion of reuse, recycling and sharing of goods to reduce carbon footprint can be closely related to broader social and lifestyle issues. For instance, Botkyrka, the most multi-ethnic municipality in Sweden, had set a landmark in working simultaneously with social, economic, and ecological issues of urban sustainable development. Botkyrka demonstrated the possibility to connect and build on local businesses and resources to create synergies for urban sustainable development. The project 'Earth.Re.Create Botkyrka' [53], aimed at creating a network of young designers and social entrepreneurs interested in sustainable design.

V. Discussion

The previous three sections described techniques and mechanisms to promote urban transformation and future urban vision for developing new cities. At the same time, it is to be noted that the steps adopted by Europe, USA and other countries to promote sustainable transformation might not exactly suit for the development of new cities in South Asian countries. This could be attributed to particular living/life style and the environment in South Asian countries which includes:

1) Dense population
2) Primary mode of transportation being 2-wheeler and 3-wheeler
3) Low/Very low per capita income
4) Extreme disparity in the wealth of rich and poor people

In India, around 10,000 people migrate every day to different cities from rural areas to look for better livelihood/ lifestyles. It is anticipated that around 1 billion people will live in urban areas by 2050 [54]. With the mass scale movement of people from rural areas and agrarian lifestyle to a blue-collared and semi-blue-collared jobs in towns and cities, what could be done is to create new cities that would not only adhere to the sustainability criterion but importantly, provide the basic amenities for a smart and healthy living. Notably, there is a greater need to find smarter ways to manage complexities, reduce expenses, increase efficiency and improve the overall quality of life.

Importantly, as India is a developing nation with still nascent institutional framework and a comparatively weak delivery system, the policy of sustainable cities of the developed countries will not suit the requirements directly. For instance, in Indian environment, it is extremely essential to give detailed attention to connecting people, proper financing and importantly, bring in an accountability that will cater to all sections of the society. Notably, it would be a primary task to plan for land use and other basic services like electricity, water, sanitation and health care; before focusing on other high-end sustainable measures. Financing the infrastructure like sewerage, sanitation, roads, and other public amenities is another important factor itself, something that is available by default in case of developed countries and not significant to be considered at this stage [55]. Further, the social/economical divide among the people in India is extremely high. This results in a completely varied requirements that might not be possible to fulfil the development of a full-fledged sustainable cities. For instance, in case of public transportation,

1) The usage of public transportation by low income will be very limited, if the cost of the systems are not economical. On the other hand,

2) Usage of 4-wheelers will increase significantly, if the price of public transportation is subsidized as the upper strata of the society will definitely not want to have shared transportation.

There are several other challenges that need to be dealt with, before developing a sustainable city in India. Many of the current Indian cities are extremely congested, not well planned, has several manufacturing industries which generate significant carbon footprint. For instance, consider the case of silicon city of India, Bangalore [55]. For the last two decades, Bangalore has been the centre of innovation to catalyse engines of job creation and gateway to the global marketplace, but still is quite far away from being considered as smart city. The dense population makes it very difficult to provide clean, efficient and sustainable public transportation along with other features like solar energy, electricity, water-supply, waste disposal and sewage treatment.

Notably, unlike Western/European countries, most people in India still consider building a house as a biggest accomplishment in life. In this regard, the scarce available of resources to construct a green and sustainable building/society is the single most hindrance in the development of sustainable town/city. In this regard, there are several steps needed to first develop the basic amenities in a sustainable manner. To begin with, there is first a need to provide housing, especially for the poor [56]. For that, there is a need to amend the Government policies and provide sufficient resources to achieve sustainability in context of housing, sanitation and subsequently, transportation, sustainability and urban living conditions. If required, the Government could bring in private players and encourage people to use different renewable resources, solar energy, building green buildings and assist them in adopting sustainable lifestyle. Further, Government must expand the opportunities to enterprises to test new, green solutions on a larger scale in urban development areas including new energy forms, waste handling etc., and leveraging existing policies for low-carbon planning. Moreover, in order to ensure that the benefits of these scheme reaches the end-user, there is a need for active participation from people [57] [58]. The local people should come together to form communities, campaign and co-operate in parallel, participate in detailed discussion/dialogue with the Government as it is the people who would be aware of the immediate societal requirements [59].

Finally, in order to ensure the long-term sustenance in the development of sustainable cities, there needs to emerge two major clusters. The first is the presence of top-quality academic and research institutions. This will help in identifying different challenges, carrying out multi-faceted research for these challenges and developing technological solutions. Importantly, the research-oriented academic institutions would serve as the basis for multiple start-ups and innovation parks that can solve the problems in a much focused manner. Such institutions would not only bring in intellectuals but also result in improving the intellectual quality of people coming and staying in the city [60]. At the same time, the business community and third party stake holders would be motivated to create investment for start-ups that could focus on different nuances of sustainable cities. It is to be noted that spin-off companies that can help build a new identity for a city often emerge from Universities, typically those specializing in research and emerging technologies. Hence, it is imperative to have a world class institute, particularly focusing on STEM (Science, Technology, Engineering and Mathematics) & Sustainability, and collaborating extensively with industries, Government & other stakeholders [61].

VI. Conclusion

This paper presents a survey on various sustainable measures & how it has been considered in the planning/implementation of different sustainable cities across Scandinavia, Germany & USA. The essential factors needed for the achievement of Sustainability such as energy efficiency, transportation, climate, Governance and importantly, future urban visions are discussed in detail, along with particular instances of some of the prominent achievements of sustainable cities. This not only provides an insight into different potential techniques in the planning and development of sustainable cities, but also suggests how these changes can be the key drivers of green economy and urban transformation. Finally this paper also discusses the differences between sustainable cities in developed countries and developing new sustainable cities in south Asian countries. Importantly, it details various challenges and limitations uniquely experi-

enced in Indian/South Asian region along with the various steps needed to be considered both by Government & private stakeholders for long-term development of sustainable cities.

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